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&
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Lucian Blaga University of Sibiu (LBUS) started to organize the Balkan Region Conference on Engineering Education (BRCEE) in 2003, with an important support from UNESCO International Centre for Engineering Education. There were 2 very successful editions in 2003 and 2005 when participants from all over the world published scientific papers that were included in internationally recognized proceedings covered by the prestigious Thomson ISI. In 2007, the year when Sibiu was declared European Capital of Culture, a joint conference was organized together with another international periodical conference organized by LBUS – MSE (Manufacturing Science and Engineering). In 2009 we decided to broaden the international dimension of the conference and we agreed, together with Hochschule Wismar, University of Applied Sciences Technology, Business and Design, Germany to organize the conference together with the International Conference on Engineering and Business Education at the 2nd conference, the first one being organized in 2008 in Wismar, Germany.

This joint conference is intended to assemble reliable ideas, applications and tested implementations for engineering and business education that represent important requirements of the global world.

The coverage of this special issue includes but is not limited to the following subjects:

1. Entrepreneurship education and research
2. Innovative new methods for engineering and business education
3. Collaboration in engineering and business education
4. Knowledge management in engineering and business education
5. New curricula development
6. Quality management in engineering and business education
7. Multimedia in engineering and business education
8. Social and philosophical aspects of engineering and business education
9. Management of engineering and business institutions
10. HCI (Human Computer Interaction) applications for educational purposes
11. LifeLearn and the European Qualification Framework

It is anticipated that the conference will enhance the links and the networks that were already created in the previous meetings, and will set the stage for more innovative and collaborative undertakings.

Constantin Oprean
General Chairman of the Conference
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INVITED PAPERS
ENTREPRENEURSHIP: A SUSTAINABLE AND TRANSFERABLE ATTRIBUTE OF ESSENTIAL VALUE TO PERSONAL AND PROFESSIONAL DEVELOPMENT OF ENGINEERING AND BUSINESS GRADUATES

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ABSTRACT: Entrepreneurship is reviewed in terms of its evolution, growth and meaning. Arguments are detailed and advanced for the establishment of entrepreneurship as a sustainable attribute within the curriculum of engineering and business programmes. Consideration is given to emerging trends in relation to the interpretation of the meaning of entrepreneurship within the context of current 21st century thinking where entrepreneurship is considered in the context of social responsibility and social justice. Established models are reviewed and it is proposed that for engineering and business graduates that existing models should be rejected in favour of models which address entrepreneurial thinking in terms of personal mindset for life and within a framework of ethical practice. Consideration is then given to the development of entrepreneurship as a global competence particularly considering how best this competence can be established and taught. A range of learning environments are considered in relation to the most effective way to teach entrepreneurship in the context of social mission and ethical practice. It is concluded that the teaching of entrepreneurship within a global context needs to be based on evolving thinking around personal entrepreneurial mindset, ethical values and social mission using appropriate learning environments which involve the close integration of the on-campus environment with appropriate life based off-campus environments. It is also concluded that full development of competence in entrepreneurship can be best achieved at postgraduate level with sustainability realised through lifelong learning practice.

1. INTRODUCTION AND BACKGROUND

"It is concluded that entrepreneurship which is a sustainable and transferable attribute is of essential value to the personal and professional development of engineers and technologists through their careers" [1].

"It is concluded that this competence offers an essential mindset change through it being approached as transformational learning and it is concluded that tacit knowledge has a major role to play in the success of developing this competence" [2].

These conclusions, recorded earlier by the authors with regard to the research into the development of entrepreneurship as an engineering competence for the personal and professional development of engineers took account of the delivering of the competence within the context of a global information society. It was also viewed that tacit-based skills and tacit knowledge have a major role to play in the makeup of the competence in entrepreneurship. Earlier the models of entrepreneurship were not considered with the conclusions reached supporting taking forward entrepreneurship as an important competence for the 21st century engineering profession. Further research has now shown the need to consider entrepreneurship within the context of social mission and social justice. The latter aspects have now become recognised as increasingly important factors to be considered in defining a model for entrepreneurship. "The need for a clarification of the concept of entrepreneurship is paramount"

This comment was recorded as recently as 2005 in a report examining the ways towards the 'Entrepreneurial University' by Gibb [3]. In the executive summary of the report it is clearly pointed out that present models are almost exclusively built around a business school/business management approach which is greatly influenced by the traditional economist interpretation.

This report also argues that existing models take little account of the need to expose students to tacit knowledge and the value which derives from this.

"The world of the entrepreneur is one that values tacit knowledge..... …" [3].

This supports very much the arguments regards tacit knowledge and its role in education which the authors have put forward in recent years and more recently regarding it being a vital component for entrepreneurship as a competence for the personal and professional development of engineering and business graduates operating in our expanding global information society.

"The model chosen for the learning environment will ensure that tacit knowledge in addition to explicit knowledge underpins the competence development" [2].

In this paper the authors report their continuing considerations of how to model competence in entrepreneurship within the context of social responsibility and social justice using ethics as a basis for the reasoning.

It has been shown that there is now a driving interest in looking at alternative models of entrepreneurship across most European countries. [3] The EU for example have given a firm policy commitment to creating this type of culture. [4] It has already set in motion reviews relating to entrepreneurship.
The term entrepreneur has its origins in the 17th Century associated with French economics. The French interpretation related to a person with capability to undertake some significant project or activity. Jean Baptiste Say, the French economist recognised as giving the term this particular interpretation stated:

“The entrepreneur shifts economic resources out of an area of lower and into an area of higher productivity and greater yield”

Another economist Joseph Schumpeter defined entrepreneurs as individuals driven by a creative and innovative motivation related to the “creative – destructive” process of capitalism. He stated: [5]

"the function of entrepreneurs is to reform or revolutionize the pattern of production"

"by exploiting an invention or more generally, an untried technological possibility for producing a new commodity or producing an old one in a new way, by opening up a new source of supply of materials or a new outlet for products, by reorganising an industry and so on".

J G Rees has reviewed the origins of the term entrepreneur and usefully states: [6]

"Schumpeter's entrepreneurs are the change agents in the economy. By serving new markets or creating new ways of doing things, they move the economy forward".

Schumpeter's descriptions are very much in sympathy with the profile required of our future engineering and business graduates where they seek to continually reform and innovate in relation to production, systems and business practice to create and invent new ideas to produce new commodities and to innovate through creative thinking.

Schumpeter very usefully mentions the "creative – destructive" process of capitalism and for our engineering and business graduates a mandatory requirement for a competence model would be to take account of the "creative" process of capitalism set within the context of globalisation and social mission. At this point, early in the 21st Century it is no longer acceptable to move economies forward regardless of society and environment. Recent global developments and the problems in the global economies in 2008 provides adequate evidence of the destructive side of capitalism where social mission, ethical practices, society and environment have been ignored. The authors reject current models of entrepreneurship which reflect a long history which supports the "destructive" process of capitalism, now well illustrated by the developing global recession.

Development of a model for engineering and business professionals will need to be one where entrepreneurial thinking is considered in terms of social mission which is explicit and central to the delivery of any new products, systems, processes and business. It requires educators to take forward competence in entrepreneurship which creates a personal mindset for life in relation to professional practice. This represents a controversial mindset shift where wealth creation is not the prime driver but rather wealth creation is established without comprising the social mission of protecting society and environment. Cunningham and Lischeron [7] at a later stage report from the literature six views about entrepreneurship as follows:

- Entrepreneurs essentially have intuitive ability with which he/she is born.
- Entrepreneurs have unique attitudes, needs and values which creates an innate drive and motivation.
- Entrepreneurs have a highly developed innovative capability.
- Entrepreneurs have an innate capacity to organise, take ownership, manage and accept risks involved.
- Entrepreneurs exhibit an innate leadership capability above others in dealing with the needs of people.
- Entrepreneurship skills are desirable in complex organisations.

Mort et al [8] indicates that some researchers believe entrepreneurs display three key characteristics: able to stand up to and tolerate risk; highly proactive and high innovative capability.

Casson [9] argues entrepreneurial thinking is associated with the development of new services, and products delivered to market and sold at a greater value than the production costs. This approach is supported by Singh [10] who describes entrepreneurship as involving as feasible profit generation through the delivery of new products and services or the improvement of an existing product or service.

It is also now widely accepted that entrepreneurial thinking and an entrepreneurial mindset can be learned and developed. [2][11]

If indeed the entrepreneurial ability was genetic there would be little point in teaching entrepreneurship and developing competence in entrepreneurship. Again the argument which suggests that entrepreneurs have unique attitudes needs and values would be better considered where the attitudes, needs and values are developed through a teaching and learning approach.

3. ETHICAL CONSIDERATIONS: SOCIAL JUSTICE

It is important to define social justice in relationship to entrepreneurship education where the interpretation involves the learners in understanding the socio-political dimensions of social justice so that in practicing their profession within an ethical framework in society they can effectively deliver in the context of equality, give support for diversity, ensure economic justice, and ensure environmental harmony. This interpretation of social justice was suggested by Lakey et al [12].

To develop engineers and business professionals with competence in entrepreneurship means they have to understand this competence is interpreted within the context of the global information society as reported by Chisholm and Blair. [2] Cultural dexterity which underpins the development of competence in entrepreneurship was shown to be important by Overton–Adkins [13] who demonstrated that it essentially provides for the levels of empathy needed to deal with ethnic diversity across the communities of practice.

Educators and educational policy makers will need to be prepared to articulate and explore social justice issues if the students' understanding of competence in entrepreneurship is to be encapsulated and interpreted through a social responsibility approach. Essentially the social responsibility in delivering engineering and business practice derives from effectively appreciating the range of social justice issues involved in any given work situation. This is well illustrated by Rhoads [14] who defines the caring self as;
"a social oriented sense of self founded on an ethic of care and a commitment to the social good"

At present competence in entrepreneurship is not really built around the focus of this view and thus educators need to be prepared to change the ways in which entrepreneurial ability is developed by ensuring that in addition to critical thinking and innovative skills that students develop the ethic of care and commitment described by Rhoads [14].

4. ROLE OF TACIT KNOWLEDGE AND SKILLS

Chisholm and Holifield [15] have previously reported on the failure of the traditional educational system to recognise tacit knowledge alongside explicit knowledge. This is particularly true in relation to entrepreneurship yet it is obvious that the tacit experiential knowledge is fundamental to developing competence in entrepreneurship which depends on an intuitive approach. Social mission and an understanding of ethical practice cannot be effectively developed using the traditional on-campus explicit based approach. This is well illustrated by work reported by Warren [16] and by Rhoads [14].

To develop competence in entrepreneurship effectively, Chisholm and Holifield [15] believe that a move towards an experiential off-campus approach involving tacit knowledge and tacit knowledge skills is essential. A focus on tacit knowledge will lead to an intuitive interpretation within the environment in which the person is practicing entrepreneurship. For explicit knowledge to be of any value it needs to be internalised by the person through a process of application or thinking, tacit knowledge is already internalised within a person and the explicit knowledge can only be integrated with tacit knowledge through internalisation. Gibb [17] argues for learning in relation to entrepreneurship to be "... ... pursued by processes of solving problems, grasping opportunities, experimenting and making things up, making mistakes, copying and overall by 'doing'." It is this type of approach which will facilitate the development of social responsibility.

It is tacit attributes such as those related to emotional intelligence which become the intuitive drivers for an entrepreneurial way of doing and seeing situations. It is tacit developed awareness which will ultimately underpin the integration of entrepreneurship with social responsibility and social justice.

5. ETHICAL CONSIDERATIONS: SOCIAL MISSION

Engineering and business graduates need to understand the value of being able to use their creative knowledge in the context of social entrepreneurship where acceptable solutions involve sustainable long term return to protect both global society and the future of planet Earth. Educators need to be prepared to change the mindset of graduates and build their around creative and innovative delivery in the context of societal mission using a framework of ethical values.

Existing education and thinking regards competence in entrepreneurship is built around a capitalist business model where normally profit is seen as a fundamental to value creation and where wealth creation is the quintessential measure on which success is measured. This model of entrepreneurship is market driven and gives little or no consideration to delivery in the context of social responsibility or social justice. For this model social mission and societal values are far from being central to the process of delivery.

It is important to emphasise that developing entrepreneurship in the context of social responsibility and social justice involves delivering financial return and value creation alongside seeking to deliver, without prejudice to the communities in which they operate.

The conceptual perspective is considered to be one where behaviours, skills, attributes relevant to entrepreneurial thinking are developed against an understanding of the need for interpretation within the context of social responsibility and social justice in the wider social environment. Graduates need to be taught that ethical values and practices need to be at the core of any entrepreneurship model and this will involve the educators developing an in-depth understanding and empathy with the delivery of entrepreneurial thinking set strictly within the context of social responsibility and social justice.

6. PROPOSED MODEL FOR ENTREPRENEURSHIP

If students are to develop effectively a working understanding of how to be entrepreneurial within the context of social mission then they need to be exposed to 'real world' situations which directly show the requirement for entrepreneurial thinking skills to be interpreted against societal issues such as the causes of global poverty, the need for social protection systems and protection and the needs of the community. Thus students need as part of their curriculum to have the opportunity to examine the theory and practice which relates to social and ethical issues. This may seem far removed from the development of entrepreneurship competence but without the foundations of an understanding of the need for social responsibility the competence will fail to develop away from the traditional model of entrepreneurship. So how can the 'real world' experiential learning be achieved? Work over the last three year period by Chisholm and Blair [19][20] has led to the establishment of life-place learning in the community, the home, the workplace and many other relevant life environments. There is little doubt that by building life-place learning courses/modules into the curriculum of degree programmes that experiential education relating to social mission and ethical practice could be successfully achieved.

Although not directly related to engineering programmes, examples have been recorded in the literature relating to social justice learning. Warren [16] usefully reports on the education of students in the area of social justice through the use of service learning projects in programmes. It is shown how service learning has proven to be a useful vehicle to achieve 'real world' experiential learning and develop students' social responsibility. Warren [16] describes an important study by Sax et al [18] where it was shown that students who had taken part in service learning projects were more liable to contribute to promoting racial understanding, to contribute to community action programmes and to have a desire to influence social values in society. Those aspects underpin the core values of achieving competence in entrepreneurship set within the context of social responsibility and social justice and delivered against practice in a global information society.

The service learning reported appears to be similar to the life-place learning developments reported by the authors [19][20] and life-place learning could be a useful way to achieve credit based courses within engineering and business degrees where the students could be challenged by dealing with a range of social justice issues in the 'real world' off-campus environment.
Most important for the students would be to bring their creative and innovative skills to solving and delivering entrepreneurial solutions to the problem situations which they encounter in experiential-life place environments.

However developing entrepreneurship against social mission and ethical practice raises a number of complex issues. While experiential life-place learning is based on developing the 'know how' by 'doing', educators will need to ensure that the experiential aspects are supported by guided reflective practice followed by analysis and discussion leading to the development of innovative entrepreneurial solutions within a framework of ethical practice. To achieve all this educators will need to discuss potential 'life-place' environments with the students and agree the content of a life-place project to be taken forward off-campus.

Thus the basis of the equation for entrepreneurship is the delivery of innovative ideas which lead to a new services, system, business practice, product or process which satisfies economic obligations balanced by responsible consideration of social and sustainable obligations required if societal issues justice is to be realised. The conflict which will face most professional engineers during their career almost certainly will be associated with defining and interpreting societal are to be realised. Graduates responsible for an organisation may be faced with significant conflicting loyalties where they have responsibility as employees of the owners to deliver maximum profit knowing that there are social consequences which should have been taken into consideration. In this respect the professional graduate engineer may wish to argue for a entrepreneurially virtuous approach which recognises social value consequently creating opportunities which may lower profit but deliver a product more acceptable in terms of protecting society and environment.

The question which arises relates to the entrepreneurial behaviour. Having recognised an entrepreneurial opportunity the exploitation and delivery of a product at maximum profit is one route to follow and the profit generation is generally a precondition of entrepreneurial activity. However the delivery of the same product which has been innovatively developed to take account of environmental sustainability does not mean the production for profit has been disregarded. In marketing the product profit will still be maximised perhaps at a lower value than if no environmental sustainability had been built into the product. It could be argued that more entrepreneurial thinking has gone into delivering the environmentally sustainable product where the role of social responsibility has been recognised.

7. CONCLUSIONS
- Traditional on-campus learning is not a suitable learning environment to achieve an understanding of social mission in the context of a framework of ethical values to underpin the teaching of entrepreneurship.
- Life-place learning environments offer an ideal way forward to achieving an understanding of social responsibility and social justice in relation entrepreneurship competence, educational management.
- Engineering and business graduates are ideally suited to be at the forefront of entrepreneurial thinking where they can combine their knowledge with the creative and innovative thinking associated with entrepreneurship to provide global solutions which are set in the context of social responsibility to ensure future sustainability.
- A contemporary approach to teaching entrepreneurship needs to be based around development of a personal entrepreneurial mindset set within the context of values, social mission and ethical practice.
- Competence in entrepreneurship can be best achieved at the postgraduate/post-experience levels where sustainability can be best achieved through continuous professional development in the workplaces of life.

8. REFERENCES
http://findarticles.com/p/articles/mi_qva3907/is_199812/ai_n8809145/print. (March 2007).


ABSTRACT: It is helpful to think of the engineering process according to the aspects of CDIO. However, although this formulation presumes that most engineering work is shared and collaborative it does not specify the particular features and problems associated with collaboration. These days much highly technical collaboration is done at a great distance and across disparate cultures. This phenomenon is increasingly the case with the growing influence of China and India. The rise of China and India in the global technological economy has demonstrated the effectiveness of technology clusters as highly flexible venues for innovation and entrepreneurship. How do such clusters foster engineering collaboration in China and India? What impact will these Asian technology clusters have on engineering practice across the rest of the world? Given the power of instantaneous electronic networks to share even the most complex sets of data and to support collaboration on large, elaborate and proprietary endeavors, does the geographic location or cultural setting make any significant difference?

1. INTRODUCTION
Several presuppositions guide the reflections in this presentation:

- Modern technology depends on multiple layers and types of collaboration.
- Often such collaborations are international and multicultural, involving especially India and China.
- China and India are becoming technological centers of gravity in the world of the 21st century, but their practices depart in cultural ways from those familiar to the West.
- Various regions within Asia, often dominated by either China or India, have urgent economic incentive to develop collaborative technology clusters within their own sphere of influence.
- Many of the technology and engineering leaders in China and India received their professional training in the United States or Europe, creating a basis of understanding necessary for successful collaboration.
- This creates an opportunity for engineering and technology entrepreneurial firms in the West to participate in the economic rise of China and India and a new set of challenges for technological universities in the West. Engineers need to understand how their particular contribution, while different than pure innovation, is both essential and beneficial to creative techno-science.

2. TECHNOLOGY COLLABORATION FROM SEVERAL PERSPECTIVES
It is increasingly the case that technological innovation depends upon effective collaboration. Among the obvious reasons for this are that very few technologies stand alone; technologies themselves are natural collaborators. Google, the world's largest and most successful internet search engine, in the vast majority of instances, runs on the Internet Explorer browser designed and distributed by its corporate arch rival Microsoft. The relationship between Google and Microsoft is truly symbiotic, the success of each dependent to a great extent upon that of the other. The browser came first but its utility and value were overwhelmingly enhanced by the supplementation of an efficient search engine. Thus in this symbiotic relationship Microsoft and Google are each responsible for the health and well-being of the other.

This type of relationship points to the character of successful technology collaboration.

The observation extends and renders problematic the meaning of both collaboration and responsibility. The idea of collaboration is unusual because, while not sub rosa is not acknowledged by an MoU or other instrument of cooperation. Indeed a kind of paradox is elicited as these two corporations are supposed to be in competition and, as recent legal history reminds us, Microsoft has been judged as being too dominant in the marketplace. In order to sustain their near dominant position it is necessary that Microsoft – advertising for Bing to the contrary – not take over the search engine market. If they did they would risk the prospect of being broken up under various anti-trust provisions. Of course this is not absolutely clear because of the global character of the Internet. The regulatory environment differs from the United States to Europe to Asia. And so collaboration is presented as competition and as an engine for innovation.

With the notion of responsibility the situation becomes if anything even more murky. As both Microsoft and Google are public firms a prima facie responsibility is the fiduciary duty each has to its shareholders. Does such responsibility have any connection to a possible responsibility to innovate and improve existing technologies? If the successful implementation and reliable operation of Internet communications are in the public interest, and if corporations like Microsoft and Google are the means to sustain this capability, then there would surely seem to be a kind of responsibility to improve existing technologies. But what is the nature of this responsibility and where should the agency be located? This question becomes more complex when one recognizes the disorderly character of technological innovation and the inequities of the global workplace.

Let us concede first that whatever the nature of the responsibility to improve technology is, that it is a human responsibility. By this is meant that the agency must be distributed among humanity and not given over fully to proxies (such as corporations or governments). Correlatively the improvement of technology should be for the sake of humanity at large and not the means to corporate or national hegemony.
This suggests that the responsibility to improve technology should be open, i.e., non secret, in the same way that scientific research is open. This of course raises a host of problems which shall be addressed subsequently. However the ideal of openness in technology development is consistent with collaboration.

Moreover technology innovation seems to work best in a highly collaborative and open environment as evidenced by the open source software movement. Open source software (or at a distance, perhaps, from pure or scientific technology, Wikepedia) emulates a skunk-works like environment conducted in an open virtual space. This space transcends legal jurisdictions, traditional cultures, political borders and (for the most part) natural boundaries. In fact this type of collaboration favors radical openness with efforts to keep it closed constantly challenged by technology itself. Yet a tension persists between the expectations embedded in a particular cultural tradition and the more or less free floating attitude of technology per se.

There are numerous incentives supporting technological collaboration (expressed in popular clichés):

Necessity is the mother of invention. Invention or innovation is a response to desire or need. The inventor is one who perceives an unfulfilled desire or practical necessity and takes action to satisfy it. A plurality of inventors therefore multiplies the number of recognized needs and desires which in turn multiplies the number of attempted solutions. Since only some solutions will work and of those some will work better than others a coordinated multiplicity, i.e., collaboration greatly increases the likelihood of an effective solution being discovered.

There is no need to reinvent the wheel. Technology builds on previous technology, incorporating into a new device specific technics from existing (or occasionally anachronistic) tools, machines, etc. While this principle may be grounded in the economic interest of minimizing cost it also promotes creativity. Often the appropriation puts an existing technic to a new use (the employment of wheels in gear mechanisms, for an obvious example), in ways that those most involved with the new device may not at first recognize (as in the case of the addition of the alphabetic keyboard to the computer to make the PC). Since there is a level of serendipity in technological innovation the size and diversity of the design group collaborating on a project increases the probability of groundbreaking solutions to a much greater degree.

Genius is 99% perspiration and 1% inspiration. Much of technological innovation reduces to drudge work; measuring, counting, testing, reviewing, and so forth. The more complex the innovation the more testing is required. A complex software program such as a computer operating system may not reveal “bugs” until many months of “beta” testing are complete. Stress testing puts tools to use under conditions perhaps not imagined by the designers. This type of work must essentially be collaborative and may involve the “endusers” as much as the designers. Engineers understand this requirement better than anyone. As we shall see this aspect of collaboration is strongly connected to issues of responsibility and will be taken up later.

Many hands make light work. Technological innovation is often a matter of urgency; an acute problem calls for a prompt solution. The energy and climate crises of our day call for technological solutions in short order. The human need demands that as many resources as possible be brought together to find a solution. In this type of circumstance collaboration is very closely bound to responsibility.

Beauty is in the eye of the beholder. What technology do we need? This is a transient question as the answer shifts through time and across distance. One technological solution does not fit all: excessive or destructive technology may be desired; the optimal technology may be too costly; an innovation may displace more beneficial technology. These are significant issues for globally distributed technology and indicate a point where collaboration and responsibility intersect.

Each of these characteristics of technology development is to a large extent modified by the practices that have resulted from globalization. Collaborative interaction across geographic, political, cultural and economic borders poses serious questions concerning responsible practice with both ethical and legal dimensions. How the engineering profession responds is our special concern.

3. THE NEW WORLD OF CHINA AND INDIA

It is now acknowledged nearly universally that the economic and geo-political world center of gravity is shifting (how quickly is a matter of debate) from the west to Asia, with India and China presumed to regain the influence and power they had in previous eras. The question anxiously put in the West is how should we respond both to preserve our own hard won quality of life while at the same time establishing meaningful and mutually beneficial cooperation with these two re-emerging great powers. Yet the size, complexity and diversity of both China and India, and with long and polysemic histories, and varying characteristics of the systems that fostered their return to prominence on the world stage in the 20th century, makes these considerations difficult.

“While both India and China have a long history, their histories are very different. China has been by a large a stable, centrally run state throughout its history with limited periods of instability and a lack of a single authority. India's history has been exactly the reverse. The periods when a single king or political authority ruled over even the major part of India's territory can be counted on the fingers of one hand. In China's case there was a deep desire for unification of the country as a driving force of nationalism in the twentieth century. ... In India's case, there never was any authority which has ruled over all of India; indeed, not even the British or even the present Indian government. India has been idea in world culture for millennia, but its borders had been fixed only in the late nineteenth century...” [1].

The return of India and China to preeminence on the world stage is usually considered under the category of globalization. Yet it may be useful to refocus the lens and consider the various phenomena that together explain this rise under the broader philosophical category of world. Hannah Arendt has elaborated the notion of world as the fundamental, public space where specifically political discourse takes place. The realm of the political, in her sense, comprises precisely what is of concern to the public that is the arena of human action including but not limited by the constraints of society or culture. In her trenchant analyses of society and culture Arendt has delineated the levels of labor, work and action and differentiated the vita contemplativa and the vita active [2].

Under this schema technology is acknowledged in several ways that get beyond the narrow paradigms most often used in contemporary discussions. The human and public dimensions of technology are often overlooked or insufficiently acknowledged in the econometric analyses that focus on
financial benefits and costs. In this proposed Initiative technology is to be regarded not simply as a set of instrumentalities; or will the instrumental understanding be ignored (or demonized) as it is sometimes has been in humanistic studies. Arendt cautions against the dangers of a technocratic world but does not dismiss the accomplishments of the technical nor its potential to improve quality of life.

This aspect of responsibility focuses on technology not specifically from the aspect of the technical itself, but from the aspect of the public use of the technical. This approach is not humanistic or anthropomorphic, a point of view Aristotle said would be absurd [3], but rather one that is attentive to the dynamic interconnections that obtain between human action (whether it be technical, economic, social, cultural) and the given natural order as it is disclosed through science and technology. Technology thus comprises the technical and the public dimensions of humanity.

Such considerations challenge the widely accepted thesis of Samuel Huntington that argues that certain cultural traditions inhibit and strive to destroy others and that this condition must be overcome in order to realize the salutary benefits of Western modernity, a capitalist economy and a rational, scientific worldview [4]. In undertaking a correction of Huntington it will be necessary to step back from the distinction of Herder and others between culture and civilization and even the subsequent analyses of mass culture as developed by such thinkers as Adorno and Horkheimer [5]. Underlying questions that need to be addressed are:

1. Whether India and China have by now inherited sufficiently the operative values of Western modernity, capitalism and scientific rationalism to become full and respected participants on the world stage? and;
2. How much --if at all-- do residual cultural norms and values stifle global collaboration and mutually beneficial economic development?

(These questions need to be addressed because they reflect the often prevailing point of view in the advanced countries of the west.)

The ideals of the enlightenment and liberal democracy are often said to be western and contrary to the traditional and prevailing values of China and India. Without trying to resolve this debate the presupposition of the Initiative is that within both Chinese and Indian traditions there are available philosophical structures entirely compatible with, although conceptually different than, the principles of Western modernity. In particular the approaches of Rabindranath Tagore, whose multiple modernizing tendencies are well known within Indian traditions, and certain revisionist views of the Confucian tradition, beginning as early Song-Ming neo Confucian thought and continuing today with a lively re-examination of the classics, offer useful insights [6]. Song-Ming neo Confucianism is not as remote as it might seem from contemporary concerns as discussions therein regarding practicality (somewhat different than American pragmatism, although that too, especially in the versions presented by Dewey, is now part of Chinese discourse) offer a valuable perspective on technology. Ironically while both Tagore and the neo Confucians were developing varieties of cultural nationalism they nevertheless lay the ground, each in their own traditions, for a trans-cultural ethical humanism open to diversity, change and development.

Regardless of the particular perspective it is essential that a pluralistic outlook be accepted. While traditional cultural claims should be respected it must also be the case that the limits of the legitimate claims of culture be understood. This is imperative both on the level of ethics and and pragmatic technology, as the success of mutual enterprise depends upon agreement concerning values and rights [7].

Much of the work of Amartya Sen has been directed toward exploring the kind of global economy that will not lead to the decline and often serious deprivation of certain regions at the expense of growth and success in others [8].

These issues develop greater and more complex significance in the technologically driven global environment. For some time there have been prognostications of the decline in influence of the nation state as a result of the ever growing power of multinational corporations. Jean-Francois Lyotard’s analysis of scientific knowledge [9] as a kind of discourse connects this anticipated phenomenon with reference to the state of technology. From an entirely different point of view Keniche Ohmae has more recently argued that technology is the foundation for the new regional economies that have replaced the nation-state driven economy [10]. As he sees it, the economic “challenges and opportunities” of the future are to be found in those regions of the world with innovative technological environments.

The majority of discussions of the future of India and China tend to abstract from their historical-cultural legacies and consider only the extent to which western models are successfully emulated [11]. As Yaheng Huang and Tarun Khann point out, there were two different paths to technological development following western precedents. "... China's export-led manufacturing boom is largely a creation of foreign direct investment, which effectively serves as a substitute for domestic entrepreneurship." And "...India has managed to spawn a number of companies that now compete internationally ... many of these firms are in the most cutting-edge, knowledge-based industries." [12] Such observations, while pointing to issues important to economic development anywhere, tend to be narrowly construed, taking too little account of the cultural environment that constitutes the arena for economic development and technological innovation. Careful consideration of such crucial topics as knowledge and human resources, educational policies, systems and institutions, including engineering education and technology development in China and India is also imperative [13].

In other words, the phenomena that Huang and Khann describe may be better approached if re-contextualized under the broad historical/philosophical categories suggested above.

An important element of the such considerations are the conditions for economic development. These include the opportunity (for example in Yunnan Province) to develop markets and access to seaports through India, Bangladesh and Myanmar; conversely, the opportunity for these regions to plug into growth in China; the complementary nature of high tech in India and China leading to an opportunity for synergistic development centered in this region [14]. Accordingly in the early stages of the project a study of the physical infrastructure links will be undertaken to determine their relevance in addition to the “soft” and virtual links between the academic institutions and government agencies, industries and NGOs in the region.

It is possible that the conditions for synergistic development obtain in this multicultural and multinational region analogous to the conditions exhibited by such competitive/collaborative corporations such as Microsoft and Google.

A recent paper by Wu Xiaobu et al frames the issue of regional, technological development as follows: "Today's
economic map of the world is dominated by what are called clusters... clusters not only become the basic framework of regional economy, but also act as the main form of spatial distribution of global economy. With the enhancement of both investment and trade activities among countries, the pace of global industry transfer speeds up, which results in interregional technology gaps and industry clusters as byproducts. The questions are how the industrial clusters in developing countries collectively identify, pursue and acquire external technology resources from industrially advanced countries by constructing external innovation networks to strengthen their technological capabilities in virtue of industrial clusters' advantage, and how they can effectively internalize external technology resources acquired, and successfully transit from imitation to innovation." [15]

An important element of the research to be undertaken as part of this Initiative is the study, in a comparative and interdisciplinary fashion, the cultural, social and historical conditions that are associated with regions where technology innovation clusters thrive. While the primary focus will be on the SW China - NE India region other regions, particularly regions with strong connections to China and/or India, will also be studied.

In his widely read work, Capitalism with Chinese Characteristics [16], Yasheng Huang argues that one of the great potential strengths in China is the existence of a highly motivated rural entrepreneurial class.

In his intriguing historical analysis, Adam Smith in Beijing [17], Giovanni Arrighi maintains similarly that historically the economies of Asia were based more on locally specific industry than was that in Europe – a tendency that continues today and which supports the possibility of strong, regional development.

The current climate of opinion in China particularly appears poised to benefit from regional technologies and the situation in India is perhaps even better. Bill Emmott predicts a power struggle between China and India that he says will shape the global economy for at least the next decade [18]. The alternative could be regional cooperation.

Other areas of the world could also become paradigms of such technological regional collaboration, but most likely with facilitation from either China or India – or both. The Nigerian state of Imo, for example, is poised to take advantage of opportunities to develop high tech industry by building a robust IS infrastructure. What is needed is acculturation and training.

Much of this was anticipated by Joseph Stiglitz [19] who argued that the policies and approach of the IMF has not recognized the differences inherent in local and regional economics and therefore somewhat paradoxically contributed to movement resisting globalization.

And from a different political standpoint Jagdish Bhagwati points out that technology and technical change foster far reaching local and regional cultural changes that require acknowledgment and adjustment in a global economy. The penetration, for example, of American popular media culture, perhaps a double affront to traditional culture because of its wide acceptance and popularity, ought not, Bhagwati argues, lead to protectionist policies but rather encourage measures to support indigenous cultural activity [20].

It is clear that the recent rise of China and India measures the deployment of technology. The expectation in the West that manufacturing could be outsourced leaving the West with control and ownership of the creative property was little more than a latter day attempt at colonialism.

4. THE AGENDA FOR ENTREPRENEURIAL ENGINEERING AND TECHNOLOGY EDUCATION.

Engineering and technology educational institutions worldwide but perhaps especially those in the developed countries of the West need to adopt several reforms in order to serve the needs of the 21st century. It is a sign of how rapidly the changes in the global economy are making demands on education that even recent documents outlining needed curricular reforms (such as the United States National Academy of Engineering's publication, The Engineer of 2020) [21] already appear slightly anachronistic. The fact that this is the case challenges more than simply engineering education: it points to inhibitions within the canons of best practice in the engineering profession at large.

There are important differences between what is offered in the standard engineering education and the skills and dispositions needed to practice innovative technology. These differences are mostly cultural (rather than technical or scientific) and call for rather than discourage collaboration. What are these differences? To answer this question we shall reflect on several characteristics that reveal the nature of engineering.

Engineering is reactive: it responds to problems that have been presented and the desire for a solution expressed. Engineering is a variety of problem solving that seeks to preserve resources, protect circumstances and improve the reliability and efficiency of operations. Engineering is concerned with details, how things function and what the causes of failure are.

Engineering therefore makes a vital contribution to the new world of technological innovation and entrepreneurship. Factors such as reliability, safety, and economy with respect to resource demand are intrinsic to engineering and comport with the CDIO approach. The understanding of these categories results from the testing and feedback protocols characteristic of the conservative tendencies of traditional engineering methods. The driving impulse of innovative technology, on the contrary, is a commitment to the "new". The processes of discovery are often most successful when there is little concern for the way things have been done traditionally. At the right scale that is with a diverse and large enough number of persons engaged in entrepreneurial innovative activity the success rate will pay dividends sufficient to overcome the costs of failure. The notion that failure is reasonable and a cost of invention contrasts profoundly to the ethos of engineering.

In this scenario engineering enters the process of innovation at a point later than the birthing of new ideas. The "C" of CDIO is largely removed from engineering which must now exercise the other aspects of responsible parenting. How should this happen in the current world of rapid, interdependent, global collaboration?

Engineering is the material and technical expression of cultural needs, preferences and traditions. The techniques and even the expertise of engineering are easily exported but the underlying culture is not. If one accepts Giovanni Arrighi's thesis then we would expect the persistence of fundamental differences in the organization of industry and trade between Europe and Asia. As the world shrinks or flattens it is easy to assume that one culture will at least eventually pervade and dominate. Yet this may not be the case. A significant and far reaching failure of the approach of the West to the rise of China and India may very well have been the belief that all business can and should
be conducted on the basis of a hierarchical Western model – with the West providing management functions and setting the terms for trade. In fact what is far more likely is that the rising technology regions of the world are going to resist the imposition of Western cultural, political and economic models in favor of alternative paths to modernization. That this not leads to destructive competition (as was the extreme consequence of the pan Asian movement of the 1920s and 1930s) announces an imperative to equitable collaboration.

The model that suggested that Asia can be the factory for Western design and innovation, with significant profits accruing to the West to permit the ongoing growth of consumer society, is no longer viable. What should be the path taken in the West?

Technology clusters are local or regional phenomena. They take advantage of the expertise, including the tacit knowledge that flows from historical endeavors, that is present in a region. A technology cluster acknowledges the need for a threshold level of involvement as well as an appropriate plurality of skills and capabilities. A technology cluster need not be formally organized, although resources and other incentives will be attractively available. But the energy of a technology cluster derives from natural synergies and the serendipity that result from relative proximity. Imagination defines working protocols and the structure of any formal exchange.

Such technology clusters, as they succeed, would create the need for various support services (such as manufacturing capability, warehousing, marketing and distribution) if their objective were to develop into a mature industry. In some regions, where economic development is behind the establishment of the cluster, this may be the case. But technology clusters may not spin off companies in their immediate vicinity as it is the intellectual property that is their actual product. Nonetheless there is in the relatively late stages of innovation the need for good engineering.

Engineering can lift a new innovation out of the specific context in which it was originally devised. Eliminating the the “C” engineering now develops a practical and durable design (“D”), sees to the implementation of the design within available facilities – which may vary greatly from place to place (“I”) and establishes the operating standards which are the final test of the effectiveness of any device (“O”). An existing automobile company, no matter how deep their financial resources and however accomplished their pool of talent, has certain inherent restraints that make it highly unlikely that it will be the venue to innovate the radically new mode of transportation necessary to address the interlocking crises of the environment, energy resource and economics. On the other hand the “car of the future” think tanks create highly innovative prototypes that existing industry is unable to produce. What is needed is a new type of engineering capability that can integrate these two disparate types of organization in the development of useful new technology.

It is quite unlikely that major corporations will support the kind of innovative research and development labs made famous in the 20th century by such concerns as Bell Labs and General Electric [22]. Even a highly innovative and progressive company like Google places very strict limits on its engineers’ ability to pursue new ideas. The new technology of the future will emerge from a different type organization than the large corporation of today. It is in this emerging environment that engineering must find its place. Given the geo-political seismic change it is quite probable that will find themselves supporting and complementing innovations taking place far afield. But the instantaneous communication of the Internet, fortified by powerful tools for technical collaboration, will prevent displacement and exclusion provided engineers are prepared to work in this new context.

5. CONCLUSIONS

Modern technology and techno-science are driven by the desire to create new solutions (devices and systems) that will be desired and hence marketable.

Successful innovation is highly collaborative drawing, as it does, upon a diverse set of skills and viewpoints. Collaborations are frequently ad hoc and serendipitous.

The industrial-technical establishment in the West is not the only or best source of innovation.

The subordinate role China and India have been assigned of manufacturing products conceived and designed in the West does not foster innovation.

This subordinate status is rapidly coming to an end as both China and India are poised to become dominant world leaders in certain crucial fields.

The excellence of the engineering tradition has emerged over time based on both scientific/technical and cultural grounds.

Engineering is inherently conservative, procedurally guarding such concerns as safety, reliability, social cost and cost to the natural environment.

The culture of engineering is normally at home in large institutions such as the military or industry and not in the unstable and transient organizations conducive to innovation. This needs to change.

The culture of innovation needs the culture of engineering. The future of engineering should to a large extent be that of regent to the enfant terrible of innovative technology. In this way both the profession of engineering and society will benefit. However this must be done in a global setting, most especially in collaboration with the burgeoning centers of technology creation rapidly appearing in Asia.

6. REFERENCES

2. Hannah Arendt, The Human Condition (1958), passim. George Kateb interprets Arendt's attitude toward technology insofar as it contributes to "world alienation," i.e., the sense of displacement that is fostered when one's lived-in world is fundamentally structured by technology. The reference is not only to modern technology, although in Arendt's view this process of alienation was greatly accelerated with the rise of modern science, but may include the agrarian way of life as well. Kateb, Technology and Philosophy, Social Research, vol 64, No. 3 (Fall 1997), pp 1225 -1246.
3. Nicomachean Ethics, book VI, ch. 7 (1141a20ff).
progressive, just and equitable society that is not based on the principles of Western liberal democracy but rather derives from the basic tenets of Confucianism.

7. Seyla Benhabib in *The Claims of Culture - Equality and Diversity in the Global Era* (2002), writes: "... the politics of multiculturalism is defined by these theoretical commitments: the discourse theory of ethics; the dialogic and narrative constitution of the self; and the view of discourses as deliberative practices that center not only on norms of action and interaction, but also on negotiating situationally shared understandings across multicultural divides." (p 16) Commitments such as these undergird the approach of this Initiative.


9. "Scientific knowledge is a kind of discourse. And it is fair to say that for the last forty years the “leading” sciences and technologies have had to do with language: phonology and theories of linguistics, problems of communication and cybernetics, modern theories of algebra and informatics, computers and their languages, problems of translation and the search for areas of compatibility among computer languages, problems of information storage and data banks, telematics and the perfection of intelligent terminals, to paradoxology." Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, Chapter 1, The Field: Knowledge in Computerised Societies (1979).

10. Kenichi Ohmae, *The Next Global Stage: Challenges and Opportunities in our Borderless World* (2005). In this book he makes the case that China in particular is becoming the exemplar of this new economic paradigm.

11. Even the most excellent recent discussions have tended to formulate the issues narrowly in classical economic and technology building categories. See Yasheng Huang and Tarun Khanna, *Can India Overtake China?*, *Foreign Policy* (July-August, 2003).

12. Ibid., p. 75.


22. The recent work of the distinguished historian of science Steven Shapin addresses this phenomenon.
RESEARCH AND EDUCATION IN ENGINEERING AND BUSINESS WITH SPECIAL CONSIDERATION ON GEOMETRICAL PRODUCT SPECIFICATIONS AND VERIFICATION - GPS

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ABSTRACT: The prescription and consumption of material and energy to achieve the necessary and required workpiece accuracy in series manufacturing depends to a great extent from the workpiece (geometrical) tolerances of any kind (roughness, form, positional, dimensional) which are prescribed for the production and the fulfillment of these tolerances and therefore for the function of the produced workpieces and their fitness for practical application and none the less of the economy of production altogether. This requirement is of great importance at the time being which is characterized by shortage of energy and raw material.

Adequate knowledge in this area is an important presupposition to achieve waste free production and low costs of manufacturing with high as possible quality and accuracy at the same time. This is of extreme importance in present time of worldwide international competition in industry and production.

1. INTRODUCTION- GEOMETRICAL TOLERANCES AND DEVIATIONS

If the geometry of machined workpieces is considered as a whole there exist interactions between the different features forming the periphery of the workpiece. But also within the surface of every single feature there exist interactions between geometrical deviations of different kind and different order. If we take these deviations of dimensions, roughness, form and position collectively the existing interactions are significant for the accuracy and the functions of the parts that should be accomplished during practical application.

2. THE DESCRIPTION OF THE WORKPIECE GEOMETRY

Since about 1970 computer-aided production metrology has been of ever increasing importance for the comprehensive analysis of the workpiece geometry used in modern production technology.

Depending on whether macro geometry or micro geometry is the focus of the analysis, in general distinction is made between geometrical deviations of different order. It is common practice to collectively consider the more or less short-wave geometric deviations of third or higher order as surface roughness, on the basis of internationally established parameters.

As already described in former research reports there is evidence for the existence of “inherent interrelations” and “so to speak a natural relationship”, as it were, between the different kinds of form errors or geometric deviations [1]. First and foremost it has been in [2] where the term of a “uniform approach to geometrical deviations of different order” has been coined. This uniform approach and way of analysis has been translated into reality in particular through the development of co-ordinate metrology, and its applicability to microgeometry measurements has been pointed out successfully [3].

Extensive industrial investigations have been carried out as support for practical industrial application and appropriate correlations and guidelines have been worked out. Especially the already mentioned developments of computer-aided metrology supported in building up the basis for correlating permissible and function oriented geometrical deviations with workpiece accuracy [4, 5]

3. COMPREHENSIVE DESCRIPTION OF THE WORKPIECE GEOMETRY

For the geometrical description of workpieces GPS (Geometrical Product Specifications and Verification) defines on a technical drawing the shape (geometry), dimensions and surface characteristics of a workpiece. In this way the optimal function of the respective part is supposed to be guaranteed by considering certain manufacturing tolerances. Nevertheless workpieces will be produced, which do not fulfill these requirements. Therefore workpieces are measured and inspected in order to be able to compare the finished parts with the specifications. There is a need to relate between actual workpieces and:

- the workpiece imagined by the designer,
- the workpiece as manufactured,
- the knowledge about the workpiece as measured.

In order to establish this relationship between design, production and measurement and to clarify the mutual importance, standards have been developed in the area of Geometrical Product Specifications and Verification. A set of requirements concerning the geometry of a workpiece (or of an assembly of several workpieces) is known as the “Geometrical Product Specifications and Verification” covering requirements of size and dimension, geometrical tolerance and geometrical properties of the surface (Figure 1).
Comprehensive knowledge in this area is an important presupposition to achieve economic design, construction, production, metrology and quality management.

Figure 1. Geometrical Tolerances and Tolerances of Dimension and Geometrical Properties of the Surface

The concept of the Geometrical Product Specifications and Verification includes:

- several types of standards, some are dealing with the fundamental rules of specification, some are dealing with global principles and definitions and some of them are dealing directly with the geometric characteristics;
- different geometric characteristics such as size, distance, angle, form, location, orientation, roughness;
- workpiece characteristics as results of different manufacturing processes and the characteristics of specific machine elements and

• occurs at several steps of the product life cycle, in the development of a product, design, manufacturing, metrology, quality assurance, etc.

This concept is represented in Figure 2, showing four different types of GPS standards and designated as the "GPS-matrix-model" (Figure 2).

Figure 2. The GPS-matrix-model – GPS Masterplan – Overview
According to the original idea, the group of fundamental GPS standards should contain such standards which establish the fundamental rules for dimensioning and tolerancing. However, in this group there are only two documents - ISO 8015:1985 [6] and ISO/TR 14638 [7] - which contain the outline of the Masterplan [7].

Global GPS standards are closely related to many other GPS standards - first of all those contained in the General GPS Matrix. Global standards influence general GPS chains of standards directly (being referenced to) or as default documents. A very important global GPS standard is ISO 1 on the standard reference temperature in metrology. Another global GPS standard is for example ISO 14660-1 which establishes terms and definitions of geometrical features. Complementary GPS standards contain technical rules for drawing indications, definitions and verification principles for specific categories of features or elements. Some of the rules depend on the type of manufacturing process (machining, casting, welding, forming); other may concern the geometry of certain machine elements like screw threads, splines, or gears. Most of the big number of Complementary GPS standards have been prepared by different ISO Technical Committees; only a few are the direct results of activities of TC 213.

The Complementary GPS standards are divided into:

- Tolerancing standards for special production methods (e.g. casting, cutting)
- Geometrical standards for mechanical parts (e.g.: gears, screw thread)

4. WORLDWIDE INTERNATIONAL STANDARDISATION IN THE AREA OF GPS

Since a lot of years - more or less since the 1930's - it has been tried hardly by Technical Committees (TCs) of national and international bodies for Standardisation (especially the International Standardization Association ISA before World War II and the International Standardisation Organisation ISO since the late 1940's) to develop generally understandable and as far as possible harmonized international standards.

So quite a long time the GPS standards have been developed by committees in ISO and published as soon as that there has been a specific requirement. However a comprehensive survey of all GPS standards was sometimes missing. This led to standards with different aims and representations and sometimes also to inconsistent determination. Furthermore there are gaps between the GPS standards. Since 1996, the Technical Committee ISO/TC 213 on “Dimensional and Geometrical Product Specifications and Verification” has been working towards harmonizing previously standardized practices in tolerancing (specification) and related metrology (verification). The Technical Committee ISO/TC 213 works in close collaboration with a similar committee in the European organisation CEN/TC 290. According to the Vienna Agreement all projects are processed in parallel by these two technical committees - so documents on GPS prepared by ISO and CEN are identical.

5. GPS AS FUNDAMENTAL REQUIREMENT FOR ECONOMIC MANUFACTURING

In general it is the intention of the manufacturer to satisfy all requirements that are demanded for a product. Every manufacturer is looking forward to satisfy all the criteria that its product must have. Technical means, tools and methods are used to ensure the consistency of product characteristics. One of its important characteristic or feature is geometrical specification or it is better to say Geometrical Product Specifications (GPS).

Geometrical Product Specifications are a means to transform function dependent demands into produced workpieces and parts based on:

- mathematical rules and methods,
- consideration of macro and micro geometry,
- possibilities for measuring of quantities and especially tolerated quantities and
- evaluation of uncertainty, etc.

Generally there are many definitions and concepts in Geometrical Product Specifications and Verification (GPS) but one of them which has been presented some years ago named "Skin-Model" [4] was studied in the frame of some research projects. The "Skin-Model" presents a new description for Geometrical Product Specifications and Verification (GPS) with its associated details and on its basis every workpiece can be geometrically defined and considered by applying manipulations of the workpiece geometry. This determination is based on mathematical rules and definitions. It means that according to this determination every workpiece can be designed and on the other hand according to the design it can be measured very clearly.

6. WORKPIECE CHARACTERIZATION IN COORDINATE MEASUREMENT TECHNIQUE AND THE SKIN MODEL

The "Skin-Model" is a geometric model of the physical interface between a workpiece and its environment. It defines non-ideal features with consideration of ideal features at the workpiece circumference. A real feature is a non-ideal feature the shape of which depends of the production process and its conditions whereas ideal features exist only in theory (Figure 3).

![Ideal features and Non ideal features](image)

Figure 3. Ideal model and "Skin-Model" of a Workpiece
The Skin-Model is based on some general and basic definitions. It uses some tools which are named "Operations" which can be compared with mathematical operations as in mathematics and especially in arithmetic.

Operations which are applied within the Skin-Model are:

1. Partition,
2. Extraction,
3. Filtration,
4. Association,
5. Collection,
6. Construction and

This gives principal ideas in respect of the evaluation of measurement results with regard to GPS.

7. SYNOPSIS AND CONCLUDING REMARKS

The presented ideas explain in principal the correlation between different geometrical deviations and the manufacturing conditions. This can help to achieve lower manufacturing costs and at the same time higher quality in present production. The presented study can be seen as a further step in the direction of a comprehensive analysis of workpiece geometry and it is fully in line with research work already carried out in the past. By the described successful application of co-ordinate metrology for the solution of measurement problems of various kind also new challenges are put onto precision production measurement technology especially in the area of GPS.

8. REFERENCES


ENTREPRENEURSHIP EDUCATION AND RESEARCH
INVESTING IN EDUCATION, A WAY OF ACCUMULATING AND DEVELOPING HUMAN CAPITAL

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ABSTRACT: The investments in the human capital are generating benefits for the individual and the society by improving the labor productivity, the organization of activities, reducing the crime rates etc. Because most of the knowledge, competences and qualifications are obtained through the instructional and educational process, education has a major role in the accumulation and development of the human capital and therefore in a country’s economical development. The effects of education on the economical development are greater there are fulfilled conditions like: the state and population give a greater attention to education reflected through the percentage from the PIB that’s accorded to it, the rate of school attendance, the obtained results; there is a connection between the actual demands and labor market force perspectives and the educational offer. Improving the quality of education implies the development of the student’s ability to correctly apply and use knowledge to real life situations, assuring an adequate and diversified material base, changing the school programs so they will fit to the labor market’s requests and so on.

1. INTRODUCTION

The human capital stands for the professional knowledge, the habits and the health, who enhances the individuals creative capacity, it’s capacity to produce socio-economical assets, allowing him to obtain incomes in the future. It represents the individuals abilities who can be put to value by doing various socio-economical activities.

The human capital is based on the educational and biological capital. The educational capital stands for the abilities obtained by individuals by training in educational units and outside of them. The biological capital stands for the physical abilities of the individuals, synthesized by the health condition [1].

Between the biological capital and the educational one there are some interdependencies. This way, the health status is an essential condition to assimilate the educational capital.

The lack of economical resources stops the individual from making expenses for the maintenance and development of the educational capital, and a lower educational level can also mean preoccupations and lowered possibilities to maintain the health level in optimal parameters. The health’s status is an essential resource for the individual development, especially in order to obtain incomes.

The degradation of the health determines the diminishment of the labor force. On the other hand, poverty can also determine the degradation of the human capital stock, the individual not being able to get enough funds for its maintenance and development.

This way you can enter a vicious circle that can cause permanent poverty. The two categories of health and education expenses can be regarded as an investment as well as a consume.

The investments in the human factor are continuous and they target either maintaining the human capital, either his development.

The concept of capital is especially seen as a potential of productive knowledge obtained by investing in the labour factor.

The educational capital is presented in two distinct ways: on one hand there are the abilities gained after participating in the formal educational systems, abilities certified by diplomas; on the other hand there are any other knowledge and abilities gained during your lifetime by personal efforts or by interacting with specialists from various areas, finalized with a gain in knowledge by assimilating the information received.

The result of the investment in the human capital is usually presented as a higher productivity that the individual can use to do various socio-economical activities. A high educational capital implies a higher value of the used labor force due to the increased productivity, implying a larger payment in the case of its usage, the salary growing according to the education level.

In the same time, a higher level of training also implies a greater flexibility in adapting to the specific conditions of the labour market, contributing to the diminishment of the unemployment risk. The gap between the salaries of the most trained and less trained employees is getting larger.

In the past years, the number of the highly specialized working places has grown on all the levels of education in the detriment of the unqualified working places that require a lower specialization level and the managers of inferior level (foremen, section chiefs and others).

2. THE RELATION BETWEEN THE HUMAN CAPITAL AND THE PRODUCTIVITY

The development of the human capital means a higher level of training, more developed creative skills and a better health. Therefore, between the human capital of the employees and the work productivity of a firm is a direct relation.

The investments in the human capital bring benefits both to the individual as well as to the society, by increasing the productivity, a better organization of the economical activity and by the decrease of the criminality levels.

In the process of the economical development, the human factor interferes by increasing the volume of performed labor, as well as its quality, reflected in the labor productivity. The investment in the development of the human capital constitutes a composing part of the national wealth.
Under the aspect of quantity, the human factor can be evaluated through the level of work done by the occupied population during the time of effective work.

The action of the human factor under the process of the economy’s development is related to the evolution of the occupation of the available active population.

Under the aspect of quality, the analysis of the human resources implies the evaluation of the level of scholar and professional training of the population, the health status, the cohesion degree, social stability etc.

Investments in the development of education and professional training of the human resources generate human capital. The development of human capital increases the productivity of the labor factor, who positively influences the ratios of economical growth.

The human capital of an employee can be specific to a firm or general.

The human capital specific to the firm refers to the knowledge, competences and other qualities specific to the activity done in a specific socio-economical unit. Doing an activity in any firm requires having some knowledge regarding the mode how the information are obtained and stored, how the decisions are made and how they can use the relations between the employees in an advantageous manner.

As the employees gain this knowledge, they become more valuable for the firm. This kind of knowledge doesn’t have any use for another firm, the persons that move being forced to learn the information specific to the new working place.

The companies do not want to lose employees who gained the human capital specific to the firm, because other employees must be trained then.

Depending on the particularities of the firm, the time required for the assimilation of the specific human capital can be greater or lower. In the activities that employees gain a human capital specific to the firm for a number of years, the differences between employees reflect the different period of time they have been working for the company.

In the case where the specific human capital for the firm can be learned quickly, the differences between salaries are based on the general human capital.

Unlike the human capital specific to a firm, that can be gained by activities (training) at a certain company, the general human capital includes knowledge, aptitudes, competencies that allow a person to do activities of a certain qualification in various working places.

The human capital specific to the firm and the general human capital influence the work productivity of an employee, and its salary must reflect that productivity.

If the firm pays the employee a salary that reflects the productivity given by the human capital that it has then the employee has the motivation to stay at that working place.

The firms don’t have the interest of losing the labour force used to the specific of the activity. The human capital gained by activity and experience at the working place represents a motive for increasing the income according to the length of the period of time spent working for the firm.

The companies have the tendency to pay the employees the value of the current marginal product, the usually pay less than the marginal product at the beginning of the employee’s activity and a lot more later.

The lower payment from the first years is seen as a reward for the employee from the firm because it helps him gain valuable human capital. The higher payment he receives in the following years it’s a benefit brought by this capital.

3. THE ROLE OF THE EDUCATION IN THE DEVELOPMENT OF HUMAN CAPITAL

The human capital has been approaches especially in the economical theory in the moment when they noticed that as well on the level of the individual as on the country’s level, the higher profits are caused by investment in knowledge, competence, qualifications and less in the physical capital.

Because most of the knowledge, competence and qualification are gained trough the instructional and educational process in the school, education has a determined role in the accumulation and development of the human capital and also in the economical development of a country.

The effects of education on the human capital development and the economical development are higher when there are met requirements like:

-a special importance is given to the state education and the population, reflected in the percentage of the I.B.P. allocated for the education, the rate of scholar participation and the obtained results

-there is a correspondence between the actual requirements and the perspective of the working force and educational offers

-the socio-economical and political environment is stable and the rhythm of economical growth is high

-the occupations of the active people correspond to the level of professional training of the individual.

The volume of the expenses with the education varies from one individual to another and from a country to the other. It reflects the capacity of the country to sustain the development of the human capital and the place that it has it on the long term development strategies.

Table 1. The ratio of public expenses with education in 2006/2007 in some European countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Public expenses with education in % of the National Brute Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>2006</td>
<td>2,46</td>
</tr>
<tr>
<td>Belgium</td>
<td>2006</td>
<td>1,85</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>2006</td>
<td>0,48</td>
</tr>
<tr>
<td>Denmark</td>
<td>2006</td>
<td>2,44</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2004</td>
<td>2,93</td>
</tr>
<tr>
<td>France</td>
<td>2005</td>
<td>2,13</td>
</tr>
<tr>
<td>Italy</td>
<td>2005</td>
<td>1,10</td>
</tr>
<tr>
<td>Portugal</td>
<td>2005</td>
<td>0,8(1)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2006</td>
<td>1,80</td>
</tr>
<tr>
<td>Romania</td>
<td>2007</td>
<td>0,53(2)</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>2006</td>
<td>1,08</td>
</tr>
<tr>
<td>Slovenia</td>
<td>2006</td>
<td>1,63</td>
</tr>
<tr>
<td>Sweden</td>
<td>2006</td>
<td>3,82</td>
</tr>
<tr>
<td>Hungary</td>
<td>2006</td>
<td>1,00</td>
</tr>
</tbody>
</table>

1) Provisional data, 2) Semi-definitive data

Source: Romania’s statistic annual 2008, page. 949

You can notice that the percentage of public expenses in the Brute National Income records a lower level (0,53%) compared to most of the European states. The highest levels are recorded.
in the so-called “countries of the democratic socialism” from the north of the continent, Denmark (2.44%), Sweden (3.82%), Austria (2.46%), Switzerland (2.93%) and France (2.13%).

Romania, as other countries found in the development process, is confronted with what it’s called the vicious circle of poverty: because a country has a very low level of development it can allocate a small number of resources for the economical development, for accomplishing investments in education and therefore in the human capital, which diminishes the qualitative and quantitative use of the labour factor.

And the usage at a low level of the main factors of economical growth makes the level of economical development reduced.

The level of the individual expenses allocated for education is variable and evolves with a certain incertitude, which led to the accentuation of the state’s role in financing the education, either in totality, either partially[1].

In our country, learning is free at all the levels and access to education is guaranteed by the law for all the persons, disregarding sex, nationality, religion or socio-familial provenience environment. The existence of a favorable legislation to education is insufficient as long as the economic situation is bad and most of the population has low incomes.

Financing the education targets its advantages for the society and for the individual. The total financing of the primary and secondary education stages is more advantageous for the society than for the individual.

The education received during the years of primary and secondary education determines a higher level of alphabetization, the increase of the degree of participation of the population at the socio-economical level, enhancing the quality of the family life and the health etc.

Because of this, in many countries the primary and secondary learning are free and the mandatory period of school is longer. Financing the superior education is partially made by the state.

Investments in the superior learning have a higher degree of profit in individual plan than for the society, especially by increasing the future earnings.

Because of this, most of the superior education costs are being paid by the individual.

The scholar participation rate is different on the three levels: primary, secondary and superior.

**Table 2. The rate of scholar comprehension in some European countries in 2006/2007**

<table>
<thead>
<tr>
<th>Country</th>
<th>Primary Cycle</th>
<th>Secondary Cycle</th>
<th>Superior Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>102%</td>
<td>106%</td>
<td>80%</td>
</tr>
<tr>
<td>Belgium</td>
<td>101%</td>
<td>106%</td>
<td>80%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>99%</td>
<td>106%</td>
<td>80%</td>
</tr>
<tr>
<td>Denmark</td>
<td>97%</td>
<td>93%</td>
<td>80%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>110%</td>
<td>114%</td>
<td>80%</td>
</tr>
<tr>
<td>France</td>
<td>104%</td>
<td>100%</td>
<td>80%</td>
</tr>
<tr>
<td>Italy</td>
<td>107%</td>
<td>118%</td>
<td>80%</td>
</tr>
<tr>
<td>Holland</td>
<td>115%</td>
<td>98%</td>
<td>80%</td>
</tr>
<tr>
<td>Portugal</td>
<td>103%</td>
<td>98%</td>
<td>80%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>104%</td>
<td>87%</td>
<td>80%</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>96%</td>
<td>84%</td>
<td>72%</td>
</tr>
<tr>
<td>Slovakia</td>
<td>100%</td>
<td>94%</td>
<td>72%</td>
</tr>
<tr>
<td>Spain</td>
<td>105%</td>
<td>119%</td>
<td>72%</td>
</tr>
<tr>
<td>Sweden</td>
<td>96%</td>
<td>103%</td>
<td>72%</td>
</tr>
<tr>
<td>Hungary</td>
<td>97%</td>
<td>96%</td>
<td>69%</td>
</tr>
</tbody>
</table>

*The scholar rate can surpass 100% because of the students that are repeating the year or who go to school later.

Note: The primary learning represents primary school, secondary learning represents gymnasium, high-school, professional school, organized in cycles according to each countries rules (short or long term) and post-high-school learning (studies that aren’t equal to the university levels).

Source: Romania’s statistic Annual 2008, page 948

As you can see, the brute rate of comprehension is lower as we advance to superior levels of education.

While in the European countries the primary and secondary learning are generalized (only children with special physical or mental health problems, immigrant’s children or delinquents don’t go to school) in Romania the percentage of scholar participation is 100% only for the primary cycle, while for the secondary level is only 87%. Our country records a lower level of the brute comprehension rate in the superior level, 50%, close to the ones in Bulgaria (46%), Slovakia (45%). The highest levels recorded for this indicator are recorded in Denmark (80%), Italy (67%), Hungary (69%) and the United Kingdom of Great Britain (59%).

At this is added the reduction of the mandatory scholar period (from 10 years in 1980, to 8 years in 2003 and from 2004 prolonged to 9 years), in the conditions where at the level of the E.U. the tendency is to increase the mandatory period of school. The impact of these oscillations over the general levels of training of the population is higher in the conditions of economical recession, when the request for education from the population and the trust in the institutions of education are usually low.

Raising the quality of the education in our country implies the development of the capacities of the students to apply and use correctly the learning gained in actual situations, in new contexts. For example, the Romanian students obtain high performances in the case of the objectives that target the reception, recognition and reproducing the obtained knowledge. The educational system doesn’t develop enough the student’s innovational spirit. The graduates that will lack this sort of aptitudes are exposed to the risk of unemployment, social exclusion, poverty.

In our country, the structure of the occupied population after the level of training in the year 2007 is characterized trough a high percentage of persons with average studies.

**Table 3. The structure of the occupied population after the level of training in the year 2007**

<table>
<thead>
<tr>
<th>Level of training</th>
<th>Total of occupied population with working age %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>thousands of pers.</td>
</tr>
<tr>
<td>Total</td>
<td>9353</td>
</tr>
<tr>
<td>Superior</td>
<td>1290</td>
</tr>
<tr>
<td>Average</td>
<td>5738</td>
</tr>
<tr>
<td>of whom</td>
<td></td>
</tr>
<tr>
<td>foreman</td>
<td>420</td>
</tr>
<tr>
<td>technical-</td>
<td></td>
</tr>
<tr>
<td>post-high-school</td>
<td></td>
</tr>
<tr>
<td>High-school</td>
<td>2977</td>
</tr>
<tr>
<td>Professional</td>
<td>2341</td>
</tr>
<tr>
<td>Low</td>
<td>2325</td>
</tr>
<tr>
<td>of whom</td>
<td>1706</td>
</tr>
<tr>
<td>Gymnasium</td>
<td></td>
</tr>
<tr>
<td>Primary or</td>
<td>619</td>
</tr>
<tr>
<td>without studies</td>
<td></td>
</tr>
</tbody>
</table>
In 2007, the ration of occupied population in Romania that had average studies was one of 61.3% and of those with a low level of education was one of 24.9%.

A lower ratio had those with a superior level of studies (13.8%).

The increase of the level of training and gaining new abilities are competitively factors that are becoming more and more important in an economy based on knowledge. Increasing the level of professional training requires the continuity of the educational process and professional development.

In our country it has been recorded a really low rate of participation in the education and professional training. In the year 2007 the number of persons that frequented professional forming classes (included in the training and who began training in organized classes) was one of 123.445[2], which represents a percentage of 1.4% out of the occupied population that has an age between 15 and 64 de years[2].

The low participation rate in the professional forming classes has reasons like:

- the low interest of the contractors/companies for the investment in developing the human resources
- the offer of training insufficiently developed, concentrated mainly on programs for general aptitudes (using the computer, foreign languages, accountancy etc.) and less on specific aptitudes.

An important problem of the educational system is its adaptation to the socio-economical requirements. This implies the modernization of the educational system in what regards the education and continuous initial professional training.

For our country it’s a priority to increase the access of young people from the rural environment at the professional and technical learning that must offer services and preparation standards according to the requirements of development of various areas.

Increasing the quality in the education and continuous professional development implies changing the programs according to the requests from the labor market. These programs must contribute to the compensation of the qualification deficit of the young people in order to make them fit to the employer’s request. Because of this, the objects of study that have a “community aspect” must target the gain of necessary qualifications and competences. Through the development of the complementarities of the continuous professional training programs and initial training, the attractiveness and flexibility of these programs is increased.

Another problem that Romanian education system must face is the school drop-outs, a lot of students dropping out of school without having the necessary qualifications. Reducing the phenomenon of school drop-out in an early stage implies focusing the efforts into keeping in the educational system the kids from the socio-economical disadvantaged groups, the kids from the special schools etc. The efforts that are being made to assure transport services of the students from isolated areas to the scholar units are also made for organizing the schools, contribute to attracting the youngsters in the educational system. Increasing the quality of the education and making it compatible with the European education system implies the assurance of an adequate and diversified on learning profiles material base, facilities needed for a complex educational process and recreational activities etc. This implies building modern campuses that will focus the offer of educational services.

Educatung the youngsters for an active participation in the socio-economical life based on knowledge requires the stimulation of the development of abilities for the digital economy. An enhanced attention must be given to reducing the gaps between the schools from the rural environment and those from the city, under the aspect of IT systems, which requires promoting investments into the generalization of the development of IT technology in schools from the rural environment. In the context of making the labour market more various the efforts made for adapting the formation services must be continued according to the requirements of the employers and creating new occupations so that persons with abilities will be able to easily switch occupations by gaining new competences.

The educational offer must correspond to the economical requirements based on knowledge. In Romania, the educational offer was diversified starting with the beginning of the 90’s as well as in the level of secondary learning as in the level of superior education. In the first years of the transition, the growth of the number of specialists in the economical, medical, juridical, informatics and so on responded to the needs of the labor market. The lack of system to monitor this relation between the educational offer and the labor market request led to major dysfunctions like: over-crowding with certain categories of specialists, narrow specializations, under-occupation and so on. Because of this, in our country took place a decrease in value of the diplomas, but not because they were too many, but because they weren’t used.

The investments in human capital are depreciated in the case where the qualifications, competences and knowledge aren’t used regularly and accordingly.

In our country there are frequently met situations where between the levels of specialization the obtained income is no direct relation. This way, activities that imply a lower or limited level of educational and professional training and have a lower degree of responsibility are better paid than other that requires a larger level of training and responsibility. Maintaining such a relationship on a long term determines the lack of motivation for individuals to invest in education and the growth of immigration, especially in the case of the highly-qualified youngsters. And the deterioration or loss of human capital does not favor the development of an economy based on knowledge.

4. REFERENCES

2. *** The Statistic Annual of Romania 2007, paragraphs 3.18 and 3.8


Abstract: Herein will be briefly presented few results of an extensive empirical research realized in 2009 under National Council of Private Romanian SMEs auspices. The research was based on direct interviews with Romanian entrepreneurs from 1099 SMEs – micro, small and medium sized enterprises – operating in all economic sectors, covering every age category and each of the eight development regions. This paper will point out assessments regarding the broad evolution of the Romanian business environment, main opportunities for small and medium sized enterprises, performances of companies, the level of using counseling services and innovation activities in SMSs.

1. ENTREPRENEURS’ PERCEPTIONS REGARDING THE BROAD EVOLUTION OF THE ROMANIAN BUSINESS ENVIRONMENT

The broad situation of the economic environment in Romania at this moment (figure 1) was appreciated as hindering development for 58.18% of SMEs, neutral for 24.69% and favorable for business in 17.13% of companies. If we compare these perceptions with those from the previous years (for example the environment was considered to be favorable for businesses for 51.61% companies in 2008, and for 42.91% of the companies in 2007), we can state that more and more entrepreneurs/ managers within SMEs are not satisfied with the environment of their activities, because of internal and international crisis started in 2008.

As for the evolution in 2010 of the business environment (figure 2), in 57.94% of the analyzed SMEs is estimated that the Romanian economic environment would be hindering for business and in only 25.57% companies it is considered to be favorable for development, which proves the distrust that entrepreneurs have regarding economic environment improvement on short and medium term.

Table 1. Differences in SMEs assessment for the actual business environment by size classes

<table>
<thead>
<tr>
<th>No.</th>
<th>Broad situation of the actual economic environment</th>
<th>Size classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Micro-enterprises</td>
</tr>
<tr>
<td>1</td>
<td>Favorable for business</td>
<td>15.47 %</td>
</tr>
<tr>
<td>2</td>
<td>Neutral</td>
<td>25.00 %</td>
</tr>
<tr>
<td>3</td>
<td>Hindering for business development</td>
<td>59.53 %</td>
</tr>
</tbody>
</table>
Table 2. Differences in SMEs assessment for development of business environment in 2010 by size classes

<table>
<thead>
<tr>
<th>No.</th>
<th>Future situation of the economic environment</th>
<th>Micro-enterprises</th>
<th>Small enterprises</th>
<th>Medium enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Favorable for business</td>
<td>14.78 %</td>
<td>20.25 %</td>
<td>13.33 %</td>
</tr>
<tr>
<td>2</td>
<td>Neutral</td>
<td>25.53 %</td>
<td>25.63 %</td>
<td>20.95 %</td>
</tr>
<tr>
<td>3</td>
<td>Hindering for business development</td>
<td>56.69 %</td>
<td>54.11 %</td>
<td>65.71 %</td>
</tr>
</tbody>
</table>

2. MAIN OPPORTUNITIES FOR SMES

Of all the enterprises subject to this study, 64.88% considered that one of the main business opportunities for 2009 is the sales’ increase on the domestic market, which indicates that despite of recession/crisis started in 2008 the entrepreneurs stake further on purchasing power of population and internal economic agents. Other significant opportunities pointed out are: entering new economic markets (indicated by 41.77% of the entrepreneurs), uptake of new products (40.22%), business partnerships (33.39%), the use of new technologies (31.94%), grant procurement (23.66%) and exports’ increase (20.56%). The relatively high rate of enterprises in which introduction of new products and use of new technologies were considered among the most important business opportunities demonstrate that SMEs are open to new activities although, with very few exceptions, they don’t have a strong innovative character. We have to notice that in 3.09% of SMEs other business opportunities are identified for the current year, out of which: disappearance of competitors, outsourcing services, purchase of new equipments at affordable prices, retention of customers, shifting the object of activity, recruiting personnel, increasing the registered capital, implementation of quality standards, expanding space, stability/retention of employees, revive of real estate market, exchange rate evolution, imports’ increase, boosting of lending, expansion of activities in territory etc. See figure 3.

Figure 3. Intensity of business opportunities for Romanian SMEs

Depending on SMEs’ size, one can notice certain interesting differences: proportionally with SMEs size increase, a weight rise is registered for the enterprises that consider as business opportunities the exports’ increase, the use of new technologies, and entering new economic markets. This situation is explained by the fact that the increase of a company’s size is followed by an growth of its economic power, which enlarges the area of commodity market for its products/services (domestic and international), and it also increases the capacity to improve technologies. Increased sales in the domestic market and assimilation of new products are found in a frequency inversely proportional to the size of SMEs, a business partnership is targeted more often in the micro-firms and obtaining a grant is reported among a larger number of small companies. Details in table 3.

Table 3. Business opportunities by size classes

<table>
<thead>
<tr>
<th>No.</th>
<th>Business opportunities for 2009</th>
<th>Size Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Micro-enterprises</td>
</tr>
<tr>
<td>1</td>
<td>Sales’ increase on the domestic market</td>
<td>67.59%</td>
</tr>
<tr>
<td>2</td>
<td>Exports’ increase</td>
<td>13.28%</td>
</tr>
<tr>
<td>3</td>
<td>Use of new technologies</td>
<td>29.31%</td>
</tr>
<tr>
<td>4</td>
<td>Entering new markets</td>
<td>40.86%</td>
</tr>
<tr>
<td>5</td>
<td>Introduction of new products</td>
<td>40.52%</td>
</tr>
<tr>
<td>6</td>
<td>Business partnerships</td>
<td>36.03%</td>
</tr>
<tr>
<td>7</td>
<td>Grant procurement</td>
<td>18.10%</td>
</tr>
</tbody>
</table>

3. PERFORMANCES OF SMES

Considering SMEs’ performances in 2008 compared to 2007 one can notice that 45.60% of the SMEs subject to our research registered superior performances, 35.95% companies registered identical performances and 18.45% firms registered inferior performances, which indicates a considerable entrepreneurial-managing capacity. See figure 4.

Figure 4. SMEs’ performances in 2008 compared to 2007

In terms of size classes of the SMEs (table 4), the following important aspects are emphasized: medium enterprises are the most performing, registering superior results in a 58.40% share. Only 48.58% of small enterprises and 41.37% of micro-enterprises registered superior performances. Micro-companies also register the highest weight among the companies with inferior (20.59%) and identical performances (38.03%). This situation can be explained through the existence of a correlation between the size of the companies and their capacity to generate short term performances.
Table 4. SMEs’ performances in 2008 compared to 2007 – classified by size classes

<table>
<thead>
<tr>
<th>No.</th>
<th>SMEs performances in 2008 compared to 2007</th>
<th>SMEs classified by size classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Micro-enterprises</td>
</tr>
<tr>
<td>1.</td>
<td>Superior</td>
<td>41.37%</td>
</tr>
<tr>
<td>2.</td>
<td>Identical</td>
<td>38.03%</td>
</tr>
<tr>
<td>3.</td>
<td>Inferior</td>
<td>20.59%</td>
</tr>
</tbody>
</table>

Regarding the estimated economic performances of SMEs in 2009 compared to 2008 (figure 5), we notice that lower performances are envisaged in 55.73% of companies, identical performances in 30.44% of firms and superior performances in only 13.84% of enterprises, which reveal considerable decreasing of Romanian companies’ development potential.

Comparing the estimated performances for the current year with those achieved in 2008 compared to 2007 (see figures 4 and 5), we observe an increase of SMEs with inferior results (from 18.45% to 55.73%) and a decrease of the enterprises with superior performances (from 45.60% to 13.84%), which indicates a strong economic recession.

Figure 5. SMEs circuit design by performances dynamics in 2009 compared to 2008

Concerning SMEs performances (2009 compared to 2008) in terms of size classes, the research has revealed that once with decreases of the SMEs size, increases the rate of the companies expecting better and identical results, but reduces weight of companies where entrepreneurs anticipating inferior results, that can be explained through higher flexibility of smaller firms, their better capacity to accommodate on environment changes. See table 5

Table 5. Companies’ performances in 2009 compared to 2008 by size classes

<table>
<thead>
<tr>
<th>No.</th>
<th>SMEs performances in 2009 compared to 2008</th>
<th>Size classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Micro-enterprises</td>
</tr>
<tr>
<td>1.</td>
<td>Superior</td>
<td>13.87%</td>
</tr>
<tr>
<td>2.</td>
<td>Identical</td>
<td>31.75%</td>
</tr>
<tr>
<td>3.</td>
<td>Inferior</td>
<td>54.38%</td>
</tr>
</tbody>
</table>

4. USE OF COUNSELING SERVICES

Given the fact that development of competitive activities is generally conditioned by entrepreneurial consultancy, especially for financial, managerial, legal, marketing, technical, human resources and computerized domains, it is very important to know the frequency of Romanian companies that requested external consultants.

The studies reveal that the percentage of SMEs that hired external consultants in 2008 is of 24.35% (figure 6), quite low if we take into account their homologues in the European Union countries and major positive influence that consultancy has upon the content and efficiency of managerial processes within companies.

Figure 6. Use of counseling services by SMEs

The analysis of SMEs according to their size (table 6) reveals that medium enterprises hired external consultants in a direct proportion to their size (40.00% - medium enterprises, 33.81% - small enterprises, 15.10% - micro enterprises), situation explained by the fact that once the enterprise size grow up, the need to use consultancy services also increases.

Table 6. Use of counseling services by SMEs – classification by size classes

<table>
<thead>
<tr>
<th>No.</th>
<th>Use of counseling services</th>
<th>Size classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Micro-enterprises</td>
</tr>
<tr>
<td>1.</td>
<td>Companies that hired external consultants</td>
<td>15.10%</td>
</tr>
<tr>
<td>2.</td>
<td>Companies that did NOT hired external consultants</td>
<td>84.90%</td>
</tr>
</tbody>
</table>

5. INNOVATION ACTIVITIES

In order to create a general perspective on small and medium enterprises in Romania, apprehension of the innovative activities developed within these institutions has an essential role. The undertaken research revealed that innovative efforts within SMEs were especially focused on new products (37.49%), new technologies (28.75%), new managerial and marketing approaches (24.02%), renewing the informational system (15.92%) and human resources training (13.47%). We also highlight the relative low percentage of companies where the absence of innovative approaches was noticed (19.38%), demonstrating that Romanian entrepreneurs are aware of the fact that as the competition increases within each activity field, innovation represents an efficient method to insure a high competitiveness. See figure 7.
Innovation activities within SMEs

Searching innovation activities in Romanian companies by size classes (table 7), we noticed that:

- small firms register a higher percentage of companies that innovate in new products (46.67%) and new technologies (40.56%),
- the percentages of SMSs with a view for human resources training and modernization of informational system increase together with the enterprises’ size.
- new managerial and marketing approaches are registered in higher degree within medium firms (33.86%) and in lower level in small enterprises (22.50%)
- the weight in which the entrepreneurs do not innovate decreases at the same time with the size of the SMSs, explicable through usually diminished financial resources of smaller companies.

Table 7. Innovation activities within SMEs by size classes

<table>
<thead>
<tr>
<th>No</th>
<th>Innovation activities</th>
<th>Size classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Micro enterprises</td>
</tr>
<tr>
<td>1</td>
<td>New products</td>
<td>31.70%</td>
</tr>
<tr>
<td>2</td>
<td>New technologies</td>
<td>20.10%</td>
</tr>
<tr>
<td>3</td>
<td>New managerial and marketing approaches</td>
<td>22.88%</td>
</tr>
<tr>
<td>4</td>
<td>New informational systems</td>
<td>11.76%</td>
</tr>
<tr>
<td>5</td>
<td>Human resources training</td>
<td>12.42%</td>
</tr>
<tr>
<td>6</td>
<td>No innovation activities</td>
<td>27.12%</td>
</tr>
</tbody>
</table>

Analysing the part of turnover generated by new or renewed products and/ or services introduced in the last year, we notice that: 22.09 of the enterprises hold a percentage of 0-5%; 19.84% register a 10-20% percentage; also, 19.84% of the economic agents had no innovation activities in 2008; 19.16% of SMEs register a 5-10% percentage; 13.10% of the companies register a 20-50% percentage. Only in 5.96% of the SMEs, the turnover resulted more than 50% from new and/or renewed products and/ or services. Taking into account these aspects, we may conclude that the processes of products innovation are relatively frequent for the majority of the SMEs in Romania. A graphical representation of this situation is designed by the figure 8.

Figure 7. Innovation activities within SMEs

Figure 8. Part of SMEs’ turnover generated by innovation

In terms of SMEs size classes (see table 8), we noticed that: The weight of the firms with no innovation activity increases in an inverse proportion with the SMEs’ size, and the number of enterprises with a 20-50% percentage from their turnover generated by new products/ services increases as the size of the firm increases as well. As for the enterprises having 5-10%, 10-20% and more than 50% of their turnover obtained through new products and services, the small sized companies hold the highest weights (23.60%, 25.07% and respective 6.78%).

Table 8. Part of SMEs turnover generated by innovation – classification by size classes

<table>
<thead>
<tr>
<th>No</th>
<th>Part of turnover generated by innovation</th>
<th>Size classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Micro enterprises</td>
</tr>
<tr>
<td>1</td>
<td>0%</td>
<td>27.58%</td>
</tr>
<tr>
<td>2</td>
<td>0-5%</td>
<td>21.89%</td>
</tr>
<tr>
<td>3</td>
<td>5-10%</td>
<td>16.73%</td>
</tr>
<tr>
<td>4</td>
<td>10-20%</td>
<td>16.90%</td>
</tr>
<tr>
<td>5</td>
<td>20-50%</td>
<td>11.03%</td>
</tr>
<tr>
<td>6</td>
<td>More than 50%</td>
<td>5.87%</td>
</tr>
</tbody>
</table>

6. REFERENCES

1. O. Nicolescu, C. Nicolescu, Florin Anghel, Irina Isaic-Maniu, White Chart of SMEs 2009, Tipol Lidana Publisher, Bucharest, 2009
2. O. Nicolescu, Luminita Nicolescu, Economy, firm and Management based on knowledge, Economica Publisher, Bucharest, 2005
3. C. Nicolescu, Intreprenorial strategies, Olimp Publishing, Bucharest, 2005
DIFFERENTIATION STRATEGIES FOR BUSINESS SCHOOLS IN EMERGING MARKETS: THE CASE OF ROMANIA

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ABSTRACT: Business schools operate nowadays in a competitive and tumultuous market, driven by several forces: non-traditional competition, the emergence of corporate universities, increasing students’ expectations, the continuous rise of distance learning programs, and rising program costs. Today, the business schools market in Romania sees a variety of institutions offering different types of business training, as it is perceived to be open and training providers still comfortably assume a constant demand for their products. Our paper aims at addressing the issue of postgraduate business education in emerging countries, with a focus on the Romanian market, through an investigation and critical evaluation of market differentiation strategies employed so far by programs offered by business schools in Romania, accompanied by an analysis of these programs’ prospects in the years to come, under the pressure of a more competitive business environment and in the wider context of trends in business schools around the world.

1. INTRODUCTION

In recent decades, the MBA degree or its equivalent has become a degree with international scope, as more and more students are receiving such a degree, and competition between business schools has increased, both in the developed and developing world. But, despite their success in higher education, MBA programs are at a crossroads in their evolution. For a number of years, researchers such as Pfeffer and Fong (2002, 2004), Bennis and O’Toole (2005), Ghoshal (2005), Mintzberg and Gosling (2002) have shown that they are faced with an image and identity crisis and their status as academic and professional schools has been largely criticized and debated. One of the widely found criticisms addressed to MBA programs is related to their lack of connection with the business world, accompanied by the failure to offer students an ethical and globally oriented way of thinking. Goodall et al. (2004) provide an excellent review of the criticisms of MBA programs, presented in Figure 1.

- Weak relationship between gaining MBA and career success
- Weak relationship between MBA grades and career success
- Non-MBA holders perform as well or better in key areas
- Too focused on quantitatively based analytical techniques at the expense of interpersonal and leadership skills
- Inadequate integration across functional areas
- Little variety in course content across programs
- Almost no-one fails ↔ little screening of student competence at exit
- Few opportunities for “learning by doing”
- More focus on business functions than managing
- Little innovation in curricula since the 1960s
- Low attention to values and attitudes versus intellect

Our paper aims at providing a critical analysis of differentiation strategies employed by MBA programs currently present on the Romanian market, accompanied by an overview of the most important challenges faced by business schools worldwide. The paper is structured as follows: Section 2 outlines the changes in the internal and external environment of nowadays business schools, Section 3 discusses the concept of strategy applied to the educational environment and presents some of the strategic options for business schools aimed at addressing the environmental challenges, Section 4 discusses the differentiation options available for Romanian MBAs, and Section 5 concludes.

2. MANAGEMENT EDUCATION IN A DYNAMIC ENVIRONMENT

The management education environment, which includes governments, competitors – either academic or non-academic -, technological and social developments, is rapidly changing. The future evolution of management education is influenced by important key drivers, emerging from the demographical, technological, social and political areas, which are briefly outlined in Figure 2.

These key drivers directly affect the competitive dynamics of business schools’ markets and force them to alter their current positioning strategies and to actively plan their future competitive approaches.

The competitive landscape in management education is transforming, by including an increased number of substitutes for the traditional business school. As Hawawini (2005) makes the point “top business schools will either transfer themselves to meet the demands (of a more complex environment) or cede some of the terrain to alternative providers of business education”. Of these alternative providers, the most important are:

Corporate universities – they are in-house providers of business education for companies’ employees, which compete, but also sometimes collaborate, with the customised executive business education programmes offered by leading business schools; the best known example is the one of General Electric’s Crotonville campus, seen as the engine for developing and strengthening GE’s corporate talent (The Economist, 2006).

University alliance programmes – they are collaborative programmes that use faculty from various business schools to offer MBA degrees with an international flavour; their aim is to enhance the reputation of each school member of the alliance and to consolidate its position in the global management education market.
Distance learning programmes – an increasing number of universities are offering nowadays such programmes, using online resources; the largest is Appollo Group, which owns the University of Phoenix, followed by Universitas 21 and Thomson Learning (Thomson, 2007)

Leading faculty – leading academics have recently become competitors for the traditional business schools, as companies view them as key strategic resources and use them for training and consulting.

| Political factors | • Standardisation of business schools in Europe, as a result of the Bologna Accord  
• Regulatory pressures for programme and school accreditation by bodies such as EFMD, AMBA, AACSB  
• Regulatory pressure for higher teaching and research quality  
• Tighter visa regulations for international students following 9/11 and terrorism threats  
• Reduction of government and public funding for higher education |
| Economic factors | • Globalisation and international free trade trend  
• Rapid growth of emerging economies, mostly China and India  
• Increased competition from consultants and private business schools |
| Social factors | • Changing societal values; ethical issues; corporate social responsibility; sustainable development and environmentally friendly  
• Demographic changes |
| Technological factors | • Growth in e-learning and internet education  
• Technology in the classroom  
• Knowledge revolution and knowledge formation as assets for value creation in an organisation  
• Web-based dissemination of knowledge |

Figure 2. A PEST analysis of business schools (Thomas, 2007).

The implications of competitive dynamics for management education are numerous, ranging from a constant search for lower costs and market niches, to the continuing growth of inter-university consortia programmes, to an augmented focus on the school’s core competences, and to a greater customer orientation.

3. STRATEGIC OPTIONS FOR MBA PROGRAMS

Strategy represents the on-going process of formulating, implementing and controlling broad plans to guide the organization in achieving the strategic goods given its internal and external environment. In challenging times, strategy means a cohesive response to a challenge: a real strategy is neither a document nor a forecast but rather an overall approach based on a diagnosis of a challenge. The most important element of a strategy is a coherent viewpoint about the forces at work, not a plan (Rumelt, 2009). Strategy today has to align itself to the fluid nature of this external environment and it must be flexible enough to change constantly and to adapt to outside and internal conditions. Faced with increased competition, business schools should consider carefully their strategic positioning in the market, which is becoming more global given the new trend towards internationalisation. Lorange (2005) identifies several implications calling for a revised strategy for business schools, in a context of demand-driven business schools’ value offerings:

a) Research is becoming more important, but especially research that is linked to real-life business, more cross-functional in nature, and offering new insights for organizations that apply the results in the new knowledge-based economy. Besides the new focus for research, more emphasis on alternative ways of dissemination of research is envisaged, through the publication of briefer research notes, rather than fully-fledged articles, through more synthetic presentations, and through a more effective dissemination of research results to practitioners.

b) Learning approaches will be reoriented towards higher efficiency and fewer transaction costs for the learner. The new pedagogy will mean more action learning, more web-based teaching, and more emphasis on role-plays and simulations.

c) Learning is becoming more responsive to students’ needs in a “buyer’s market”. The curriculum will become more relevant to students’ needs and students will require that the inner structure of the business school does not create what they might see as barriers for them.

A differentiation strategy at a business school level should refer to the school’s identity and the target groups or audiences it addresses to. The identity and the audience are essential for the manner in which a business school design its programmes.

Quite often, business schools decide to compete on a niche, so they come up with a niche identity. As Wolverton (2006) notes, a niche identity usually signals either a real or perceived need to compete, based on either services and products offered, geographic region served, the audience targeted, or the price charged. Overall, the choice of a niche requires than an organization concentrates its efforts on a rather small segment of the potential audience. At the same time, the audience targeted by a program or a business school should be large enough to make it profitable or at least to make it break-even.

Given the changes in the competitive environment of business schools worldwide, these institutions face critical choices that may not necessarily mean development, but survival. Choices will have to be made in the following areas:

The extent to which a business school will emphasize a narrow-discipline focus versus a more cross-functional and problem-oriented direction. Lorange (2005) proposes as solution the development of two faculty groups within a business school: a classic “academic” group focused on research and a more practitioner-oriented group with heavy emphasis on teaching capabilities.

The types of programmes pursued: classic offerings or executive education?

The business school structure. This refers mainly to the difference between the administrative and academic side of the school, on one hand, and to the disciplinary fragmentation of the schools’ departments.

The professional hierarchy. Here the choice is between “brains” or seniority per se.

The school’s financing. In the traditional business school, the members of the faculty are users of resources available to them and the focus of each of the members is to obtain a bigger slice of the “pie”. In the new business school, the members of the faculty will be involved, altogether with the administrative staff, in the generation of resources that can be distributed more favourably to those that generate more value for the school. This means that the new business school will operate, from the point of view of financing, more like a corporation in its own right.

The use of information technology. In a networked knowledge society, information technology is critical for the business school’s preparation to make its necessary strategic choices.

A good example of choices made by a business school is the Terry College of Business within University of Georgia (Wolverton, 2006). The college’s development took advantage
of the unprecedented growth of the city of Atlanta during the past 20 years: on one hand, the population in the metropolitan area has increased by 40 per cent; on the other hand, albeit traditionally Atlanta has been a major banking centre and home to several large insurance companies, today it hosts companies doing business in bioscience, logistics and transportation, telecommunications, and computer software and services. The University of Georgia acknowledged the city’s growth and decided to take advantage of it. In 1988, the University of Georgia (UGA)’s full-time MBA program was small and was offered only in rural Georgia. The college did not offer any part-time or executive programs, and its faculty functioned in independent departments that did not communicate with each other. In 2000, the Terry College of Business took the decision to move back into the Atlanta metropolitan area and to reshape its programmes to meet the urban needs. A newly opened UGA Alumni Club Centre, located in the Atlanta Financial Center was used by Terry College to establish its executive MBA program. Shortly thereafter, it joined in a collaborative effort with Georgia Perimeter College to build the Gwinnett University Center to serve the Outer Perimeter business district area. UGA provides an evening, part-time MBA on this campus. The evening MBA follows the traditional part-time model with students enrolling in two to three courses at any one time. The 18-month executive MBA takes a more unique format. It targets professionals with 10 to 20 years work experience. One-half of the program is delivered via the internet. The program is divided into seven, nine-week modules that deal with core business competencies; two, week-long modules in leadership, which are held on the Athens campus; and one, two-week international residency experience.

In addition, Terry College created the Director’s College, which is located on the Buckhead campus and provides short courses for current corporate board members and senior executives who aspire to board service. These two-day seminars offered twice a year help participants build the skills they need to effectively monitor and guide corporate performance. At any session, faculty and participants might identify the warning signs of a troubled company, explore the best methods for judging the quality of financial reporting, or examine emerging issues and litigation trends. The Director’s College also offers a one-day program for audit and compensation committee members, which is the first of its kind in the south to be accredited by International Stakeholders Services.

The faculty at Terry College used two of their strengths - leadership and marketing – to reinvent its programs. They developed the nation’s first master of marketing research with an advisory board of 70 marketing professionals from a wide range of companies across the US and abroad. Also, they put in place Atlanta’s first customer relationship management leadership program, which draws from both areas of expertise. To further build connections with the real business environment they initiated the General Motors/Terry marketing research competition among students from 11 top business schools including Terry and Terry’s Third Tuesdays – informal breakfast meetings for 70 to 120 Atlanta executive and alumni. A key area of development for the school was the Institute of Leadership Advancement, which provides an undergraduate leadership development program, MBA and executive leadership programs, and a speaker series. It houses an endowed chair in servant leadership and a leadership research consortium. Many of the activities in which the Institute engages are designed to bring people from Atlanta to Athens: the executive leadership program, for instance, is a four-day training program in Athens, which is team-taught by up to ten faculty. Participants receive instruction in leadership skills and team building, faculty conduct comprehensive evaluations of leadership skills and provide one-on-one coaching for each attendee.

More recently, Terry started an international program in Germany in which MBA students design marketing strategies for foreign companies. Based on its success, the college sees limitless future possibilities for participating in the international business arena.

4. THE ROMANIAN MBA MARKET

In Romania after 1990 there is a national need for new professional business people trained to work in a global, market-oriented and competitive environment. Naturally, the market for professional business education was perceived to be an open one and training providers could comfortably assume a constant demand for their products. Two decades later, that market has been infused with a variety of institutions offering different types of business training. All these programs are quite different in terms of the length of the study period, tuition costs, partnerships with foreign institutions, and accreditations as illustrated in Figure 3.

In Romania, there are 13 MBA programs - 5 Executive MBAs and 8 regular MBAs: EMBA Asebuss; EMBA CEU Business School; MBA City University of Seattle; MBA DeSales University/Universitatea Romano-Americana; MBA Fine University of Wales; MBA INDE/CNAM Paris; MBA The Open University Business School; PMBA Project & Process Management WU Viena; MBA Romano-Canadian; MBA Romano-German; EMBA Sheffield City College; EMBA WU Executive Academy Viena; EMBA Tiffin University. Still, the Romanian market is below other countries in the region, like Hungary, Poland, and Slovenia where one can identify strong academic business centers. The last entry in the Romanian market was made by WU Executive Academy that brought a PMBA program in Project & Process Management.

The Romanian newspaper Ziarul Financiar made this year, for the second time, a ranking of local MBAs, based on the responses of 250 graduates (70% of 2008 graduates). There were several criteria taken into account, like: salary, increase in salary, job applicability, personal skill development, promotion, networking, teaching quality, professors’ experience, a.s.o. There are significant changes compared to the previous year. A new comer is ranked first – CEU Business School, while EMBA Asebuss and the Romanian-Canadian MBA almost changed places. As shown in Figure 4, in the first 5 programs, only one is a regular MBA, all the others being Executive MBA.
For the first time, 65% of the 2008 graduates gave response related to their salary after graduation. This fact allowed making a first analysis regarding graduates’ salary. In average, salaries rise by 50% after graduation, being of 3000 euros for EMBA graduates, and 2275 euros for MBA graduates.

Figure 4. Top 5 MBAs – Ziarul financiar rankings

The next period can bring more master and MBA programs in the Romanian market due to Bologna Agreement. Graduates from the first phase (3 years) look for enrollment in the second phase. Most programs offered by private and public universities are in business administration. More universities will look for partnerships with European universities. This will make important differences between programs. If in developed economies MBAs are addressing people with a minimum of 3 years experience, while EMBA are addressing experienced managers and entrepreneurs, in Romania there are not clear principles and differences between different kind of programs. Also, the proliferation of master programs based on Bologna Agreement, will bring in our opinion programs that are named as MBAs, without respecting their major characteristics and distinctions.

After a boom in the first part of the ‘90s, the management education around the world started to feel a number of growing pressures particularly from the students and the businesses that employ them after graduation. Management education is currently transformed under the influence of a number of variables, of which the most important refer to the needs of potential customers for such education, the requirements of the employers regarding the knowledge and skills of graduates, and the resources available to business schools. At the same time, management education at a graduate level is offered not only in the traditional university-based framework, but also in for-profit institutions, such as corporate universities, consulting companies, company-based training departments and executive development centres. This leads to a heightened competition, while the employers of graduates are not at all indifferent to the management education provider. Indeed, the reputation of a business school discriminates between graduates and is reflected in their employment and payroll.

For both American and European MBAs, survival depends on the flexibility of the program’s content and the course schedule. Different strategies are available: some MBA programs offer specialized degree programs, focusing on certain areas of business rather than simply general management. These specialized degrees tend to address to candidates hoping to change fields, or significantly broaden their professional perspective. The drawback for these MBA programs lies in the fact that a candidate must identify the precise field before application.

To respond to globalization, MBAs had to create partnerships between European and U.S. institutions. Preparing students for international management careers, some of these bi-national institutions provide real international experience without requiring participants to change continents; others offer programs with opportunities to spend time on both campuses. Many partnered MBA programs offer degrees from both universities on completion of the program. Holding degrees from not one, but two top international programs has increased benefits.

At present, businesses and business schools face some major challenges at the global level:

a) Preparing the new generations of business leaders: the skills and competencies necessary to be taught in business schools are changing.

b) Optimizing the research in business schools: research themes should be relevant for businesses and not for academics and there should be an effective way to communicate results to business leaders. One way of encouraging research is represented by the development of case studies by mixed teams of professors, students and businesses, adapted to the local business needs.

c) Meeting the challenges of globalization: globalization affects business schools too, as they have to prepare graduates capable to face global challenges. Regardless to their scale and students’ profile, business schools need to adapt their curricula in order to address two opposite trends: on one hand, the increasing need for training on global business operations, and the need for locally adapted training, on the other hand.

d) Mutual and increasing engagement between businesses and business schools: the involvement of the business community in the development of business schools, making sure that the graduates are prepared to face the business realities, which can be made through Advisory Boards, but there should be also other ways to be developed.
Despite all these challenges that business schools had to deal with in the last years, the global financial crisis and the economic recession is putting now new pressures on business schools, not only in reshaping the curricula, but also in becoming more efficient and reducing tuition fees. This challenge is already faced by Romanian MBA market, being confronted with a descending trend in business education demand. If traditionally, at this time (Spring - Summer), most companies had already training plans for their employees, including financing of MBA programs for some of their managers, this year budgets are reduced or not yet defined.

In this context, most MBA officials take into consideration a reduction of 20% to 35% in the number of students enrolled in 2009. This reduction is due not only to companies but also to individuals that have to analyse more carefully an investment of 4 000 – 35 000 euros in their personal development in a local MBA. They take into account not only the risk of not having the revenues in the next months/years to pay for their MBA, but also the lack at the level of local programs of a clear and professional structure, curricula, teaching methods. They are aware that such training should not be finalized only with a diploma, but with accumulated knowledge and skills to face more challenging situations in their business. More and more Romanian candidates for MBA programs look to study abroad. They find far better programs, and are willing to pay more. They clearly identify characteristics that differentiate these programs compared to the local ones: international experience (not only from the teachers but also from the students), networking, strong brands, international recognition (AMBA, AACSB, EFMD). Many are choosing an MBA that is in Top 10 at international level.

5. CONCLUSIONS

In our opinion, in order to survive today circumstances and develop, local MBAs have to clearly differentiate their strategies based on following characteristics:

a) MBA format: Full-time, Part-time, Executive, Modular, On-line MBA. It is to mention that on the local market no Full-time program is currently acting. The only full-time program, the Romanian-Canadian MBA that was differentiated in the market having this form, gave up 2 years ago, and enrolled in the competition of part-time programs.

b) Content: general management, or specialized degree.

c) Real partnerships with foreign business schools with strong international brands. These partnerships have to ensure competitive curricula, teachers with international experience both in teaching and business, international recognized diploma.

d) Real partnerships with the local business community and Alumni.

e) Professional infrastructure: dedicated buildings, equipped classrooms, labs, library, meeting rooms.

f) Competitive tuition fees.

6. REFERENCES


CONSEQUENCES OF THE INVESTMENT IN EDUCATION AS REGARDS HUMAN CAPITAL

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ABSTRACT: A sustainable and democratic society cannot exist if the majority of the citizens have not a minimum level of education. The education of a child has benefits not only for his parents or for the child himself, but for the other members of the society. “The education of my child contributes to your well-being by promoting a stable and democratic society”. (M. Friedman). Nobody would contest that an individual that invests in his own education could bring benefits not only to his family, but to the others. However, there are a lot of other good things for the human co-operation or to a society, but it does not result that they should be produced by the state and financed by taxes and fees. Additionally, the investment in one’s training/education can finally be retrieved, when the individual comes to the labor market.

1. INTRODUCTION

In the fierce competition caused by economic globalization, the quality and inventiveness of human resources are definitely the main factors underlying the essential differences between the states. That’s why human resources are now the main competitive aspect, both at corporate and national level.

In this context, the authors’ aim is to demonstrate, on the one hand, the importance of vocational training for the individual and the society, and on the other hand, that vocational training level, individual income amount and social welfare are interrelated and that investment in education, especially at higher education level, is a profitable investment which has long term benefits both for the individual and for the whole society. This paper also represents a comparative analysis, based on the EU countries model, of the cause and effect relationship between the resource level individuals and the society allocate for education and the economic and social development of each country.

2. HUMAN CAPITAL – A PROGRESS ELEMENT FOR THE INDIVIDUAL AND THE SOCIETY

Many studies published in the last decades show the positive correlation existing between individual and social welfare and the investment in human capital. K. Murphy, R. Tamura, N. Tomes and J. Mincer are just some of those who were able to clearly demonstrate that income differentiation is mainly caused by the people skill level and the complexity of their studies. There are numerous studies proving that the educational stage related efforts (primary, lower secondary, upper secondary, higher education) are followed by increased benefits according to the training or qualification period. Highly qualified people are likely to obtain higher incomes than less qualified people.

In his work, "Human Capital", Garry Becker underlined the idea that information means power, and that education and vocational training are the most important long-term investment at individual level. The author also mentions that "people with a higher education level earn in most cases above the average, their benefits being more significant in less developed countries".

Becker also recognizes that education requires a lot of resources from the beneficiary, even where education is free. In reality, there are costs which express, in terms of opportunity costs, the amounts likely to be lost when choosing further education instead of entering the labor market.

Some famous authors (Roger Ibbotson and Gary Brinson) have studied the possibility of measuring the human capital contribution to social welfare. In what Great Britain is concerned, they have shown that in 1946 human capital ensured about half the country's welfare, while in 1989 around 80% of the welfare of the developed countries has been ensured by the human capital contribution [3].

The Japanese model is perhaps one of the most relevant examples of human capital contribution to economic development. Almost completely destroyed after the Second World War, Japan has become in less than fifty years one of the main global economic powers thanks to its human capital special qualities, relying on a value system that fosters loyalty and reliability in every work field and on a very well organized vocational training system.

Marcelo Selowski pointed out that the most important element that differentiates countries in terms of production factors is the educational capital indicator per worker. Thus, while coefficients of variation related to the GDP/capita and to the physical capital are relatively close (1.21 and 1.78), the coefficient of variation related to the human capital per worker is higher than 1.78. This is also evidenced by comparing some extreme situations described in the above mentioned study (India and the USA). According to this study the U.S. has a GDP/capita over 30 times bigger than India, however the physical capital stock is only 25 times bigger in the U.S.A. On the other hand, the differences related to the human capital/worker indicator are huge - 186 times. These results have been confirmed by other studies, even though the methodology used was different. Thus, Ruttan, Vernon W
estimated a coefficient of elasticity of human capital output in relation to input of 0.472 compared with that corresponding to physical capital, which was 0.263 [4].

The results underlined by these studies should trigger an alarm for the developing countries which should consider education as a priority, as a means of human capital investment in order to reduce the gap between them and the developed countries.

3. ASSESSING HUMAN CAPITAL

Human capital refers to the stock of skills and knowledge embodied in the ability to perform labor so as to produce economic value. Specialists in the field of economic growth and development, agree that once a specific human capital accumulation level is reached, it becomes more productive, coming into a positive relation with employment and growth rates within economic development patterns. The benefits that human capital brings to an organization led to an increasing interest in developing methods of measuring human capital value.

An OECD report (1998) states that: “Human capital assessments were influenced by what it can be measured, rather than what it should be measured.”

Bontis (1999), starting from the possibilities of measuring and assessing “the human capital contribution to the organization development, refers to three types of human resources accounting models:

- cost models, which take into consideration the historical cost, procurement cost, replacement cost or human assets opportunity cost;
- human resources value models, which combine non-financial behavior methods with financial economic value patterns;
- financial models that calculate updated estimates of future revenues” [5]

The special economic value of human capital is considered to be its specific feature compared with other traditional forms of capital. The intellectual dimension of human capital also displays other features arising on the one hand, from the nature of stock and its organic relation to the owner's individuality, and on the other hand, from the conditions of accumulating and distributing the revenues generated thereof.

Among the human capital main features, it is worth noting the following:

- portability, it can not be separated from the human being. Human capital can not operate without the presence and direct involvement of its owner. The way human capital comes into action is customized;
- immateriality, human capital belongs to intangible assets. As already mentioned, it represents a stock of economic value knowledge and skills;
- limitation, arising from the restrictive physical and intellectual capacities of the individuals embodying human capital;
- opacity, human capital is "hidden" in the individual;
- transferability and interchanging possibility of knowledge. People can share their knowledge with others. This quality is highly capitalized, for instance in education;
- extensible and renewable; when using it, human capital doesn’t wear itself out, on the contrary, it regenerates and develops itself. These features are filtered by working experience.

A detailed analysis of the labor force in Romania shows a fierce competition between the local owner of skills and knowledge and the human capital from a high performance economic area. A simple comparison between the income level in Romania and the income level in the European Union reveals the hard truth. More specifically, the national human capital productivity level is far below the Western level which may explain the income gap.

Table 1. Productivity of labor force for employed people EU 27=1

<table>
<thead>
<tr>
<th>Country</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
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<td>100,0</td>
<td>100,0</td>
<td>100,0</td>
<td>100,0</td>
</tr>
<tr>
<td>Bulgaria</td>
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<td>31,6</td>
<td>33,0</td>
<td>33,4</td>
<td>33,5</td>
<td>34,1</td>
</tr>
<tr>
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<td>108,1</td>
<td>108,4</td>
<td>106,4</td>
<td>106,8</td>
<td>108,5</td>
</tr>
<tr>
<td>Germany</td>
<td>107,4</td>
<td>107,4</td>
<td>106,2</td>
<td>108,5</td>
<td>107,5</td>
<td>106,7</td>
</tr>
<tr>
<td>France</td>
<td>125,7</td>
<td>125,7</td>
<td>125,3</td>
<td>121,5</td>
<td>122,2</td>
<td>125,4</td>
</tr>
<tr>
<td>Romania</td>
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<td>25,0</td>
<td>29,9</td>
<td>32,1</td>
<td>34,7</td>
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<tr>
<td>United Kingdom</td>
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<td>Norway</td>
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<td>134,8</td>
<td>141,8</td>
<td>154,2</td>
<td>160,0</td>
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</tbody>
</table>

Source: Eurostat

Analyzing the data from Table 1 we find a direct proportionality between the productivity level and the education investment level. Thus, countries with significant percentages of education and training investment benefit from greater effects of human resource utilization.

The analysis of the Human Development Report published annually (UNDP, 2007) shows that Romania has the lowest budget allocations for education (5.2% of GDP in 2006) compared to all other European countries. The same is true when it comes to research and development expenses (0.4% of GDP). By comparison, Sweden - ranked among the first in the HDI ranking - allocates 46 times more. Obviously, possibilities are different, but the fact that the other countries allocate at least twice should make us adopt a different strategy in this field. A similar situation is to be found when it comes to the number of researchers per one million inhabitants. Again we are ranked last with a total of 879 researchers / one million inhabitants while Sweden has six times more people working in this field, and Iceland eight times more.

These discrepancies are summarized by the HDI differences (0.778 for Romania and 0.956 for Norway, the latter being on top of the list of the United Nations annual ranking). Without going into too much detail, it is also worth noting that Romania has one of the lowest educational indicators across Europe - 0.8 (UNDP, 2005). If we compare the above mentioned figures with the GDP per capita, carrying out a comparative analysis between countries, we understand that the economic performance of nations (reflected in the overall quality of life) is closely related to their investment in human capital.

A summary assessment of the human capital in Romania reveals the chronic lack of investment in this area and its
effects on the economic performance of the national workforce. Of course, there are also competitive employees, but their number is quite low within the overall context.

This situation is easily noticed when it comes to labor migration to the EU countries. Most Romanians looking for a job in Western Europe usually get low paid jobs compared to local people, which clearly underlines the difference in terms of productivity and the training investment discrepancies. A similar situation is to be found if we take into consideration the structure of the Romanian export of goods and services which shows that national labor force is employed in areas such as hired labor where wages are quite low.

4. THE IMPACT OF INVESTMENTS IN EDUCATION ON HUMAN CAPITAL

The human element considers that investment in education brings first of all a benefit by the sense of credibility granted by holding a higher education degree, an idea amplified by the prestige of a certain educational institution, and this often represents an advantage for the applicant in the labor market. Instead, workers who have a low education level can be faced with various difficulties in the labor market, not because they are not able to perform a certain activity, but due to the fact that they don’t have the necessary degree or qualification in order to have access to a certain social and professional status.

Therefore, the supplementary income a student expects to obtain as a consequence of every year of education, the marginal income of the investment in the human capital, may be suggestive for the tendency and marginal propensity to invest in education.

The analysis from a social point of view is based on the same principle costs-benefits, costs including both subsidies and support allowances, and benefits subsuming the reduction of unemployment rate and thus the reduction of unemployment benefits, lower costs for the social field (lower taxes for the social protection programmes, a fund created for the prevention of antisocial phenomena) and the money earmarked for this purposes may be also used in other fields such as: health, culture, environment, research and so on.

Among the investments in the human capital, we can identify investments in education and training, migration, and some current living expenses, such as those for accommodation, food, clothing, supplies and so on.

The special concern for investments in human capital is also reflected in the constant concern of OECD to support the economic growth through programmes sustaining the development of educational capital. International comparative studies accounted for OECD countries proved that at an individual level profit rate for investments in education is higher for graduates of higher education institutions than for highschool graduates. At the same time, unemployment reduction and poverty probability is directly connected to the degree of education. At a macrosocial level, profit rate for investments in secondary education generally surpasses the profit rate for the capital used in business (production or commercial activities), while benefits from investments in higher education are situated at corresponding levels with the profit rate for the capital invested in commercial or production activities.

An OECD study shows that “attending a suplementary year of average education amplifies economic development with a percentage of 5 % and with a percentage of 2.5% on a long term”. An additional educational year, also raises the level of average wages by about 6.5%. Records have also shown that unemployment rate decreases proportionally with the levels of higher education attended, reducing additional social costs involved. We may conclude that employment rate increases proportionally with the level of education achieved.

Regarding education, we should take into consideration that investments ensure a future update of material resources, in the context of reorganizing the whole economic, social and cultural activity.

In this particular context, the main objectives for the investment policy in the educational field must provide the development of the technical and material educational resources, an improvement in the quality of education and an increase of the social impact of education.

5. THE EXPERIENCE OF THE DEVELOPED COUNTRIES IN FINANCING HUMAN RESOURCE DEVELOPMENT

The analysis of the present situation and of the trends shows that the European Union suffers from an insufficient investment in the development of human resources. In average, the European Union member states spend a little more than 5% of the GDP for education and training (financed from public funds), but with substantial differences from one country to another. According to the information provided by the Ministry of Education and Research, in the Report concerning the state of the national education system for 2006, the average recorded by the European Union member states in 2002 was of 5.2%. As indicated in table no. 3, at present, the percentage of the GDP allotted for education is very high as compared to the European Union average, precisely in the countries with a higher quality of life level.

Table 2. Expenditure on education as % of GDP or public expenditure

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
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Source Eurostat 28.04.2009
From this perspective, the convergence of the Romanian education with those of the main countries belonging to the European Union can only be assured on a long term, requiring investments for the development of the two great categories of infrastructures, of physical and human type.

The consolidation of a development pattern on these two directions, under the terms of insuring the coherence and complementarities with the already existent strategic-programmatic instruments (The National Plan for Development 2007-2013, the National Program for Reforms 2007-2010, The National Strategic Reference Frame 2007-2013, The Durable Development Strategy 2025, the Governing Programme 2004-2008, the Convergence Program 2007-2010, the National Strategic Report on the Social Welfare and Social Inclusion 2006 - 2008) reflect the strategic hierarchization of Romania’s development objectives, the priority being imposed by the limited character of the available resources.

**Table 3. Employment rate of persons aged between 15 and 64 (%)**

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<td>63.0</td>
<td>62.4</td>
<td>57.6 (b)</td>
<td>57.6</td>
<td>57.7</td>
<td>57.6</td>
<td>58.3</td>
<td>58.8</td>
<td>59.0</td>
</tr>
</tbody>
</table>

Source Eurostat 28.04.2009

Employment rate is the highest in countries where the concern for training human resources is higher. It is noticeable that the highest degree of employment is registered in Denmark, a country that assigns the greatest percentage of public expenses for education [6].

**Table 4. GDP per capita (EU-27 = 100)**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>EU 27</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Denmark</td>
<td>127.8</td>
<td>128.4</td>
<td>124.1</td>
<td>125.7</td>
<td>123.6</td>
<td>122.8</td>
<td>120.0</td>
<td>118.3</td>
<td>127.8</td>
</tr>
<tr>
<td>Norway</td>
<td>164.9</td>
<td>161.1</td>
<td>154.7</td>
<td>156.2</td>
<td>164.4</td>
<td>176.2</td>
<td>183.7</td>
<td>178.5</td>
<td>190.1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>119.0</td>
<td>119.8</td>
<td>120.6</td>
<td>121.8</td>
<td>123.7</td>
<td>121.9</td>
<td>120.7</td>
<td>118.9</td>
<td>117.5</td>
</tr>
<tr>
<td>Germany</td>
<td>116.6</td>
<td>115.2</td>
<td>116.5</td>
<td>116.3</td>
<td>116.8</td>
<td>115.7</td>
<td>114.8</td>
<td>115.8</td>
<td>116.6</td>
</tr>
<tr>
<td>France</td>
<td>115.7</td>
<td>116.0</td>
<td>111.8</td>
<td>110.0</td>
<td>110.6</td>
<td>109.0</td>
<td>108.9</td>
<td>107.3</td>
<td>115.7</td>
</tr>
<tr>
<td>Roumanie</td>
<td>26.1</td>
<td>27.8</td>
<td>29.4</td>
<td>31.3</td>
<td>34.1</td>
<td>35.0</td>
<td>38.3</td>
<td>42.1</td>
<td>45.8</td>
</tr>
</tbody>
</table>

Source Eurostat 08.07.2009

The same proportion can be noted if we consider the evolution of GDP per capita. Denmark has the highest level of income per capita, 4 times bigger than the income in Romania.

The convergence of Romanian education system with those of the main countries in the EU can be achieved only on a long term and requires investments for the development of the two main categories of infrastructure – human and material. [7] The strengthening of a pattern of development in these two directions, in the context of ensuring coherence and complementariness with the already existing strategic and programmatic tools. (The National Development Plan 2007-2013, The National Strategic Reference Framework 2007-2013, Sustainable Development Strategy 2025, Convergence Program 2007-2010 etc.) reflect the strategic ranking of development objectives for Romania, the priority being determined by the limited available resources.

In the countries where the individuals contribute significantly to the financing of their own education, the governments offer them a considerable support by providing the financial subvention granted for students. These countries have at their disposal various financing schemes for the higher education, either through directly financing the education, or through indirect financing, by supporting students living costs or schooling expenses, or by combining both systems. The public authorities from the Czech Republic, Greece, Spain, France, Poland, Portugal and Switzerland grant more than 90% of the total public expenses for higher education directly to the education institutions.

The transition from the education system to the labour market is an important factor in evaluating the human resources quality. The long term unemployment, the professional declassification are factors that lead to the depreciation of knowledge, abilities and capacities acquired during the schooling period, namely to the depreciation of the human capital. Romania has, at present, an unemployment rate quite low (5.3%) comparatively to the other European Union member states (9.2%), but also an increased part of the population involved in agriculture (27.41% as compared to 5% in the EU) and industry – namely the fields of activity where the level of qualification required is also reduced. The lack of educational and professional training or its reduced level will render quite difficult for the future the integration of high performance technologies necessary, for increasing productivity. [8]

M. Friedman accepts this situation when it comes to technical education. The Romanian education system is faced with structural issues, especially educational institutions in rural areas being confronted with great difficulties concerning investments in physical infrastructure, qualified teaching staff, limited access to vocational training and life-long training programmes for the people in rural areas.

According to recent studies, Romania has the highest percentage of primary school drop-out in the entire region, 23% of the population aged 18 - 24 leave school, and also registers the lowest percentage of people involved in the life-long learning process. Only 1% of the population aged 25 - 64 attended a programme of vocational training longer than four
weeks. In comparison with the other Central and Eastern European countries, education-related expenses in our country are the lowest. Having this as a background, school drop-out is another serious issue of the educational system, and from this particular point of view, educating the parents may be an important aspect. Ensuring access to relevant information and the development of various programmes created for the parents may be a solution for the prevention and reduction of school drop-out.

Education should help solving some of the problems that contemporary society is confronted with. For this purpose, it is necessary to improve the internal coherence between educational systems and the society, together with ensuring a certain stability which is to guarantee their long term efficiency. Short term efficiency of educational systems must be included in a long-term strategy, by conferring a greater importance to cultural and humanist dimensions of education.

It is necessary that the impact of new IT technologies on educational systems should be supported by the Government. The introduction of computer science will induce a quality improvement at all levels of educational systems. In this respect, Denmark, Great Britain and Finland are way ahead of the other member states of the EU. The percentage of population able to work who acquired education and vocational training in 2008 rises to 29.2%, 26.6% and 23.1%, way past the average of 9.6% in the EU. Bulgaria and Romania had the worst performances in EU, with a rate of 1.3% each, ranking themselves after Greece which had a rate of 1.9%.

„Education and vocational training at the highest standards are essential factors for the development of Europe as a society of knowledge, able to compete in an effective way in the context of globalised world economy”, stated Jan Figel, European official for Education, Vocational Culture and Youth, at the introduction of the annual assessment of the European Commission. „Unfortunately, this report suggests that the member states should enhance their efforts in order to be sure that education and vocational training in the EU can face the challenges of the XXI century. The message directed to the decision making factors from the member states is very clear: we need more efficient investments in our human capital.”

6. CONCLUSIONS

We have tried to emphasise the idea that the education level and the income value are closely and positively connected and that employment rate and the education span (that is, the quantity of investments in the human capital) are also related.

Analysis concerning Romanian labor market shows that people who have a medium level of education are most affected by unemployment, while people with higher education are better protected from this phenomenon.

Investments in education, especially higher education, are a profitable investment that assures positive long-term effects, in what concerns the individual and the socio-economic progress of the society.

As the educational level increases, there can be noticed a change in the same way of the individual earning – that is, almost every time, much more over the average. The higher levels are more obviously in the developed countries. If we analyse the United States situation, the differences between the medium earnings of the university graduates and of the high school graduates were of 40-50% at the beginning of the 60ths, and their level kept increasing.

The economic analyse can highlight the reason why, during the history there were countries having long periods of a continuous increasing of the income per capita. Therefore, some countries such is the United States and Japan have had continuous increasing in the individual income during the last hundred of years and even more. The explanation consists in the extending of scientific and technical knowledge, contributing in increasing the labour productivity and production increasing.

Systematic implementation of scientific knowledge to the production of goods has increased the importance of education, mainly technical education. It is obvious the existence of a positive connection between investments in education and the technological progress, having a considerable influence on all social and economic fields.

We may conclude that education, information and knowledge are power.

7. REFERENCES

THE INVOLVEMENT OF THE ROMANIAN ENTREPRENEURS IN ACHIEVING THE ORGANIZATIONAL OBJECTIVES

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ABSTRACT: The first purpose of this paper is the evaluation of three dominant factors in determining the degree of involvement of the Romanian entrepreneurs in achieving the objectives of the organization they belong to: the wish of professional achievement, the degree of involvement in the organizational life – even at the risk of limiting the private life – and the degree of entrepreneurs’ initiative in the firm. To achieve this objective, a research was made, based on a questionnaire. The second essential objective of the paper is to issue some suggestions, based on the results of the research, for new development directions of the managerial disciplines, in order to raise the degree of involvement of the faculties’ graduates in achieving the organizational objectives. The originality of the paper consists of the research made, the results obtained and the recommendations made.

1. INTRODUCTION
Considering the globalization of business and the intensification of competition in any field, today’s entrepreneur has to possess many qualities to help him gain success in the organization he belongs to.

The degree of his involvement in achieving the organizational purposes is determined mainly by three factors which characterize him more or less: the wish of professional achievement, the degree of involvement in the organizational life – even at the risk of limiting the private life – and the degree of initiative in the firm.

Therefore, we call for a research to find out to what extent these factors are characteristic of Romanian entrepreneurs. Given the results of this research, one will work out useful recommendations related to the directions of development of the managerial disciplines in the Romanian higher or university education.

2. THE METHODOLOGY OF THE RESEARCH
To evaluate the wish of professional achievement, the degree of involvement in the organizational life and the degree of entrepreneurs’ initiative in the Romanian firms, a research was made, based on a questionnaire. This ample exploring research aimed at defining several co-ordinates of Romanian entrepreneurial education, this paper debating only upon those aspects concerning the entrepreneurs’ involvement in achieving the organizational objectives.

All the questions asked were closed questions. The scale for measuring the answers had full values ranging from 0 to 5, corresponding to the following answers: 0 – I don’t understand the question/I cannot answer; 1 – to a very small extent; 2 – to a small extent; 3 – to a moderate extent; 4 – to a large extent; 5 – to a very large extent.

Data were processed in Excel.

The entrepreneurs who were questioned (34 in number) varied in age and training, having different experience and aims in the development of business and working in domains that call for entrepreneurial activities, within small, average or big firms.

3. THE QUESTIONED ENTREPRENEUR’S WISH OF PROFESSIONAL ACHIEVEMENT
The first questions of the questionnaire had in view finding out the following elements that co-operate in defining the entrepreneur’s wish of professional achievement:

- his orientation towards results, in everything he undertakes;
- the extent to which he settles ambitious objectives;
- the involvement in searching information needed to establish better ways of action, with a lower degree of risk;
- the extent to which he learns how to improve his performance.

The answers showed that the majority of entrepreneurs wish to gain professional achievement, being oriented towards results and often establishing ambitious objectives. Moreover, they search and assimilate information to cut down the incertitude of the results of their actions and to improve their performance.

After the analysis of the first element (see figure 1), we can say that 50% of the questioned managers say that they are oriented towards the results of their activities.

![Figure 1. To what extent are you oriented towards results?](image-url)
maximum one is 5 – “to a very large extent”, the average of the answers being 4.41 with a standard deviation of 0.66.

More than a half of the questioned managers state that they settle ambitious objectives to a large and very large (figure 2), only 6% among them choosing the variant of answer “to a small extent”.

Figure 2. To what extent do you settle ambitious goals?

The values found in the analysis of the answers to the second question are: minimum 2 (to a small extent) and maximum 5 (to a very large extent). The average has the value 3.74, and the dispersion 0.93.

Analysing the involvement of the entrepreneurs in searching the necessary information to establish better ways of action, with a lower degree of risk (figure 3), I ascertained the fact that 49% of those questioned say that get involved in this process to a great extent, and 33% to a very large extent.

Figure 3. To what extent do you search information to find better ways of action which have a lower degree of risk?

The minimum value of the answers to this question is 2 – “to a small extent”, the maximum one is 5 – “to a very large extent”. The average obtained is 4.09 and the standard deviation is 0.84. On the whole, we can say that the Romanian entrepreneur searches useful information to find out better and less risking ways of action.

In order to finalize the first set of questions regarding the entrepreneurs’ wish of professional success were centralized in figure 1.

Table 1. Determining the Romanian entrepreneur’s wish of professional success – centralized results.

<table>
<thead>
<tr>
<th>Figure</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.41765</td>
<td>0.656789577</td>
<td>0.43137255</td>
</tr>
<tr>
<td>2</td>
<td>3.735294</td>
<td>0.931236504</td>
<td>0.86720143</td>
</tr>
<tr>
<td>3</td>
<td>4.090909</td>
<td>0.842749828</td>
<td>0.71022727</td>
</tr>
<tr>
<td>4</td>
<td>4.205882</td>
<td>0.769864678</td>
<td>0.59269162</td>
</tr>
</tbody>
</table>

As a result of this analysis we can state that the majority of the entrepreneurs questioned wish to be successful and this motivates them in their managerial activities.

Still, having in mind the results obtained at the second question, we consider that the Romanian entrepreneurs are not sufficiently ambitious in the goals they set. Of course, to a large extent, the blame is to be placed on the education acquired at home and in school. Modesty is not the best card nowadays, and the economy-based disciplines taught in faculties, especially Management and Marketing, should emphasize the development of a healthy ambition with the students.

4. THE DEGREE OF INVOLVEMENT OF THE ROMANIAN ENTREPRENEUR IN THE ORGANIZATIONAL LIFE, TO THE DETRIMENT OF HIS PRIVATE LIFE

To determine the entrepreneurs’ involvement in the organizations they belong to, the following have been analysed:

- The extent to which they sacrifice their private life in favour of the firm’s objectives;
- Their degree of resonance with the firm’s mission, to the detriment of achieving their personal objectives;
- The extent to which the decision making is realized on the basis of the main values of the group;
- The intensity of searching opportunities to accomplish the group’s objectives.

On the basis of results obtained in the analysis of the question „To what extent do you promptly make personal sacrifices to attain the firm’s objectives?”, I ascertained that most of the entrepreneurs questioned make prompt personal sacrifices (figure 5) Thus: 27% to a very large extent, 41% to a large extent and 29% to a moderate extent.

The results show the fact that, for those who were questioned, the success of the firm and fulfilling its objectives come first, which points out their deep involvement in the organization.
life. The lowest value of the answers is 2 – „to a small extent”, the highest one is 5 – „to a very large extent”, the average being 3.91, and the dispersion being 0.83.

**Figure 5.** To what extent do you promptly sacrifice your personal life to accomplish the firm’s objectives?

Even if the majority are willing to make personal sacrifices in the favour of the organization (figure 5), not all of them can say that they reason with its mission to the detriment of carrying out their personal objectives (figure 6).

**Figure 6.** To what extent do you reason with the mission of the organization to the detriment of carrying out your personal objectives?

In the answers to this question (figure 6), we identified the fact that 3% of the managers stated that they didn’t understand the question or could not answer it. Still, the majority of subjects consider that they reason with the mission of the firm rather than achieving their personal goals, to a moderate extent (38%) or to a large extent (38%) the rest saying that the resonance is to a small extent (6%) or to a very large extent (15%). The only answer that doesn’t show is the value 1-variant “to a very small extent”, which makes us draw the suspicious conclusion that some of those who opted for the value 0 variant actually avoided to mark the value 1 variant. We mention that the subjects didn’t know anything about the scale of evaluation.

**Figure 7.** To what extent do you make use of the main values of your group to make decisions?

The average of the obtained answers is 3.53, with a dispersion of 1.02.

As one can notice in figure 7, the majority of subjects consider that they make use to a large extent of the values of the group they belong to in the decision making process, 9% stating that they do so, but to a small extent, and 29% to a moderate extent. On the basis of the received answers, we can assert that most entrepreneurs take into consideration the values of the group they belong to in the process of decision making. The average of the answers to this question has the value of 3.65 and the standard deviation goes to 0.81.

Following the answers to the question regarding the intensity of search for opportunities to achieve the group’s objectives (figure 8), we notice that 38% of the entrepreneurs get involved in this search to a large extent, 21% to a very large extent, 29% to a moderate extent, 3% to a small extent and 9% state that they don’t understand the question or cannot answer this question. The only value-answer that was not given to this question was 1 – “to a very small extent”.

**Figure 8.** To what extent do you actively search opportunities to achieve your group’s objectives?

The average of the answers is 3.5 and the dispersion has the highest value (1.35) of the entire set of questions analysed in this paper. Pearson’s coefficient, 0.387, indicates that the average obtained at this question is not relevant for the analysed sample.

The centralization of the results of the four questions concerning the entrepreneurs’ involvement in the organizational life, to the detriment of the private one, can be found in table 2.

<table>
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<tr>
<th>Figure</th>
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<th>Variance</th>
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</thead>
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<tr>
<td>6</td>
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<td>1.04456328</td>
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<td>7</td>
<td>3.647059</td>
<td>0.812118552</td>
<td>0.65953654</td>
</tr>
<tr>
<td>8</td>
<td>3.5</td>
<td>1.354006401</td>
<td>1.83333333</td>
</tr>
</tbody>
</table>

Although the obtained averages are over the scale’s average, (3), the results could be greatly improved by making the entrepreneurs to come aware of the importance of the group values in any organization within the university education.

5. Entrepreneurs’ Manifestation of Initiative in a Firm

A new set of questions aims at identifying whether managers are ready or not to take advantage of the identified opportunities, whether their objectives are more ambitious than what they are asked (figure 10), whether bureaucracy and rules are forgotten when they do their job (figure 11) and whether they are able to mobilize others (figure 12).
Figure 9. To what extent are you ready to take advantage of the identified opportunities?

![Pie chart showing readiness to take advantage of opportunities]

Figure 10. To what extent your objectives are more ambitious than what you are asked?

![Pie chart showing ambition levels]

We notice that most of those questioned are capable of cutting down bureaucracy and modifying rules to finalize their work (figure 11).

Figure 11. To what extent do you cut down bureaucracy and modify rules, when it’s necessary to do your job?

![Pie chart showing cuts in bureaucracy]

Figure 12. To what extent do you mobilize others to fulfil the organizational objectives?

![Pie chart showing mobilization efforts]

After the centralization of the results of the four questions regarding the mobilizing initiative of the entrepreneurs in the firm, we can state that the majority of managers take the initiative in their organizational activity, take advantage of the opportunities that show up, cut down the bureaucracy and modify the rules to finalize their work and manage to motivate other members of their group to fulfill the organizational objectives.

| Table 3. The Romanian entrepreneur’s initiative in the organization. |
|------------------|------------------|------------------|------------------|
| **Figure** | **Mean** | **Standard Deviation** | **Variance** |
| 9 | 3.941176 | 0.982920092 | 0.96613191 |
| 10 | 3.911765 | 0.965076447 | 0.93137255 |
| 11 | 3.794118 | 0.91384674 | 0.83511586 |
| 12 | 3.441176 | 0.990597508 | 0.98128342 |

6. CONCLUSIONS & RECOMMENDATIONS

Although the average values obtained in the questions of the questionnaire are over the scale’s average (3), we consider that the Romanian higher education – especially the disciplines in the management field – could take great steps to increase the degree of involvement of entrepreneurs and managers to come in achieving the organizational objectives. [4].

The practice on a large scale of modern methods of teaching in the universities, such as role playing and case studies, together with the addition, in the curriculum of the economic disciplines of some applications specific of today’s business environment – for example, operating bank transactions on a computer, the work in the networks of simulated enterprises, the participation in teleconferences part, the initiation of real market tests, the development of a small ‘satellite’ business for the education institutions the students belong to etc. – could lead to an increase in the Romanian entrepreneur’s ambition towards the objectives he settles and self-confidence.

Team work could lead to a better awareness of the importance of the group values in the organizational life [5]. An emphasis of the team work during university studies must not neglect the students’ individual aptitudes, and must be realized by emphasizing the importance of the particular in general. Each and every student is unique and, in relation to the group, must not lose his identity, but has to complete the collective one.

If the disciplines that are taught will ask students to work in team, so that every student make his own value known, still remaining unique and indispensable, but completing the power of the group, the ambitions of those trained will enhance and so will their hunger for knowledge.

We think that another possible improvement of the situation could be generated by a greater involvement of the pupils/students who are in the secondary and higher education in the activities of scientific research.

7. REFERENCES


THE OPTIMISM AND THE CREATIVE MANAGERIAL THINKING – SUCCESS FACTORS IN THE KNOWLEDGE BASED ECONOMY

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ABSTRACT: In knowledge based economy, teaching should put the accent on creative thinking of the instructed ones. To keep up with the actual dynamic environment, where every organization plays its role, the faculties’ graduates must own creativity and a high degree of optimism, too. A first step in making clear the importance of those two factors in the knowledge based management and economy is represented by the research done by authors, using a questionnaire which was distributed to Romanian managers from different activity domains. The results of this research, presented in the paper, guide us to interesting conclusions about the possibilities to improve the Romanian educational area. We consider that the present explorer research opens a large field for the study of the roles which optimism and creative thinking play in the Romanian management and entrepreneurship.

1. INTRODUCTION

As Juran stated, no one can say that there is a complete list of clients’ needs, as they are a truly “mobile target” [5]. Creativity and optimism are two indispensable instruments of any entrepreneur or manager who want to detect the permanent changes in the consumers’ priority list.

In order to detect the coordinates of managerial creativity and optimism, a complex questionnaire based on a selective research was initiated [1, 2]; one of its objectives is the measuring of the presence of the two features among Romanian entrepreneurs. Therefore, the study only refers to the questions in the questionnaire relevant for this purpose.

Closed questions were used only. The measuring scale of the responses had full values between 0 and 5, corresponding to the following responses: 0 – do not understand the question/I cannot respond; 1 – to a very small extent; 2 – to a small extent; 3 – to a moderate extent; 4 – to a large extent; 5 – to a very large extent.

The 34 chosen subjects had different ages, education and experiences, occupying positions with managerial responsibility requirements within large, medium or small companies.

The resulting data was processed in Microsoft Excel.

2. THE OPTIMISM OF ROMANIAN MANAGERS

In order to determine the level of optimism of the respondents, the following defining elements were chosen:

- the way managers keep in trying to reach their objectives, despite any possible problems and obstacles;
- the extent to which the expectation of success, not fear of failure, determine the actions of the interviewed;
- their belief that the problems occur in the organization because of controllable circumstances, rather than because of personal faults.

When reviewing the managers perseverance in reaching their goals (figure 1), it was established that the minimum value of the obtained responses is 3 - “to a moderate extent” – with a percentage of 15% and the maximum value is 5 – “to a very large extent” – with a percentage of 32%.

The remaining responses (53%) show that many managers consider they posses the ambition to continue the necessary activities for reaching their objectives to a large extent, regardless of any obstacles and problems they may face.

Figure 1. To what extent do you persist in achieving your goals, despite the obstacles and problems that might occur?

The average rate of responses to this question is high, 4.18, and the dispersion rate is relatively reduced, 0.67.

The main reason for accomplishing the activities is the expectation to be successful and not fear of failure for most of the interviewed managers - to a high extent (64% - figure 2).

Figure 2. To what extent do you act with the expectation of being successful, rather than fear of failure?
Only a few managers stated that the expectation of success motivates them to a very small extent (3%) or to a small extent (3%), in comparison with the fear of failure. 15% of the managers claimed that the desire for success motivates them in achieving their objectives to a very large extent. The minimum value of answers to this question is 1 – “to a very small extent” and the maximum is 5 – “to a very large extent”; the average value of responses is 3.85 with a dispersion rate of 0.82. These values indicate a high degree of optimism of the interviewed persons; they think to their success rather than to failure to a large extent. This is very motivating in the management activity.

Another issue taken care of in the analysis of optimism was the extent to which managers consider that their problems are caused by different circumstances they can control, and not by their own faults (figure 3). Most of the interviewed managers stated that the problems they encounter in their activities are mostly determined by different controllable circumstances to a large extent (44%) or to a moderate extent (32%). 6% of subjects stated that the problems are caused only to a small extent by them. The responses provided by managers determined the minimum value 2 and the maximum value 5. The average is 3.74 and the dispersion is 0.83.

When centralizing the information in Table 1, we conclude that most managers are optimistic because they watch their objectives; even if problems or obstacles occur, they work with the expectation of success, not with the fear of failure, and they consider that the emergence of problems is due to different controlled circumstances, not to their personal faults.

### Table 1. The optimism of the interviewed managers – centralized results.

<table>
<thead>
<tr>
<th>Figure</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.176471</td>
<td>0.672876603</td>
<td>0.45276292</td>
</tr>
<tr>
<td>2</td>
<td>3.852941</td>
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<td>0.67468806</td>
</tr>
<tr>
<td>3</td>
<td>3.735294</td>
<td>0.827878762</td>
<td>0.68538324</td>
</tr>
</tbody>
</table>

### 3. CREATIVE THINKING AND DIAGNOSIS CAPACITY OF ROMANIAN MANAGERS

The last set of questions – 9, all in all – is supposed to identify the degree to which the interviewed managers have a creative thinking and a diagnosis capacity; these elements should lead to very good results in their activities and hence to the success of the groups to which they belong, by means of synergy. The 9 questions mainly approach the following aspects:

- ability to transform the environmental trends into company benefits;
- ability to identify the necessary information for taking wise management decisions;
- ability to assess correctly a given situation;
- ability to develop the new plans required for achieving the organizational goals;
- ability to implement new business plans;
- confidence in acting in accordance with the innovative decisions adopted by the company.

When analysing the frequency of the received responses to the first question in this set (figure 4), we find out that 52% of the managers consider that they have the ability to think creatively to a large extent, 21% state that they have this ability to a very large extent, 24% to a moderate extent and only 3% to a small extent.

Therefore, most managers think creatively in their work, which is necessary in order for firms to grow and be competitive on the market. The minimum rate of responses to this question is 2, the maximum is 5, the average is 3.91 and the dispersion rate is 0.75.

Regarding the creative problem solving (figure 5), about 65% of managers stated they have this ability “to a large extent” or “to a very large extent”. The average of responses is closer to the answer “to a large extent”; it has the value 3.88 with a dispersion of 0.84.

When analysing the next question from the set (figure 6) 50% of the managers claim that they have the ability to identify new opportunities, only 3% say that they do not understand the question or may not respond. The only missing response option is that of value 1 – “to a small extent”. The minimum obtained rate is 0 and the maximum is 5, with the average of 3.53 and a dispersion rate of 0.96. Starting from the idea that success in business is related to environmental comprehension,
identification of opportunities and their transformation into company strengths, we can say that the most interviewed managers will lead the organizations from which they belong to success.

Thus, to the following question (figure 7) most managers state that they have the ability to transform the environmental trends into benefits for the company to a large extent (44%) or to a very large extent (21%). Only 9% of the respondents stated that they have this ability only to a small extent and 26% to a moderate extent. The minimum rate of responses is 2 and the maximum is 5. The average for this question is 3.76 with a dispersion rate of 0.89.

According to Figure 8, 45% of the managers state they have the ability to identify the necessary information for taking wise decisions to a large extent, 26% say they have this ability to a very large extent and 26% say they have this ability to a moderate extent.

When asked about the ability to develop new plans necessary in achieving organizational objectives, 50% of the managers said they have it to a large extent, 26% to a very large extent, 21% to a moderate extent and 3% to a small extent (figure 10). The average response is 4, with a dispersion rate of 0.78, which shows us that a large proportion of the interviewed managers consider they have a great ability in carrying out new plans which lead to the achievement of company’s objectives.

After analysing the responses to the question related to managers' ability to correctly assess a given situation (figure 9), we find out that over 50% of the respondents have this ability to a large extent. 15% say they have the correct assessment capacity to a very large extent, 26% to a moderate extent, and 3% say they have it to a small extent. The average of responses to this question has the rate 3.82 with a dispersion rate of 0.72.
Concerning the ability of the respondents to implement new plans in the organization (figure 11), 59% say they have this ability to a large extent, 29% to a very large extent and 12% to a moderate extent. The minimum rate of responses at this question is 3, the maximum is 5, the average being 4.18 and the dispersion, 0.63.

If comparing the last two analysed questions, we find out that there is a greater share of the ones implementing new plans, than the ones who develop them.

The confidence in acting in accordance with the innovative decisions adopted within the company (figure 12) characterizes the studied group, as follows: 59% shows a confidence to a large extent, 24% to a moderate extent and 17% to a very large extent.

The average of responses is 3.94 and the dispersion is 0.65.

![Figure 12. To what extent do you trust in acting in accordance with the innovative decisions adopted within the company?](image)

Table 2. The creative management thinking and the diagnosis capacity - centralised results.

<table>
<thead>
<tr>
<th>Figure</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Variance</th>
</tr>
</thead>
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<td>0.56773619</td>
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<td>5</td>
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<td>0.844400662</td>
<td>0.71301248</td>
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<td>7</td>
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<td>0.8896313</td>
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</tr>
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<td>8</td>
<td>3.941176</td>
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<td>0.6631016</td>
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<td>0.648596455</td>
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</tr>
</tbody>
</table>

Anyway, at the question related to the identification of new opportunities in the business environment (figure 6), the average 3.53 is only with a half point above the average evaluation scale (3). So, Romanian managers are either not “trained” to recognize new opportunities, or are too stressed in evaluating the problems occurring in the business environment.

A correction of this issue could come in high-school and superior education. A modality is to increase the number of the applications classes in managerial disciplines and in marketing, too.

Management disciplines should make the students aware on an old saying successfully used in sports: this saying could be used in other areas, too: “The best defence is the attack.”

In order to make the organization competitive, the Romanian manager must possess, in addition to creativity, distributive attention, oriented towards dangers and towards opportunities of the external environment, too.

4. CONCLUSIONS

We must recognize that, although the results of this research give us many clues on the approached items, it has certain limitations stated in the following:

- lack of a clear situation distributed on activity spheres, about the optimism and creative managerial thinking;
- absence of any terms of comparison - the results are obtained from analysing the subjects’ opinion about themselves.

The study in this paper should therefore be followed by a quantitative research, which could determine clearly the existing differences between Romanian entrepreneurs from different industries, in comparison with the interviewed groups regarding optimism and their creative thinking. Then, specific recommendations could be made for each category [4] for improving the aspects studied in the paper.

A comparative research could also be very useful for highlighting not only the managers’ opinion about themselves in terms of optimism and creativity, but also the view of some of their employees, who could assess their superiors from their own perspective. Although in this future research the degree of subjectivism would be higher, we believe that its results would be extremely useful in the statement of proposals for improvement of optimism and management creativity in Romania.

Nowadays, there are more and more economic theories that argue that the list of production factors was completed by another element: creativity [3].

Tony Proctor states that the occurrence of creativity is conditioned by the way one organises his thoughts in a manner which allows the formation of different perspectives on a given situation [6]. If taking into consideration this opinion and the importance of creativity in the current economic system, we should note that the first “different perspective” that the Romanian manager should consider on a given situation is the one related to the employee.

5. REFERENCES

MODERN METHODOLOGIES FOR COMPLEX MANAGERIAL SIMULATIONS

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ABSTRACT: The paper presents the most important aspects of design and use complex management simulations. Elements of field approached are summarized, both nationally and internationally, giving some of the most valuable and valued achievements. Based on their experience, as creators of entrepreneurial management simulation PRELEM - XXI, the authors develop aspects of the use of simulation in the university training and in the continuing education. The presentation it will be accompanied by a practical demonstration of the use of simulation management mentioned above, awarded to the 53-th World Salon of research and new technologies in Brussels - 20.11.2004 (53-th World Exhibition of innovation, Research and New Technology “ - Brussels, 2004).

1. INTRODUCTION

Business games, simulations represents a natural way of learning which can be found in nature at superior animals for acquiring basic skills in order to survive. People design games with economic content thousands of years ago but first managerial simulation that reproduce the activity in an economic environment have been designed in the milie of XX century. First simulation of the activities from a factory was designed by Mary Birshtein at Leningrad Institute in 1936 and was about a typewriter factory. Unfortunately the Second World War interrupts those initiatives and the next one we will find it in supply processes of the USA army, but first managerial simulation with acknowledgement from the management specialists is “Top management decision simulation” from 1956.

The development of managerial simulations continue in the next years and enter in the curricula of the large majority of business schools from USA and Europe. This development also gave birth to a number of profesional association and now we find a plenitude of them on different continents: America – ABSEL and NASAGA, Europe – ECGBL, SAGANET, ISAGA, ASIA – JASAGA, INDSAGA.

The IT&C field was a constant suporter of the growth of business games and this was reflected in reduction of development time, growing complexity and accessibility and also in simplicity of use.

A. J. Faria identifies six major axes on development of managerial simulations: realism, accessibility, flexibility, scalability compatibility and simplicity of use. The author also identifies why managerial simulations or business games at a superior method of training comparative with other methods (Faria, 2008):

- Allows the trainee to acquire experience through the simulation which means acquiring explicit and tacit knowledge
- Orienting the trainee to the strategic aspect of the business and proving that this activity is rewarding in the future.
- Learning process is oriented not only to memorizing and comprehension but also on application, analysis, synthesis and assessment capabilities of the trainees
- Complex managerial simulations involves teamwork and complex interacting between participants, allowing knowledge exchange

Other advanges identified by specialists are (Thornton, 2004):

- Allows assessment of other abilities that are hard to evaluate in other conditions like: communications skills, problem solving, interpersonal relations
- Simulations can be adapted to reflect the condition within the company

In a recent article austrian specialist Richard Fortmülleridentifies four categories of objectives that can be reached using managerial simulations: to be able to use already acquired specialized knowledge in specific problem situations, to be able to combine activities acquired separately to a systematic sequence of action, to be able to reconstruct basic correlations and processes, to be able to asses the interactions and consequences of an individual’s and others’ activities. (Fortmüller, 2009)

Managerial simulations or business games are an excellent environment for assessment but the dominant are the formative valences regarding the forming of managerial abilities , stimulating a systemic approach of the enterprise, making trainees familiar with the use of IT&C in managerial process and having the advantage of a shorten period of training. (Nicolescu, 2005)

The process of conception of simulations it is an excellent method to make the transfer between tacit and explicit knowledge in the classic fields like industries and general economic activities but also in healthcare, disaster recovery, military and others (Crokall, 2009)

Most of the managerial simulations or business simulations have been oriented to a small number of activities from an organization, usually from the commercial part like: pricing, dimensioning quantities to be sold, dimensioning the retail network, logistic etc and less on human resources and accounting or financial aspects. (Goosen, 1999)

2. THE PRESENTATION OF THE MANAGEMENT AND ENTREPRENEURSHIP SIMULATION PRELEM - XXI

The In the new context, characterized by the passage to a new type of economy, i.e. the knowledge economy, the training and educational activities emphasize the usage of active training
methods on a large scale, meant to generate knowledge at students in a most directly and ample way. This trend becomes dominant in all the educational processes, including those regarding life-long learning.

This management and entrepreneurship simulation PRELEM-XXI is remarkable for both its economic and managing characteristics and its computer-assisted ones, being one of the most complex, modern and efficient simulations used in the world at present. It got international recognition thanks to the two prestigious awards: The bronze medal and The EUREKA Diploma! 2004 during the 53rd World Exhibition of Innovation, Research and New Technology” in Brussels organized on 20.11.2004. It has brought its immense contribution to the training processes, the appropriation of a dynamic and systemic view on the organization’s management, the development of the capacity to analyze and solve complex managing situations by making the right decisions, and to the training of efficient managing behaviors.

PRELEM XXI concept is based on the requirements concerning the economists’ training and the managers and experts’ perfecting, taking into account the current stage of Romania’s development, its accession the European Union and the passage to the knowledge economy. These requirements refer to the basic characteristics of a processing company, the average degree of complexity considered, the ways how to handle the latest information, the type and the importance of the simulated activities, the game’s duration etc. The result was a managing game shaped on a medium wood processing company.

The standard usage of the game refers to the functioning and management of the simulated company on a 1-year term. It counts 12 successive rounds of forecast decisions and forecast running that correspond to the 12 months involved. Just like the computer-assisted situations involving results, these decisions refer to each main activity of the company, and the activities concerning the marketing, output and the company as a whole are treated in detail.

According to the typology of the management simulations and games, PRELEM XXI may be characterized as:

- a general management game as it simulates most of a company’s activities with a stress on achieving the general objectives;
- a participative management game as it is based on the grouping the trainees into companies’ managing boards;
- an individual management game in case of the long-distance learning, where each trainee assumes and performs the management processes involved;
- a computer-assisted management game as it ensures computer-assisted information processing;
- an interactive management game as the decisions and actions taken and applied by the participants at the game overlap and influence each other to a certain extent;
- a high and average management game as it mostly simulates managing and executing processes performed by high and average level managers within an company.

Based on the above-mentioned information, one may deduce that PRELEM XXI belongs to the superior category of the management games from the point of view of the coverage, the ways how trainees get involved, the way how the information is processed participants’ dependence of each other and the dominant management echelon we took into account. Hence, the complexity regarding its usage and especially its development.

3. SPECIFIC ELEMENTS REGARDING THE USE OF THE PRELEM IN LIFE-LONG TRAINING

The usage of the management simulation “PRELEM-XXI” within life-long learning programmes entails the adjustment to their specific features as for the objectives, the participants’ profile and the training programme’s duration. Based on our experience with the simulation’s usage, we have derived several specific IT-related and pedagogical aspects.

3.1. IT-related aspects

The main elements specific of PRELEM-XXI usage within life-long learning programmes may be summed up as follows:

- Ensuring the electronic distribution of all information used within the simulation: the simulation manual, information instances for the basic period and decision-making forms.
- Submitting managing decisions to the simulation’s coordinator in electronic format by means of decision-making forms.
- Ensuring the trainees an on-line communication instrument, by means of which they can communicate and receive consultancy besides the training in real time.
- Submitting the decisions’ results to trainees via e-mail or publishing them on a web site.
- Printing the managing reports and submitting them in electronic format.

3.2. Pedagogical elements

The lack of direct “face to face” contact between the trainer and the trainee is reflected in the following elements specific of PRELEM XXI development:

- Using PRELEM-XXI only in its individual variant; each trainee has to adopt and implement all decisions by means of which the company is run, to assume and play the parts of all the managing team’s members (general manager, technical manager, research manager, product manager, sales manager, HR manager, financial manager)
- Trainees’ not delivering any general introductive presentation of the simulation, which makes PRELEM-XXI concept and functioning understanding more difficult at the beginning.
- Developing the strategy of the simulated company, as well as the set of monthly decisions by which it is implemented is less laborious and more simplified since all these processes are performed by one single person per company, and not by a team and the trainee no longer benefits of the aspects discussed on with the trainer within the training directly and on a regular basis.
- Increasing the effort and the time the trainees need so as to participate at PRELEM-XXI as each of them has to carry out a set of tasks, competences and responsibilities which a managing team usually assumes. Thus, the degree of trainees’ involvement in the simulation’s development is substantially amplified.
- Diminishing the scope and the quality of the general, decision-making analysis as there is no group discussion with
the other members of the managing board, their presentation and discussion within the seminars under the guidance of the training staff.

- No usage of the case studies identified and assumed by trainees and trainers during the simulation due to the specific development and intensity of the work done by each trainee participating at PRELEM-XXI at a distance.
- No more managing team work and no more communication with the other managers of the company. Thus, PRELEM XXI human, communication and leadership-related aspects is hardly present and may have a negative impact on managing abilities’ training and development in case it is used in distance training.
- The assessment of the participants in the simulation is quasi-exclusively based on the quality of the decisions that have been made and the performances of each simulated company, which means this is a limited assessment. Certain major sources of information relevant for the assessment, generated by teamwork and the direct interface with the game leader disappear.

4. THE ADVANTAGES OF USING PRELEM-XXI IN THE LIFE-LONG LEARNING

The intense use of simulations and managing games, including PRELEM-XXI within life-long learning programmes is determined by their important training roles. In the life-long learning process, the practical abilities the participants acquire during the training are extremely important. Moreover, their development under stronger time’s pressure (the training sessions generally last for a short time) makes the trainer use highly efficient and attractive methods.

For the participants in life-long learning processes, PRELEM-XXI represents a real decision-making lab as it gives them the chance to simulate highly complex decision-making processes, make controllable managing experiments without any inherent risk in real life. While training and perfecting human resources, the simulations and the games share similar roles and are as important as the practical lab work meant to train and perfect physicists, chemists etc. They obviously contribute to making managing training a science.

In comparison with other methods, PRELEM-XXI contributes to a great extent to training and perfecting the managing abilities concerning: the development and application of strategies and policies, decisions’ scientific substantiation, the organization of leaders’ work etc. At the same time, it substantially contributes to perfecting students’ and managers’ economic abilities concerning: the economic analysis of different phenomena, the usage of market surveys, the financing of the company’s activities, products’ commercialization and technical-material supplies etc.

PRELEM-XXI has brought an important contribution to assuming and developing the systemic approach of the company and its components. PRELEM-XXI incites to noticing and taking into account the main interdependent relationships within the company that are closely related to its main objectives. The participation at the game increases the participants’ capacity to place the entity or the set of managing processes in the foreground while identifying the main components and the relationships between them so as to fully achieve the major objectives they have been allotted.

Thanks to the dynamic simulation of activities faster than they are actually performed, PRELEM-XXI greatly contributes to the compression of the managing training process’ duration. The big, computer-assisted managing games such as PRELEM-XXI enable the participants to gain, within 3 or 4 months, experience in the management of certain processes, which would otherwise take one or even two years. Moreover, the training process’ duration is diminished while eliminating the risks it involves in real life for both the company and the managers running similar processes.

The usage of computer-assisted means of information processing helps the participants get familiar with the aspects specific of computer usage in managing processes. Thus, since the trainees participate at the simulation at a distance, they may reinforce their knowledge of the advantages and limits of electronic computers, the ways how to use them so as to turn the best account of their potential in the best way with a view to increase activities’ efficiency.

Thanks to the very way it has been conceived, PRELEM-XXI provides a set of objective indices used to assess the training of the human resources involved in life-long learning programmes. While increasing the accuracy of students’, managers’ and experts’ assessment based on criteria used within companies such as: output, profit, profitableness etc, they increase their interest in the training process and ensure a more accurate assessment of the participants’ managing potential.

To sum it up, the usage of PRELEM-XXI in life-long educational system is characterized by numerous specific aspects involving substantial potential advantages and, of course, certain limits and disadvantages. Their synthesizing makes us consider that PRELEM-XXI has a great educational potential in life-long education, as well, since it helps those who are trained in the managing and economic field assume and develop certain abilities impossible to reach while using the other training methods. The passage to a new type of economy, i.e. the knowledge economy, substantially increases the need to use PRELEM-XXI and, of course, other simulations, as well thanks to its capacity to quickly train and develop managing, economic and marketing-related knowledge as it has a great potential to generate added value for the Romanian companies irrespective of their size and structure.

5. REFERENCES

5. (Crookall, 2009) - D. Crookall, W. Thorngate – Acting, Knowing, Learning, Simulating, Gaming, Simulation & Gaming, February 2009, p. 8 – 26
6. (Goosen, 1999) - K. Goosen, R. Jensen, R. Weels - Purpose and learning benefits of business simulations: a design and development perspective, Developments in

A THEORETICAL MODEL OF INVESTMENT IN EDUCATION. FROM JOB-LOCK TO PROMOTION

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ABSTRACT: Many individuals and firms make choices of investing in education and training based on rational benefits and costs. The Nobel laureate, Gary Becker, introduced the distinction between general and specific education in order to explain the individual’s incentives to invest in human capital and their influence on job-lock and promotion. The aim of this paper is to offer a theoretical analysis of investment in human capital, and to explain why different rate of returns are associated with different kind of education.

1. INTRODUCTION

T. Shultz used to say that , „Many paradoxes and puzzles about our dynamic, growing economy can be resolved once human investment is taken into account discrimination. The large differences in earnings seem rather to reflect mainly the differences in health and education.”(T. Shultz, 1961)

Therefore, investments in education are the ones accounting for the economic growth (by increasing work productivity) Not all expenses related to human capital are investments, but only those determining positive effects on work productivity. Investments in the human capital are among the most risky ones, because they are wasted the moment employees walk away from the firm. This is why enterprises are not so keen on investing money in the professional training of their employees.

It is worth mentioning the fact that migration is seen as a kind of investment in human capital. This theory can help explain why young people are more prone to migration: because they have a larger amount of time to recover the investment than the older ones and so they expect higher revenues.

Private investments play a crucial role in economic growth. They, unlike public investments cannot be accurately measured, partly because they are under-reported by companies (they don’t show them as investments, able to generate more profit, but as expenses) and, on the other hand, it is hard to assess the training of employees by seeking of informal measures(for example through structured coaching or mentoring organized by management or workers seeking advice and information relatively independently). (OECD, 1998)

T. Shultz asserts that the amount of money invested in human capital can be seen with approximations, but he seems to agree with the estimations made by H.F. Clark, who states that they are roughly the same with the annual expenses in formal education.

Because training expenses are so difficult to estimate, authors will assess them as being identical with those for vocational training, since they prepare the individuals for a certain kind of job, depending on different techniques and technologies.

Specific forming leads to increased productivity mainly in the companies spending those money. For example, an individual knowing how to use a financial program existent only in that company won’t be able to use his knowledge anywhere else. Therefore, people don’t have a strong enough motivation to invest in such a kind of professional training.

General professional education is also useful in other companies except the ones offering it. For example, a teacher trained in an institution can be transferred to a similar faculty. It is obvious that in this case, institutions (and, more generally, firms) are not willing to invest in general education. Actually, they will promote the certain types of programs that don’t require them to give the money. On the contrary, employees are much more eager to benefit from general education because that would lead to an increase of their income (as a consequence for increasing work productivity). However, the vast majority of educational programs are nor general nor specific, considered entirely.

Recently, some economists trying to asses Becker’s conclusions concerning the situation in which employees must pay for their general education have actually discovered that circumstances such as insufficient funds can lead to splitting the cost between employees and their company. (Bishop, Kang, 1996). Subsequently, Loewenstein and Spletzer (1998) showed with empirical data that a split between costs for general education is possible if some contractual clauses are inserted in the working legal frame guaranteeing the recovery of the employer’s investment.

G. Becker emphasizes that a private investment from companies is absolutely required to boost professional education because graduates are not enough prepared for work when they finish their studies, and their accommodation with this new environment can be done using theoretical unconventional trainings. This kind of training is necessary because success in academic terms could be obtained individually, while labour activity involves interactions between individuals, collaborations and specific characteristics: discipline, punctuality, commitment etc.

Although it may seem that companies don’t have enough motivation to invest in human capital, especially in specific trainings, G. Becker states that there is a correlation between education investments in the workplace and the loyalty of employees. Japan is a perfect example, because of its high
investments in human capital and job migration is very low, while in the US employees tend to have much higher job mobility because there are no special bonds established between them and their employers. There is also a scientific explanation of the fact that employee who benefited from a special training are rather reluctant to leave that company. They get a higher payment because of their increased productivity due to the specific training they had and should they leave, they would have a smaller payment because the skills they acquired won’t also increase their productivity in the new work environment.

2. GENERAL TRAINING

Although companies can be reluctant to invest in general training it has been shown that the productivity of employees with a general training is much higher compared to the specific training (Bettina Lankard Brown, 2001). In the same perspective Barrett and O’Connell (2001) used data about companies in Ireland in order to estimate the productivity effects of a general, specific and combined training. Their results are quite surprising, showing the positive effects of combined and general training, but they were not the same in the case of specific training. There are many other cases apart from these examples, of situations where we can infer the contrary of Becker’s hypothesis - that companies can actually be interested to support expenses for general training even considering the risk of that employee leaving the company after a while.

A. Barrett, T. Callan and B. Nolan showed a graphic dispersion of earnings that can be explained by the growth of incomes corresponding to high levels of education. This phenomenon is due to the huge need for high qualified labour. Therefore, there is an economic incentive for individuals to accomplish general training using personal funding, knowing that in the future they would have a return on investment by obtaining a higher payment.

Still, some situations, (some employees are unable to pay their trainings) determine companies to make a contribution to financing their employees. In order to diminish the risk of this investment companies choose to insert in work contracts certain clauses (it is compulsory for the employee to stay within the company for a certain amount of time, usually for 3 years, and paying back the expenses if the employee decides to leave anyway, etc.).

Since the property rights are held automatically by those attending the classes, this right can turn into a source of stimulation to invest into one’s own education, employees accepting even smaller payments initially. After attending those courses employees consider themselves worthy of a bigger payment since this training and the new knowledge contribute to their increased productivity.

3. SPECIFIC TRAINING

The type of training determining a higher growth of the productivity can be considered specific training. (Becker, 1997) Supposing the training program is entirely specific, companies would beneficiate entirely from the increase of productivity of the trained employees, since the potential wages for those employees elsewhere would not be influenced by the human capital gained here. Once specific training has no economical value anywhere else, the employer must cover all the costs of the training. During the training period the company offers an initial wage, exceeding the marginal productivity of the student employee. In the post training period, the companies gain more profit if the employee is kept with the same wage since it is now inferior to the work productivity, and thus it may recover the expenses from previously. Still, often companies pay a higher wage than the initial one in order to motivate the employee to attend this course.

The theoretical implications of investments in specific training are extremely useful for managerial decisions concerning wage and formation policies. First of all, specific training, compared to the general one has some external effects (Becker, 1997), since once the employees leave the company with such skills this prevents the company from getting back their previous expenses or to obtain profit.

Secondly, lay offs due to the cyclical evolution of economic activity have similar effects for the company staff. Still, such lay offs are the result of different circumstances related to the socio-economic environment and not at all linked with the behaviour of the competition.

Concerning the lay off of people with specific training, it is reasonable to suppose that they are not interested to leave their workplace, and companies themselves are not interested to get rid of them. While, generally trained employees get wages quite the same to the ones that would be potentially paid by the competition, the attitude of companies towards those with specific training is different: they often get a higher wage than anywhere else. Moreover, companies don’t seem too preoccupied by the migration of their employees who had general training, or by financing such courses. In the case of specific training, companies are compelled to pay employees more in order to prevent them from leaving, for the main reason that they cover all the expenses for that particular training.

4. INVESTMENT IN HUMAN CAPITAL: FROM THEORY TO REALITY

A study done by the European Commission shows that the percent of employees who benefited from vocational all over the European Union territory (which we can approximate with investments in specific training) has decreased to 33% in 2005 compared to 40% in 1999. The attendance rate to vocational courses varies between 14% of all employees in Greece to almost 60% of them in the Czech Republic. It is interesting to consider the fact that these investments have decreased mainly in old members of the E.U., while in the aderring countries (Romania and Bulgaria) or those recently part of E.U, the percentage of employees benefiting from specific training has increased. This phenomenon can be explained by the necessity of new members to catching up the older more developed ones.

If one analyses the average vocational training hours of employees we can see the same direction with the number of employees benefiting from specific training. The old EU members have reduced the average number of hours for specific training, while the newer ones have increased theirs. It is worth mentioning the fact that even in these circumstances the average number of hours for specific training is higher in old EU members than in new ones. For example the average number of hours in France has dropped from 17 to 13, in Holland from 15 to 12, in Great Britain from 13 to 7 etc., while in the new members of the EU there was an increase from 4 to 5 hours in Lithuania, from 3 to 4 hours in Romania, from 4 to 6 in Poland, and from 8 to 14 in Slovakia.

1 Measured as percentage to the total number of employees.
Overall, in 2005 the average number of hours of specific training varies between 3 hours in Greece and 16 hours in Luxemburg.

Combining the 2 sets of information (the number of hours and the percentage of employees attending the specific training) we can say that the countries ensuring intensive specific training are The Czech Republic, Slovenia, France, Luxemburg and Sweden with an attendance rate of over 45% and more than 13 hours of specific training per employee. On the other hand, among the countries with poor specific training there are Latvia, Hungary, Lithuania, Greece, Bulgaria and Romania.

Company expenses on specific training (vocational) all over the EU has dropped from 633 Euros in 1999, to 461 Euros in 2005. Although there has been an overall decrease of 30%, in new member states (Romania, as well) the investments for specific training have increased. The most spectacular growth can be seen in Slovenia (from 167 Euros in 1999, to 517 Euros in 2005).

The study of the European Commission has also shown that the access to specific training decreases with age. Employees over 55 years are found in specific training programs in a much smaller proportion than 25 years old ones. The highest percentage is of employees between 25-54 years old. The conclusion is that the old population is much more exposed to social exclusion and income inequality than the youngest.

In some papers there is an analysis of the link between the company’s size and the intensity of human capital investments. Size is therefore a decisive factor in explaining the percentage of employees benefiting from professional training out of all the employees. Usually smaller companies with less than 50 employees are those investing more in training courses than the big ones [5]. Studies also have shown the decisive influence of the net cost of formation over the intensity of investment. These authors conclude that for 60% of the companies providing training, the net cost was negative, which means that they would recover all their expenses after their employees finished attending the courses. The productivity rate of employees after the courses could generate even some profit for the companies compared to the previous situation when employees did not have those skills and knowledge.

Considering this phenomena we can conclude that in countries with a specific training system base on the cost-benefit analysis, the benefits offered by the employees who attended those trainings exceed the costs of the trainings, so there is no need for further regulations on the workforce or other public institutions to provide the training.


5. REFERENCES
1. HUMAN CAPITAL INVESTMENT - An International Comparison, OECD, 1998
GLOBAL ENTREPRENEURSHIP WEEK – CHANGING THE ENTREPRENEURIAL MINDSET OF THE YOUTH WORLDWIDE

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ABSTRACT: If it is to achieve a greater success of the European Union’s Lisbon strategy, that means focusing the efforts on two principal tasks – delivering stronger, lasting growth and providing more and better jobs for growth and employment, Europe needs to stimulate more “favourable societal climate” for the “entrepreneurial mindsets” of young people, encourage innovative business start-ups, and foster a culture that is friendlier to entrepreneurship and to the growth of small and medium-sized enterprises (SMEs). So the European Parliament and the Council set out the eight key competences for Life Long Learning among them “Entrepreneurship” as an individual’s ability to turn ideas into action. The “Global Entrepreneurship Week” (GEW) campaign, which runs 2008 the first time in 75 countries worldwide, is supporting young people to be more creative and self-confident in whatever they undertake and “develop entrepreneurial capacities and mindsets”. So the GEW, this year with more than 100 countries worldwide, will continue to address these challenges vigorously. In consequence the hosts, organiser of the campaign in every country, pursue not just the development in their own country, but also to advance in areas outside their country. And Wismar University will be the host of the GEW Germany.

1. INTRODUCTION

Although each of Germany’s 16 states sets its own education requirements, nearly at all schools they teach through the lens of workplace conflict between employer and employee, the central battle being over wages and work rules. Surveys [1] shows that if there’s one unifying characteristic of German school textbooks, it’s the tremendous emphasis on group interests, the traditional social-democratic division of the universe into capital and labour, employer and employee, boss and worker. If it is to achieve a greater success of the European Union’s Lisbon strategy, that means focusing the efforts on two principal tasks – delivering stronger, lasting growth and providing more and better jobs for growth and employment, Europe needs to stimulate more favourable societal climate for the entrepreneurial mindsets of young people, encourage innovative business start-ups, and foster a culture that is friendlier to entrepreneurship and to the growth of small and medium-sized enterprises (SMEs). So the European Parliament and the Council set out the eight key competences for Life Long Learning [2] among them “Entrepreneurship” as “an individual’s ability to turn ideas into action. It includes creativity, innovation and risk taking, as well as the ability to plan and manage projects in order to achieve objectives. This supports everyone in day to day life at home and in society, employees in being aware of the context of their work and being able to seize opportunities, and is a foundation for more specific skills and knowledge needed by entrepreneurs establishing social or commercial activity”. The “Global Entrepreneurship Week” (GEW) campaign, which runs 2008 the first time in 75 countries worldwide, is supporting young people to be more creative and self-confident in whatever they undertake and develop entrepreneurial capacities and mindsets. During November 17-23, 2008 millions of aspiring young entrepreneurs from more than 75 countries were connected through Global Entrepreneurship Week. An array of activities and challenges – everywhere from remote villages to dense urban centres – were equipped these budding innovation with the knowledge, skill, and networks needed to grow new and sustainable enterprises that will make a positive impact on their lives and the lives of those around them.

2. ENTREPRENEURIAL MINDSET AND ENTREPRENEURIAL EDUCATION IN EUROPE AND GERMANY

A fundamental issue of our time is: innovation. Human progress, economic growth and social reform depend on new ideas and the ability to implement them in reality. Entrepreneurship is the process of putting innovation into useful form. Compared with the United States, Europeans are, on average, less inclined to become entrepreneurs. Entrepreneurial skills and attitudes are not sufficiently encouraged amongst young people. Some organisations successfully offer enterprise education programs to close the gap. Entrepreneurial education works particularly well when all stakeholders work together and the business world is actively involved. The Commission states that European universities are not currently in a position to achieve their potential in a number of important ways, and as a result, they are behind in the increased international competition for talented academics and students, and miss out on fast changing research agendas and on generating the critical mass, excellence and flexibility necessary to succeed. Even Germany is an example for being behind the times of entrepreneurship education. In a recent (so far unpublished) Guess (Global University Entrepreneur Spirit Students’ Survey)-study shows that Germany, Belgium and France belongs to that European countries with the lowest entrepreneurial activities. One reason could be the country socio-economic milieu that is expected to have a significant impact on the entrepreneurial sector.

Important for entrepreneurship is the “creative mindset” [3] that helps entrepreneurs to create new ideas and bring these to the market in a way appropriate to create value for an external audience.

The four poles that were developed mainly through the phenomenological action research by Senges [4], are reported
to influence the individual as well as collective and institutional entrepreneurial identity or mindset.

Figure 1. Philosophical Model of an Entrepreneurial Mindset

The four poles that were developed mainly through the phenomenological action research by Senges [4], are reported to influence the individual as well as collective/institutional entrepreneurial identity or mindset. The circle begins with exploration and realising existence, which is argued to lead to an internal locus of control. Next, the meaning of life question is formulated as “what do we want”, which is argued to be the most adequately contested with axiology and teleology. This permits the setting of priorities and subsequently leads to the possibility of engaging in entrepreneuring. With the entrepreneurial ambition clarified, the implementation and practice comes to the forefront. These trends are believed to instil the creative bootstrapping practices of 'trial and error' based optimisation favoured by entrepreneurs. Lastly, the life-plan is set in relation against the rest of world. Ethics as well as sustainability are questioned, because only just causes that consider their environment are successful in the long term. This last pole introduces the ‘other’ not only as part of a shared world, but also as differentiating factor. Thereby, it gives raise to yet another level of reflection. The differentiation, and thereby definition, of the ‘self’ contrasts and complements other beings, values and practices.

You can meet some amazing young people with great entrepreneurial ideas who want their lives to count for something significant. You can also meet many students who have no interest in entrepreneurship because they have not heard anything about entrepreneurship or they have a negative perception of business. In Germany it is also a fact that some teachers and professors reject business as a morally responsible way to spend one's life. The issue that is underlined here is not that too many people would rather work in the public sector (government) or the social sector (non-profit work), but that they assign a higher moral calling to these two sectors than to the private sector (business). But every day, these teachers and professors use and benefit from the products and services of business: Google, bookstores, clothing, transportation, and Enjoying the local coffee shop. They fail to differentiate between business leaders and dismiss the whole sector as greedy, uncaring, and destructive. In fact, everyone can make a vital contribution in any of the three sectors – business, government, non-profit - because all three are needed for a society to function well. Likewise, there have been many new stories about horrendous wrongdoings in the social and public sectors. For every example of misconduct, one can counter with many more stories of courage and sacrifice, of moral people living out their lives in the private, public, and social sectors. As people see more and more successful entrepreneurs in their direct environment, this may enhance their perception of their own capabilities. This effect may be stronger when the economic climate is favourable. And again, education plays a significant role. Education levels and the availability of entrepreneurship training programs are possible determinants of perceived skills. That's why we will need people who know how to implement new ideas and make them accessible to large populations. We will have to build and maintain an entrepreneurial society.

The investments in education should lead students on a path to self-sufficiency, preparing them to hold good-paying jobs, raise their families, and become productive citizens. By making entrepreneurship education available to students across all disciplines of study, students will become even more aware of entrepreneurial activity and its importance to our economy and society.

Entrepreneurship education must be available for both, the practitioners and the consumer. Broad education in and about entrepreneurship can help students who are not entrepreneurs understand the skills and intelligence, and the political, cultural, and economic infrastructure that enable new enterprises to emerge. That's why entrepreneurship is appropriate for both general education (university-wide, trans-disciplinary education, where students acquire the fundamentals of learning that they can then apply to more specialized areas of study and to the rest of their lives) and to the major (the collection of courses that constitutes an extended and integrated program of learning in a particular subject).

3. ENTREPRENEURSHIP AND THE MANAGEMENT OF UNIVERSITIES

A key task of Germany higher education management should be to establish innovation and its implementation as core educational goals. It has to be the “Chefs-Matter”. The role for programs of entrepreneurship at universities is to develop the human capital of university staff and students to further entrepreneurship development concentrating on the softer aspects – enterprise education and entrepreneurial thinking and acting – while indirectly supporting some of the harder aspects such of spin-off and enterprise creation. An educational culture of "curricular entrepreneurship" would create budgetary practices and incentive structures to reward faculty and departments for curricular innovations, fresh interdisciplinary partnerships, and experiments with new methods of teaching and learning that foster creativity and originality. Similarly, in the areas of research and tenure, universities should treat translational research as basic research, and the "measure of impact" of research should be part of the review for tenure and promotion. But we know that we are not-always-welcome presence inside our universities. But, if universities fail to change in the way they prepare students for an entrepreneurial culture and in a way they share their inventions and innovation, they will lose their authority and credibility as economic contributors.

4. GLOBAL ENTREPRENEURSHIP WEEK

Global Entrepreneurship Week is a brilliant example of what can be achieved by bringing together different ideas and cultures around the theme of entrepreneurship. The aim is to unleash young people's ideas around the issues that matter most to society, from poverty reduction through to climate change, and to foster a global culture which recognises entrepreneurs as drivers of economic and social prosperity.
Through this initiative, the next generation of entrepreneurs will be inspired and can emerge. In doing so, they will begin to acquire the knowledge, skills and networks needed to grow innovative, sustainable enterprises that have a positive impact on their lives, their families and communities.

The process of the sensitisation and the motivation of the young generation for the subject of entrepreneurial thinking and acting will be the basis for increasing growth of the society. We need an entrepreneurial mindset in the society that prepare more entrepreneurs, those entrepreneurs must anticipate the highest possible rate of success, and their success must include the creation of larger numbers of new businesses that help create new industries. Only a broad knowledge and a positive picture of entrepreneurship throughout the new generation, inspiring them with local and international success stories and opening their minds to a global market, is fundamental for life and active participation in the world as an entrepreneur, leader, and economic, scientific, and social contributor to society.

![Image](image.png)

**Figure 2. Iceberg Model**

### 4.1. History about the Global Entrepreneurship Week

Like many great movements, Global Entrepreneurship Week started with an idea. The notion to inspire innovation in youth began with British Prime Minister Gordon Brown and Carl Schramm, president and CEO of the Ewing Marion Kauffman Foundation. In announcing the plans for the Global Entrepreneurship Week, Gordon Brown said, “Together we can build the strongest entrepreneurial culture that the world has ever seen”. This initiative – founded by the Kauffman Foundation in the United States and Make Your Mark campaign in the UK, and globally sponsored by NYSE Euronext, IBM, and Ernst & Young – will bring young minds together across great divides to collaborate and create something bigger, something greater, something that can revolutionise the way we live [5]. The Week quickly grew into a worldwide movement to unleash the ideas of tomorrow’s entrepreneurs. During November 17-23, 2008 millions of aspiring young entrepreneurs from more than 75 countries were connected through 25,000 activities, and in co-operation with 8,800 partners of the Global Entrepreneurship Week. An array of activities and challenges – everywhere from remote villages to dense urban centres – were equipped these budding innovation with the knowledge, skill, and networks needed to grow new and sustainable enterprises that will make a positive impact on their lives and the lives of those around them.

Make your Mark, one of the two founders of the GEW, is the UK’s national campaign to give people the confidence, skills and ambition to be enterprising – to have ideas and make them happen. Having a can-do attitude and the skills to spot opportunities, overcome challenges and implement ideas is more important and urgent than ever in today’s tough economic climate. The Global Entrepreneurship Week model is an adaptation of Enterprise Week in the UK, which is now running for the sixth time this year as Global Entrepreneurship Week UK. The Kauffman Foundation, the second founder, was established in the mid-1960s by the late entrepreneur and philanthropist Ewing Marion Kauffman. The Foundation vision is “a society of economically independent individuals who are engaged citizens, contributing to the improvement of their communities”. With the mission “to help individuals to attain economic independence by advancing educational achievement and entrepreneurial success, consistent with the aspirations of the founder” the foundation works in the fields of education and entrepreneurship. Education; to builds people’s capacity to innovate, and entrepreneurial; to catalyze an entrepreneurial society in which job creation, putting innovation into reality, and flourish the economy. It works with leading educators, researchers, and other partners to further understanding of the powerful economic impact of entrepreneurship, to train the nation’s next generation of entrepreneurial leaders, to develop and disseminate proven programs that enhance entrepreneurial skills and abilities, and to improve the environment in which entrepreneurs start and grow businesses.

### 4.2. Global Entrepreneurship Week 2009

GEW 2009 promises to be bigger. A growing coalition of organisations is actively planning the Week in more than 100 countries. From 16 - 22 November 2009, the Global Entrepreneurship Week will connect young people everywhere through local, national and global activities designed to help them explore their potential as self-starters and innovators. There are four goals of GEW:

**Inspire.** We introduce entrepreneurship to young people under the age of thirty who otherwise might not have considered it as a career path.

**Connect.** We network young people and organisations across national boundaries to discover new ideas at the intersection of cultures and disciplines.

**Mentor.** We enlist active and inspiring entrepreneurs around the world to coach and mentor the next generation of enterprise talent as they pursue their dreams.

**Engage.** We demonstrate to opinion leaders and policymakers how entrepreneurship is central to a nation’s economic health and culture, and give them the opportunity to learn about each other’s entrepreneurial policies and practices.

### 4.3. Global Entrepreneurship Week in Germany

Because of the socio-economic milieu it is a real challenge to foster the entrepreneurial mindset in Germany. But the financial and economic crisis wakes up the society in thinking broader and deeper about entrepreneurship and its impact as well as importance for the economic progression. Wismar University is one of two hosts in Germany that are preparing and coordinating the GEW09 in Germany. The created website delivers all information and impressions by the Germany Week09 (www.week-deutschland.de). The federal minister of Technology and Economy of Germany was 2008 and is also in 2009 the patron of the GEW in Germany. In 2008 Wismar University and MicroMountains Network e.V. as the second host got more than 120 partners, among them universities, employer associations, schools, companies and political authorities. With almost 120 events that were organised by the
partners more than 12,000 people were reached. Best events were published in a GEW calendar 2009 that was distributed all over Germany.

One sign that the GEW 2008 in Germany was a success is the fact that the hosts were invited to Berlin in January 2009 to introduce the GEW08 to a selected audience of interested authorities who are supporting entrepreneurial activities in Germany. The federal ministry of Technology and Economy in Germany voted the idea of GEW firstly under the TOP 10 of more than 50 suggestions of entrepreneurial activities in Germany. After the presentation from Wismar University on the event in Berlin the GEW08 became the winner of the competition. Now consultations between the hosts and the Germany government are ongoing. It is expected to start a country wide campaign in 2010 with big support by the government as an adoption to the British Make Your Mark model. This year the Global Entrepreneurship Week09 could be extended, big companies such as Telekom, German Chamber of Industry and Commerce (DIHK), BDA (Bundesvereinigung der Deutschen Arbeitgeberverbände) and many regional employer associations are partners of the GEW09. Also cross border activities such as joint events with the GEW-office in Poland, Slovakia and Sweden are planned.

5. CONCLUSIONS

So the GEW, this year with more than 100 countries worldwide, will continue to address these challenges vigorously. In consequence the hosts, organiser of the campaign in every country, pursue not just the development in their own country, but also to advance in areas outside their country. The economist Paul Romer [6] pointed out that “the most important idea of all are meta-ideas – ideas about how to support the production and transmission of other of ideas ... the country that takes the lead in the twenty-first century will be the one that implements an innovation that more effectively supports the production of new ideas’’. The GEW could be such a meta-idea, and as Gordon Brown said “Together we can build the strongest entrepreneurial culture that the world has ever seen”.

6. REFERENCES

1. Theil, S., Europe’s Philosophy of failure, Foreign Policy, January/February 2008, pp. 54-60
2. COM(2005)548
Wismar- Entrepreneurial University

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ABSTRACT: The Wismar University runs a successful project from 2000 till 2008 called INFEX. The project INFEX (abbreviation for “information for entrepreneurs”) was a project of the Educational Institute of Economy (BdW gGmbH) in cooperation with the Wismar University of applied sciences Technology, Business and Design and the Agency for Technology Transfer and Furtherance of Innovations West Mecklenburg GmbH (ATI). INFEX offered a basic- and advanced seminar for entrepreneurs as well as individual educational modules for each participant. The seminars were built upon a semester and step by step the students were led through the process of setting up a business and the necessary entrepreneurial competence. The contents were good and reached about 10% of all students. After eight years of a good project the Wismar University thought over again and decided to develop a system, which will reach nearly 100% of students. Entrepreneurship has to become a mainstream at the University system. The responsibility has to be at the University management, at Wismar University the rector (Prof. Grünwald) is in charge of the new developments.

1. INTRODUCTION

The duty of Universities is to educate young individuals. For this reason they are in charge to mediate specialized knowledge as well as competence for entrepreneurs. [1]

Entrepreneurship education is seen as an important instrument to increase the sustainable establishment of more business and to help to provide the flexible, motivated and skilled workforce for the existing businesses and for creating new enterprises, which is essential for future national and international competitiveness. Higher Education institutions play a significant role in the development of entrepreneurial attitudes, aspirations and capabilities in their students.

The Wismar University always had a special interest in entrepreneurship education and so we originated the project INFEX in the year 2000. The ultimate goal was to filter and bundle the innovative potential of universities in Mecklenburg – Western Pomerania and to collaborate with the students and professionals for establishing an entrepreneurial spirit and to support them on a way to found a new business. The last eight years were successful and set up at the most successful university during the project period, the Wismar University, more than one-hundred start-ups. [2]

Since this year at Wismar University all entrepreneurial activities are coordinated by the University with a closed cooperation between the newly established Centre for Entrepreneurship, the former partner the Educational Institute of Economy (BdW gGmbH) and the Career Service of the university. By taking account of advantages and disadvantages for students and professors we set up new ideas for entrepreneurship education across the campus for two extra-curricular taught seminars (see below) we are going to develop new content. For all of our educational offers we are using trainers and lecturers who have substantial practical experience. That means that lecturers have experience as entrepreneurs or are active even as entrepreneurs. This guarantees an application-related and practically orientated mediation of the educational subjects. Entrepreneurship has to become a mainstream at the University and we are going to reach all of our students. We stick to the well- tried contents of the seminars and will improve the structure and the modules, which are not completely benefit so far. Entrepreneurship is more than just a subject beside.

Entrepreneurship education focuses on the training of entrepreneurial skills like creativity, problem solving abilities, communication, conflict management, interdisciplinary teambuilding-activities and negotiation; lectures and business simulations games are also used. The project also signifies motivation, screening of ideas and goal oriented support of innovative new businesses as well as new ideas in the technological sector.

To mediate required knowledge and to sensitize students for Entrepreneurship, the team of the Centre for Entrepreneurship offers a lot of different events. Still major parts are two different kinds of seminars. [3]

2. BASIS SEMINAR

Every semester we offer the Basis Seminar for students without less economical background knowledge. The seminar is built upon a semester with one session (four hours) per week. The didactic concept is based on educational modules. They are independent of each other as well as they are built upon each other. Step by step the students are led through the process of setting up a business and the necessary entrepreneurial competence. Especially architects, designers and engineers attend in Basis Seminar. Some of the graduates will still go to a large-scale enterprise and work there as permanent employees, but many of our students won’t go this way anymore. A lot of free engineer's offices which accept project-related orders of large-scale enterprises will also settle in this area. Therefore, the ability is more and more significant for the foundation and guidance of a free engineer's office in the qualification of students from engineer-scientific subjects.

Component 1: contents and structure

Module 1

In the first lesson students get an introduction on future perspectives and the options of a professional independency.
Module 2
We make a workshop (eight hours) with a unit how to find a good idea for businesses. So it makes it easier for students to follow the business-start-process, even if they do not plan a start up the next years. Additional participants learn methods for creativity and whose benefit.

Module 3
The personality of entrepreneurs is focussed in this session. Students get an idée, what it means to be an entrepreneur. The trainer demonstrates advantages and disadvantages of being an entrepreneur and shares own experiences with participants. Examine topics are: organization- and time-management, challenge for young founder and their families as well as personal suitability.

Module 4
Participants work on their own checklist from the idea to setting up their business. Students help each other to put the idea in concrete terms.

Module 5
Financing issues were discussed in this session. The main focus is bookkeeping and balance sheet. Students get a good view over basis of calculation.

Module 6
Market and competition will be analysed in this lesson. Participants get information about supply and demand as well as market analysis

Module 7
Students argue with marketing instruments in this module. Experienced trainer shows them the basis of marketing and the necessity and benefit of good customer advertising.

Module 8
Special questions concerning law and legal questions in enterprises are focussed in this session. Additional, terms and conditions of trade are explained to participants. In this lesson contents depend on the needs of our students.

Module 9
Finance planning in particular capital requirement are explained to participants, which has none economical knowledge. For this reason it takes a longer time and more than one module.

Module 10
Finance planning is also the subject in this module, but financial support, equity capital as well as loan capital are in the main focus at this time.

Module 11
Students still learn about finance planning like calculation, planning turnover as well as expenses.

Module 12
Following all finances, special trainer gives them information concerning tax law in Germany. There are differences between income tax, turnover tax and wages tax. Students have the possibility to try their own tax return and ask personal questions as well. As experience shows, students are having a hard time to understand differences and to put it in action.

Module 13
This module is about higher chances of success. The most significant point is to be a great salesperson. Students learn basis from sales from an experienced seller.

Module 14
How can I present myself and what would be the best presentation for my business idea? Basis and methods from the trainer are useful for participants to get an own style and personal profession. Communication is also focussed at this module, because both subjects belonged together concerning entrepreneurship.

Module 15
The last module is an examination for the students. The test includes at least one question out of every module. Multiple Choice Questions take part in the examination. After every module trainers handle at least one question to the organizer, to give students a fair chance at the end of the semester to pass the test.

So far 15 modules are concluded by a whole consideration. Described hard facts are complemented with soft skills, like arrangements to the personality and presentation.

Component 2: recognition and credit points
For all modules we use trainers who have substantial practical experience. That means that they have experience as entrepreneurs or are active even as entrepreneurs. This guarantees an application-related and practically orientated mediation of the topic. At this point we straighten the academic-theoretical knowledge completely on the perspective of the application and practice-driven conversion.

The Basis Seminar is credited on almost all parts of the Wismar University as an electoral compulsory subject. It still depends on the course of studies, if participants need or do not need a mark, if they have to make an examination or only visit the modules regularly.

The basic knowledge in terms of entrepreneurship and entrepreneurial thinking and action is taught in the Basis Seminar as well as in the Advanced Seminar.

3. ADVANCED SEMINAR
We also offer an Advanced Seminar every semester for students with economical background knowledge. Like the Basis Seminar it is built upon a semester with one session (four hours) per week. The didactic concept is also based on educational modules. The following structure will show, that contents of modules are independent of each other as well as they are built upon each other. Students are also led through the process of setting up a business and the necessary entrepreneurial competence, but it is on a higher level. Participants need to have economical knowledge or experience to handle the contents. The Advanced Seminar is conceived for advanced students.

Component 1: contents and structure
Module 1
In the first lesson students get an introduction about structure, demand and content in a Business plan. It is important to give this information to them in the very first beginning, because at
the end of semester, most of them write their own Business plan.

Module 2

The personality of entrepreneurs is focussed in this session. Students get to know, what it means to be an entrepreneur. The trainer demonstrates advantages and disadvantages of being an entrepreneur and shares own experiences with participants. Assessment topics are: organization- and time-management, challenge for young founder and their families as well as personally suitability. This lesson is supposed to scrutinize if participants would be a good entrepreneur (only at this time).

Module 3

In this module special questions concerning law and legal are answered by a special trainer. Especially questions about contractual unions, draft agreement, terms of contracts as well as conclusions of a contract are focussed in this session. Additional, terms and conditions of trade are explained to participants.

Module 4

This session is a mix between seminar and workshop and last for eight hours. Participants work practically on numerical figures and use this experience for their own Business plan. An experienced trainer helps them and answers questions.

Module 5

Tax law in Germany is focussed in this lesson. Differences between income tax, turnover tax and wages tax are demonstrated. Students have the possibility to try their own tax return and ask personal questions as well. Especially for participants, who are planning to start their own business soon, this module is very important.

Module 6

Students learn to plan necessary budget for a project or enterprise. Most important for them is to plan liquidity and profitability. This module is even hard for business students, as experience shows.

Module 7

Finance planning in particular capital resources and loan capital are in the main focus at this lesson.

Module 8

In this session students get information about possibilities for financial support. Especially for participants, who are focussing a start up in the technology sector an innovative sector as well, this module is very important.

Module 9

Market and competition will be analysed in this lesson. Participants get information about supply and demand as well as Market analysis. Additional they argue with marketing instruments and an experienced trainer shows them the benefit of good customer advertising.

Module 10

This module is about higher chances of success. The most significant point is to be a great salesperson. Students learn basis from sales from an expert for sale.

Module 11

With the help of a case study participants run through the hole process of a start up in 8 hours. Special attention is at the marketing sector. The trainer works more like a moderator in this module. Experience shows, that this workshop is really effective, because students work together in a team and find solutions for problems by themselves.

Module 12

In this session we have an expert for banking as a trainer. The participants get information firsthand, what business-start-up means from bank point of view. Trainer also give them instruction, how to carry on conversations with banks if they apply for financial support. They trainer will also be a member of jury, when students defend their Business plans at the end of the seminar.

Module 13:

The risk-analysis is content of this module. Participants get information about risk-profile and swot-analysis.

Module 14

The last session is about presentation and communication as an entrepreneur. In this special case students also get information about basis and methods of presentation. This is a big help for participants if they defend their Business plans. It helps them to find their own style and personal profession.

Module 15

The last activity in the Advanced Seminar is defending the Business plan. Almost every participant writes a Business plan at the end of seminar.

Students are free to choose about the businessplan- subject. The defences start with a 20 minutes presentation and are judged by a jury at the end. The jury exist of a professor, an expert for banking, a member of the Centre for Entrepreneurship and one person from the Educational Institute of Economy (BdW gGmbH, our cooperation partner in the project). Usually the jury asked a couple of questions for a better understanding and finally mark the Business plans immediately after defence.

So far 15 modules are concluded by a whole consideration. Described hard facts are complemented with soft skills, like arrangements to the personality and presentation.

Component 2: recognition and credit points

For all Advanced Seminar modules we use trainers who have big practise relation. That means that they have experience as entrepreneurs or are active even as entrepreneurs. This guarantees an application-related and practically orientated mediation of the topic. At this point we straighten the academic-theoretical knowledge completely on the perspective of the application and practice-driven conversion.

The Advanced Seminar is credited on almost all parts of the Wismar University as an electoral compulsory subject. Like in the Basis- Seminar we are still working on the parts, which don’t recognize the seminar.

It still depends on the course of studies, if participants need or do defend a business plan only visit the modules regularly.

The Wismar University is doing statistics to improve offers at Basis Seminar, uncover problems, find solutions and reach best result, finally.
The graph shows, that we mainly reached design students. As a success we see an upward tendency at the participation from technology sector compared to the last years.

**Figure 1. Composition of participants at BASIS Seminars**

### 4. COMPOSITION OF PARTICIPANTS AT ADVANCED-SEMINARS

The Wismar University is also doing statistics to improve offers at Advanced Seminar, uncover problems, find solutions and reach best result, finally.

The graph shows, that we mainly reached business students. Some participants are design students, which is objectively based in an increasing rate of freelance professionals.

### 5. COMPOSITION OF PARTICIPANTS AT ADVANCED-SEMINARS

**Figure 2. Composition of participants at ADVANCED Seminars**

### 6. EDUCATIONAL METHODS

Similar to an Institute of Technology in Ireland the content, structure, duration and delivery style of such modules have developed significantly over the years, resulting in a differentiation between levels and disciplines. [4]

Starting point to choose the best learning- methods is acceptance that students and graduates have different needs of information and education. It depends on their individual situation and their personal reason for being participants in project offers.

That means that students who just start their study and take part in one of the seminars to get credits have different aims and needs than students or graduates who want to start their own business soon. Different aims and needs require separate educational methods.

Concerning educational methods, we distinguish between the Supply- Method and the Expansion- Model- Method.

The Supply- Method corresponds to a normal structure at a University. Contents are mediate in a typical frame. Students need to have a bigger budget of time as well as time for regular presents in seminar modules for at least 4 months. Mostly the moment of getting and using gained knowledge is far away from each other.

The Expansion- Model- Method assumes that moment of getting and using gained knowledge is tight to each other. If participants want to start their own business they are interested in fill their gaps. They need the knowledge right away for a start up. The motivation and period of use in this method is much better and sustainable. Independence to organize learning needs attitude like involvement, motivation and eagerness to learn. These characteristics are also typical for entrepreneurs. [5].

Our offers are orientated on adult education, principles and guidelines. The general aim is to impart knowledge for entrepreneurs. To fulfil all individual needs and demands we enable a self-defined learning process on its own pace in seminars. Trainers characterize seminars not like lectures. Seminars are not frontal lessons. Participants are part of Seminars with broad discussions and exchange of experiences and ideas.

### 7. CONCLUSION

Beside the seminars Wismar University offer many events focussing entrepreneurial acting and thinking. So the Centre for Entrepreneurship offers individual training, workshops and theme-evenings.

Regularly there are interviews of the students to get suggestion for improvement. We are interested in their needs and wishes as well. Our aim is to reach with different entrepreneurship activities (including intra-curricular enhancement) nearly 100% of students at the Wismar University.

The evaluation should have a lot of functions like innovation, optimize, legitimation, prognosis, decision as well as control [6]. Because of the interview results, internal and external discussions we are going to change the structure of seminars. Starting with the beginning of next semester we will offer three different seminars instead of two.

1. Basis- Seminar
2. Advanced- Seminar
3. Training for entrepreneurs and leaders
With this decision we open the seminars for a bigger target group. Students and graduates without less economical background knowledge can also take part at Advanced Seminar, if they want to write a business plan. We start to separate hard facts and soft skills. So far hard facts and soft skills took part in the seminars. With the beginning of the new semester and start offering of three seminars, we separate these skills. Basis and Advanced Seminar will include all hard facts and training for entrepreneurs and leaders will involve soft skills.

Because of self-defined learning process, we mentioned in point 6. The seminars will exist of 10 instead of 15 modules. Participants will have less present modules than before, but will work more independent and individual outside the University.

We will not integrate participants in seminars anymore. They decide by themselves depending on their individual situation and needs. So the motivation and personally care will be improved and learn-results will have a lasting effect.

8. REFERENCES
1. Good Practice in der Entrepreneurship- Ausbildung- Versuch eines internationalen Vergleichs, Studie für den FGF erstellt von Dr. Petra Moog, page 7, August 2005
   E-format ISBN 978-3-939159-67-4
3. www.gruenderbuero-hswismar.de
4. Entrepreneurship Education in Europe: Fostering Entrepreneurial Mindsets through Education and Learning, page 41, Oslo, 26 – 27 October 2006, Final Proceedings
5. Anderseck, Klaus; Braun, Gerald; Grüner, Herbert; Neuberger, Lars; Uebelacker, Stefan; Voigt, Eva: „Entrepreneurship Education an deutschen Universitäten“, 33-35 (2006)
FREE TO CHOOSE YOUR EDUCATION. A COUNTERFACTUAL PERSPECTIVE

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ABSTRACT: In the last decades, an enormous economic literature has been developed in the field of education and schools’ reform. It is generally accepted the idea that Romanian education system, despite the attempts of institutional reform according to European standards, has various functioning problems. The weak capacity of education to stimulate creativity and human capital accumulation is the natural consequence of lack of incentives among state-run-schools. What could be wrong if the education system will be managed according to the market rules? This paper looks to examine the main arguments favoring pro-market reform in education, and to offer a counterfactual approach in education field. We believe that educational entrepreneurship and competition are the only way to succeed in order to have better education for our children.

1. THE ECONOMICS OF EDUCATION

Presently there is an increasing interest towards the economic analysis of education, once it has been acknowledged as a determinant factor for the progress of society. Analyzing the concept of education we can find, on the one hand, a formal level: the school and the educational system and, on the other hand, an informal level represented by the education received inside one’s family, from the media, the Church or other social institutions.

Education is a learning process occurring during the entire life, not only in schools but also in all other aspects of social life. When an individual is playing, listening to his friends or parents, reading the paper or working, he acquires knowledge. From this perspective, the formal education represents only a small part of the educational process, and it is suitable only for academic topics, especially complex and specialized ones. The essential aspects such reading, writing, calculating and so on, can be easily taught at home and outside school. [8]

In our paper we will focus mainly on the formal education. The approach is derived mainly from building a frame for the economic analysis of education.

The market is an exchange system of the private property rights; the economic dimension of the exchange terms is the market prices that are making the economic calculation possible. Using the mechanism of profit and loss, the decentralized allocation of resources contributes to their distribution according to the most valuable uses. As there are a very large number of individuals on the market, there is also an efficient allocation of the scarce resources in the society. All the above can help us to appreciate correctly the realities existent on the educational market, in order to finally be able to identify some possible solutions for an efficient functioning and -apparently paradoxes- ethical principles of this domain. Thus, we try to show that education, such as any other public service, cannot be provided more efficiently apart from the mechanisms of the market.

Similarly to the ordinary market, we can talk about defining elements for the education market: demand, supply, market price, competition. [4]. Thus, the demand of education expresses the need for information, knowledge and abilities that are coming from the consumers of educational services: pupils, students, parents, corporations. A defining feature for this market is the fact that those who demand educational services (students and pupils) are not passive customers – as for the majority of the goods - but they are also producers, by actively participating to the educational activities.

The education supply comes from different public or private educational institutions, and their mission is to satisfy the needs of their clients. This situation could make us believe that, as suppliers of educational services, there is a strong competition between schools to satisfy the educational needs of parents and children. Then, we can ask ourselves what is going wrong with the education supply or more broadly with education system? Presently all private schools who want to enter the market of education are compelled by the law to ask for an authorization and accreditation from the Ministry of education and research. In other words, every private school cannot organize his business as he thinks necessary to suit his clients, but as the public institution feels it has to be organized. That’s why we believe that is wanted a private alternative to the actual public education system, but only according to its principles and organization. Still, despite all institutional constraints and barriers, it appears that the private education system is more suitable for the public needs. A proof to support this is the different development of economic, juridical or polytechnic education in the two systems, which shows on one hand a greater opening of the private sphere to the stimulants of the education and labor market, and on the other hand the reluctance and inflexibility shown by the public sector when it comes to change and adapt the educational services.

We can anticipate therefore the necessity of a massive liberalization of educational services, of eliminating of most of institutional constrains to entering the education market as a measure to show more interest for the demand coming from the consumers of education. Practically, we suggest a new way of thinking, a new paradigm change in education meant to overpass the present approach based on uniformity and to replace it with the one oriented towards diversity. In a paper regarding state education, Rothbard appreciated that it is in the nature of every governmental bureaucracy to be guided by a set of rules and therefore to impose them in a uniform, rather aggressive manner. Except for the last attribute, there are many opinions even inside the governmental structures coming to support this reality. But why is it not good to have a unitary
treatment or in other words, what would make the difference in promoting diversity in education matter?

Certainly, ensuring too much diversity wouldn’t be good for the government who would feel compelled to take different decisions depending on the levels of education, their profile and so on. Still, even if it stays faithful to the uniformization policy, the bureaucrats have to face many crucial and controversial decisions when he must decide the pattern of the formal education system under his jurisdiction. He must decide how this system should be, traditional, or progresist. Favoring competition or being even? Segregated or integrated? Including sexual education or not? Focusing on liberal arts or based on vocation? [8]

There is a fundamental distinction between the expectations guiding the behavior on the market of the private and public schools. The market oriented schools have strong stimulants to allocate their resources towards developing a set of educational services compatible to the expectations of the families, and the specialized abilities required by the economic activity. Accomplishing this kind of compatibility between education quality and the level of school taxes is the necessary condition to continue this activity. In other words, not respecting this rule can lead to financial difficulties and, in the end, to bankruptcy. But can we say the same thing about the public schools? No, unfortunately. The fact that public schools do not depend entirely on the consumers’ payments to get their financial resources offers weak incentives for public education managers to increase the quality of their services, to reform organizational structures or to adapt school programs depending on the new social-economic factors. Thanks to redistribution process of budgetary resources, the state keeps its schools away from the market rules (e.g. possibility of bankruptcy). Therefore these schools are not necessarily motivated to adapt to the dynamic demand of the customers, parents and children being captives of the public education system.

Analyzing the educational process from an economic perspective we can suggest that only by manifesting liberty of choice and competition between schools can the reorganization of the system be achieved. The development of the private sector as education supplier has, among the positive implications involving quality also an ethical reason. Parents who consider public education not suitable for their children, or just don’t believe it provides a suitable education according to their own beliefs and values and whose children attend private schools, they have to face a double issue: they are compelled, on one hand, to pay taxes and support the education of all the children from the public schools and, on the other hand, to pay for their own children’s education. Is this situation ethical? It is obvious that this money transfer is not voluntary and this shows utter ignorance of this fundamental principle.

2. “THE RIGHT” TO EDUCATION - A CRITIQUE

According to the article 32 align. 1 from the Romanian Constitution „the right to education is ensured by the compulsory primary education, the secondary, the professional one and also the superior ones, including other forms of instructions“. Generally it is considered that the right to education (and, afterwards, the right to a job) is as important as the right to defends one’s life or free of speech. As a consequence, it is considered that’s our duty to sustain, respect and protect these rights. But if we analyze it thoroughly we would unveil some problems concerning the above interpretation.

Is there any distinction between the right to protect one’s life or the right of free to talk, on one side, and the one to work and to be educated, on the other side? Although our analysis can be considered rather philosophical, it is strictly necessary in order to understand the fact that, while the first of them come from human nature itself, the other two are not fundamental rights to apply no matter the time and place. The right to work and education cannot be guaranteed and applied legally despite all legal reglementations, but the natural right of freedom of speech or to defend one’s life is equally and universally applied. Moreover, the right to speak one’s mind does not involve consequently affecting the freedom or the rights of other to express their own opinion, while the institutionalization of the right to public education, for example, means compelling a group or community to pay taxes for it, so there is a restriction of freedom to use their income as they wish.

On a different level of analysis, by introducing and accepting compulsory education, even if it is entitled free, the concept „right to education” has been misinterpreted and completely transformed into an obligation. If we agree that „from a philosophical view, a right must be something within human nature and reality, something that can be preserved and sustained anytime” [8], we find no mentioning of the terms obligation or compulsory. To have the right to an education means being free to choose whether to act or not, meaning only people who want to use their right to go to school, and the others must not be forced by anyone else (not even by the state) to go through all the necessary steps of education.

3. THE PRINCIPLES OF PRO-MARKET REFORM

Today more than anytime we witness a process of reorganization of the education system from the entire world. The reform in education is generated by the idea that any educational system may be improved. Taking into account the directions of the education reforms in different places of the world, it is surprising to conclude that although they have several particularities, all of them are built on some basic ingredients: promoting choice among the consumers and competition among schools.

It is acknowledged the fact that the deficiency of the public education system in shaping competent and creative young people is the consequence of poor disponibility to offer consumers opportunities and viable alternatives. What can be wrong in encouraging choice and competition in education sector? Is it not fair for parents to have the right to choose which school is considered best for their children? Then what can we say about the possibility that some schools (less popular) would have to shut down because educational services consumers choose other schools? Will the decentralization and competition between schools lead to improving the quality of curricula and academic courses? We will consider further four major arguments which altogether will support the idea of promoting choice.

The first argument is based on the presumption that parents have the fundamental right to decide on matters regarding their children. There are a few Conventions and International Declarations supporting this idea. For example, the Universal Declaration of the Human Rights adopted by the United Nations in 1948 states that: „…parents have the right to choose
the kind of education their children will receive “. Also, the European Convention over the Human Rights states that ...,in exerting the education and teaching process, the state will respect parent’s right to ensure the education and teaching according to their religious and philosophical beliefs”.

As a natural consequence, the second argument for justifying choice in education would be that parents are the most appropriate to choose a school to suit the needs of their children. Generally, parents have both a higher interest in the education of their children and also a deep knowledge of their possibilities and needs, more than anyone else. Social reformers and especially education’s reformers start from the wrong premise that parents, especially the poor and less educated ones, are not interested in the education of their children nor have the competence to decide and choose for them.

The third argument in sustaining the free choice of schools comes from the idea that an increase of parents’ implication would be beneficial for the way children see school, and their motivation. Few can contradict the fact that the high interest of parents in their children’s education is mainly useful in the educational activity of children. Finally, there is the following issue: If parents can choose food, clothing and the place to stay for their children, why couldn’t they choose also the school where they could study? In modern societies people still have different values regarding religion, ethics and so on. This diversity reflects the freedom that modern societies seek and protect.

The forth argument of liberty to choose in education matters is the belief that the existence of competition among schools may contribute to the improving of the quality of education services.

Once we agree with these arguments, we can identify the basic principles for a real reform in education, meaning a substantial change of the philosophy of education and not only superficially shaping this system.

The following reform’s measures aim to increase competition in education field and to increase the involvement of parents and communities in this process. As long as education is considered by many an important field with deep social implications, we agree that the market principles of an educational policy must be placed outside any political controversies.

Among these fundamental principles we find the quality of education, equal opportunities for all, autonomy and economic efficiency, diversity and closeness to the demands of parents and children. There is also a fundamental question regarding the reform process: which is for Romania the most adequate institutional arrangement to lead us to achieving the principles mentioned above? The relevance of institutions comes from the idea that the existence of competition among schools may contribute to the improving of the quality of education services. These measures are favorable to assimilate modern information and communication technologies in educational process. Reforming the actual educational system must consider autonomy a stimulant for innovation and creativity.

The success of every school depends on the degree in which it develops new didactic methods and curricula. Therefore increasing the quality of education in certain schools is a determinant factor for the transformation of all education levels.

- **Autonomy:** we can make the principle opportunities for everyone easier to achieve if one of the reforms conditions is focusing on autonomy and diversity. Autonomy means an increase in the responsibility of schools regarding the educational process, and more freedom in management decisions. These measures are favorable to assimilate modern information and communication technologies in educational process. Reforming the actual educational system must consider autonomy a stimulant for innovation and creativity. The success of every school depends on the degree in which it develops new didactic methods and curricula. Therefore increasing the quality of education in certain schools is a determinant factor for the transformation of all education levels.
- **Diversity:** Ensuring diversity is important from two points of view: the first one refers to the fact that people have different needs and expectations. It is therefore necessary that schools offer a larger set of educational services according to the individual demands and aspirations. Moreover, by ensuring diversity, schools will be able to meet the parents’ expectations as they are guided by the evolution of the labor market. The second argument shows the fact that diversity leads to a better understanding of choice among all the alternatives of the education system.

In conclusion, any reform proposal must be developed by taking into account three fundamental values and, even more importantly, all must be accomplished: increasing the overall level of education, ensuring equal opportunities for all and promoting choice, diversity and innovations in the educational process.

4. APPLYING PRINCIPLES: THREE PROPOSALS OF ALTERNATIVE INSTITUTIONAL ARRANGEMENTS

The patterns and programs developed in different countries have already shown that improving quality of the education process, facilitating the access to education for marginal groups, increasing diversity, choice and competition are possible to accomplish. It is therefore essential that the long waited reform of the Romanian system be focused on the liberalization of the educational services market.

According to the principles mentioned above, we can identify three different instruments for reform:

The specific voucher educational program

It is addressed especially to the pupils educated in public schools with low performances to turn to private schools which have well-known standards of education. Using the voucher system those children can be able to finance their studies. If this program is applied, it is expected that inefficient public schools become more motivated to improve their educational process, teaching methods, curricula and so on. It is also stimulated the emergence of new private schools focused on offering new innovative ways to serve education demand.

The mentioned program is based on the experience of the state of Florida, combined with financing elements from Europe or Asia (e.g., Hong Kong); it is supposed to be flexible enough to ensure substantial growth of private education. For example,
We can also think of reducing public expense, for two reasons: almost exclusively on quantitative evaluations. Firstly, as mentioned above, it increases parent’s influence in choosing schools (they become more responsible), assures opportunities for everyone and also stimulates competition between schools. Secondly, the development of the private schools is paradoxally meant to compete for public funds according to the demands and preferences of parents. In conclusion, we strongly believe that such proposals are aimed at achieving common goals like increasing quality in education process, bringing more ethics in this field and, furthermore, stimulating competition among schools.

**The universal educational voucher program**

The second proposal for reform is more radical, trying to implement a universal voucher program based on Sweden’s experience. Among the main features of this model we can identify:

- the educational voucher can be used for both private and public schools, depending on the parents choice;
- Any school is free to participate at this program, including private schools profit-motivated.
- the amount of governmental financing must no cover the entire school taxes (for example it could be about 75-80% of the sum, as in the Danish model);
- Schools must be able to cover the rest of the costs for the educational process by imposing schooling taxes, such as in Germany or Hong Kong.
- Similar to the model of Hong Kong, there must be a special system of scholarships meant to facilitate the access to education in private schools of children coming from low income family.

If this program would be applied in Romania, we foresee a very good perspective, for two reasons. Firstly, as mentioned above, it increases parent’s influence in choosing schools (they become more responsible); assures opportunities for everyone and also stimulates competition between schools. Secondly, the development of the private schools is paradoxally meant to stimulate the government to implement this program. Most primary and secondary schools are public and by introducing the universal voucher there will be no extra pressure over budgetary resources. This program will only redistribute the public funds according to the demands and preferences of parents and not according to the bureaucratic decisions based almost exclusively on quantitative evaluations.

We can also think of reducing public expense, for two reasons: Firstly, voucher covers only 75-80% of the educational cost in the public system and secondly, because increasing the education services competition, will lead to a cost-cutting management. Although such a measure can be blamed to put aside the quality standards, we remind that private schools (and even the public ones) depend on offering high quality education, because this is the criteria for receiving the voucher.

**Fiscal credit for education**

The third proposal is the result of a success of USA and Canada’s models. It basically involves offering a fiscal credit to parents whose children go to private schools. The procedure is relatively simple: from the total amount of the taxes paid by one family, expenses for education are deducted. If the family has low incomes and the taxes paid are less then the schooling taxes we recommend creating a legislative context to allow additional funds to facilitate the access to private schools.

The advantage of this proposal is encouraging parents to send their children to private schools, and therefore stimulating competition among education services suppliers. Some parents, whose children used to attend public schools, will choose private schools. Therefore, the fiscal credit will bring into force the ethical criteria. The only losers in this model would be the inefficient schools, practically, that ones that don’t fulfill the quality standards according to the customers’ expectations.

- In conclusion, we strongly believe that such proposals are aimed at achieving common goals like increasing quality in education process, bringing more ethics in this field and, furthermore, stimulating competition among schools.

5. **References**

INNOVATIVE NEW METHODS FOR ENGINEERING AND BUSINESS EDUCATION
HIGH LEVEL MINING EDUCATION: FROM UNPROMISING EXPECTATIONS TOWARDS REAL DEVELOPMENT CAPABILITIES

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ABSTRACT: The major changes occurred in worldwide mining education system are inducing specific consequences both at graduate and postgraduate courses level. The need of change is coming from several directions, which are going to be discussed in the paper. Mining education is evolving nowadays, as it struggles to meet the demands of an overheated industry, on a number of developing fronts. On the other hand, industry is beginning to recognize the importance of career improvement, in the form of corporate training programs or accredited professional development. Based on a brief analysis of the Romanian mining high level education present state, the paper synthesizes the trends concerning the interconnection in networks of the universities and high mining schools, the operational collaboration with mining industry, the extension of the distance education programs and emphasises the perspectives and the possible development ways.

1. INTRODUCTION
Major changes occurred in worldwide mining education system are generating serious consequences, both at graduate and postgraduate level. It has an impact on all levels of tertiary and professional education, the pressure for change coming from three principal directions:

- a chronic shortage of mining personnel: „... over the next 10 years, the Canadian minerals and metals sector will face a shortage of approximately 92,000 workers ...” [4];
- high salaries in mining industry and the extreme competition for qualified personnel: „... a survey of graduating engineers has found the median graduate starting salary to be $ 99,713 ...” [3];
- imminent retirement of aging faculty members and teaching staff at mining schools and universities [2].

These pressures exerted are aggravated by relatively large, linked and related issues. Therefore, the following trends can be emphasized:

industry is turning, more and more, to other, related disciplines such as civil/mechanical/chemical/electrical engineering to alleviate the demand for personnel, as a result there is a rapidly growing demand for cross-training of personnel in order to professional conversion;

industry is beginning to recognize the fact that professional career improvement, in the form of corporate training programs or accredited professional development, is a big incentive for young professionals and graduates, resulting in increased employee retention, which in turn leads to an increased demand for training and professional development resources;

mining schools and universities are struggling on their own to justify the resources required for development and delivery of new and specialized teaching programs, programs dedicated for existing profiles continuation, development and implementation of new study profiles required by the labour market needs. A factor in this is the limited audience accessible to a mining school using conventional approaches to high level education.

2. THE PRESENT STATE OF THE ROMANIAN HIGH LEVEL MINING EDUCATION
Presently, the „Mining Engineering” branch is established only in two universities: the University of Petroșani (within the Mining Faculty) and the Northern University of Baia-Mare (within the Mineral Resources and Environment Faculty).

The pronounced decline of the mining high level education was induced by the restructuring process of the mining industry. The retrenchment of the mining activities has generated a severe reduction of the candidates for admission, the restricted audience representing the basic problem which the above mentioned university are confronting with.

The diminished number of students within the „Mining Engineering, have lead to a gradual decrease of the teaching staff members dedicated to this field, because the recruitment and employment of young graduates was not any more feasible, while the experienced professors were retiring. On medium and long term, if the present trend will be maintained, a serious lack of experienced and competent teaching staff will betide in the field of new mining professionals‘ instruction.

The persistence of the conventional educational process approach, based on frequent tradition invocation, didn’t allowed a real and effective modernization of the Romanian high level education system and, consequently, the premises for further development and implementation of new specializations required by the labour market needs did not appeared.

In this context, it should be noticed that, in the last years, the graduates of the „Mining Engineering” branch, did not succeed to satisfy the needs of the labour market, neither numerically, nor by skills and competencies acquired, regardless of we consider the mining industry or other industrial areas (such as, mineral extraction for raw material and building development industry, hydro-technical and infrastructure developments etc).

The acute deficiency of qualified staff, had determined the major Romanian mining companies to get involved in supporting the high level national education, by contracting...
students from the „Mining Engineering” branch. Unfortunately, this assistance from the great-sized mining companies represents a solution only for the time being.

The redressing of the high level mining education will happen only when all the implied parties and factors will become aware that the training of well-prepared specialists should be seen from a perspective allowing them to act on a global workforce market, were competitiveness holds a prevalent role.

3. PERSPECTIVES AND POTENTIAL DEVELOPMENT DIRECTIONS

Currently, it can be estimated that a positive evolution of the high level mining education system, on medium and long-term, is determined by its adaptation capacity to the effects induced by the above-mentioned factors.

Within this context, mining education is evolving as it adapts to these constraints on a number of developing fronts, the following sustainable development directions being identified as feasible in the future:

- networking links between mining schools and universities with a focus on the strengths and specializations of individual schools: “... the answers lie in national and international collaboration [...] no one institution will survive alone, and none of these initiatives can be achieved without strategic, and coordinated industry participation and support ... ” [1];
- operational cooperation with industrial partners from the mining industry and involvement of professionals and research experts in the competencies, skills and abilities acquiring processes, collaboration with industry on the development of special programs and the involvement of industry specialists to fill the gaps in mining school curricula, both at graduate and postgraduate level;
- increasing development and integration of online (Internet-based) education and professional development into mining school curricula, corporate training programs, continuous education and professional competency requirements in conjunction with the reassessment of corporate and continuous training programs role in professional skill improvement process.

Considered individually, none of these developments is a solution by itself; they collectively integrate, enhance and complement each other. None of the development directions previously cited can represent a viable solution to solve all the problems confronting actually the high level mining education system.

Consequently, it is compulsory that their implementation to be carried out in an integrated manner, while only that way they can complete and sustain each other, giving also more strength to the actual conventional approaches.

This paper presents a more detailed analysis and discussion of each of these developments able to facilitate real and sustainable development of the high level mining education system, illustrated by numerous examples in the view of a better understanding of the approached issue.

3.1. Networking and collaboration between universities and high level mining schools

Networking and collaboration between high level mining schools and universities is a way of taking advantage of the strengths, opportunities and various teaching profiles and specializations of individual schools, by forming a larger group. Both industry and universities have seen increasing development and integration of Internet-based education within which schools complement each other.

This approach also increases the available student audience and helps justifying the development and the delivery of the teaching programs. Students are required to travel between mining schools and universities and experience different teaching, working and cultural environments. During their visits, the students following the study program offered by a high level mining education network do not gather only knowledge, skills and abilities characteristic for the mining industry itself, but also a large and significant life experience. This facilitates them to better adapt to the requirements imposed by the significant globalization of the mining industry, where language, cultural, and other kind of differences are having a pronounced decreasing trend.

From the significant examples illustrating the networking and collaboration between high level mining schools and universities there can be outlined the program developed and promoted by the Federation of European Mining Programs (FEMP) [5] and the Globally Employable Mining Engineer (GEME) program [6], developed and operated by Colorado School of Mines.

FEMP is the organization that co-ordinates the 2 year European Mining, Minerals and Environmental Program (EMMEP) for students in Mining and Geotechnical Engineering, Mineral Processing, Recycling and related academic studies. The FEMP programs involve six European mining schools with strong industry support. The programs include three two-year M.Sc. programs in mining, geotechnical and environmental engineering, accommodating a total of 60 students, distributed in 3 groups, each one having a number of 15-20 students.

Students spend one of the two years travelling and studying at four of the other institutions involved.

The academic institutions involved in this program are listed below:

- Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany;
- Delft University of Technology, Holland;
- University of Exeter, Camborne School of Mines, United Kingdom;
- Helsinki University of Technology, Finland;
- University of Miskolc, Hungary;
- Wroclaw University of Technology, Poland.

The program is strongly financially supported by more than 30 multinational companies. The students included in this program dispose of various opportunities for professional training stages and to be hired in the supporting companies, whatever if they came from European Union member states or not. The programs have been in operation for almost ten years.

The Globally Employable Mining Engineer (GEME) program is a relatively new undergraduate program that networks four mining schools with the stated aim of increasing enrolments in Mining Engineering programs by emphasizing the exciting international nature of a career in the global mining industry. Students are encouraged to spend at least a semester at one of the other participating mining schools. Faculty members are exchanged on a regular basis and work together on cooperative research projects. The program is sponsored by four major mining companies. The 5 universities and high level mining schools included in the project are the following:

- Colorado School of Mines, Golden, Colorado, USA;
The GEME program aims at preparing talented mining engineering students for global employment by enhancing their education by international study and work experiences. It features a student exchange program, scholarships, and internship opportunities with international mining companies. Students are encouraged and stimulated to study at least a semester in one of the mining schools involved in this program. The academic teaching staff members from institutions involved in GEME are carrying out visits, on regular basis, in the other involved institutions, working together in various research projects.

3.2. Effective operational collaboration with mining industry

The mining industry has a history, both on national and international level, of active collaboration with mining schools and universities, in the past primarily involving research-development projects and provision of internship opportunities for students.

Within the operational collaboration with mining industry companies, the following recent initiatives can be mentioned:

• development of postgraduate courses tailored both to fit mining industry actual needs and corporate requirements (Sandvik International Mining School) [7];
• development of industry focused continuing education programs aimed at the growing demand for cross-training (UBC Certificate) [8].

Sandvik and six international mining universities have started a unique collaboration. The new (October 2007) Sandvik International Mining School is an example of industry sponsored development of courses tailored to company requirements. It is the result of a partnership between the company and six high level mining schools and universities around the world.

The high level mining education institutions participating to the Sandvik International Mining School project are outlined below:

• Montanuniversität Leoben, Austria (course coordinator);
• University of New South Wales, Australia;
• Colorado School of Mines, Golden, Colorado, USA;
• University of the Witwatersrand (WITS), Johannesburg, South Africa;
• University of Exeter, Camborne School of Mines, United Kingdom;
• Helsinki University of Technology, Finland.

The UBC Certificate of Mining Studies is another example of industry focused continuing education, accredited by a mining school, and delivered by industry specialists. The program is targeted at a cross-training audience comprising professionals from mining-related disciplines who need a fast, convenient route towards upgrading and augmenting their current skills.

The program combines the convenience of online learning with intensive short-courses presented by industry specialists in a classroom and then finishes the learning experience by assigning a take-home project. The program has been in operation for 5 years and currently has 40 registered participants from around the world. This program has been developed as a collaborative effort by the following institutions:

• University of British Columbia, Canada;
• Canadian Institute of Mining, Metallurgy and Petroleum (CIM), Canada;
• EduMine (the professional development division of InfoMine Inc).

The Certificate of Mining Studies (CMS) from the University of British Columbia is an innovative approach to educational development, which uses a flexible approach to continuing education and cross-training of people in the mining industry and related trades.

The program combines the convenience of online learning with short-courses presented by industry specialists in a classroom and then finishes the learning experience by assigning a project to be completed after the short-course.

Benefits of the learning model include:

• integration of the convenience of online learning with the dynamics of a classroom session by industry specialists;
• academic accreditation by an internationally recognized and respected mining school;
• professional accreditation by a leading mining institution (CIM);
• the participants to the UBC Certificate program are representing a resource for mining corporations to enhance their intellectual capital;
• the courses can be integrated into corporate engineer-in-training programs or equivalent.

3.3. Online education programs development

Both companies from the mining industry and high level mining schools and universities have seen increasing development and integration of online (Internet-based) education and professional development into mining school curricula, corporate training programs, continuing education and professional competency requirements. Presently it is obvious that corporate training programs and continuous learning, is strongly supported by great mining companies are based on large-scale information technology use.

Online learning has known and accepted disadvantages, mostly due to its lack of the peer review and interaction of a classroom course. However, it has the recognized advantages of space and time convenience. In today's mining world, where the reality is a chronic shortage of qualified personnel, these advantages have increasing significance. The best of both is a blended learning approach such as the UBC Certificate in Mining Studies program.

One of the first examples of online education was the Master of Engineering in Mining program offered by the University of
Leading to the degree of Master of Engineering, this program is intended primarily for non-mining engineers and scientists working in the mining industry, and for the mining engineers who wish to bring their knowledge of the profession up-to-date. The program has an enrolment of over 20 students located at various mine sites scattered between Alaska and Connecticut.

This course is offered by UMR [9], using on-line learning methods. Students will learn by listening to the on-line lectures and through directed self-study. The participants are gathering knowledge by downloading the available documentations existing on the university web-site, by self-education and tutorial activities of teaching staff involved in the activity.

Another significant example in the field of online education is the Graduate Diploma in Mine Ventilation (UNSW), one of several such courses offered by the University of New South Wales in Australia. The program is offered by the University of New South Wales. It provides professional development in mine ventilation and environment (UNSW Graduate Diploma in Mine Ventilation) [10] for mining engineers and other mining personnel. The Diploma is structured so that it can be tailored to the needs of either the metal ore or coal mining sectors.

The program is delivered in a distant, flexible format using an Internet platform and his development was an initiative of Minerals Tertiary Education Council (MTEC), the tertiary minerals education arm of the Minerals Council of Australia, organism having as main mission to develop a partnership between industry, the academic environment and governmental bodies in order to continuously rise the Australian mining industry’s efficiency, by providing a high professional training level for the tertiary education level.

EduMine is the professional development division of InfoMine Inc., an industry leader in delivery of online mining intelligence and technology [11]. EduMine has been delivering online courses and certification to the global mining industry since 2000. Its audience of active enrolees, from mining operations, mining companies, consultants, suppliers and individual professionals around the world, currently has about 1050. Over the past six years, in collaboration with mining schools, professional associations and industry, EduMine has developed an online educational resource of about 80 courses representing about 1100 hours of professional development. An additional 10 courses are available in Spanish. The courses are authored by industry specialists and cover a wide range of mining topics. They include an online certification process that meets professional competency requirements. The great number of potential students which can be included in online education forms represents a significant advantage when justifying the costs related to elaboration and development of new specialized courses in the mining area.

EduMine courses are currently used in a range of educational contexts, including:

- continuing education for the cross-training audience in mine-related activities (see UBC Certificate above);
- professional competency requirements, supported by many professional associations in mining;
- augmenting of mining school curricula;
- the integration into corporate training programs.

4. CONCLUSIONS

Education in mining will continue to evolve positively in a number of directions as it struggles to meet the normal demands of an overheated industry. Students and other participants to educational programs will find more networking between existing mining schools and universities, increasing collaboration between mining schools and universities and industry and increasing development and integration of online education and professional development. It also must be emphasized that the world economy globalization determined the mining companies to become more and more aware of the fact that available human resource represents a basic capital and the investments in education and training at high level standards are a profit source and an efficient instrument of recruiting well-trained staff members, in their own benefit.

The developments presented in this paper will augment and complement the more traditional approaches to education in mining, allowing better results in the activity of each involved factor.

5. REFERENCES

4. ***, Stratégie d’attraction, de recrutement et de rétention pour l’industrie minière (SARIM) - Aperçu du projet, Mining Industry Human Resources Council (MiHR), Canada, (2007), available at: www.mihr.ca, accessed: (date: 09/05/14).
5. ***, Federation of European Mining Programs - FEMP, available at: www.femp.org, accessed: (date: 09/05/14).
7. ***, Sandvik International Mining School, available at: www.si-ms.com), accessed: (date: 09/05/14).
9. ***, Master of Engineering in Mining Engineering - Distance Education Program, University of Missouri - Rolla, USA, available at: mining.mst.edu, accessed: (date: 09/05/14).
E-ASSESSMENT’S ROLE IN THE E-LEARNING EXPERIENCE

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ABSTRACT: the term assessment turned in e-assessment as a consequence of the use of e-learning in 21st century practice, in a technology-rich context. This paper highlights several issues regarding the integral relationship between learning, teaching and assessment by describing the implementation of the “Test” module of the developed e-learning solution module in engineering domain, and the impact on students that found the e-learning experience positive and useful, contributing not only to better understanding of subject knowledge, but also to better improvement in critical and analytical thinking, and problem-solving skills.

1. INTRODUCTION

The potential of e-assessment to enhance the learning environment and the outcomes for students in a wide range of disciplines became obvious these days, when universities have to meet the educational challenges of the 21st century. It was advocated the position that assessment of student learning should be considered an integral part of the teaching and learning processes as well as part of the feedback loop that serves to enhance institutional effectiveness.

Being defined as the use of electronic technologies to drive student learning assessment and as a generic term to describe the use of computers within the assessment process, e-assessment should encourage the rethinking of curriculum, e-learning, and technology.

Computer-based assessment (CBA) and computer-assisted assessment (CAA) are interchangeable terms that refer to assessments delivered and marked by computer.

Assessment of any kind: diagnostic, formative or summative, is central to learning and teaching. The three stages at which a learner’s attainment and progress come under review can be associated with a specific form of e-assessment [1]:

- Diagnostic – is the assessment of a learner’s knowledge and skills at the outset of a course.
- Formative – is the assessment that provides developmental feedback to a learner on his current understanding and skills. Formative assessment is the so called “assessment for learning” because an assessment on which no final qualification depends can prompt learners to adjust their own performance.
- Summative – is the final assessment of a learner’s achievement, leading to a formal qualification or certification of a skill. Summative assessment is the so called “assessment of learning”.

Also, assessment of any type can be of low, medium or high stakes as follows: a low-stakes assessment is formative, with locally recorded results, a medium-stakes assessment where the results may be recorded locally and nationally, but is not “life changing” kind, and a high-stakes assessment is one in which the outcomes are of high importance to both centre and candidates, affecting progression to subsequent roles and activities.

So, formative assessment occurs when teachers feed information back to students in a low-stakes manner that engage students in a self-reflective process regarding the feedback and allow them to learn better. Providing feedback on performance and suggestions for improvement, such an assessment can be made using a wide range of methods. In contrast, summative assessment is not designed to provide the immediate feedback useful for helping students during the actual learning process. It represents a higher-stakes evaluation of student learning at a given point in time, assigns grades and requires making a judgment about the learning that has occurred. If the primary purpose of evaluation is to support high-quality learning, then formative assessment ought to be understood as the most important assessment practice.

E-assessment is currently more frequently found in low- to medium-stakes than in high-stakes contexts, and this is also the situation with the “Test” module of the developed e-learning solution within the engineering domain, in Land Forces Academy.

2. INITIATIVE

The initiative is called Advanced Distributed Learning (ADL) and it is one of the most recent initiatives from a long campaign designated for developing the information technology advantages during education and training performance in our academy. This paper aimed at the Land Forces Academy’s educational side in the field of mechanical engineering, by elaborating an educational module for students, named e-plasticity, as a CNCSIS grant outcome. Aspects will be presented according to the followed objectives in the implementation of the asynchronous e-learning solution and the way in which they were attended.

The e-plasticity educational module combines exercise with demonstration and evaluation. The exercise is interactive and allows the students to experiment with buttons, menus, text introduction fields or other items in a simulated interface. The demonstration shows the student how to fill in an online request and it doesn’t need input data or interaction. Eventually, the assessment designed in a test shape offers the student a single chance to fill in each step in a simulated request.

This represents a challenge to the formal education system, but it may increase the motivation of more learners to stay within it. When interactive online tests are available for formative assessment, there is evidence that students retake tests voluntarily and that their availability any time, anywhere, can
help to establish more regular patterns of study. So, a very important part of the designed educational module is the assessing ability of the user’s learning means regarding the presented educational material. Offering a richer, more engaging, and a potentially more valid assessment experience than paper-based testing, there is a variety of different reasons practitioners look to e-assessment [2]:

- to handle increased class sizes;
- to reduce the burden of marking;
- to provide additional assessment opportunities such as repeated practice;
- to allow students more freedom as to when and where they carry out their learning by the flexibility of delivery location and time;
- to enhance question styles which incorporate interactivity and multimedia;
- to provide richer and more immediate feedback;
- to improve reliability.

In practice, e-assessments are often a bit of both formative and summative assessment, the former being of primary importance.

The way in which the assessment will be carried out as well as the way in which it will be approached by both students and teachers is affected by how the resulting information from the assessment is to be used. If students are aware that an assessment is entirely formative in nature, they might choose to take the assessment earlier in the course of their learning in order to discover areas of weakness, where they will then focus their attention on. On the other hand, a teacher using formative assessment would be more interested in improvements in learning, or spotting areas where students have misconceptions, but less interested in grades. Whatever the motivation, it is demonstrated that assessment guides learning and teaching. This means, it is vital that e-assessments are educationally valid, being capable to send out the message about what is considered to be really important [3].

### 3. DESIGN AND IMPLEMENTATION OF THE TEST MODULE

For assistance in this request, the ToolBook Instructor authoring tool was chosen to create the e-learning application module because it provides a comprehensive authoring solution [4] to create effective software application simulations, assessments, and rich, interactive e-learning content (figure 1).

![Interactive e-learning content window example](image)

**Figure 1.** Interactive e-learning content window example

Effective e-assessment for formative purposes can be set up by using the assessment authoring tool within the institution’s Virtual Learning Environment (VLE).

The implementation of the e-learning solution’s Test module has been achieved following the objectives of the project’s second stage, namely testing and assessing learning items of the module.

ToolBook Instructor supports three important functions in the e-learning world. First, it is an authoring solution for interactive learning content and scenario based training for delivery on the Web, or in native mode on CD-ROM, over corporate networks, and through any standards-compliant Learning Management System. Second, it creates software application simulations, using its Simulation Recorder and Simulation Editor. Simulations support demonstration, practice, and assessment. Third, it is an excellent vehicle for developing assessment and testing applications [5].

Our methodology is based on the following:

- the professional educational module is created with Content Templates, SmartPages and SmartStyles: Content Templates are provided for common types of learning, SmartPages already have the interactivity built-in and SmartStyles are designed by professional graphic artists and define course’s overall style and layout;
- assessments are elaborated by different graded question types – including true/false, multiple true/false, multiple choice, fill in the blank, matching, hotspot, drag-n-drop and more;
- multiple deployment options are considered being allowed by delivering the learning experience across major operating systems, Web browsers, mobile phones and devices;
- more information and better control when working with content in the course are achieved by flexible authoring views with the Book Explorer;
- custom interactions and branching are created with ToolBook Instructor’s Action Event system that automatically export to DHTML;
- user scores and activity information are easy to capture with the learning management system because of the built-in support for SCORM 1.2, SCORM 2004 and AICC.

The assessment features used to design and implement the “Test” module match very well e-learning solution’s goals and intentions [6]. As an object-oriented authoring environment that uses the book metaphor to organize content and interaction for the course that is created, ToolBook offers question items used for students’ knowledge tests by over twenty assessment objects types.

It’s important that these objects have a built-in behavior that provides feedback to the users and supplies with information about how users respond to these questions, and with the ability to randomize questions and answers for a secure testing. According to this, question items used by the “Test” module allow the design of different types of questions, including single/multiple choice, true/false, fill in the blanks, choose correspondent, match items, drag item, and many other answers. The interactive learning assessment offered by the module application used a rich variety of question items [7], such as the following described:

- A designed question using an item arrangement. An item that arranges items, allows the specification of item adequate position in a page and student knowledge about positions testing. When the book is running, the objects are mixed on the page, and the student will try to arrange them using drag-and-
drop. The student’s score is based on the number of correct positioned items.

• A designed question using a drag item-type question. A drag-item question allows the items’ definition as potential answers and the students’ capacity to identify correct answers. The student picks out an answer by dragging items over a pre-established potential answer.

• A designed question using a drop-target item. A drop-target item allows the definition of items as potential answers and the students’ ability testing to identify correct answers. The student chooses the answer by dragging an item over the drop-target item. The drop-target item is typically an image of a container or a target. This question item is used when the correct answer allows the student to put more items in a single target.

• A designed question using a fill-in-the-blanks item. Such an item allows defining a word or a phrase as a correct answer to a question. The student tries to answer the question in the item answer area.

• A designed question using a match-things item. This item allows defining thing couples as correct answers and testing students’ capabilities to identify the correct couples. The student tries to match the correct things by tracing an arrow from one item to the matching one (figure 2).

![Figure 2. Question using a match-things item window example](image)

- A designed question using a multiple choice item. A multiple choice item allows defining a button, field or another item as a correct answer. The student tries to answer the question by clicking the button, field or item. Using this object, many correct answers can be selected, also specified not to take the position into account (the correct answer appears in another place at each try).

- A designed question using an order-text item. Such an item allows defining a word or phrase ordered list as a correct answer for a question and testing the student’s ability to reconstruct the list in correct order. The student tries to answer the question by dragging the phrases in the correct order.

It’s important to note that besides indicating the correct answer, the question can be set to calculate the student’s score. After each question, the student’s score can be presented, at the end of the book or it can be registered in a log file. This text-type file will include information, such as the student’s score, the answer to each question, time spent on a page. The instructor could view the course either in a web browser associated to the HTML format or by using the Neuron plug-in to make the course look like a ToolBook native file in a web browser. Thus, the possibility to distribute the course as a run-time application accessible from the hard disk or CD-ROM was in the enriched environment that is offered by the computer display and interaction possibilities. The computer offers indeed the possibility of dynamic displays which are not only limited to static images, but which also include videos, animations, simulations and which offer the possibility to deliver audio stimuli.

An aspect with novelty elements is the importance/weight attribution of an answer. With the most item questions a weight is attributed to each answer (figure 3).

![Figure 3. Weight attribution of answers window example](image)

From its design, the difficulty of a correct answer is 100% if the question has only one answer and a fraction of 100% if there are more possible answers. The difficulty is automatically updated as the correct or incorrect answers are cataloged. The weight is a percentage of the possible points for each question. With the help of a fill-in-the-blanks question, for instance, different weights can be attributed to the different answer possibilities. This attribution can be also designated to the implicit features of the question dialog window, according to the type of question and the number of answers.

The feedback is another very important aspect and consists in that is associated to question items, which determines the item answer means when the student interacts with it. Offering feedback to a student allows an interaction with an increased quality, which leads to a better retention [8]. Feedback, in a traditional way, is used in computerized training for offering students answers and solutions regarding how good they answer a question. But, feedback is also useful for other purposes, like the guidance of a student through a request or application.

4. OBSERVATIONS AND RESULTS

It is well known that each discipline has traditions in what regards assessment, from the balance of continuous assessment versus end of course assessment, to the types of questions used. During the project’s third stage, throughout the first semester of 2008/2009 academic year at the Land Forces Academy, the autofrettaging of artillery barrels based on the plastic flow theory was planned for teaching. This subject was taught by using the e-plasticity educational module and the e-learning student group was trained for using it. It was distributed to all the students who had Internet access, or via the university Intranet, by means of flexible transfer options. The students could view the course either in a web browser associated to the HTML format or by using the Neuron plug-in to make the course look like a ToolBook native file in a web browser. Thus, the possibility to distribute the course as a run-time application accessible from the hard disk or CD-ROM was
created. The e-learning group was able to use the educational module any time, anywhere they wanted.

The fourth stage of the project was planned for the assessment of the accumulated knowledge and skills.

Even the experience, stakeholders and the nature of the discipline influencing these practices, the response to the written questions determines their classification into two main types: with selected and with constructed response questions [9].

The “Test” module has both types of questions:

- Selected response questions - are those where the student chooses an answer from a predefined set, examples including multiple choice (a single answer from a list), true/false or yes/no (specific forms of multiple choice), multiple response (more than one answer from a list), sequencing (place items according to the importance), hotspot (select an area of an image).

- Constructed response questions - are those where students must create their own answer, examples including: free text answers (typically a sentence or two), essays, single word or phrase answers, numerical responses, mathematical expressions, graphical responses.

For the first questions category - selected response questions – i.e. that the student needs to recognize which answer is correct. It was noticed that it may be that students use elimination strategies to reduce the number of possible correct answers. The probability of guessing the correct answer should be factored into the marking and interpretation of the performance data. As there should be no ambiguity over the correct answer marking is quick and consistent. This form of question is used to focus attention on various stages within the course and can be usefully used to sample efficiently knowledge over a wide area of the curriculum.

For the second questions category - constructed response questions- these questions do not rely on recognition of the answer. The students are allowed to express the answer they believe is correct, and more, they must know and create the answer. Being more open-ended and allowing a variety of possible responses, these questions are used to demonstrate student’s knowledge by explaining reasoning, developing an argument or evaluating a situation. The questions are easier to write, but harder to mark than the selected response questions. The delivery of marked constructed response questions to the student is not so problematic, but they are more difficult to mark automatically. Toolbook environment contains certain automatically marked constructed response questions, but the marking is limited by the complexity of describing the variation of acceptable correct answers and the difficulty of programming this knowledge. For example, a textual input would typically be limited to specifying a small number of correct answers, which must match exactly; a mathematical answer is likely to be restricted to numerical answers allowing specification of an accuracy or range.

Students have appreciated and categorized the following questions as a kind of extension of the first type, examples including: questions using a match-things item and questions using a drop-target item.

We have noticed that the educational validity of the test questions is influenced both by the category to which the question belongs and the way that it built itself.

Thus, there are a number of common errors students make when answering selected response questions. If the main purpose of the assessment is formative, the interest consists in diagnosing misconceptions and providing feedback. So, answers, which result from students having the misconception, need to be available. A small number of possible wrong answers available are likely that the answer the student believes is correct is not one of the options and this can be a problem with selected response questions. If the students’ answer is “not available”, they do one of the two things: guess an answer (by first eliminating some options) or review their solution. How desirable this is, will depend on the purpose of the assessment: if they guess correctly the misconception will go unnoticed, if they guess incorrectly the chances of identifying the reason behind the problem are considerably reduced. Prompts to review their answer may be desirable in a formative assessment, but in a summative assessment this lets the student know their original, intended answer is wrong.

Another issue is the space taken up by presenting an appropriate set of options. Where the options are graphical, a small number of options can take up a lot of space and this can cause problems if scrolling is required to view the question and options together. For textual response questions, it may be possible to use display options like drop down lists to overcome this problem. However, including too many options from which to select, or necessitating selection from a number of very similar options can also cause problems with excessive reading, and care needs to be taken.

Another option is to use a hotspot question type. A selected response question type can be created to operate like a constructed response question by creating a number of clickable hotspots on a graphic or image. In this case, the impact may well be greater, the possibility of being able to identify misconceptions is opened up, and the question itself takes up less screen space as all possible answers are created on one image.

Another interesting aspect of the assessment consisted of two different groups of students: students who took the “Test” module scored a higher percent on the summative exam than did those who did not take the online test. This represents almost a full point grade higher for the formative test-takers. The formative e-assessment results were immediately electronically available to the students once they completed the test, as were the correct answers to each question (figure 4).

Figure 4. e-assessment results window example

Under these experimental circumstances, providing formative e-assessments appeared to promote student performance as reflected by higher scores on the summative exams.

5. CONCLUSION

The designed and created educational module is part of the trend indicated by the study made by the European Union Roadmap of the European Technology Platform for Advanced Engineering Materials and Technologies, 27 June 2006, Grand
Challenges and the Vision: Materials for the Life-Cycle and Vision for 2020 and of the e-learning initiative: Designing Tomorrow’s Education, an integrative part of the e-Europe Action Plan, adopted on May, 24, 2004 in Lisbon, which sets the knowledge triangle: research, education and innovation, as the main factor in achieving the strategic objectives of the European Union.

This research proves that formative e-assessment has a positive effect upon student learning. Not only what is learned, but also students’ approaches to learning are influenced by the “Test” module.

It was demonstrated that providing students with practice online exam questions enables those who took e-assessment to perform better on subsequent summative exams than did students who did not utilize this opportunity. Students agree that the formative e-assessment helped them prepare better for the summative exam questions.

The use of e-learning solution via ToolBook allows for the effective presentation of information, provides guidance to the user, allows the student to practice the information presented to develop mastery of the content of the course, and provides for the option of assessing the student’s skills.

Observing the frequency and timing of access to tests has revealed interesting information on how and when students study. This insight showed that many students retake the “Test” module, enjoying the challenge of competing to improve on their previous score, as in computer games.

The designed and implemented asynchronous e-plasticity e-learning solution places the Land Forces Academy on high-standard positions in promoting e-content. The obtained results led to the increasing of the e-learning capabilities achieved by the Land Forces Academy, the investigation of the didactic methods in the engineering field being essential to the e-content designers.

Through this study, technology becomes subordinated to the pedagogical methods. The understanding of the potential of e-assessment tools and systems needs to be matched by awareness of their pedagogic benefits and pitfalls. A great challenge to be faced over the next period is choosing the best and most appropriate ways of using these tools.

However, this project represents only a modest attempt to provide formative assessment as a method for improving student’s performances.

Based on the relative success of this initial effort, subsequent efforts can now justifiably be of a more ambitious nature. Since this specific e-learning solution deals with only a small portion of the overall curriculum, it is possible that if online formative assessment was extended to the entire basic science curriculum, the impact might be considerably greater.

Further investigation will be necessary to determine whether the observations and conclusions noted in this research will be of practical value.

6. REFERENCES

1. BTL in association with AlphaPlus Consultancy Ltd, White Paper on e-assessment,
INNOVATING ENGINEERING EDUCATION, TO FACE THE KNOWLEDGE SOCIETY

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It is a miracle that curiosity survives formal education.
ALBERT EINSTEIN

ABSTRACT: The paper develops its title, explaining it in reverse order. Since the onset of the Knowledge Society is inescapable, whereas its details are yet fuzzy, the approach is pragmatic: the starting point is based on the general framework of the Lisbon objectives filtered through the contextual expectations of a Romanian university. Thus, the target is challenging, moving, and far too complex (as both multifaceted and convoluted) to be approached within a single short-term undertaking. Hence, it is impossible to be dealt with in solely one paper. In fact, in the conceptual and temporal environment of this conference, there are five interconnected papers, corresponding somehow to five stages of a long-term endeavour.

The first paper related to this subject matter was a broad outline of “A Bumpy Ride towards Reform: Higher Education Challenges Journeying from Sibiu to Lisbon via Bologna”, [16] where the author blended the educated guess of a manager with the “educated vision” of a doctoral advisor. On this groundwork, a kind of exploratory leap into the foreshadowing of the Knowledge Society (KS) was performed in [18], describing an ongoing task – unfortunately now partially frozen: “the first Romanian project to apply agent-oriented paradigms in open, uncertain, and dynamic industrial environments; thus, it appears as one of the first European attempts to adjust quality management to the Knowledge Society, via agent-orientation” [18]. (Both mentioned papers play the role of a prolegomenon for the present one.)

With regard to the two papers to be presented during this conference, in essence, this one is focused on managerial-strategic aspects (what kind of engineering education is needed), while the next (hereafter referred to as fourth paper) is focused on academic-tactical ones (how could the objectives be achieved). The last one, submitted to the World Conference on Educational Sciences (Istanbul, 2010, hereafter referred to as fifth paper) goes into details, illustrating the way of applying new paradigms in engineering as a whole and in engineering education (EE) in particular via modern artificial intelligence (the syllabus studied as case in point is for “Agent-orientation”).

As a result, the rest of this paper is organised as follows: Section 2 presents the rationale, explaining the title and transforming it from a declarative sentence into an almost imperative one, setting thus the target. Section 3 is more specific because abridging the history it illustrates the main university assets: two research strands able to endorse the attempt. Section 4 suggests the approach: devising top-down, implementing bottom-up. Then, Section 5 – together with Section 2 representing the paper core – describes the challenges, making an inventory of the key paradoxes run into on the way to Lisbon. On the other hand, the next two sections have overoptimistic titles: “Start. The First Affordable Steps” (Section 6) and “What Next? A Possible Roadmap” (Section 7), respectively; in reality they intended to catalyse the political will of the universities represented at this conference to both change mentalities and start off transdisciplinary collaboration in EE. Indeed, as Section 8 concludes: “cooperation becomes a must”.

1. INTRODUCTION. LISBON IS FAR AWAY

The paper aim is to explain, support, develop, and start to approach its very title. The starting point is based on the general framework of the Lisbon Strategy [27] filtered through the contextual expectations of a Romanian university. Thus, the target is challenging, moving, and far too complex (as both multifaceted and convoluted) to be approached within a single short-term undertaking. Hence, it is impossible to be dealt with in solely one paper. In fact, in the conceptual and temporal environment of this conference, there are five interconnected papers, corresponding somehow to five stages of a long-term endeavour.

The first paper related to this subject matter was a broad outline of “A Bumpy Ride towards Reform: Higher Education Challenges Journeying from Sibiu to Lisbon via Bologna”, [16] where the author blended the educated guess of a manager with the “educated vision” of a doctoral advisor. On this groundwork, a kind of exploratory leap into the foreshadowing of the Knowledge Society (KS) was performed in [18], describing an ongoing task – unfortunately now partially frozen: “the first Romanian project to apply agent-oriented paradigms in open, uncertain, and dynamic industrial environments; thus, it appears as one of the first European attempts to adjust quality management to the Knowledge Society, via agent-orientation” [18]. (Both mentioned papers play the role of a prolegomenon for the present one.)

With regard to the two papers to be presented during this conference, in essence, this one is focused on managerial-strategic aspects (what kind of engineering education is needed), while the next (hereafter referred to as fourth paper) is focused on academic-tactical ones (how could the objectives be achieved). The last one, submitted to the World Conference on Educational Sciences (Istanbul, 2010, hereafter referred to as fifth paper) goes into details, illustrating the way of applying new paradigms in engineering as a whole and in engineering education (EE) in particular via modern artificial intelligence (the syllabus studied as case in point is for “Agent-orientation”).

As a result, the rest of this paper is organised as follows: Section 2 presents the rationale, explaining the title and transforming it from a declarative sentence into an almost imperative one, setting thus the target. Section 3 is more specific because abridging the history it illustrates the main university assets: two research strands able to endorse the attempt. Section 4 suggests the approach: devising top-down, implementing bottom-up. Then, Section 5 – together with Section 2 representing the paper core – describes the challenges, making an inventory of the key paradoxes run into on the way to Lisbon. On the other hand, the next two sections have overoptimistic titles: “Start. The First Affordable Steps” (Section 6) and “What Next? A Possible Roadmap” (Section 7), respectively; in reality they intended to catalyse the political will of the universities represented at this conference to both change mentalities and start off transdisciplinary collaboration in EE. Indeed, as Section 8 concludes: “cooperation becomes a must”.

2. RATIONALE. EXPLAINING THE TITLE

Since the onset of the KS is inescapable – despite the fact that its features are yet fuzzy – it is considered as a premise. Therefore, the title is examined in reverse order.

Knowledge Society. The objectives put forward by the Lisbon Strategy [en.wikipedia.org/wiki/Lisbon_Strategy] are considered here as working definition for KS for eight reasons:

a) When it was set out by the European Council in March 2000, it yielded the most highly structured document portraying Knowledge Society [27].

b) All the way from diagnosis and analyse to target and strategy was dealt with in the documents it triggered; most of them are formally adopted as EU acts (e.g., FP7 [6]).

c) The links to education are manifold, essential, adaptable, and ever more significant: “Universities therefore look for-
ward to playing a pivotal role in meeting the innovation goals set by the Lisbon Agenda” [9].

d) Almost as a corollary: this strategy built the framework for some “Pacts for Education”, not only in Europe (e.g., in Germany the Nationaler Pakt für Ausbildung und Fachkräftenaufwuchs in Deutschland, 2004 [www.en.inbas.com/projects/d_pro089_quih.html]), but worldwide: [24] “synthesises the Brazilian strategy towards a knowledge-based society and economy, the perception and the influence of European Union’s Lisbon Strategy in the country, its impacts already visible and the possible future ones”.

“The knowledge dimension involves the current world situation in which knowledge is a differentiation factor of national development levels. This dimension will spread more and more over all human activities and should consider: education of quality; access to information for all; the rise in the capacity of scientific, technological and innovation knowledge creation; the interaction between popular and scientific knowledge” (the program for strategic planning Brasil Três Tempos, quoted in [24]).

e) In particular, the same principles are taken into account in the Romanian “National Pact for Education” [23].

f) More specific, this strategy was adapted and adopted explicitly by our university [16] [25].

g) Likewise, both research strands this paper is founded on – quality management and modern artificial intelligence – have vital roles in attaining the target. Thus, prefaceing the report on the renewed Lisbon strategy, in December 2007, José Barroso asserted: “By re-launching the Lisbon strategy in 2005, and refocusing it on growth and jobs, Europe has come a long way. […] The Lisbon Strategy is the EU’s vehicle for accompanying change. […] Here are a few examples of what we need to do together: reduce the number of early school leavers to ensure that no one is left behind in the age of globalisation; give Europe a new “fifth freedom” – the free movement of knowledge, to allow Europe to capitalise on its creative potential; […] reinforce the education-research-innovation triangle, notably through the establishment and operation of the European Institute for Innovation and Technology (EIT) and the Joint Technology Initiatives (JTI)” [6].

h) At last, a very pragmatic reason: no research project ignoring the Lisbon objectives could aspire to EU funding: “FP7 was only launched at the end of 2006 […]. Annual work programmes are now issued in each summer, […]. the 2010 work programmes were adopted by the Commission on 29-30 July 2009 and the first calls for proposals from these work programmes were published on 30 June 2009 […]. Any transnational research activities can be funded within this programme. The following ten thematic priorities have been defined: […] 1. Health - 19% […] 3. Information and Communication Technologies - 28%. 4. Nanosciences, Nanotechnologies, Materials and new production technologies - 11% […] 7. Transport (including Aeronautics) - 13%” [en.wikipedia.org/wiki/Seventh_Framework_Programme].

To Face. From the diverse meanings of “to face” in [thefreedictionary.com/face], three connotations are relevant here in an almost chronological order: “To confront with complete awareness”, “To overcome by confronting boldly or bravely”, and “To bring or to be brought face to face with”. In short, we have to admit now that soon we will be in front of the KS, and then we should cope with. (How we intend to cope with is presented in the fourth and in the fifth paper.)

Engineering Education is regarded as the area where a paradigm shift is both more influential and more urgent. On the other hand, since it is the very substance of this conference and, at the same time, a quite contentious issue, it is dealt with, in detail and as less biased as possible, in the fourth and in the fifth paper, where some solutions are proposed based on a “Robot-Portrait of a Postindustrial Engineer”. As a result, here are investigated only aspects relevant to “Education” – mainly higher one. “Universities and the Knowledge Society: The central task is to equip Europe’s populations – young and old – to play their part within the Knowledge Society, in which economic, social and cultural development depend primarily on the creation and dissemination of knowledge and skills” [9]. Universities strive to innovate “in particular through their commitment to the European Higher Education and the European Research Areas” [9]. “All over the world, but particularly in Europe, universities face an imperative need to adapt and adjust to a whole series of profound changes. These changes fall into five major categories: Increased demand for higher education […] The internationalization of education and research […] The proliferation of places where knowledge is produced […] The reorganization of knowledge […] The emergence of new expectations” [5].

Innovating. Section 4.3 of [6], having the title “Investing in knowledge and innovation”, explains: “Under the new cohesion policy programmes, more than € 85 bn will be made available for investments in knowledge and innovation. […] Europe needs a “fifth freedom” – the freedom of knowledge – completing the four freedoms of movement of goods, services, people and capital. This “fifth freedom” should spur the EU’s transition to an innovative, creative knowledge economy: […] information and communication technologies, driven by high-speed internet are key to raising productivity and stimulating innovation in Europe” [6]. In [27] the need for innovation is emphasised: “Europe needs strong universities (in the broadest sense) as “motors” in the knowledge triangle of education, research and innovation. […] European universities have gone through the second half of the 20th century without really calling into question the role or the nature of what they should be contributing to society. It is no more so. Universities also must change for good”. Thus, “Innovating” is considered not just a means, it becomes a must.

In the end, the last sentences of the Lisbon Declaration: “Not just Europe, but the whole world, is becoming a "Knowledge Society" and the Lisbon Strategy, the creation of the European Higher Education and Research Areas, together with the efforts of national governments, will require constant reconsideration in order to meet the challenge which this presents. These are exciting times for universities as they contribute to innovation through teaching and learning, research and knowledge transfer. Europe’s universities welcome the opportunity which this gives them to help to shape Europe’s future” [9].

3. HISTORY. MERGING TWO RESEARCH STRANDS

The (pre)history of this undertaking stems from the pioneer-times context when “our university had begun in the late 1990s two separate research strands (that were then quite rare in Romania): quality management and modern artificial intelligence” [16]. Both started in 1997 - 1998, almost from tabula rasa (without experience, Google, explicit funding, research teams, logistics, and so on) and were developed each “in more than 30 papers/articles/books in the last decennium” [18].
**Quality Management.** Research originated from the practical need to ensure ISO 9000 quality management [21] to the applications of the domain of parallel engineering [20] – then still in embryo in Romania and was first summarised in [19]. Quality management research was applied to education first for a Master Program [12] and then explicitly for e-learning (a decision support system for higher education institutions was described a year ago in [13], [17]). A major part of the research results was expounded in a recent monograph [22].

**Modern Artificial Intelligence** (practically, agent-orientation [1]). Research began in human-computer-interaction (HCI) [4], whereas the first explicit reference to agent-orientation was made in a chapter of [11]. Results until 2002 are given in [2]; later work (including also intelligent learning is referred to in [3]. More references are in the fourth and in the fifth paper.

From Convergence to Merging. After reaching maturity, the two strands “converged – without merging – into transdisciplinary research” [16] (in this regard a most relevant PhD thesis is [15]). “Recently – this time from an explicit Lisbon perspective – they began to fuse organically into research on the “3L” (Life-Long Learning) for the groundwork of a knowledge-based approach to affordable technological innovation […] The joint strand exploits the synergy emerging from coalescing the results achieved in both areas, proposing new approaches for decision support systems and testing them in improving decision making in a significant plant (in the domain of automotive engineering). For the new strand, other research is rather hard to find – since it is an obviously innovative undertaking in a transdisciplinary research niche” [18].

**New Approach to Quality Management.** It is most likely the key achievement of this research niche and was dealt with in Section 3 (“New Quality Management”) of [18]. The approach will be reiterated in the next section, from the standpoint of this paper. Here just its very abridged history: from the very beginning “the trend toward anthropocentric systems distinguished by human-oriented interface, and based on cognitive ergonomics” [4] was taken into account based on cognitive models [7] and on the concept of ecological validation – having a broader meaning than that in cognitive psychology [14] where it comes from. Later it was applied in validating experimental models of interface agents (e.g., virtual therapist, virtual guitar player, agent with a more human-like sense of time): “The history (since 2003) includes more focused research regarding intelligent HCI embodied in agent-oriented interfaces (expressed or not as pseudoavatars)” [3].

### 4. APPROACH. DEVISING TOP-DOWN, IMPLEMENTING BOTTOM-UP

The double nature of the paper – position paper (following the target set up in [16]) and research paper (refining the results obtained in [18] and moving the focus from industrial engineering to EE) is now over. Thus, the approach is pragmatic: keep consistency with [18], reorient the investigation to deal with the new research topic, and impair redundancy. Therefore, the results of [18] – and to some extent its conclusions too – are used as starting point and scrutinized whether they could be reworked (focusing on EE) to serve the overall aim of the paper triad to be presented. On this groundwork, the span of this paper can be set up. On the other hand, this section should do more than offering an approach: the most promising, wide-ranging and adjustable results of [18], namely those described in Section 3 (“New Quality Management”) must be revisited:

- **a) Quality is hard to measure.** Since the quality of any educational process is much more elusive than that of an industrial application, all assertions are, even a fortiori, pertinent to EE. Moreover, the grades – standardized or not – are acknowledged to be among the most subjective “quality indicators”.

- **b) Quality is highly contextual.** Again all assertions are a fortiori relevant to EE. Just two amendments: b1) Despite the fact that human-centeredness was acknowledged – already in Socrates’ times – as a key feature of any educational undertaking, no modern university is perceived by its stakeholders as “anthropocentric enough”, while improving academic quality management is a cardinal concern for every Rector. b2) Strange enough, as regards teaching the shift was rather in the opposite direction: the highly contextual Socratic “duologue-based-maieutics” needed no grades.

- **c) Quality is hard to describe.** Idem, Moreover, the educational environment is increasingly uncertain, firstly because it is very dynamic. Hence, education quality becomes more and more hard to describe because of its high time derivative. Indeed, how could students evaluate the quality of their education “when past quality becomes suddenly irrelevant, present quality is elusive, and future quality is unpredictable?” [18]. On the other hand, even for education conventional numerical quality indicators are still relevant for processes with a suitably high number of instances, where results have usable statistical significance.

Then, how to approach this seemingly uncontrollable educational process, when its very quality is so hard to pin down? The answer is below (again as comments to Section 3 in [18]).

**Qualitative validation.** Since any knowledge-based approach should be based on cognitive ergonomics, then even more so for an approach to education – a process cognitive par excellence. Likewise, any “Viet-kind approach” is inappropriate: “Qualitative validation consists in showing that a model is able to mimic available observed data. In population level biological models, the available data frequently represent a group status, such as pool testing, rather than the individual statuses. They are aggregated. Our objective was to explore an approach for qualitative validation of a model with aggregated data and to apply it to validate a stochastic model” [26].

Finally, to show that qualitative validation is inextricably linked to any educational process, three remarks: a) Medieval universities like Oxford or La Sorbonne established their high esteem during centuries, on a purely qualitative base – without describing, contextualizing or measuring the quality of the services provided. Why? Because quality – like beauty or any other elusive macro-feature – is firstly perceived, later explained. b) “How can we assess the potential effectiveness of yet not born skills (i.e., the quality of learning) measuring (often just by grades) the volume of knowledge acquired by the students (i.e., the quantity of teaching)? Primarily in education, quality should regain its prevailing role” [16]. c) Unavoidably, strategic planning (for instance, to win a war or to make a journey) is architectural, basically holistic, and top-down, whereas carrying it out (to prepare a battle or to start an excursion) is structural, basically reductionistic, and bottom-up. Otherwise – above all in higher education – it foreshadows failure. That explains the section title and defends its content.
5. CHALLENGES. NINE PARADOXES ON THE WAY TO LISBON

Why describe challenges by counting paradoxes? In fact they are hurdles perceived on a scale of nuances from intricacy or difficulty to trouble or even worry. However, the paradox is a statement “exhibiting inexplicable or contradictory aspects” [thefreedictionary.com/paradox]. In short, a challenge is in the real world but yet to come while a paradox is in our mind and by now. Thus, restating the problems by means of paradoxes (most of them have been already described as such in [16]) aims at:

a) Suggesting that the current “Scientific Zeitgeist” based on a quantitative “Kelvin way of thinking” [8] will be unable to coexist with the “Knowledge Society Zeitgeist” – yet unborn but already foreseeable. (The problem was extensively dealt with in [8], filtered through the sieve of “affordable technological innovation” in [18] and its huge consequences for EE will be elaborated upon in Section 3 “Speed of Change” vs. “Change of Needs” of the fourth paper.) Hence, the paradigm shift is unavoidable.

b) Implying that the way to unravel the paradoxes, proposed for each of them, is a pointer to a solution for adapting EE to KS and, on the other hand, showing that no effective solution is possible within the existing paradigms (indeed, if a solution could be thought of, why is the paradox still in force?) Hence, the paradigm shift is urgent.

Old Paradoxes. They regard mostly education as such and were pointed up in [16] because they are aggravated by KS; here, after quotes from [16], the impact of KS is emphasised.

- “In fact, the well-known policy of "following the leader" is not workable unless someone who has already drawn close to the final destination could give you a roadmap”. There is no time to wait for best solutions from advanced Western universities, since KS is coming soon.

- The “double truth” of the divergence between inertial, conservative short-term objectives and dynamic, innovative long-term targets” is worsened by the diminishing interval from “short-term” to “long-term”.

- A rather general paradox: “avoiding risks is a most risky policy”. Indeed, ignoring the advent of KS involves risks unbearable for any university.

New Paradoxes. They regard education as such, but mainly EE because they are generated by KS features based on new engineering paradigms; here, they are abridged from [16] without comments, since their vital impact on EE is elaborated upon in Section 6 (“The Hurdle: Teacher and Learner Live in Different Times”) of the fourth paper. (Likewise, the paradoxes relating predominantly to Information and Communication Technologies (ICTs) are dealt with in the fourth and in the fifth paper.)

- Despite its name, education in the KS would focus rather on skills than on knowledge because the global, easy accessible, Internet-based “Webliothek” is its key texture (in most nuances of the word). Hence, knowledge tends to become a utility whereas the real challenge is to be skilled enough to put knowledge to work.

- How can we assess the potential effectiveness of yet not born skills (i.e., the quality of learning) measuring (often just by grades) the volume of knowledge acquired by the students (i.e., the quantity of teaching)? Primarily in education, quality should regain its […] role.

- The last baffling paradox to cope with when heading towards “3L” stems from a kind of “temporal contradiction”, i.e., how to organize institutional teaching, clearly limited in both time (corresponding to the Bologna degree framework) and objectives (corresponding to the focused curricula) to meet the expectations of a dynamic and indistinct environment, as implied by the concept of life-long learning.

- Our present object of work (teaching) is neither present nor object, since it aims at a future, quite far away, process (learning). Why should the teacher focus on solving (predictable) problems, when the learner should focus on managing (unpredictable) situations?

- We have to live with two still divergent conditions: a) The educator profile should move from teacher, to trainer, to catalyst (because the target moves swiftly from knowledge to skills). b) The “e-” prefix is inexorable (because of the “temporal contradiction” mentioned above. Acknowledging the hurdles in devising “e-teachers”, how could we expect to devise better “e-catalysts”?

- How could be “computer-aided” an intellectual activity that is human-oriented par excellence?

6. START. THE FIRST AFFORDABLE STEPS

Here are only the first steps (namely those related to the position nature of this paper; those regarding 3L could not anticipate the fourth paper). They must be affordable since a key thesis of the entire undertaking is affordability – in the meaning implied by the first papers. Thus, a prerequisite of the “Ride towards Reform” [16] is to propose “a robot portrait” of an affordable tourist-class roadmap to Lisbon […] on the groundwork of a knowledge-based approach to affordable technological innovation. (“Affordable” is a sine qua non requirement for universities like ours.”) Likewise, [18] shows that “radical technological innovation is affordable (as time, cost and effort) in current industrial environments if it is based on new development paradigms – stemming from the Knowledge Society framework as outlined by the Lisbon objectives” and that “only powerful organizations could afford the hazard of exploratory research. For all others – universities included – the only affordable innovation was due to the predictable but limited yields of incremental research, achieved within established paradigms. On the contrary, during a period of severe funding shortage, the only affordable research is based on exploring new paradigms”. In short, affordability, after being recognized as main part of the problem, should be now accepted as core part of the solution: here affordable steps means those not requiring explicit funding in the next two years.

Educational steps. The first three are inevitably sequential; the next three are either syllabi components or just alternatives.

- Gather the papers dealing with EE based on the Lisbon strategy into a book, together with similar papers asked from every Balkan country – as well as from EU officials. (First ideas for the title could be “Engineering Education from Bologna to Lisbon” or “Engineering Facing the Knowledge Society”) A less significant but faster alternative: selected papers from the Conference Proceedings could be the contents of a special issue of an ISI Journal.

- Improve on this groundwork the syllabus proposed in the fifth paper.

- Use that syllabus as model for related syllabi.

- Prepare a course-based master’s program for Master of Post-Industrial Engineering focused on “ICT Paradigms for the Knowledge Society”.

- Idem for “Quality Management for the Knowledge Society”.


• Idem for “Engineering Education for the Knowledge Society”. (Training the Trainers.)

Organizational steps. They are ranked in order of decreasing EU funding required:

• FP7 proposal. The FP7 Cooperation scheme promotes collaborative research projects in ten thematic areas. As shown in Section 2, the top priority area, Information and Communication Technologies, will get about 28% alone and, together with the following three areas, about 71% from the total funding [en.wikipedia.org/wiki/Seventh_Framework_Programme]. Thus, a well-defined and accurately formulated application proposal could be of noteworthy interest. A common organizational form could be a Network of Excellence – e.g., using as model AgentLink (European Coordination Action for Agent-based Computing).

• COST Action (Workgroup). COST (European Cooperation in the field of Scientific and Technical Research) supports strongly such initiatives if they are well prepared, within available funding. If it is intended to become a separate Action, the proposal is expressed as a Memory of Understanding (MoU) to be signed at country level, while if it is only a Workgroup within an existing Action it is approved by the very Action.

• No funding. The following steps may have a more limited impact but need neither explicit funding nor explicit institutional structures inside every university involved in EE (the staff should work on volunteer basis):
  • Institute BRCEE as organization. Set up a permanent Balkan Region Conference on Engineering Education (BRCEE) having secretariat, website, and teleconference facilities.
  • Appoint officers in charge. To reach the Lisbon goals “each Member State must appoint a senior member of cabinet to be the sole representative in cabinet meetings in charge of the Lisbon Strategy as Mr or Ms Lisbon”” [10]. In line with the principle of subsidiarity each university should appoint a senior faculty member (for instance, a Head of Department) in charge of the Lisbon strategy.
  • Initiate a Delphi survey. To be able to launch a realistic “Call to Cooperate in Engineering Education”, the first questionnaires should focus on university potential to reach Lisbon educational objectives rather on describing ideas about potential features of the KS. Thus the first stages could be limited to gathering information for an opinion poll.

7. WHAT NEXT? A POSSIBLE ROADMAP

If the previous section content could be deemed to be overoptimistic – mainly when work has to be done without explicit funding – the title of this section seems at least an obvious overstatement. Indeed, “no one yet has clear milestones leads to Lisbon to share […] we must embark for a foggy destination before knowing how to approach it, only to flee the danger of being approached by this very target before we are ready to accept it. Indeed, our “Lisbon target” […] must be arrived at before it could overwhelm us – since if we are not yet prepared to live and work in such a post-industrial society, the blessing could turn into a curse. In short, how to devise a to-do list without knowing what to do?” [16] (see also the first “Old Paradox” in Section 5). Hence, a roadmap is not just premature but appears as almost unworkable.

However, it seems important to sketch an – albeit very fuzzy – “robot portrait” of a roadmap (see also the previous section) firstly to show that the target is not a fata morgana. There are neither deadlines, nor evaluations whatsoever – without reliable information about funding it would be pointless. Thus, it is more forecasting than planning (that is the main rationale of the Delphi survey proposed before). In contrast, some milestones could be anticipated:

At first come the steps proposed in Section 6 – mainly a workable logistic infrastructure and the Educational steps – since they do not unquestionably require cooperation. Then the first Balkanic Lisbon-oriented network should be set up via the feedback to “Call to Cooperate in Engineering Education”. After a positive response from universities from about seven or eight countries, EU sponsorship could be asked for – based also on the results of the Delphi investigation. In parallel, from the improved syllabi could be assembled curricula, commonly agreed upon. Afterwards the horizon is open.

In short, the outline above aims at reassuring us that Lisbon is reachable, albeit far – even before investigating closely the methods proposed in the fourth paper and improving the syllabus yielded by the case study in the fifth one.

8. CONCLUSIONS. COOPERATION BECOMES A MUST

In theory, the nature and context of this paper should involve conclusions organized on three echelons regarding: a) the paper standing for a research per se; b) the third account of an ongoing research undertaking covering a much wider scope; c) the paper as position paper on the topic of EE in the KS. In practice, such separation would be cumbersome, difficult to follow, partially redundant, and – above all – loosing the relevance of its holistic approach. Thus, the conclusions will skip over the first echelon, focus on the second, and comment shortly upon the third one.

• The research topic, as expressed in the paper title, is of paramount significance to any university – here and now. Moreover, it becomes urgent to deal with.
  • The rationale is exposed comprehensively (covering premises, objectives, and context – from European to Romanian, to local) via X-raying the title and is defended by a recent and rich webliography.
  • The approach is architectural, basically holistic, top-down, and based on advanced, state-of-the-art concepts like: niche transdisciplinary research merging synergistically vital strands explored before; open, uncertain, and dynamic environments; anthropocentric systems; cognitive ergonomics; life-long learning. The approach is also pragmatic, reorienting – with minimal redundancy – the investigation from industrial to educational environments.
  • The focus is on managerial-strategic aspects, affordability, shifting to KS paradigms (e.g., “Just in Time”, agent-orientation, qualitative validation of macro-features), and strategic planning. (The focus will move to academic-tactical aspects when implementation methods will be described in the fourth and fifth papers.)
  • In short, the undertaking appears to be the first attempt in Romania to adjust quality management to KS and to apply consistently KS paradigms in exploratory research regarding EE.
  • As regards the position-paper echelon there is a single conclusion: to attain the Lisbon objectives, cooperation becomes a must because the inexorable and vital paradigm shift is beyond the reach of both traditional solutions and local approaches. There is also a hope: the paper is convincing enough to boost the outlook for cooperation in embarking for Lisbon.
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9. REFERENCES
DESIGN AND CONSTRUCTION OF INTERNAL COMBUSTION ENGINES TEST BEDS AS EFFICIENT MANAGEMENT ACTIONS IN SCIENTIFIC EXPERTS TRAINING DEVELOPMENT PLAN

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ABSTRACT: During the last years the highly scientific training have been heavily stressed in the project management field. The constant emerge of new markets and the strong development of delivery and running capacity became obvious in the internal combustion engine department – seen as an essential part in the energy and transport industry. The present paper deals with several aspects regarding the need to improve the students specialized theoretic training and skills in the internal combustion engine field. This concerns design and construction of fully equipped modern beds for engines testing and research. The paper’s primary goal consists in stressing the importance of training experts – in internal combustion engine, as source of energy recovery and/or ecological combustion drive – highly skilled in research and marketing project design and management.

1. INTRODUCTION

Internal combustion engines test beds design and construction have been continuously developing as far as industry and civil requests refer to higher efficiency, safe operation and reliability of these engines. Moreover the fact that thermal engines continue to reach an important place in many applications, new graduating specialists series are called to solve basic problems concerning the needs of operating the engines under increasing severe conditions, such as limiting the gas emissions pollution and the classic fuel consumptions together with preserving the engines mechanical performances. The performances of the internal combustion engines could be improved only by remote control systems implementation. This permanent preoccupation is highlighted in Figure 1, which shows the trend of the human operation involvement in engines direct operation until nowadays. Automatic systems connected through the ECU (Electronic Command Unit) enable the engine operation within the optimum scale parameters corresponding to the maximum power and the minimum of the engine specific fuel consumption.

Each experimental program is based on a theoretical model. The model consists in various criteria and hypothesis that fit each work simulation. Once the simulation is completed with comprehensive results, the experiments could be carried on in order to get final results to be compared to the simulation ones. Figure 2 shows the general scheme that allows the control and the optimization of both phases of the research – the theoretical and the experimental one.

![Figure 1. Degree of engines human direct operation](image1)

![Figure 2. Test bed theoretical and experimental research](image2)

After this brief view of the activities developed inside an engine test beds, it has to be revealed, as following, the basic structure of the bed, types of data acquisition and some procedures regarding the obtained data process. These aspects are developed in the next sections.
2. THE GENERAL STRUCTURE OF AN ENGINE TEST BED

The design of an internal combustion engine test bed should fulfill the requests of the European Directive 80/1269/EEC concerning these types of tests [7]. That means that all the measurements equipments should be assembled in a special chamber with grilled anti-vibration foundation and noise absorbing materials coating the walls in order to protect the test bed operation personnel. For the emission gas it has to be designed an underground evacuation way with good ventilation. Figure 3 describes the basic structure of the test bed that could easily lead to any supplementary systems installation to perform more detailed work.

![Figure 3. Standard structure of a test bed.](image)

The very basic equipment of the test bed consists in the assembly engine-dynamometer. An eddy-current dynamometer allows the control of the engine operating parameters (load and speed) from a safe distance. The mechanical characteristic of the engine must correspond to that of the dynamometer (as shown in Figure 4). Otherwise, the dynamometer is to heavy to test the engine, or, on the contrary, it couldn't load the engine. The connecting coupling has to be sufficient light and flexible to join together with minimum errors the engine and the dyno shafts. As said, the dynamometer panel allows the remote control of engine speed and load. A crucial role is played by the electronic command unit (ECU) of the engine, receiving various types of signals from the sensors and commanding the actuators. All acquired data could be stored on the PC allowing to be processed almost in real time [1]. A diagnosis board could also be connected between ECU and the PC.

![Figure 4. Dynamometer and engine power characteristics](image)

In order to establish the correct level of the air-fuel mixture formation, it is necessary to measure the direct air and fuel flows. Therefore, the bed is equipped with both types of flowmeters (fuelmeter and air-flowmeter). The precision of air-fuel ratio calculation gives the same level of precision in evaluating the quality of combustion and that of the cycle heat release, and consequently the efficiency of engine operation. The air fuel mixture formation could be also verified by measuring the indication of the Lambda sensor, which gives the information related to the oxygen concentration from the exhaust gas. In order to maintain a certain value of the air-fuel ratio ECU controls the parameters of the fueling system (FS). The injected Spark Ignition engines (SIE) as Diesel engines have at least the same type of control of the injection timing, using injectors with electromagnetic or piezoelectric motion. The correlation between the set air-fuel ratio and that given by the Lambda sensor measure is made in a “closed-loop” adjustment system formed by this sensor together with the injection system through ECU (being in fact a microprocessor containing the optimized charts of engine parameters) [2].

Together with the data concerning the parameters of the engine operating regime, it appears necessary to evaluate the efficiency of the engine (at the same time with the mechanical performance). Thus, a special data acquisition system is designed to record and to process the in-cylinder pressure values during a cycle and a number of cycles. The pressure transducer mounted in the cylinder head transfers the signal through the acquisition chain until the PC special acquisition board. The recorded pressure diagram proves vital aspects related to the combustion efficiency [3]. This data, together with the measured values of the main exhaust gas emissions species represent the key of the knowledge about what really
happens inside the engine cylinder during the combustion phase.

3. DATA MEASUREMENT AND ACQUISITION

As it has been said, an engine operating regime is completely defined by values done to the following parameters: speed (rpm), load (%), advance to injection or spark ignition (deg. CA-Crankshaft Angle), air-fuel ratio (-), thermal gradient (K). Once these parameters set, and the engine set on the steady-state, it can be proceed to the main acquisition operations.

The most important of these procedures consists in reaching the in-cylinder pressure diagram. As shown in Figure 5, the pressure curve is plotted versus the crankshaft rotation angle, and it has to offer significant details concerning the combustion efficiency. This is an important procedure, a basic operation in which frequently students practice their skills in engines laboratory works. The result is also important because it reveals the method to measure the mechanical loses as the difference between the indicated power and the effective power of the engine.

Another type of automatic acquisition reefer to the engine thermal state values. Using a wide net of thermoressistances and thermocouples is it necessary to obtain the values regarding the temperatures in multiple points of: the inlet air, the cooling agent, the oil, the exhaust gas, the fuel, the cylinder, the cylinder head, etc.

Tests could not be complete without exhaust gas emissions’ measurements. There are a lot of types of gas analyzers applying different measurement methods: infrared detection, stroboscopic effect, chemiluminescence, etc. The basic scheme to detect and to measure the main species of gas emissions is highlighted in Figure 6 [4].

![Figure 5. In-cylinder pressure data acquisition chain](image)

There are more research procedures to be applied in order to complete a research theme, depending on its specificity. For example, considering the study of engine combustion an aspect consists in the study of the spark ignition parameters (to Spark Ignition Engines). Or, on combustion itself various techniques apply rapid camera use in catching on film the propagation of the flame inside the combustion chamber. Different other research subjects reefer to the use of alternative fuels or engine dynamics and vibrations.

![Figure 6. Gas analyzer general scheme](image)

At the University POLITEHNICA of Bucharest, in the Dept. of Internal Combustion Engines Laboratory, Master students and PhD students have been working to develop research programs dedicated to the use of the alternative fuels. Modern fuels like alcohols [5], LPG, DME, bio-fuels and hydrogen have been
tested in order to improve the efficiency of classic internal combustion engines.

At laboratory classes bachelor students have their own laboratory works connected to the disciplines like Internal Combustion Engines Fundamentals or Design of Internal Combustion Engines, Thermal Processes Adjustments [6].

4. CONCLUSIONS

Internal combustion engines test beds are designed and build with specific purposes, converging to rise the level of knowledge and to develop the skills of the students in mechanical and automotive engineering.

Automotive researchers have been working for years to solve various problems concerning the engines operation and future development. Automotive market products represent nowadays the results of testing engine prototypes for many years in such laboratories equipped with test beds. The design of a test bed has become a domain of precision and high technology. The sooner the students start to be involved in this preoccupation field the higher will be their knowledge to push continuously forward the quality of the work.

High technologies and instruments encountered in this professional area rise the level of scientific work and give to the master and PhD students high motivation and recommendation.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

7. *** European Directive 80/1269/EEC
IMPLEMENTING INNOVATION IN THE ENGINEERING TERTIARY EDUCATION – ON FOREIGN LANGUAGE LEARNING AND USING STRATEGIES

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ABSTRACT: The educational context we are moving in is characterized by features that have lately emerged, thus inaugurating a necessary era of change. As educational actors, teachers should adopt an attitude of reflectivity and incessant search for answers, providing support to learners in understanding the contemporary period’s dynamism. At both institutional and personal level, we must all become adept at learning, in order to reshape the current structures and processes, thus generating an educational framework able to flexibly give birth to its recurrent modifications. It is therefore imperative to follow the direction of learning about learning throughout all societal constituents. The paper presents the empirical research of the author in the area of foreign language learning and using strategies. All the facets of the innovative component – that of creating and introducing a strategy awareness raising set of activities in an originally designed English for Computer Science module – are presented in some detail, including the tasks types, their rationale and a discussion of results.

1. CONTEXTUALIZING THE NEED FOR INNOVATION - GROUNDWORK

We are witnessing a period characterized by a vast array of social, political, economic and cultural processes, whose dynamics of change should be analyzed and, if possible, controlled.

The pace of daily life has increased considerably, generating the need for permanent realignments to the modified circumstances and even an effort towards anticipating the alterations that may occur, especially at managerial and organizational levels of the society.

As far as the field of education is concerned, the consequences of becoming more and more aware of the relationship between such a difficult to foretell evolution of the societal components and the implications for the factors involved in the educational decision making process have been conducive to initiating various paths in order to keep pace with or anticipate change in the current educational settings worldwide.

However, whether we seek information from the macro-educational level of the existing structures, where change is seen, as Huberman [9] puts it, as innovation by substitution, alteration and even restructuring, or we take into consideration the more subtle modifications taking place at the micro-educational level, the common goal of such endeavours is the optimization of education.

A further necessary step in determining the concrete modes of implementing change in education, in an appropriate manner from the point of view of the scientific support underlying it, is to conceptually return, even briefly, to the multiple refined forms of relationships amongst the elements of the basic teaching - learning - evaluation ternary.

Although the connections that can be established within this triad are quite intricate, being comparable to the myriad of interwoven threads in a Persian carpet or to the multiple harmonies in a symphonic structure, what we are mainly interested in here is the methodological conversion of the main theories of learning into models of instruction.

As Neacsu [10] shows, an analysis of the main directions in teaching and learning involves both theoretical and practical elements. The existent models have scope, content and degree of generality that are covariant with the quality of the dominant methodological direction.

Thus, theory and innovative action may merge, in order to generate educational solutions. The inside perspective is related to the outside one – from indicating the action to the action proper, ensuring an increased rate of conversion of the theoretical program into that of the methodological design.

There are a range of stages in the instructional process that should be considered when attempting to implement change in an innovative manner:

- identifying goals;
- determining the content that can bring about the expected change;
- organizing and managing of change by specific strategic options;
- generating the conditions that will favour the occurrence of change,
- control and evaluation of its nature and quality.

As this study is mainly directed on the main facets of the proposed innovative component of creating and introducing a strategy awareness raising set of activities in an originally designed English for Computer Science module, which represents the core of the author’s research in the area of implementing language learning strategies (LLS) and
language using strategies (LUS) in the course of English as a foreign language at advanced engineering tertiary education level, the concept of strategy, with an emphasis on LLS and LUS, should come under focus, as well as that of strategic competence.

Oxford [11] sees LLS as steps or patterns of behaviour used by language learners to increase and improve the acquisition process. Considering that the main aim of LLS is to help the communicative competence to develop, they must generate interaction, hence a particular interest in affective and social strategies, but certainly without neglecting the other types, such as the cognitive ones.

In a later study, Cohen [6] synthesizes the plethora of views on strategies that occurred in the 1990s, proposing that a continuum be considered from the widest meanings and up to the specific, lower level ones, of the term.

As regards the strategic competence concept, the literature comprises some rather dissimilar views; however, if these are seen holistically, they may contribute to the effort of surprising the multiple aspects involved in it.

Thus, for Canale and Swain [5] it is the set of remedial strategies that speakers possess and make use of in order to communicate. At a later stage, Canale [4] amended the initial sense, adding that such strategies are used to enhance the efficiency of communication.

In their turn, Yule and Tarone [15] see strategic competence as the ability to select an efficient mode of fulfilling an act of communication.

Douglas H. Brown [3] points out that all the communication strategies a person may have arise from that person’s strategic competence, understood as the way people manipulate the language in order to attain their communication purposes.

For Bachman [1], strategic competence appears as a totally independent element of communication, having an executive function in making the final decision, selected from among other possible options. It refers to all the productive and receptive means used in communicating in a competent manner.

At national level, Romania, as a member state of the European Union since 2007, has been facing certain educational standards that must be adopted and adapted to the specific concrete conditions.

The Bologna documents [12], as well as as the Common European Framework of Reference for Languages [13], have generated implications in increasing the efficiency of foreign language teaching at tertiary level. One main objective is that of providing appropriate support to the learners so that they could attain a high level of linguistic competence.

It may be useful to stress that a certain amount of cautiousness is necessary in implementing change efficiently and in a highly qualitative manner, for the reason that the process is not an easy one, as it is seldom possible to transfer ready made solutions to a different context. Such a project design should take into consideration both the potential risks of any kind and the positive experience of our partners.

A set of useful guidelines in this respect is that proposed by the European Association for Quality Assurance in Higher Education - ENQA [8]. In understanding the principles of quality, it is advisable that they should be seen as a coherent systemic approach.

The holistic perspective is crucial in creating a culture of academic excellence in universities. Therefore, when our research project was designed and applied, all these guideposts were considered.

Anticipating the demands of the present and mostly those of the future, as far as the educational process increase of efficiency - with the observance of quality principles - is concerned, in the concrete educational context of teaching English to the Computer Science Faculty students of the Bucharest POLITEHNICA University, we have tried to optimize the foreign language teaching/learning, starting from the demand that IT students should become highly proficient in English with mid- and long-term impact, in order to be competitive and flexible on the labour market and refine their autonomous learner skills.

This desideratum comes, however, against the severe constraint in terms of the restrictive time allocated for the course of English, getting dramatically shorter over the last years at first university level.

2. RESEARCH OUTLINE

With the above requirements as a background compelling immediate action, a research project was designed and carried out. It represented an empirical applicative research activity of the process and action type, having the objective of improving the given context.

The main directions of the research were, not necessarily in a prioritized order, but rather conjointly aimed at, to:

• analyze if the teaching/learning process can become more efficient by introducing a cycle of activities in the language practical course, having as main goals to increase the awareness and acquisition level, in a motivated and participative manner, of LLS and LUS by the students, as well as to provide support to the trainees in identifying, maximizing and refining their strategic repertoire at while- and post-course stages;
• check the usefulness of extending the concept of strategic competence in a foreign language by correlating it with LLS and LUS;
• identify pedagogically justified modalities of increasing the students’ communicative competence by systematically and explicitly including LLS and LUS at the level of the main skills under focus;
• determine the extent to which, by teaching a coherent systematic set of LLS and LUS within the ESP module, the academic progress of the learners in terms of their communicative competence in English can be positively influenced, thus justifying and instrumenting further pedagogical options in designing an ESP course which should include such a strategy oriented component;
• place stress on both the potential transferability features of such an approach and on the requirement that teachers should receive training in order to be able to take it up in their educational contexts on the basis of a clear rationale, thus increasing their chances of attaining success.

Accordingly, the hypotheses we wanted to verify with this research were formulated in line with the established directions.

The main hypothesis stated that if a set of awareness raising activities on LLS and LUS is explicitly introduced, in a coherent and systematic way, in the ESP module, it is expected
that the learning progress and the communicative competence level of the students should increase.

The main specific objective proposed throughout the research stages consisted in the design and implementation of an experiment whose features were as follows:

- it lasted 14 weeks, on a sample of 200 second-year students;
- it was of the pre-test and post-test type, with witness group;
- the experimental scheme was of the type:

\[
\begin{align*}
R & \quad O_{T}^{1} \\
X & \quad O_{T}^{2} \\
R & \quad O_{C}^{1} \\
& \quad O_{C}^{2}
\end{align*}
\]  

(1)

The symbols stand for:

- \( R \) = random selection of participant groups
- \( O \) = a measuring process
- \( X \) = exposing the experimental groups to the experimental variable whose effect was measured;
- the effect of the treatment was measured by the formula:

\[
|O_{T}^{2} - O_{T}^{1}| - |O_{C}^{2} - O_{C}^{1}|
\]

(2)

- it included, in parallel, throughout the second semester of year two (14 two-hour seminars), the experimental group, exposed to the original experimental English for Computer Science (ECS_exp) module, including the differentiated set of LLS and LUS focused activities, and the witness group – taught on the basis of a pre-existing communicative ECS_wtn module, in which the time allocated with the former group to LLS and LUS development was compensated by various other language skills development tasks.

The ECS_exp was mainly focused on the development of reading and writing skills. It was conceptually different from the ECS_wtn one by the fact that original and/or adapted activities comprising LLS and LUS were included in it, in both implicit and explicit ways.

The following aspects were considered significant in designing the ECS_exp:

- a) supporting learners to attain a higher level of communicative competence, placed in the B2/C1 range in CEFR [13] terms;
- b) placing emphasis on those language skills which will, according to the needs analysis carried out initially, be most useful to the learners as engineering university graduates;
- c) embedding in the instructional process, in both implicit and, mostly, explicit ways, of activities meant to facilitate an increase of the students’ awareness of their own strategic options in learning and using English, in order to determine the further development of their motivation and responsible commitment to their own learning process;
- d) helping students to enlarge their strategic repertory, with a view to becoming more autonomous learners after the conclusion of the course and later on, as graduates.

The manner in which the strategy awareness raising activities were inserted in the ECS_exp module comprised, in an original design adequate to the concrete context objectives, demands and constraints, a blend of tasks whose readily observable purpose was to increase the students’ repertory of strategies of immediate utility in their process of language learning and of strategies useful for continuing to improve their command of English after graduation.

The module also included cases in which the modalities of embedding the strategy awareness raising activities were not strictly delimited from the language skills oriented ones.

An example of the latter kind is that of a seminar focused on translation from L2 into L1, during which the students had to fill in an especially created electronic document called Working Protocol, with rubrics for difficulties encountered during the translation activity and solutions adopted to solve them.

It involved, in parallel with developing the students’ translation skills, implicit attention to refining the learners’ capacity to plan, organize and monitor their own activity (metacognitive strategies), as well as affective and social (pair work) strategic elements.

**Table 1.** LLS and LUS awareness raising activities - exemplification.

<table>
<thead>
<tr>
<th>Seminar</th>
<th>SEMINAR ACTIVITIES</th>
<th>STRATEGY TYPES UNDER FOCUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Explaining student diary rubrics. Filling diary first time.</td>
<td>METACOGNITIVE STRATEGY - SELF-EVALUATION OF OWN LEARNING PROCESS; Elements of affective strategy - analyzing emotional component.</td>
</tr>
<tr>
<td>2</td>
<td>Solving online test to determine own learning style.</td>
<td>METACOGNITIVE STRATEGY - SELF-EVALUATION OF OWN LEARNING PROCESS.</td>
</tr>
<tr>
<td>8</td>
<td>a) Interview with Good Language Learner (GLL)</td>
<td>A) GLL VIEWPOINT: METACOGNITIVE STRATEGY - SELF-EVALUATION OF OWN LEARNING PROCESS, INCLUDING AFFECTIVE ELEMENTS. CLASS VIEWPOINT: SOCIAL STRATEGIES/EMPATHY.</td>
</tr>
<tr>
<td></td>
<td>b) Analysis and grading of portfolios as mid-term evaluation</td>
<td>b) Metacognitive strategy - self-administration of learning and affective elements - in homework.</td>
</tr>
</tbody>
</table>

Certainly, the combination patterns and weighting of these types of activities will depend on each concrete educational context features and objectives in designing the language course.

An example of the kind of LLS and LUS awareness raising activities which were designed for the ECS_exp module is provided in Table 1.

Our view was that in our particular educational context, with a quite high level of students’ communicative competence, it was advisable that strategy focused activities should be introduced in both explicit ways, as in seminars 2 and 8a in Table 1, and implicitly, given the very nature of the discipline – English as a foreign language, in which things actually happen in class, as in seminars 1 and 8b.

The following recommendable steps were included in the design and teaching of the ECSexp, as they can be considered as representing a (minimal) strategy development core:

- identification, of a relatively empirical type at the beginning, then by scientific measurement techniques/instruments, of the favourite learning style
of each student, followed by designing the group average profile in terms of learning style;

- discussing the set of strategies already acquired/preferred by the students, by means of explicit activities conducted in English, as they also aimed at developing the oral communication skills of the learners;
- supporting students in identifying the strategies that they lack and/or those may need;
- discussing the correlation between the students’ strategic repertory and their personal learning styles.

To determine whether by teaching the ECS exp significant progress in learning took place, as compared with the witness groups exposed to the ECS wtn, the following instruments were created:

a) as pre-test, the first semester final grades were used, calculating the difference between the experimental and the witness groups;

b) as post-test, the second semester final grades differences were calculated at the end of the experiment.

As the research had a processual character, we were interested in getting data about the dynamics of the students’ improvement, by comparing their on-going evaluation scores differences, viz. their mid-term form of assessment consisting in portfolio evaluation, with the end-of-semester achievement test results for both types of groups.

Besides these evaluation instruments, data were collected throughout the experiment by means of questionnaires addressed to students and graduates, interviews taken to good language learners, students’ diaries, focus groups and case studies.

The data were processed using the Statistical Package for Social Sciences – SPSS software. In analyzing the results, the triangulation principle of the quantitative and qualitative data collected was observed.

The variable issues analyzed post-treatment in the research in order to identify trends and find out answers were:

- success in learning;
- level of communicative competence in English;
- progress in reading and writing skills;
- awareness of the LLS and LUS repertoire;
- level of students’ motivation and involvement;
- assuming responsibility by the learners for their own learning process;
- the optimization of the teaching process.

All the hypotheses were confirmed. However, as we can strictly select only a few of the most relevant aspects to present in this study, we have chosen to illustrate our approach to interpreting the obtained data by briefly presenting the main conclusions referring to the level of success in learning that was attained. This can be seen in Figure 1.

Thus, if for the mid-term test administered in week seven of the experimental semester the differences exist but they are not yet statistically significant, although there is already a minimal trend in favour of the experimental group, this difference becomes statistically significant only upon the conclusion of the semester.

We can conclude that there was an ascending tendency, although a certain period of time was necessary for the improvement to really become apparent.

As we proceeded in most cases in interpreting the results, the quantitative data were corroborated with the qualitative data provided by the experimental group learners’ answers to the student questionnaire, as well as from their diaries.

Figure 1. Evolution of grades differences (Exp – Wtn) at mid-term and final test.

We should point out that, given the nature of this type of qualitative data, the students’ impressions and comments appeared more dissipated along the semester weeks.

However, at global level, their increasing attempt to analyze their own learning process in its evolution is indeed noteworthy, as can be seen from the following excerpts from the experimental group students’ diaries:

- I have learned how to improve my grades using new learning techniques corresponding to my own learning style;
- I think that sometimes I must change something in my way of learning to make it more efficient;
- It is good to enrich my repertoire of learning strategies in order to improve the quality of my learning.
- Today I realized that the way I learn can be improved, certainly in small steps, but I must be patient to get some results.
- It is obvious that you must reflect more about the way you learn; that can help you to improve faster and it may be useful to you in the future, too.
- It is certainly important to know your own learning style, because in time you can develop new strategies to compensate for the lack of time at your disposal in faculty for learning English.

3. OPEN-ENDED CONCLUSIONS

In spite of the inherent limitations of any research of this type, carried out on people and by people, although effort was made to maintain good control over potentially occurring variables such as the classroom environment conditions, the materials used, the students’ attendance and so on, a range of useful conclusions emerged, but we consider them only as a starting point for further amendments and possible transferability to other contexts.
The project can be considered to be useful, as a definite tendency of optimization was recorded with the experimental group, whose students developed their capacity of identifying what strategies they preferred and how often they used them.

Among the most appealing LLS and LUS were:
- establishing clear learning objectives;
- creating opportunities to use the foreign language;
- self-monitoring of the learning progress;
- cooperation with peers and/or good speakers of the foreign language.

Data from interviews with GLLs and focus groups confirmed the above. Moreover, they indicated other strategies identified as being of use, which the respective students already had:
- communicating without the fear of making mistakes;
- being permanently open to communicating in English;
- increasing their own level of communication competence by both intensive and extensive reading.

There are grounds to believe that the efficiency of an English course of the ECS type can increase up to the attaining of the objectives envisaged, even against a limitative temporal frame of reference.

It is certainly necessary to select and place under focus those LLS/LUS and linguistic skills that the student/future graduate will need on mid- and long-term.

There are also good chances that a consequent increase of the learners’ level of further autonomy in learning may develop.

As regards the potential quality of such research of being transferable, as Trochim [14] points out, researchers are the first responsible for ensuring the transferability of their endeavour.

Consequently, researchers should enhance it by thoroughly describing their research context and main assumptions, which is what we have tried to do in this study.

However, it is the person who wishes to take up results, but in a different context, that is responsible for the choices /changes to be made/operated to ensure an optimal transfer.

Moreover, if we consider Cziko’s [7] point of view, stating that in social sciences it is not actually possible to carry out comprehensive and definitive experiments and that the most we can realistically hope for in educational research is not to predict or control, but only to temporarily understand phenomena, we can realize the risks involved in transferring solutions abruptly into different contexts, as well as in considering them as patterns set in stone, thus disregarding the necessary recurrent remodeling/changing of focus demanded by the dynamics of each context features.

We should therefore underline that, in identifying the most productive modalities of embedding LLS and LUS in a language course, the teacher/course designer should give thoughtful attention to the concrete features of the context in which the implementation of the strategy-oriented set of activities is going to occur, taking into account the many influential specific factors in attaining success, among which the main foci of the course, the learners’ profile, the facilities and equipment used, as well as the time available.

As a conclusion of significance, emphasis should be put on the importance of the need that teachers should receive specialized training in order to be able to make the necessary choices in designing and implementing similar projects, which could contribute to their permanent professional and personal development.

4. REFERENCES

INTERNET/INTRANET/EXTRANET BASED SYSTEM IN THE PREMINV PLATFORM FOR VIRTUAL PRODUCT DEVELOPMENT ENVIRONMENT

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ABSTRACT: Development teams involved in the product development are often geographically and temporally distributed. There is a high level of outsourcing in the actual product development efforts. It is then possible to say that enterprises give rise to a special type of virtual enterprise (VE), in which each company maintains the greatest flexibility and business independence. The key elements of a VE are the desired product, the targeted environment, the lifecycle processes and the people involved in the processes. Virtual teams for engineering design are becoming more commonly used in industry and the engineering education community must prepare graduates to be employed in such work environments. It is inevitable that multidisciplinary teams for product design, with members located in different geographic locations, will become more common place in the future. To be effective, a virtual team must be able to communicate, collaborate and coordinate, all at distance. This paper gives a solution for engineering education beside on the virtual teams, and presents the general architecture of an experimental platform for training, research and consulting in new digital economy, located in the PREMINV research centre at the University “POLITEHNICA” of Bucharest.

1. INTRODUCTION

Under the concept of a global economy, enterprises are assigning design and production environments around the world in different areas. A serious issue of information exchange emerges as companies use traditional hardware and very distinct software appropriate to their field of expertise. To overcome the problem of low productivity due to the interruption of information, the concept of simultaneous engineering and concurrent design becomes very significant. The ability of companies to form global networks on the Internet will transform the way that we do business in the future. Our view is that the future of global networking is very promising. The recent corporate downsizing which is happening in many countries means that new industries will have to provide employment opportunities in order for consumer demand worldwide to grow [1]. We believe that the Internet will provide the means for companies to associate themselves with one another in virtual networks and begin to develop new business opportunities for each other in global markets. Furthermore, we believe that many companies who are now considered small will exert tremendous market power with the help of global networks. The ability to share information and resources gives even very small companies an opportunity to pursue larger projects, knowing that other members of a network will provide support and also participate as partners [2].

Usually, a virtual community, e-community or online community is a group of people that primarily interact via communication media such as newsletters, telephone, email, online networks or instant messages rather than face to face, for social, professional, educational or other purposes. If the mechanism is a computer network, it is called an online community. Virtual and online communities have also become a supplemental form of communication between people who know each other primarily in real life. Many means are used in specialized software separately or in combination, including text-based chat rooms and forums that use voice, video text etc. Significant socio-technical change may have resulted from the proliferation of such Internet-based virtual networks. The importance of the virtual network can not be over emphasized in this context. The ability to form global networks on the Internet will transform the way that we do live in the future. Service-oriented computing is becoming the prominent paradigm for leveraging inter-personnel information systems to complete higher-order information transactions at the heart of the modus operandi of the virtual network.

This paper describes research aimed at supporting the formation and operations of virtual network through the setting-up of service-oriented workspace environments. Virtual collaboration for networked virtual teams is a complex and challenging activity in which there are major important components to be accounted for [3]. The ability of companies to form global networks on the Internet will transform the way that we do business in the future. Our view is that the future of global networking is very promising. Finally, local or provincial government agencies will be able to assist their local business community by joining virtual networks. The ramifications for local economic development are quite significant. By accessing a virtual network, your agency can now reach more companies and enhance your business attraction promotional activities.

The term “virtual enterprise” has been used in articulating the strategy for the 21st century global manufacturing enterprises. One of the key requirements is to develop an Information System infrastructure to integrate and control the interoperability of the distributed, heterogeneous and concurrent systems in the participating organizations. Today, cooperative processes are not the automatic results of implementing collaborative, real-time communication technologies, but the result of a carefully designed and systematically maintained virtual team development plan.

This article presents a solution for an innovative Information System infrastructure and its Networking Solution to help describing global information technology support for inter-organizational enterprises with the background of modern
Also, what is a virtual enterprise network (VEN) solution in the PREMINV platform?

2. THE PREMINV E-PLATFORM

A central point of future product development is therefore collaboration and communication. We are implemented in the PREMINV platform a solution based as a virtual network concept (see Figure 1). This is based on consistent, integrated data sets and on tools that support the collaboration [1]. As a general requirement for this infrastructure support is that the companies must be able to inter-operate and exchange data, information’s and knowledge in real time so that they can work as a single integrated unit, although keeping their independence/autonomy. A complete redesign of an existing enterprise to converged or virtual enterprise would represent a big effort, not justifiable in market terms as companies are not replacing easily their running systems. A better strategy is to try to separate the internal functionalities from the network-related ones and develop the necessary mappings to legacy systems, to correspond to the new aggregator model for modern electronic system.

Figure 1. A VN solution in the PREMINV platform.

Also, what is a virtual enterprise network (VEN) solution in the PREMINV e-platform?

- A way for businesses to achieve virtual scale enabling them to operate as if they had more resources and capacity than they actually have;
- Allowing them to operate with all the resources and reach of a large enterprise but without sacrificing their speed, agility and low overheads;
- Enabling them to compete for bigger more profitable contacts with higher innovation and design elements with bigger customers who are prepared to have strategic partnerships with their suppliers [4].

2.1. Virtual Enterprise Network solution

A Virtual Enterprise Network needs its own Private Member Collaboration System to communicate and develop its projects and bids. It needs its distinctive Network Business Applications such as Capability Aggregation and Tender Matching to enable it to function effectively as a co-operative in both pre-sales and contract operations. It also needs a Public Web Site to manage its interactions with potential customers and new members. A hierarchical network design model breaks the complex problem of network design into smaller, more manageable problems. Each level, or tier, in the hierarchy addresses a different set of problems so that network hardware and software can be optimized to perform specific roles. Devices at the lowest tier of the hierarchy are designed to accept traffic into a network and then pass traffic up to the higher layers.

The core of the network has one purpose: to provide an optimized and reliable transport structure by forwarding traffic at very high speeds. In other words, the core layer should switch packets as fast as possible. Devices at this layer should not be burdened with access-list checking, data encryption, address translation, or any other process that stands in the way of switching packets at top speed.

The distribution layer sits between the access and core layers and helps differentiate the core from the rest of the network. The purpose of this layer is to provide boundary definition by using access lists and other filters to limit what gets into the core. Therefore, this layer defines policy for the network. A policy is an approach to handling certain kinds of traffic, including routing updates, route summaries, Virtual Local Area Network (VLAN) traffic, and address aggregation. You can use policies to secure networks.

The access layer feeds traffic into the network and performs network entry control. End users access the network via the access layer. As a network’s “front door,” the access layer employs access lists designed to prevent unauthorized users from gaining entry. The access layer can also give remote sites access to the network via a wide-area technology, such as Frame Relay, ISDN, or leased lines. A reliable and available network provides users with 24-hours-a-day access. A highly reliable and available network, fault tolerance and redundancy make outages and failures invisible to the end user.

The high-end devices and telecommunication links that ensure this kind of performance come with a steep price tag. Network designers constantly have to balance the needs of users with the resources at hand. Multicast traffic can also consume a large amount of bandwidth. Multicast traffic is propagated to a specific group of users. Depending on the number of users in a multicast group or the type of application data contained in the multicast packet, this type of broadcast can consume most, if not all, of the network resources. As networks grow, so does the amount of broadcast traffic on the network. Excessive broadcasts reduce the bandwidth available to the end users and force end-user nodes to waste CPU cycles on unnecessary processes. In a worst-case scenario, broadcast storms can effectively shut down the network by monopolizing the available bandwidth. Two methods can address the broadcast issue for large switched LAN sites:

- The first option is to use routers to create many subnets and logically segment the traffic. This scenario can create a bottleneck in the network.
- A second option would be to implement virtual local area networks (VLAN’s) within the switched network.

A VLAN is a group of end devices that populate multiple physical LAN segments and switch ports; they communicate as if they were on a single LAN segment. One of the primary benefits of VLAN’s is that LAN switches (by creating VLAN’s) can be used to effectively contain broadcast traffic and manage traffic flows. The Virtual Local Area Network (VLAN) is the best support for the virtual enterprise network or the virtual teams. The interconnection of VLAN’s is realized on the level two (ELAN – Emulation Local Area Network), and on the level three (MultiProtocol Over AT – MPOA).

MPOA Client (MPC) and MPOA Server (MPS) are obtained the configuration by LECS (LAN Emulation Configuration Server). The virtual networks MPOA is named IASG (Internet Address Summarization Groups).
2.2. Virtual teams in the PREMINV e-platform

Also, today, what do you want in an e-teams with multidisciplinary optimization? First, for your enterprise: low risk, low cost, single point of support; reap benefits as soon as possible, ready for unpredictable demand and growth, future capabilities. Secondly, for your customers: excellent response time, ability to build competitive advantages from a wide variety of applications (use specialized products for unique features, integrate them for seamless customer support etc), ensure optimal customer experience to build loyalty, customer trust (security features build trust: validate who is doing business with whom; secure financial transactions, protect internal assets, halt spread of viruses, protect against hackers), high availability etc. Virtual Enterprise operates as nodes in a network. A different architecture, engineer and construction organization, a fresh virtual team, is needed every time for every new project (see Figure 2).

Innovative techniques to co-ordinate and manage information, resources and documents need to be developed to integrate successfully and reduce lead times, increase quality and keep within budget constraints [5]. Consequently, the partners in the virtual enterprise need to exchange legacy data and migrate with other systems outside their own secure corporate boundary. In order to achieve collaboration between different actors in the Virtual Enterprise, there needs to be common processes supporting the distributed product development process. Virtual teams do not operate like traditional physical teams, as their requirements reflect a whole new way of communicating, working collaboratively, sharing information and mutually supporting other team members. The new technologies and approaches required to achieve this are completely alien to most of our present organizational culture. And this is why they fail. Cooperative processes are not the automatic results of implementing collaborative, real-time communication technologies, but the result of a carefully designed and systematically maintained virtual team development plan. A virtual product development by the virtual teams in a virtual enterprise is a temporary alliance of teams that come together to share skills, abilities and resources in order to attend a project opportunity and whose cooperation is supported by computer network and adequate tools, competencies and special application software (see Figure 3). In this context a VEN is a way for businesses to achieve virtual scale enabling them to operate as if they had more resources and capacity than they actually have.

We purpose in the PREMINV e-platform (see Figure 4), a general architecture for virtual product development, geographically dispersed, in order to achieve collaboration between different actors in the Virtual Enterprise, there needs to be common processes supporting the distributed product development process [5].

Enterprises are now facing growing global competition and the continual success in the marketplace depends very much on how efficient and effective the companies are able to respond to customer demands.

The formation of virtual enterprise network is taking up momentum to meet this challenge.

The idea of virtual enterprise network (VEN) is meant to establish a dynamic organization by the synergetic combination of dissimilar companies with different core competencies, thereby forming a “best of everything” consortium to perform a given business project to achieve maximum degree of customer satisfaction. In this emerging business model of VEN, the decision support functionality, which addresses the issues such as selection of business partners, coordination in the distribution of production processes and the prediction of production problems, is an important domain to be studied.
The Internet is a world-wide conglomerate of different networks that communicate among each other via a common protocol, independently of the hardware type used. Various network services can be used by everyone, either supplying or demanding those [6]. A large range of distribution, the platform independence, an big number of user friendly services that are easily accessible through the World Wide Web as well as the open standards used and free or budget-priced products (such as browsers, html editors, software updates) have lead to a high and continuously growing proliferation of the Internet [7]. The advantages offered by this e-platform for covering the information needs are held to be the following [1]:

- Reduction of local barriers by means of world-wide information offers;
- Reduction of time barriers by means of permanently available information;
- Reduction of (transaction) costs by way of automation of information processing on the supply and/or the demand side;
- Improved coordination and cooperation with external partners using an integrated information and communication platform (i.e. platform independence, information exchange without media ruptures).

However, the application-to-application communication problem still exists. Businesses have needed a standardized way for applications to communicate with one another over networks; no matter how those applications were originally implemented [8]. Web Services, the latest evolutionary step in distributed computing, represent exactly this solution by providing a standardized method of communication by means of which different applications can be integrated together in ways not possible before. Different applications can be made to call on each other's resources easily and reliably, and the different resources that applications already provide can be linked together to provide new sorts of resources and functionality. Moreover, the application integration becomes much more flexible because Web Services provide a form of communication that is not tied to any particular platform or programming language. However, the application-to-application communication problem still exists. Businesses have needed a standardized way for applications to communicate with one another over networks; no matter how those applications were originally implemented. Web Services, the latest evolutionary step in distributed computing, represent exactly this solution by providing a standardized method of communication by means of which different applications can be integrated together in ways not possible before. Different applications can be made to call on each other's resources easily and reliably, and the different resources that applications already provide can be linked together to provide new sorts of resources and functionality. Moreover, the application integration becomes much more flexible because Web Services provide a form of communication that is not tied to any particular platform or programming language.

3. CASE STUDY: A COLLABORATIVE DESIGN SYSTEM

In order to permit a flexible answer to customer requirements, many products have been modularized in their design to the extend that entire areas of development such as, for example, the design of electrical components can now be outsourced to external suppliers or service providers if required. A majority of consumers and investment goods produced in the mechatronic engineering domain now consist of a number of modular mechanical, electrical and control software components. For example, in the context of a mechatronics
system, the idea is to find the best mechatronics system solution, not the best mechanical solution or the best electronic solution or the best software solution. The solution is the set of values for the variables, which either maximize or minimize, as desired, the value of the objective. In design for competitive advantage the objective would probably be cost, quality or value, which is a combination of the two. Also, both the mechanical characteristics of these modules and the electrical system and software, must be integrated to form a co-operative engineer system. Usually the organizational and systematic division into mechanical and electrical product development is the obstacle to creation of a common virtual product [9].

We propose in the PREMINV e-platform an Internet/Intranet/Extranet based tools, based on the VEN solution, for a collaborative framework for interdisciplinary communication in the conceptual design stage with multidisciplinary optimization [10]. To support multidisciplinary optimization a base definition must be defined as a common ground among the product development actors (see figure 5). The base definition contains two major types of information, an entity hierarchy and an entity attributes. The entity hierarchy describes how the components of the system are grouped together and the entity attributes for a part include, for example, moments of inertia, material properties etc. The design parameters are considered as attributes of entities in the base definition, and remain with the entities when they are regrouped in engineering views to create assemblies. The feature-based design parameters serve as a common language to support design trade-off across various engineering disciplines where relevant performance of the mechatronic systems is measured. The ability to work with diverse multidiscipline teams members to successfully reach a goal objective. For a multidisciplinary group, the language of the system must do is independent of the languages of the disciplines, but is common to all. Thus, functional language should be a language of choice for multidisciplinary communication. Based on the integration of entirely separated department within the development a mechatronic product it is possible to define an enhanced process for the collaborative development of product properties in partnerships. In order to facilitate effective communication across disciplines, this system argues that an integrated software framework should enable sharing and capture of multi-criteria design proposals, design semantics, critique, and explanation and change notifications. The product data to be browsed consists first of all of a base definition and engineering views (see figure 5).

Part of view model is the construction of an entity hierarchy starting with the database definition entity hierarchy according to the needs of the particular engineering discipline at the actors [10]. The actor executes the simulations and analyses in his working environment (see figure 6). The “product model” is composed of a knowledge model (features and production rules) and of data model. The different actors can use a set of predefined features and those can be shared. Some rights are given to specific actors in order to read, to add or modify a particular or universal feature. A main interest in using feature is to be able to declare the instance of this feature without to be immediately obliged to define the values of their characteristics. Instead of specifying a value for a characteristic, an actor can use the constraints on this

![Figure 5. A collaborative design system with multidisciplinary optimization.](image)
The second model alternative of product development environment considered was a fully distributed development environment (there would not be segregated local computing resources for each team member). All computing resources would be distributed across the network (through an entry point to the network all simulation and analysis tools may potentially be accessed).

In addition to the team’s full-time members, the team also includes contributing members who are recruited for specific components of the project. As such, a core group is responsible for leading the project and a sub-group is involved in specific components of the project [1]. While the full-time employees form the central core of the team, experts in the different problems of the project (control systems, mechanic systems, electronic systems, programmer’s etc.) are also team members. The system enables the different team members to retrieve a wide collection of product system data to start engineering analyses, and store the analysis results. Other team members, thus allowing for a collaborative design of the product system can use simulation results stored by one team member. The system provides a catalogue of independent objects, i.e., models, simulation scenarios, analysis results, and the product configuration hierarchy, stored in the global database and manages versions of each of these objects produced during the course of the design analysis and development process. It gives the members of an enterprise-wide product development team a convenient, uniform interface to the global product data from different platforms. The product model is composed of a knowledge model and of data model. The major functionality of the engineering views are view model creation, data consistency with base definitions to support multidisciplinary design trade-off and mapping definition to automate view model creation during design iterations. As the translation task propagation and coherence management have to assist each professional team.

4. CONCLUSION

In the PREMINV platform, we are creating a hardware-software environment for implementing the above-presented concepts, imposed by global collaborative manufacturing and Internet/Intranet technologies. This platform demonstrates an approach to solve many of the problems of interoperability, heterogeneity of platforms, and data sharing. Organization and storage of technical knowledge in such a way that it can be used in different situations and for new products being developed and Knowledge based assistance in developing new products and processes [5]. The integration of workspaces in a co-operative environment has been demonstrated through the use of internet/intranet/extranet technologies. In the paper we define a hardware-software platform named PREMINV, needed to train students, the future engineers, who must be able to work in the virtual enterprise (VE), imposed by the globalization of the manufacturing and competition. Within the framework of its activities on collaborative engineering, the PREMINV set up training projects aiming at developing competence’s in this field with objectives of education training but also research, and industrial transfers.

5. REFERENCES


7. Shakya, A., Takeda, H., Wiwongse, V., StYLiD: Social information sharing with free creation of structured linked data, in SWKM’2008: Workshop on Social Web and Knowledge Management @ WWW 2008, April, Beijing, China, (2008).


Figure 6. Engineering views (ex: Matlab Integration).
HUMANISING ENGINEERING EDUCATION: TOWARDS PROMOTING WOMEN IN SCIENCE AND TECHNOLOGY

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ABSTRACT: The aim of this paper is to assess the role and position of women in the area of science and technology in Romania, starting from engineering education and further on analysing their employability in their field of specialisation. The underlying hypothesis of this study is that the role of women in contemporary society needs to be reassessed in order to best utilise the national ‘human capital’ since “the advancement of women is an important economic, business and societal issue with a significant impact on the growth of nations” (Hausmann, Tyson, & Zahidi, 2007, p. vii). We will first present statistical data provided by the European Commission and analyse the data supplied by the survey The Contribution of Higher Education to Regional Development – Centre Region no. 7, as well as investigate the particular situation of engineering education at “1 Decembrie 1918” University of Alba Iulia.

1. INTRODUCTION

In this paper we will undertake to appraise the role and position of women in the area of science and technology in Romania, starting from engineering education and further on analysing their employability in their field of specialisation. The underlying hypothesis of our study is that the role of women in contemporary society needs to be reassessed in order to best utilise the national ‘human capital’ since “the advancement of women is an important economic, business and societal issue with a significant impact on the growth of nations” (Hausmann, Tyson, & Zahidi, 2007, p. vii). According to the EC (2006, p.13), “women’s intellectual potential, and their contribution to society are not being fully capitalised upon. In particular, their participation is dramatically low in certain branches of the natural sciences and in engineering and technology, which are key R&D areas. Women are seriously under-represented in the business enterprise sector where the EU’s R&D is most highly intensive; and in senior academic grades and influential positions where strategies are set, policies are developed, and the agenda for the future is determined”.

We will first present statistical data provided by the European Commission (She figures 2006: Women and Science. Statistics and Indicators), then we will analyse the data supplied by the survey The Contribution of Higher Education to Regional Development – Centre Region no. 7 [6] and finally we will investigate the particular situation of engineering education at “1 Decembrie 1918” University of Alba Iulia. Last but not least we will put forth some methodological suggestions for improving higher education programmes for engineering students, focused on the empowerment of women, with a clear aim at boosting female labour participation in the field of science and technology.

The under-representation of women in science and technology is not so difficult to understand, given the fact that not so long ago, back in the 80’s, technically intensive industries were managed almost exclusively by men. It was only men who were engineers; their spouses were housewives. In the rare situations the wife had a job it would often be just a job and not a career. Although in the US companies were making efforts to employ women, and not with too remarkable results, rather few in Europe paid real attention to this aspect. Women clearly resented this state of affairs but raising this issue was not accepted at the time. The companies were reluctant to change the status quo and actually no one wanted to risk bending or setting new rules.

As a result of these discriminatory practices, the business culture was definitely suffering. Despite the fact that the world was progressing, industries were prisoners of the past, from a cultural point of view. Although there was great need for talents in businesses, there was little space in European industries for women engineers. The repercussions are still to be felt nowadays in the persisting tendency in young women to avoid careers in engineering and science. The shadows of the past are still here to haunt us.

However, we should not lose faith – there are clear signs of improvement, albeit in other domains. Dual careers are becoming more and more frequent in nowadays society. Secondly, competition for female engineers is rather fierce in companies that truly engage in opening scientific, management careers for women. Nevertheless, the sad reality at present is that it is only 15% of full professors in European universities that are women, and women are under-represented on decision-making scientific boards in almost all European countries. This reality is considered by most experts at EU level as a major drawback, and it is clear that the prevailing scientific culture should change in order to become more inclusive. A fair gender balance in scientific research at decision-making level represents one of the most important factors that may contribute to improving the European Research Area.

2. ANALYSIS OF THE EUROPEAN SITUATION

It is also true that there is a slow rate of change in our industrial world and a whole surge of more advanced societal and business issues. There are still few women studying engineering at university level while many are studying medicine or natural sciences. Women don’t rise to the top as often as men. It is still very difficult especially for dual careers or single parents with young children to balance work and life.

According to the data provided by the study She Figures 2006 of the European Commission, as far as the student intake is
concerned, there is no wide discrepancy between the number of female and male students (ISCED 5A) across all disciplines. The discrepancy becomes apparent as one advances across the seniority ladder.

![Figure 1](image1.png)

**Figure 1.** Percentage of male and female participation across EU-25 countries, 1999 & 2003, all disciplines

The situation is different as far as the Science, Engineering and Technology (SET) disciplines are concerned, where we can notice high female under-representation, at all levels of the research career ladder, from undergraduate students to the highest position at which research is carried out (p. 56). (ISCED 5A = tertiary programmes providing sufficient qualifications to enter into advanced research programmes and professions with high skills requirements/ MSc programmes; ISCED 6 = doctoral programmes; Grade C = The first grade/post into which a newly qualified PhD (ISCED 6) graduate would normally be recruited; Grade B = Researchers working in positions not as senior as top position (A) but more senior than newly qualified PhD holders; Grade A = The single highest grade/post at which research is normally conducted) [2].

![Figure 2](image2.png)

**Figure 2.** Proportions of men and women in a typical academic career in science and engineering, students and academic staff. EU-25, 1999-2003.

As a general remark, first of all we can notice that many more young men enter education in science and engineering than women. Secondly, according to the first graph, in the first stages of the career – up to Grade C – the participation levels remain almost constant, indicating that there is no gender-based leaky pipeline at these stages. In other words, women and men drop out at basically the same rate. The number of female students entering science and technology education is rather low compared to other areas, nevertheless considering the academic setting, there isn’t such as remarkable drop-out rate in the ‘hard’ sciences as it happens in the case of social sciences or humanities. In the last career stage the preponderance of men is actually comparable – 85% and 91% respectively. Thirdly, the two figures also reveal the gender segregation and the presence of women across the different sectors of the labour market. Far more women are driven to the social sciences and humanities than to science, engineering and technology. Nonetheless, the different S&T disciplines also present dissimilarities: biology and life sciences attract far more female students than computer sciences or physics.

As can be easily understood, the reasons why female students do not embrace S&T training have been thoroughly investigated (Faulkner, 2000). One of the motives is that the stereotype of engineers as logical, rational, machine-oriented people does not fit with the self-image of women as ‘people-oriented’ [4]. Supposedly, because of this reason, women are less attracted to S&T. According to a study carried out by Anita Thaler, in order to analyse the relationship between self-image and S&T image, the self-image of young people does not only depend on gender but also on cultural background, more concretely on the culture of a specific nation. Austrian men, for example, would characterise themselves as more people-oriented than their Finnish or German female counterparts [8]. On account of this international research, the author concluded that there is no all-encompassing personality profile that could be attached to the drop-out process.

Other specialists (Christine Wächter, 2005) have also analysed the relevance of national culture with reference to engineering education. In his research he proved that women are more attracted to interdisciplinary engineering curricula and that a stronger emphasis on social and environmental aspects of technology would make S&T programmes more attractive to women. Interestingly enough, the study carried out among seven European countries revealed that one third of engineering students want to be taught non-technical subjects. Again, the differences across countries were relevant: students from France and Finland were content with the existing curricula, while the majority of Austrian and Greek students favoured more non-technical subjects [9].

Another study, the Moloney Search survey, comprising 100 in-depth interviews with female final-year computer scientists in the UK, showed that 35% of the female students in computer science choose not to embrace a career in their field of study, as they reckon the environment will be ‘too male’ and fear a lack of career progression. According to the same study [7], these are the reasons why they favour general management jobs, consulting or banking. Moreover, it is considered that the inexistence of role models in computing careers is by and large off-putting. Other studies among former IT professionals in the UK underlined the fact that the major drivers for women leaving this profession concern the long working hours and total commitment to the job, the lack of flexibility in balancing work and private life, as well as the organisational culture which do not foster an atmosphere of inclusiveness (DTI, 2005).

3. ANALYSIS OF THE ROMANIAN SITUATION

The same EC study, *She Figures 2006* (p. 57), Romania ranks highest as far as women in top positions in academia are concerned, on 29.1 %, followed by Latvia with 26.5 and Finland with 21.2% [2]. (Grade A is equivalent in Romania with a full professor = ‘profesor univestitar’). Currently, the Minister of Education of Romania (for the second time) is a full professor of engineering, and Rector of the Politehnica
Bucuresti. Unfortunately there was no data available for Romania concerning the proportion of female grade A staff by main field of science. However, by way of example, at “1 Decembrie 1918” University of Alba Iulia, there are only three female full professors (one in Philology, one in History and the other one in Education, i.e. none in Science, Engineering or Technology) out of a total of 24 (12.5%).

According to a study carried out at the level of the Centre Development Region [6], for three universities (Transilvania University of Brasov, Lucian Blaga University of Sibiu and “1 Decembrie 1918” University of Alba Iulia, the general proportion between female and male students looks more promising (although heed must be paid to the fact that Humanities specialisations are almost entirely made up of female students).

Student distribution by gender per region shows generally a slight preponderance of female students (51%), close to the country average (51.3%). The percentage of female students is higher for all three universities of the Region, except for Transilvania University of Brasov – UniTBv, which recorded for the academic year 2006-2007 a percentage of only 48.38% female students. However, during the next academic year the proportion of female students was 51.22%. There is an increase in the number of female students, the most remarkable figure being recorded by “1 Decembrie 1918” University of Alba Iulia - U1Dec1918AB, with a 65.17% of female students during the academic year 2007-2009 [6].

The SET (Science, Engineering and Technology) fields of specialisation offered for undergraduate students at our university (in compliance with the Bologna system) are Information Technology (1st and 2nd year of study), Cadastre (1st and 2nd year of study) and newer specialisations: Applied Electronics and Environmental Engineering (only 1st year of study). As the charts below clearly show, there is a marked disproportion between the number of female and male students in the case of IT, Cadastre and Applied Electronics. As Environmental Engineering is more or less a cross-disciplinary specialisation, having more in common with Natural Sciences rather than with Engineering proper, it is understandable why there is a 50% proportion of female vs. male students.

Information Technology seems more attractive to female students, given the fact that they have the opportunity to attend (concurrently with their academic studies) the Teacher Education Programme, upon successful passing of which they will be able to teach IT at primary and secondary level education.

In the field of Cadastre the tendency is more evident (an average 27.23% female representation. Most of the students have a role model in the family (a civil engineer or architect, who can, most probably, assure them an entry on the labour market, upon graduation).

In the first year of Applied Electronics there are only 4 female students, who declared that they had seen themselves all their lives...
life doing something with electronics or engineering. However, they can feel their male peers’ patronising indulgence. Male students consider them as a sort of oddity in a men-dominated world. They are expected to attend classes regularly, go to the library, take notes and study intensively, as if this is the only way for them to rise to the intellectual heights of the ‘male mind’.

Secondly, it would be important to nourish the talent pool, by involving women in activities that make full use of their talents and competitiveness of the company/institution. All problems have solutions, and the same can be said about engineering education. If we are to refer again to the concrete situation of “1 Decembrie 1918” University of Alba Iulia, several things can be done in order to humanise the academic curricula and educational experience in general of the female students.

In order to best address the gender gap recorded in female participation in SET disciplines, at all levels of the career ladder, several action and measures need to be taken. According to EU specialists, it is important to eradicate gender discrimination in science, engineering and technology, at all levels, from undergraduate studies to top level positions in academia, private or public sectors, and government. It is obvious that inclusive and transparent promotion processes in the research world would mean that women and men are given access to formal networks in the research world in a way that exclusion and strict decision-making by men-dominated networks could be resisted.

The first aim to be achieved in this direction would be to invest in the process of change management so as to include gender diversity, and make management accountable of progress. First and foremost the management needs to be made aware of the problem that discriminating women may cause to the competitiveness of the company/institution.

Secondly, it would be important to nourish the talent pool, by exposing women to challenging work experiences. Only by involving women in activities that make full use of their talents and intellectual capacities, would they become truly motivated and willing to pursue a career in engineering.

Thirdly, we need to address concretely work-life balance issues, which are common to men and women. Women need the support of the family, as well as the support of their employers in order to be able to achieve this balance.

Fourthly, it is necessary for companies to implement internal programs: role models, mentoring, coaching and child care. Success stories need to be made known and other women should learn from their peers’ experience. Younger women in SET need to work under the supervision, counselling and guidance of a more experienced woman. Last but not least, it is important for the company to ensure support during and after pregnancy. Child care facilities are important in order to give the mother the possibility to pursue her professional duties while at the same time making sure that children are well taken care of.

5. CONCLUSIONS

All problems have solutions, and the same can be said about engineering education. If we are to refer again to the concrete situation of “1 Decembrie 1918” University of Alba Iulia, several things can be done in order to humanise the academic curricula and educational experience in general of the female students.

First, a close relationship with technical high schools needs to be maintained. Different ‘open-door’ days may be organised, where high school students may be invited and demonstration lessons and activities may be set up in order to get female high school students involved. A whole system of mentoring and coaching may be put in place in order to offer more realistic insights into the career of engineer.

Secondly, it is important for the management of the university to promote women to top level position, as only in this way could we eventually offer role models and success stories. Thirdly, the curricula may be changed in order to allow for transdisciplinary subject. For example, a course on entrepreneurship may be useful, especially as it may educate better young women to enter the private sector as self-starters after graduation. Career counselling may also be introduced as part of a tutoring system.

6. REFERENCES

THE STIMULATION OF THE SUCCESSFUL INTELLIGENCE FOR ENGINEERING EDUCATION

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ABSTRACT: To teach for a successful intelligence require from the teacher to use a set of techniques that encourage the students to engage both in a learning that stimulates the reproductive thinking, and especially in an analytical, creative and practical learning. Purpose: to capture the specific learning and thinking styles of students from technique academic specializations depend on the preference of the learning environment. Objectives: to identify the preferences of the students from technique specializations for certain learning situations (analytical, creative and practical); to identify the learning and dispositional thinking styles preferred by students from technique specializations. Sample: 120 students from Polytechnic University of Timisoara. The instruments used: Learning style inventory (Honey and Mumford, 1986); Rational-experiential Inventory (Paciini and Epstein, 1999); Questionnaire for identifying preferred learning situations from a successful intelligence perspective (Paloş and Maricuţoiu, 2008); Questionnaire for identifying preferred learning environment (Paloş, 2009). Pragmatic value: designing educational materials, choosing efficient teaching methods.

1. A SUCCESSFUL INTELLIGENCE

In Sternberg's view, to have a successful intelligence means having the ability to adapt, to shape and to select the contexts that give you the opportunity to achieve your personal goals, socially and culturally. By adapting, the individual is changing the behaviour as to fit the environment in which he operates; by shaping the environment, he is trying to amend it in order for his actions to be successful; by selecting he chooses and searches the environment that will allow the achievement of his objectives. To realize this, the person must have the capacity and discernment to identify his strengths and weaknesses and to find ways to capitalize and to compensate or correct them where necessary.

For that, he must find a balance in the use of his analytical, creative and pragmatic skills. The analytical skills are needed to analyze and evaluate the options he has during his life; the creative skills are useful in generating solutions in order to solve the problems he faces, and the practical skills are evident in the implementation of the options in well-defined contexts and transforming them into functional options [4].

2. TEACHING FOR A SUCCESSFUL INTELLIGENCE

In the educational context, traditional teaching and training aims to develop a knowledge base, focusing on analysis and storage skills of the student. Addressing the teaching from the prospect of successful intelligence aims to extend this base, developing the person’s expertise through also valuing the creative and practical skills, together with analytical and memorizing skills, allowing him to capitalize one’s intellectual qualities, by offering multiple ways of encoding the information (analytical, creative and practical activities) that facilitates the retention of proposed materials [6]. The role of the teacher is not only to provide information for students to assimilate and then reproduce in the process of assessment, but to stimulate them to generate ideas, to evaluate them and in the effort to make these ideas to work in practice, while convincing the others of their value.

To teach for a successful intelligence is to address to a wider range of skills, means to alternate the style of teaching so as to stimulate analytical and the creative and pragmatic thinking. The evaluation, from this perspective, must be designed to allow analysis, expression of creativity and application of acquired knowledge. However, researches show that, even when the teaching is done from the perspective of successful intelligence and assessment follows the traditional model (stimulation of reproductive and analytical thinking), the results of these students are higher than of those who received a classical teaching [7].

To teach in a manner that leads to the development of analytical thinking of students, requires to encourage them to analyze the provided information, an assessment of what is subject to learning, an explanation of how things happen or work, a comparison between several cases or issues, an appreciation of the value of information, analysis of alternatives, a “decomposition of the whole into parts”. When the aim is to stimulate creative thinking, the emphasis in teaching is put on facilitating learning using game words or role playing, on the invention and exploration of new ways of solving various problems or situations, imagining the scenarios that can be used the acquired knowledge or find new uses, to do things differently, “defying” logic of things sometimes. Everything acquired in the classroom becomes really important when used in practical activities. In teaching for practical thinking, the pupil should be encouraged to apply in his daily activity the information given in the class, to verify the theoretical strategies, to experiment in practice what he knows theoretically. Practical situations can be used as a starting point or final point, giving the students the possibility to master the abstract concepts [8].

3. THE STIMULATION OF THE INTELECTUAL DEVELOPMENT OF THE STUDENT

Beyond the manner as is intended to provide information or to assess student’s progress in learning, stimulating his growth and cognitive development depends, on one hand, on his
intellectual skills, and on the other hand, the attitude toward the teachers, colleagues and himself in the process of building and sharing knowledge. We can thus speak of two categories of factors contributing to this development [1]:

- those related to the instruction, which should be thought of in a manner to valorise the most the student’s potential – including the employed methods and means, the type of distributed tasks, the clarity in formulating the expectations and the criteria for the assessment, cultural norms about the teaching-learning dyad, the supportive environment promoted in the educational environment etc.;
- those related to student – referring to his interpersonal skills (how he responds to suggestions and criticism) and the type of relations grown between colleagues, emotional development level, the degree of maturation, of self-confidence etc.

Perry [9] proposes a model of the student’s intellectual development through the years of college, structured in four stages: dualism, multiplicity, relativism and commitment in relativism. In the dualist stage, the student views the world in polar terms of white or black, good or bad, true or false. As a stage of reception of knowledge, the student’s perception on his role is that he should take notes, memorize and reproduce the information presented. In such circumstances, he prefers his work tasks and courses to have a high degree of clarity and structure, any ambiguity or uncertainty arising creating uncertainty and confusion. It is very difficult to make connections between the knowledge offered in different disciplines and to develop a holistic perspective on the phenomenon in question and the existence of more valid arguments or explanations makes him confuse, making him even to put into question the credibility of a professor who does not provide an immediate reply firmly. Overcoming this stage and the access to a higher level are facilitated by the design of tasks that allow multiple solutions to problems and alternative perspectives, so that students are taught to analyze, compare, justify and defend their ideas, to be offered opportunities to practice complex thinking. Such teaching requires an approach that fosters the development of analytical thinking.

The second stage is the one in which students realize that there may be more “correct” answers or more perspectives to approach a problem. The authority in the area is not infallible, because knowledge is very diverse, with “safe truths”, but also truths about which experts have not yet made an agreement. The student's perception of his role modifies now, and he assumes a certain degree of responsibility and tries to learn how to find correct answers, to learn how to learn effectively in different contexts, which makes him to seek ways to establish connections between knowledge gained in different disciplines. Practical activities, projects, simulations and group work are beneficial at this stage characterized by multiplicity of views and a subjective, contextual knowledge. It is indicated that the teacher is to provide structured information with a variety of interpretations, stimulating them to develop and to express their own ideas, which are to be compared with the ones of the others. Such teaching requires an approach that fosters the development of creative thinking.

In the stage of relativism, of contextual knowledge, the students already have the ability to think in relativistic terms, to discern patterns used by teachers or experts to address to less clear, reliable areas of knowledge. They examine records, compare interpretations and recognize that building knowledge is based on experience and reflection, even the authorities in the area being seen as persons who seek to understand. Faculty is regarded as a place where they can obtain information on their field of expertise and where they can learn techniques through which to assess the quality of evidence underlying the conclusions and the teacher becomes a guide rather than an authority. Developing this level is boosted by the independent research projects that allow a fairly high degree of autonomy, the critical reflections upon the things learned from the personal experience, the group discussion that emphasizes critical thinking.

Final stage of cognitive development in Perry's view, is the commitment in relativism, when students have reached the level when they know themselves, and have identified the principles which to dedicate and seek to achieve their full potential. Decisions are made based on aware consideration of alternatives, by assuming the responsibility of consequences. Research and projects through collaboration and cooperation foster knowledge creation and solving of problems. They may recognize the paradoxes, but also the importance of inter-dependent personal relations.

Structuring materials to stimulate analytical, creative and pragmatic thinking, such as, for example: a rethink of courses that would become increasingly less structured as it goes on to higher levels; offering a variety of tasks and concrete learning experiences (case studies, projects, experiences in the work environment) to facilitate many and varied interaction; creating a supportive and secured learning environment to encourage the students to take risks and to cope with the intellectual challenges of university, allow the students to develop and evolve intellectually. Working with students at different levels of development, the option of teaching for successful intelligence perspective is beneficial for several reasons: encourages a deeper and more developed encoding stimulating ways of learning that increase the probability of information rehearsal; it addresses a wide broader of students, capitalizing, correcting or compensating their skills; increases the motivator potential for teacher-student dyad involving both an improvement of the teaching activity and a better learning [7].

4. RESEARCH DESIGN

4.1. Objectives and research hypotheses

The purpose of this research is to surprise the specific learning and thinking styles of students from technical specializations depending on the preference for the learning environment.

The objectives set to achieve this goal were:

O1. Identifying the preferences of the students from technical specializations for certain learning situations (analytical, creative and pragmatic);

O2. Identifying learning styles and dispositional thinking styles preferred by students from technical specializations.

The sample of this pilot research is represented by 120 students from the 1st, 2nd, 3rd and 4th years (90 girls and 30 boys within the age range 19-23 years) from the different faculties of the Polytechnic University of Timisoara (Automation Computers, Architecture, Administration and Public Relations, Industrial Chemistry).

Portfolio of tests used is represented by:

- the questionnaire for identifying learning style - Honey and Mumford (1986), whose construction is based on the experiential learning model of Kolb (consisting of 40 items to which they respond by “yes” or “no” depending on the agreement or disagreement with the subject content and that
evaluates four styles of learning – active, reflective, theoretical and pragmatic;

• the questionnaire REI (Rational-experiential Inventory) developed by Pacini and Epstein (1999), which seeks both dimensions – experiential and rational – involved in processing information; the version has 40 items of Likert type scale with 5 steps from 1–completely false to 5–completely true;

• the questionnaire for identifying preferred learning situations from the perspective of successful intelligence, developed by Paloș and Maricuțoiu (2008), is a test of Likert type scale with 6 steps from 1–very strongly disagreement to 6–very strongly agreement, consisting of 23 items that capture the learning situations preferred by students, situations that favor the development of reproductive (RT), analytical (AT), creative (CT) or pragmatic (PT) thinking;

• the questionnaire for identifying preferred learning environment (Paloș, 2009), whose construction is based on the cognitive development of Perry model, is a test of Likert type scale with 6 steps from 1–very strongly disagreement to 6–very strong agreement, consisting of 62 items that capture the three levels of cognitive development of the students, depending on the years of schooling – dualism, multiplicity and relativism.

4.2. The analysis and interpretation of the results

O1. Identifying the preferences of the students from technical specializations for certain learning situations (analytical, creative and pragmatic).

II. The student’s perspective on learning environment influences his preference for learning situations.

Starting from the model of intellectual development that Perry proposed, to identify the preferred learning environment of the students we have developed a questionnaire with 62 items covering three levels of cognitive development: dualism, multiplicity and relativism. For each stage we focused on students’ perspectives on: knowledge and learning; the role of the professor, student and colleagues; climate and activities in the classroom; the evaluation process. The internal consistency (α Cronbach) of the three scales of the questionnaire is: α = 0.820 for dualism, α = 0.844 for multiplicity and α = 0.881 for relativism – all significant values, which proofs a high fidelity of the constructed test.

After statistical processing of data (with SPSS 15.00 and AMOS 4.0) in Table 1 we can see a preference of the students in their dualist stage for learning situations that stimulate reproductive thinking. This preference is explained by the perspective that people at this level of intellectual development have on the learning environment. We included in this environment the way the student regards knowledge and learning; the role that he plays in the learning process together with the teacher and other colleagues; educational activities and the role of evaluation. Dualism is a stage of assimilation of knowledge, considered in absolute terms of “true”/”false”, “right”/”wrong”. The student believes that information should be only learned and reproduced when the situation demands (e.g., evaluation), achieved without an analysis of them. This makes that in this stage students prefer educational activities and learning tasks that stimulate memorizing and subsequent reproduction of information in the manner in which they were offered in the area.

Table 1. The relationship “dualism intellectual development stage” – “a learning situation that stimulates reproductive thinking”

<table>
<thead>
<tr>
<th>Stage</th>
<th>AT</th>
<th>RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dualism</td>
<td></td>
<td>Pearson correlation .423(**)</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>120</td>
</tr>
</tbody>
</table>

Instead, people in the multiplicity and relativist stages of intellectual development prefer learning situations that stimulate analytical, creative and pragmatic thinking (Table 2, 3 and 4). In multiplicity, knowledge becomes diverse, and students begin to build on the foundation acquired in dualism. He does no longer limit himself to the knowledge provided by the teacher, but seeks to establish relationships between knowledge from different disciplines, to assume greater responsibility in his own training. Relativism already allows analysis, comparison, interpretation and construction of knowledge based on experience and reflection. The analytical, creative and pragmatic thinking makes possible these jumps because it encourages analysis, evaluation, explanation, invention and exploration of new ways of solving problems, practical implementation of the information itself.

Table 2. The relationship “multiplicity and relativist intellectual development stage” – “a learning situation that stimulates analytical thinking”

<table>
<thead>
<tr>
<th>Stage</th>
<th>AT</th>
<th>CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplicity</td>
<td></td>
<td>Pearson correlation .620(**)</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>120</td>
</tr>
<tr>
<td>Relativism</td>
<td></td>
<td>Pearson correlation .548(**)</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>120</td>
</tr>
</tbody>
</table>

Table 3. The relationship “multiplicity and relativist intellectual development stage” – “a learning situation that stimulates creative thinking”

Table 4. The relationship “multiplicity and relativist intellectual development stage” – “a learning situation that stimulates pragmatic thinking”

<table>
<thead>
<tr>
<th>Stage</th>
<th>PT</th>
<th>CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplicity</td>
<td></td>
<td>Pearson correlation .614(**)</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>120</td>
</tr>
<tr>
<td>Relativism</td>
<td></td>
<td>Pearson correlation .550(**)</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>120</td>
</tr>
</tbody>
</table>

The transition from one stage to the superior one (i.e., intellectual development and evolution) is facilitated by the variables age and education. The results revealed by different studies are contradictory: some argue that it is stimulated by the level of education (years of schooling) and not age, while others indicate that neither age nor education are significant in this development [10]. What is important, however, from the perspective of teaching, is that the teacher – by his teaching and assessment activity – can stimulate this development.
I2. The students’ preference for learning situations is also determined by their style of dispositional thinking.

The REI Inventory surprises the individual differences between rational-analytic thinking style (with rational ability «RA» and rational engagement «RE» dimensions) and intuitive-experiential thinking style (with experiential ability «EA» and experiential engagement «EE» dimensions). After statistical processing it can be observed a relationship between the preference for each of the four learning situations and rational processing of information (both at the level of confidence in their ability to be rational and level of desire for cognitive effort, the involvement in activities of thinking). The internal consistency of the four scales is a high one, it was obtained by calculating the Cronbach coefficient α and is α RA = 0.630, α RE = 0.678, α EA=0.772 and α EE =0.684.

Table 5. The relationship “preference for learning situations” – “the rational processing of information”

<table>
<thead>
<tr>
<th>Learning situation</th>
<th>RA</th>
<th>RE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT Pearson correl.</td>
<td>-.311(**)</td>
<td>-.333(**)</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>AT Pearson correl.</td>
<td>.282(**)</td>
<td>.384(**)</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.004</td>
<td>0</td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>CT Pearson correl.</td>
<td>.320(**)</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>PT Pearson correl.</td>
<td>.202(**)</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.042</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

The negative correlation between the rational-analytical processing of information and the preference for learning situations that stimulate reproductive thinking reveals that these people have no confidence in their ability to reason, and do not engage in activities that require thinking, and limit themselves at the memorizing aspect of the learning process. Not the same thing happens with those who prefer learning situations that stimulate analytical thinking, where is notable the need for cognitive effort with the two dimensions – confidence and effective involvement. Willingness to invest cognitive effort is also present for the preference for learning situations that fosters a creative and pragmatic thinking (Table no. 5).

Therefore, the student’s preference for a learning situation (how should be structured by the teacher the educational activities in order to enhance learning) is modelled on the one hand, by the level of confidence that he has about his own ability to be rational, and on the other hand, by his willingness to invest cognitive effort, to engage in activities of thinking. He prefers activities that require analysis, interpretation, evaluation, explanation only if he has confidence in his ability to reason and if he wants to invest effort into thinking.

Attempting a synthesis of the results obtained through the confirmation of the hypothesis of the research, we can say that our student in his dualist stage (as it is described by Perry) prefers those learning situations that require him a reproductive thinking and does not submit him to a too great cognitive effort. This stage is rather typical for people in the first year of university. The students who already have access to the multiplicity and relativist levels (or rather, the beginning of relativism) prefer learning situations that require analytical, creative and pragmatic skills. In these stages, the person is more confident in his ability to reason, but also more willing to do so. We are already talking of the years of study III- IV.

O2. Identifying learning styles and dispositional thinking styles preferred by students from technical specializations.

I3. The preferred learning styles of students are influenced by their style of dispositional thinking.

The learning style is a combination between the repertoire of learning strategies of the person and the way he organizes and represents the information (cognitive style). Involving in its structure strategies (behaviors, steps, operations, techniques used to facilitate the achievement, memorizing, rehearsal and use of information), in the preference for learning style it is also present the intuitive-experiential dimension of information processing.

From Table 6 it can be seen that, always being open to new activities and experiences and having a tendency to act first and then to think of consequences, people with an active style of learning rely very much on intuition, on a intuitive-experiential processing of information and not on a rational-analytical one. Reflective and theoretical learning styles require a thorough, in detail analysis before reaching a conclusion, taking into account all aspects and perspectives before acting. People with preference for these styles process information in a rational-analytical manner; the confidence in their intuition does not feature them. Thus, while active learning style is based more on intuition, action and practice, the reflective and theoretical styles involve mainly a rational and analytical processing of information.

Table 6. The relationship “learning style” – “style of dispositional thinking”

<table>
<thead>
<tr>
<th>Learning style</th>
<th>RA</th>
<th>RE</th>
<th>EA</th>
<th>EE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Pearson correl.</td>
<td>-.252(*)</td>
<td>-.228(*)</td>
<td>.316(**)</td>
<td>.312(**)</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.01</td>
<td>0.021</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td>120</td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Reflective Pearson correl.</td>
<td>.271(**)</td>
<td></td>
<td>-.339(**)</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.006</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td></td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Theoretical Pearson correl.</td>
<td>.237(*)</td>
<td></td>
<td>-.292(**)</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.016</td>
<td></td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td></td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

I4. The dispositional thinking styles are influenced by the stage of intellectual development of the student.

Table 7. The relationship “style of dispositional thinking” – “stage of intellectual development”

<table>
<thead>
<tr>
<th>Thinking style</th>
<th>Dualism</th>
<th>Multiplicity</th>
<th>Relativism</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE Pearson correl.</td>
<td>-.370(**)</td>
<td>.259(**)</td>
<td>.225(*)</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0</td>
<td>0.009</td>
<td>0.023</td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
</tbody>
</table>

For the student in the dualist stage of intellectual development is difficult to make connections between assimilated
knowledge, he needs structure, clarity, certainty. This is highlighted by the negative correlation with cognitive effort – produced by the analysis of statistical data – which comes to support his lack of willingness to become involved in activities of thinking. The student in multiplicity or relativist stage, however, is willing to invest effort in learning to learn effectively, in establishing connections and building knowledge and do not take it “on the ready”. The level of intellectual development marks the favourite styles of learning and thinking. Thus, the “dualist” student remains at the level of fundamental knowledge that provides certainty and does not feel comfortable in the case of subjective judgments, of divergent thinking. Those who have already reached the multiplicity and relativist stages prefer to solve problems, to apply the ideas to see if they work, to make effort to find the best solution.

4.3. Implications of the research

Through this pilot study we were able to get a picture of the relations between the intellectual development of the students and their preferences for specific learning situations that can valorise certain styles of thinking. Moreover, by corroborating the results we could even outline a “profile” of the student from our research group:

• the one in the dualist stage is less willing to invest cognitive effort in learning and therefore feels comfortable in those situations that require only a reproductive thinking and that do not create cognitive conflict;
• the one in multiplicity or relativist stage seeks learning situations that require and capitalize his analytical, creative and pragmatic skills, being interested not only in a contribution to knowledge construction, but also in finding and demonstrating the applicability of this knowledge.

Knowing all these aspects, the teacher can structure, organize and provide the information so as to capitalize the register the analytical, creative and pragmatic skills of the students he works with. It is very important the rethinking of the assessment, in accordance with the manner of teaching, in order to have an assessment for learning, to facilitate the learning and not just an assessment of learning, of the acquisitions made by the student. From the perspective of the student, the study results provide additional knowledge concerning the characteristics of stages of intellectual development, teaching and assessment methods that can facilitate progress and valorise the skills.

Also, rethinking the triad of teaching-learning-assessment may not only lead to an assimilation of knowledge offered by others, but to the involvement and empowerment of the students in the building of knowledge. Under these conditions, stimulating a successful intelligence does not remain just a nice phrase, but becomes a reality of the educational process, which may increase the motivation of all partners involved and the effectiveness of learning.

4.4. Limitations of the study and future research directions

Among the limits of the exploratory study that require further research and extension of the variables considered, we include:

• the relatively small number of subjects involved, which requires caution in the generalization of the results;
• the inequality of representation of gender (more girls than boys) which did not permit completion of differentiation in terms of relationships between thinking and learning styles in relation to the level of intellectual development specific to the gender;
• not representing a wide variety of the specializations of a technical university, which could lead to the shape of different profiles;
• nor can we overlook the risks that are involved in the application of any tests or questionnaires – to obtain from the respondents a number of desirable responses from the social point of view.

As future directions of research, we consider to be useful an increase and a diversification of the sample, which allow us to identify the level of intellectual development according to the year of study, and of some differences in reaching these levels depending on the gender variable; surprising the impact of the type of specialization in shaping the thinking and learning styles of students.

5. REFERENCES

7. Sternberg,R.J., Grigorenko,E., Successful intelligence in the classroom, Theory into Practice, Autumn 2004: http://findarticles.com/p/articles/mi_m0NQM/is_/ai_n8686065
**MATHEMATICAL MODELS AND SIMULATION SOFTWARE FOR THE GREAT POWER BLOCKS**

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**ABSTRACT:** The intelligent engineering system for the great power blocks consists of a set of mathematical models for stationary and dynamic processes specific to operation of the 330 MW power blocks, the simulation software and their implementation on a 3 workstations system to simulate in real time the processes. The application is destined to: desk training, attestation and periodically training of the exploitation personnel from thermal power stations equipped with 330 MW blocks, in higher education to accomplish laboratory studies and research, in thermoenergetics and automation, in research papers on thermo-electric installations in faculties with energetics profile and also in preparation of some papers. The accomplishment of the project involved collaboration of four partners.

1. **INTRODUCTION**

The Intelligent Engineering System for the great power blocks is conceived for use in the research field, learning, training and testing of both the specialty personnel, and operative personnel from the thermoelectric stations.

The system is destined to:

- increasing capacity of the engineering personnel to accumulate knowledge and experience in smart leadership (in stationary and dynamic regime) of the thermoenergetics great power equipment;
- increasing industrial security referring to great power blocks according to technological platform PT. 10;
- performance of a research development network in the field of energy processes modelling and creation of the research core capable to promote new projects at European level, to disseminate results at energy system level and form the future specialists in the field.

It has been necessary the accomplishment of an intelligent network of real time modelling-simulation of 330 MW energy block operation, of an integrating conception regarding the composing modules, modelling of the technological processes in stationary and dynamic regimes, and elaboration of programs packages (basic software and application software) for simulation the operation of the steam boiler, turbine and generator unit. The software is dedicated, it synchronizes mathematical models processing with parameters signalling and display existing in the real systems of technological processes management.

Application implementation is fulfilled on a configuration composed of 3 computers (electronic equipment of personal computer type - PC), that shall contain 2 workstations for operators from the steam boiler, respective from turbine-generator unit, and a post for the instructor that allows him to follow and coordinate the activity evolution.

The accomplishment of the system necessitates solving of the following aspects:

- scientific: modelling of the technological processes specific to the circuits and installations and determination of the analogue equation set for calculation of the simulated parameters, and mathematical modelling of the main existing logical algorithms for the actuating, signalling and protection systems;
- software: accomplishment of a programs package, operating under WINDOWS, destined to graphical visualisation of the processing results of the mathematical models, synchronization of their execution, modification of some inputs in condition of software adaptation to the technological schemes of the simulated installations; accomplishment of the modelling programs of the technological processes in observance with the conditions imposed by the programs package previously elaborated and performance of simulation programs of some actuating, permissive and protection systems specific to real technological installations; integration and validation of the programs packages for simulation of the operating regimes similar to real installations.

2. **MATHEMATICAL MODELS FOR SIMULATION THE OPERATING OF THE EQUIPMENT AND INSTALLATIONS AFFERENT TO THE GREAT POWER BLOCKS:**

Mathematical simulation models stands upon the following elements:

- data taken over from technical specifications of the simulated equipment;
• complex equation sets that determinates the values of the technological parameters;
• static and dynamic modelling, that permits simulation of the phenomena from real installations;
• appraisal and pursuance of signalling over range for calculated parameters.

Within the application is simulated the operating of the block (steam boiler, turbine and their annex installations, the generator unit with the excitation diagram, and annex installations).

In mathematical modelling equipment are simulated, also installations or parts of installations:
• turbine (meshes, turbine steam entrance, steam labyrinth installations, turbine oil);
• condenser (condensate pumps, water circuits for cooling condenser, condenser vacuum);
• addition water (decarbonized);
• low pressure pre-heater circuits;
• high pressure pre-heater circuits;
• high and low pressure deaerators;
• water supply (EPA pumps, supply turbo-pumps, circuits);
• excitation circuits generator unit;
• cooling and sealing up circuits of generator unit;
• solid fuel supply;
• fluid and gaseous fuel supply;
• air supply;
• water-steam circuit;
• roast gases circuit and roast gases fans.

Mathematical models of the technological and management processes simulated for turbine, generator unit and internal services, boiler, are developed based on real technological installation facility, on stationary and dynamic processes. A significant part has been represented by modelling of signalling-actuating schemes and protections afferent to simulated installations. All these mathematical models have allowed the simulation and create feeling of installation operating in real time.

Mathematical models of stationary and dynamic processes were structured in 15 modules.

For each module it has been researched the technological process, it has been followed the behaviour of the process in time and it has been elaborated mathematical relations with variables depending of time.

There are developed mathematical models of stationary and dynamic processes of the following modules:

The turbine itself, Oil installation of the turbine, The condensed installation, The vacuum installation of the turbine, Steam labyrinth installation and 9 bar an 13 bar collecting bars, high pressure pre-heater circuits, low pressure pre-heater circuits, deaerator, turbine protection, electrical network, EPA1 and EPA2, TPA, demineralised water, the boiler and the afferent annex installations (air, stack gases, coal supply, black oil supply, ash disposal, etc.).

It also develops mathematical models for schemes actuating-signalling and protections, appropriate to the equipment (pumps, valves, motors, etc.) that make up the simulated installations.

3. SIMULATION SOFTWARE AFFERENT TO THE GREAT POWER BLOCKS

Simulation software is composed of the following:

• Simulation software or system software - category of programs that constitutes the working foundation of the system and implements all the basic functions of such a system. The system software implements the functions of an instruction system and allows visualization of the technological operation schemes of the boiler, turbine, generator unit, making and taking of manoeuvres, and interfacing with similar mathematical models.

• Application software – application category programs, containing on the one hand processing of the actuating, signalling and protection algorithms afferent to the automation and protection schemes of simulated installations, and on the other hand processing modules of the analogue models afferent to operating parameters calculus of the equipment and installations in whole. Another important part of the application software represents the database with analogue parameters calculated and displayed, respective the amounts of signalling, protections and equipment actuating controls.

Graphical working interfaces reproduce the process interfaces existing at the 4th block from CTE Rovinari and are based on the use of the library of active graphical elements in the interface. For accomplishment of the graphical working interface was developed a library of graphical active elements, based on elements of ActiveX type. The design and functions of the active graphic elements have been made after discussions with staff operating of the energy 4th Block of CTE Rovinari and correspond to graphic images used in this block for running processes (OVATION automation system).

The system software and application software communicate directly and through the system database as seen in the diagram presented in figure 1.

![Figure 1. Scheme operating simulation system.](image)

The graphic component represents the basic module of the visualization and interfacing software. Unlike other components, the graphic component is indispensable to any software interface destined to a system simulation.

The database of the application ensures implementation of specific system functions and includes a very large volume data. Within this database is a clear distinction between analogue amounts and binary amounts, the two categories were grouped separately. Binary data (states and controls of the equipment, signalling, etc.) and analogue data (values of the parameters displayed, working values, etc.) are grouped in separate tables for the two categories of data.
Simulation system is a set of models, programs and graphic representations that are implemented on electronic equipment of personal computer in standard configuration.

Representing graphical interface on technological schemes allows focus of more information on a single screen display, with the possibility of simultaneous execution of manoeuvres on the active elements (pumps, valves, etc.). In these schemes the user has an overview of a particular circuit from installation, having the opportunity to order the execution elements and observe the variation of key modelled parameters.

4. CONCLUSIONS

Analysis in recent years have emphasized the importance of human factor in relation to the technical operation in plants, a significant percentage of damaged or potentially dangerous situations as being due to human error. If keep sight also of the degree of complexity and technicality of the installations, of the consequences of serious human errors, turns out that the development of aptitudes, knowledge and skills of operating personnel is a priority task. Very important is to ensure safe operation of the whole process from thermoelectric power station. Taking into consideration the mentioned, the attention of the leaden factors should focus on an efficient human resource management and the methods used in training and preparing for the specialty.

In all the countries with developed energy, coordinating for allocate material and human resources, to improve staff training and operation. By developing training programs are necessary skills for operating personnel to diagnose, to decide and to act properly under severe time conditions, in all operation regimes: normal and abnormal. Within these programs an important place is taken by the operational staff training on engineering systems that contribute to the preparation of operation personnel in the following directions:

- assimilation of general knowledge and specialized (physical phenomena and their cross correlation);
- skills development and observance prosecution of the specific operating instruction and maintaining them permanently to a higher level, corresponding to the requirements of current operating activities;
- operating under optimal economic conditions and for growth of life cycle of the equipment.

The intelligent engineering system for the power blocks is destined to increase the capacity of staff and technical engineers to gain knowledge and experience in intelligent leadership (in the stationary and dynamic regimes) of great power thermoenergetic equipment.

5. REFERENCES

2. Operating instructions for the boiler of 1035 t/h - Rovinari – ICEMENERG – 1978
3. The intelligent engineering system for the great power block – 2008
4. Documentations and regime values received from CTE Rovinari
FUNDAMENTAL RESEARCH IN THE CONTEXT OF CONTEMPORARY SOCIAL AND ECONOMIC

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ABSTRACT: The paper presents an analyze of the actual stadium of the fundamental research in Romania and all the world. It is presented the main financial possibilities of the fundamental researches, the ways which can be used for obtain the financial resources and in the mean time the importance have in the socio-economical context.

1. INTRODUCTION

Innovation activity is as old as human history. From the first attempts to transform and adapt to the needs of his nature, man has ceased to innovate, to bring something new into existence materially and spiritually. Mirror, porcelain, toothed wheel, suspended bridges, machine calculating, mapping, clock, compass, decimal system, geometry, square root, vaccines are just some of the discoveries of anonymous inventors of antiquity of Babylon, Mesopotamia or China.

In the nineteenth century innovation activity was characterized by competition for the discovery of new products, this competition is driven by the desire of people to live better and more efficiently. Attempted to organize the work of innovative research, for it to be as well made point and shorten the time from the innovative idea (invention) to the implementation of it. In the second half of the twentieth century, the supply and demand for new discoveries have accelerated along with intensifying international competition, both as a result of increasing competition and increase their industrial capacity, innovative activity is more singular privilege of competitors especially as the result of complex work in teams.

All this actions, which lately become increasingly important, requires developing a new concept of management of research, this we could deploy erratically and without a precise direction, but should be carefully coordinated.

In order to tackle this new field of business management, scientific research must be primarily based on a "language" common in terms of activities. Thus UNESCO in six and seven decades [1] he founded the first definitions of research, these definitions were subsequently taken by the Organization for Economic Cooperation and Development (OECD), the Statistical Agency of the European Union (EUROSTAT), and other forums.

Present in these definitions:

- **Fundamental research** (FR) is a theoretical and / or experimental intended primarily for the acquisition of new knowledge on phenomena and processes, and in the formulation and verification of hypotheses and theories. FR does not, in general, to a certain application or immediate practical use.

- **Applicative research** (AR) is intended primarily for the acquisition of new knowledge necessary for specific applications and uses them to achieve economic and social objectives determined.

- **Technological development** (TD) consists of the activities of systems engineering, engineering design and technology transfer and implementation of technological inventions, by which the application and transfer of research results in the economic and social, for the introduction of new systems products, technologies and services, and improving existing ones. TD is sometimes called experimental development.

However, these definitions should not be taken as such, research and development represents a "whole", with the interactions and communications between the component passes gradually from one component to another. Thus the boundary between the FR and AR is research oriented and strategic, which is a type of FR framed within a broader program aimed at the final scale applications for which existing knowledge is insufficient. At the boundary between AR and TD is a pre-research, covering objectives, but in the productive sphere as a whole and not determined a specific beneficiary.

In practice, a number of activities related to support the principal activity of Research and Development (RD) are not included in the RD but are part of a wider sphere of scientific and technological activities.

A number of activities can be included or not within the scope of the RD depending on concrete situations encountered (for example, certain services and execution models are considered as part of the RD only if they are integrated into a unit with the rest of the program's activities).

These demarcations and dissociation arising from definitions, seem at first glance, that does not play a large role in research, the researcher is more concerned about solving a specific problem and less concerned about employment in a particular definition of the business provided, however, in the management of research, this classification becomes important implications.

2. FUNDAMENTAL RESEARCH

Research and development is subject to economic and social relations governed by the supply / demand. When we refer to these terms, must take into account the particularities of this work.

Thus, as I said, FR is governed by intrinsic criteria such as by "application" we mean those today issues, at the order of the day, at the "fashion" in the good meaning. Researchers and managers in the field need to know to choose. Demand, to achieve, must be solvent, that is to have funding, and there must be someone willing to fund (buy) the product of research.
Investigator's ability to obtain funds is appreciated, even necessary.

For AR and TD, adaptation research and development managers to market requirements is the most direct, economic and financial considerations are less than for the middle FR.

Fundamental research as defined above is carried out in a true "market research", respecting the rules, existing in an appropriate market conduct any human activity with the two components: demand-supply.

Market in the abstract sense is the meeting and interaction of supply and demand. Interaction defining moment that contains the transaction: purchase request, offer to sell, in this process there is a continuous process of transformation of the two components.

Offer turns primarily to meet demand, the leader in a market economy is demand, and demand change, because has a number of mechanisms to influence and redirect it to stimulate, even to generate.

If FR, identity request is a problem, because in this case there is a separation between finance and the real beneficiaries of the FR. Funding is made, usually from public funds, plus other funds (sponsorship), the beneficiary is society as a whole but large segments of it.

Research proposes longer and other derivatives: supporting large software development company (demographic, environmental, food, health, etc.) Targets regarded as strategic. FR has strong character training, contributing essentially to the process of education. For all these applications, the beneficiary is a very broad category, economic and social.

There is a market research, there is necessarily a marketing thereof. It is sometimes said that "any discovery can FR provided to have enough money, a promise that is not risky because it has not ever". Marketing’s role in this area is to be inserted in the space between the financier and recipient to establish links between them and demonstrate that the funds advanced by the donors are really profitable for beneficiaries.

These observations remain valid even for research that does not target only enrich human knowledge in a given field; in this case, the beneficiary is the science. Donors must be convinced that the railway will reach at least "vaults record (books, magazines, etc.)" specialized knowledge will be taken by the rest of the community of specialists in specialized publications that will appear.

Defined as having the mission to discover new laws, theories, data and information. Research contributes to increased knowledge.

After the Second World War, when governments are convinced, once more, that have resulted due to FR through a complex chain of applied research, technological development and innovation, means that decided the fate of war, funding has increased spectacularly. The trend continued even if subsequently changed accents, from physical, chemistry to biology and computer science or the natural sciences in the spirit. Number of researchers involved in the activities of FR has increased more, the materials made available, and investment materials have become increasingly large. Becoming apparent that FR may play an important role in economic development and social and cultural boundaries between fundamental research, the applicative and technological development are permeable, crossed in both directions by the researchers and their work.

For financial reasons, related mainly to the rules of spending budgetary funds, the sharing of research activities are kept, FR was supported financially especially public funds. Was as shown above, a true market of FR, in which researchers and research institutes generate supply, and government representatives who manage the funds and distributes the request identifies the appropriate means.

In the last decade, were nevertheless important changes in the FR, the supply exceeds the demand, FR obtaining financing with strong efforts, even for economically advanced countries. Donors are supporting FR only if, even with a certain risk, is obtaining a benefit (scientific, economic, cultural) of the FR.

It is a true "battle" to obtain funds for FR, and only a thorough knowledge of rules for obtaining financing can bring the expected success.

Thus should be at least the following three rules:

- have launched several requests to increase the chances of success.
- success achieved under pending researchers.
- do not be discouraged, but persevere with tenacity and skill.

3. FUNDING FUNDAMENTAL RESEARCH

As a rule, fundamental research is financed from public funds. Create more centers for evaluation and funding is generally beneficial for the research. Distribution of funds is done by consulting committees of specialists, especially through open competition between applicants (grants). It is encouraged co-funding (collecting funds from multiple sources of funding for a program/project).

Public funds is also, a major source of funding for strategic research and for the pre-competitive research, because the results are interesting for a large segment of the economy or society.

Applicative research calls a substantial funding from the economic agencies. Big companies have their own strong research units applicative financed from internal funds. The funding of the Applicative Research is encouraged by the central level, through appropriate fiscal measures.

Technological development is generally supported from the funds directly interested.

In transition economies, due to the specifics of such an economy, the state allocates funds to support the majority of applied research and development even in the desire to support the economic recovery and preservation of a specialist unit and research. Trends are found to stimulate industry participation in research and development by appropriate means.

In our country, the sources of research funding can be considered as follows:

- Public funds: 50% ;
- Economic: 48% ;
- Other sources: 2% (Statistical Yearbook of Romania, 2007)

Allocation of expenditure on various forms of research was:

- FR: 38.9% 
- AR: 51% 
- TD: 10.1% (Statistical Yearbook of Romania, 2007)
There is a significant share of expenses for Applicative research, and much lower share of expenditure with technological development, which would suggest relatively low proportion of the results of the Applicative research completed by stage of the transfer to industry. Obtaining funding for a project of FR involves a real competition, evaluation and selection of projects should be entrusted to groups of experts in highly specialized, the activity called peer review (review by counterparts, specialists of the same rank). Knowing the criteria used by these experts, the FR tendered should submit his project, and put in light of its competitive advantages:

- **The originality**, the novelty of the contribution expected from the international requirement in the major projects of FR.
- **Relevance**, how the project plays an important role in the sub domain register.
- **News**, that current science may enable reception of the results.
- **Fertility**, to open other avenues for basic and applied research, to continue the project.
- **Competence team**, with emphasis on recognition and prestige they enjoy its head.
- **Credibility**, which is the most important competitive advantage, representing the sum and the other consisting of the ability to persuade counterparts mentioned that the promises made in the offer will be met with a high probability.

Competitiveness in FR is difficult, and earns losable easy, it is the result of ceaseless effort and involves a constant comparison with the highest level achieved worldwide by potential competitors. Even if the most important researchers in an area not participating in a competition is assumed that the experts who will review applications for research projects known results obtained by these requests and will report at that level analyzed scientifically.

To obtain funding for an activity of FR is thus a true art, very well endorsed by Western competitors, to be master and cultivated as such.

In order to obtain funding must take into account the following principles [1]:

- **Diversify sources of financing**. The project should seek to obtain funds from several sources: the budget, foundations, direct beneficiaries, international programs, bilateral cooperation, sponsors, etc. Reduction of one of these sources will have catastrophic effects on research pursued.
- **Co-financing**. Participation of several different donors to the project is indicated. Besides the advantage mentioned above, and one is synergistic: each funding participation is encouraged by others. It follows what was baptized by Robert Merton in the journal Science "Matthew's effect", so named after a passage of the Gospel by St. Matthew: "one who has, will be more ... and one that he hasn't will be taken even what he has"

This means that one who has proven that he knew to get what has introduced the trust and may receive other projects.

- **Information**. The driver of a research team must have a real database on the possibilities of financing: source organisms, the interests of each, the contract, how to obtain documents and making a request, any relevant particulars.
- **"Urbi et orbi"**. The secret of success in obtaining funding is launching a large number of requests. This additional effort will be rewarded by the risk reduction for acceptance under the appropriate coverage strictly necessary.
- **Reputation**. The team of researchers and the manager must award the reputation and scientific counterparts to work through the perseverance of the most effective channels of their valuable results. The choice of these channels (for magazine circulation and high-level scientific events with large and important, etc.) is in itself a matter of craftsmanship, but also for obtaining funds to cover publication costs and participation.

As I said, FR is the financing of public funds, they came to researchers and research institutes in several ways:

- Institutional funding, which the institution receives the budget in general minimum subsistence
- Funding through competitive grants
- Funding from agencies or ministries, the research programs of wider-scale and multidisciplinary divided on projects
- Funding from research contracts with a financer who is himself the beneficiary.
- Funding from sponsorship
- Funding from international programs.

It requires a diversification of sources of funding, researchers must identify in advance all possible sources and to present offerings to meet the aims and interests of donors.

The offer will be made so that the relevance of guidelines for project funding should be as obvious. Tenderness must not assume that assessors are convinced in advance, but must persuade. Offer will not compile with words but with great ideas fertile.

It welcomes in particular, and sometimes it is necessary to obtain financing for a project, financing not only facilitates the tasks of a specific funding but demonstrates that others have evaluated the project. The evaluators are careful to justify the expenditure estimate. They don’t appreciate the exaggerated bids and cut funds on principle "to ask more than that will cut all".

As a conclusion of this analysis we can say that FR researchers, the posture of applicants to funding programs must master the "art of writing a project", without this ability, obtaining the financial resources needed for the FR is difficult or even impossible.

An analysis of trends in public funding of research shows an increase in many Western or European countries, the share of funding based on competitive project. For example, in Canada this share increased from 29.8% to 36.7% between 1996 and 2000, and in the UK from 62.7% to 65.2% during the same period [2]. This trend is motivated by the fact that the allocation of funds based competition encourages excellence in research, which in turn is fueling innovation. Competition allows the identification and funding of those activities that will have the best quality, and will therefore generate the most significant effects on the economy, society and environment. E.g. [3], a study done in 2000 in Australia show that the amount allocated to research through a competitive mechanism has led to a number of at least 5 times greater than publishing the same amount allocated to universities as institutional funding research [4]. On the other hand, even institutional funding begins to be accompanied in the increasingly assessments made on the basis of measurable indicators [2]. And in Romania, a relatively important share of research funding is made through competitive funding based project.
this weighting being between 53.13% in 2004 from 22.4% in 2005 and approximately 50% in 2006.

However an analysis of scientific research in Romania can be concluded that the use of funds allocated to this activity is generally ineffective. Thus although in the period 2001-2004 in Romania was generally financed research application (by PNCDI) entities in Romania were granted in 2004 only 8 patents by the Patent and Trademarks U.S. (compared with 62 for Hungary and 18 for Poland), any patent by the European Patent Office (compared with 38 for 14 for Hungary and Poland) and 1 patent by Japanese Patent Office (compared with 38 for 16 for Hungary and Poland). Only about 7% of articles indexed by Romanian authors ISI Web of Science in 2004-2005 are the result of government programs Romanian grants, while 38% were funded by the European and North American [5].

After 2004 we may notice a shift of public funding for basic research with applicative research and technological development. An argument in support of continuing this trend can be found in a report prepared for Australian Research Council to evaluate the benefits of research funded by the Agency [6]. This study shows that investment of public funds in research level, like those funded by the ARC, has a social rate of profit of 39% (are sums invested recovered nationally and in addition produces a profit of 39%). Only a small part of that profit comes from the generation of intellectual property marketable to institutions conducting research projects (3%). Most originate from other direct benefits.

They are:

- **Benefits due to a direct improvement of human resources** (12.5%), through PhD and postdoctoral training, retention of scientists highly better preparing students, etc.;

- **Benefits from building a fund of basic knowledge** (10%), especially through the dissemination through publications and communications research results peak, which is then included in technological innovations. Thus, an article between the most cited 1% of scientific articles are 9 times more likely to be cited in a patent registered in the U.S. than any one article. From these results, however, benefit most local community, despite their publication worldwide. Thus, although global Australia produces 2% of the articles, 21.3% of the evocation of patents registered in the U.S. is by Australian authors Australian articles.

- **Benefits of an improved access to international research** (7.5%). Raising global awareness has positive effects on all countries, but these effects are very small if a country does not have enough human resources trained to understand and adapt information and whether the country is not connected to international networks of knowledge.

- **Benefits of a policy improvement** (6%). An analysis of the principal funding program of scientific research in Europe (FP6 - FP7) shows a shift, and at this level of funding for basic research in applied research expense, dominant in FP6. Thus it was decided that the future FP7 should focus on promoting and funding research at top level, and to follow the principles of scientific excellence and not other priorities [7].

### 4. CONCLUSIONS

It is important a good knowledge of the mechanisms that ensure the financing of scientific research and the means necessary to finance these activities. Orientation should be continued funding of scientific research, funding for basic research.

Participation in research may be the key to a new knowledge-based society.

### 5. REFERENCES


THE ISSUES CONCERNING THE CREATIVITY IN THE TECHNICAL SCIENCES

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ABSTRACT: The paper presents some aspects regarding the creativity with concrete reference at the technical sciences creativity. The technical innovation assures technical progress in the sciences and the general progress of the society. The fundamental research is that which open new ways for both progress and research with the application represent the source of society.

1. INTRODUCTION

In art, in science, in technical, creativity is the same. This sentence is almost unanimously accepted. Since it arises that what is says about creativity in general is true - to some extent - for creativity and engineering. It recognizes that, in each of the areas (art, science, technical), creativity is manifested by certain features that are required emphasized.

2. THE RELATIONSHIP AND RESOURCES OF TECHNOLOGICAL INNOVATION

To avoid assumptions lacking an inductive approach in research of peculiarities of creativity, you can use a method to enable research creativity compared euro-grams method [1].

A euro-gram is composed of a succession of creative sequences that integrate into a creative process. It is called so because the settlement allows the graphics to a certain sequence of the main sequence of discoveries or inventions. By analogy, mathematical reasoning as the graphic expression, is viewed, facilitating the detection and calculation errors, so creative approach and method is viewed euro-grams allowing efficient comparative analysis and a high stringency. The euro-gram allows spatial and chronological conduct follow heuristic structures, converting them into phenomena of creativity and creation.

The euro-grams method, where it is based on assertions about creativity creator and creation, the things written about how they have created, it is validated by the introspection method. Thus, the method of euro-grams and the introspection method form a couple methodological - heuristic of the research creativity and creative. Involved but the time factor (T) elapsed between the date of invention or discovery made and the date when it reported about her. Given this phenomenon, is necessary alignment torque heuristic methodological insight – euro-gram method of interpolation? Thus, the couple is now developing into a triad: introspection – euro-gram - interpolation. Interpolation method used with the precautions necessary, in a relative, in conjunction with other methods, provides the opportunity to fill some gaps of heuristic approach.

W.I. Beveridge believes that "it is important to distinguish between interpolation and extrapolation". Interpolate to find the method most often justification provided to be in possession of a valid set of data from which to start our work, but extrapolation is risky. In fact, extending beyond our theories of the field were checked on often leads us astray. The extrapolation more resembles that of the implications and is useful for providing feedback.

The quote gives a general description of the method of the interpolation (and extrapolation), not to apply or to suggest its application in the study of creativity. But if it applies in other areas not foresee any serious obstacle, not a methodological restriction to prohibit the application and study of creativity, in cooperation with other methods. Thus, the method provides introspection principles and rules validation phenomenon heuristic introspects.

The method euro-grams circumscribe heuristic graphic sequences and interpolation method aims to fill gaps series heuristic approach. Creative series is a series of sequences (documents) that makes the heuristic and involve each other. When heuristic sequences form a series A, B, C, D, E, etc. and the missing sequence in the series C, it can be reconstructed based on the sequences preceding it and succeed, which has heuristic resemblances. Probably this method is used by the creators themselves, by default, but not explicitly, when it reported about creativity and creation, at intervals of time.

Therefore, filling the gaps in memory, on the creativity and creation, becomes a methodological reason, which gives them certain legitimacy. Just on that basis, it can not be vitiates in all occasions, but not always valid without any restriction. Given the methodological introspection- euro-gram- interpolation triad, would be necessary to elaborate rules and procedures of research creativity and creative in this regard, as well as permissions and prohibitions in the joint application of these methods heuristic phenomenon.

For example, how many links may be missing from the series heuristic approach without heuristic story about the phenomenon to be irregular?!

The missing links of several series, the story about creativity and creation is more complete and more appropriate.

So, in addition to the influence of time factor (T) and in close contact, the deformation of the reports about creativity is inversely proportional with the missing links from the heuristic series.
Undoubtedly recognizing the role of initiative and creative people from all fields of activity, can’t deny the role of creators’ exception of great talent and genius of their contribution to the overall progress of civilization, science, art and culture. So is their own creative potential of all people, obviously within the limits of a wide range of levels, but whatever the value of this potential, it becomes very precious heritage for national and universal.

Legal inventions and innovations set the forms of expressions of creativity: invention, innovation and discovery.

*Invention* involves "solving a technical problem in any branch of economy, culture, social care or country defense, which presents news and progress towards the state of the art known in the country and abroad". Thus, the invention can’t only designate absolute technical news on the domestic and global. Invention is considered as a form of materialization of high scientific and technical thinking.

*Innovation* is conceived as presenting new technical achievement, progress, economic benefits, social which has not been applied in the national territory and solves a problem in industry or in any area of economic lands, science, culture, health and defense country.

*Discovery* is the process that establishes the existence of laws, acquisition or phenomena unknown before, the material world, objectively existing.

At the firm level, technological innovation involves a more efficient technology. Moreover, technological innovation should lead to a series of renewals of the processes and products to ensure survival and to make firm. These goals motivate the basic financial resources to conduct *research - development* of which is innovation.

Technological innovation can occur through a variety of forms, which determine the decision to be difficult, with high risks for the company. In most cases, a strong technological innovation that would bring a better return for the company, implies a greater risk than a minor improvement with a lower profit, the impact on business caused by the renewal of a product is different from that made to upgrade the technology or process, the renewal in various activities - electronics, chemical, and steel - are different. Decisions on volume and destination of financial resources allocated to technological renewal are taken in such cases under risk or uncertainty.

That is why the precise B. Twiss depending on experience and information with regard to innovations, the proportion of commercial success is often limited to 10% of projects initiated - in other words means 90% failure [2].

Analyzing a series of bad luck business has shown a large number of cases in which innovators have failed to translate their creativity into the profitable art activity. So, the problem is not only innovation but also that of technology innovation management to obtain profit.

Usually, managers are going to solve the current problems of production, because the industry is seen as a process of transforming raw materials into products.

When the client relationship with the manufacturer was weak, the process of transformation, played in fig. 1, looks like being predominantly oriented towards production trend apparent during 1950. Over time this approach has changed for the customer, the products have never been an end in itself but a means to meet a social need or a desire of the buyers. This approach is played in fig. 2.

![Figure 1. Technological innovation - the process of transformation - a shift towards production.](image1)

![Figure 2. Technological innovation - transformation process orientation and technology market.](image2)
The process is regarded as a direct conversion of scientific knowledge or technology to meet the requirements of the consumer, the product becomes just a carrier of technology, and the final form is defined by adapting technology to the market.

Importance of the needs of the market is highlighted by such technology as a process of transformation. In this context, because "invention" design idea - to become an "innovation" - the implementation in practice of the invention - the last to be successful on the market, which involves linking of research and development of research market of marketing.

This raises one of the practical obstacles to the renewal of the technological success even when the need is assessed at a higher level of thinking (fig. 3). Thus, factors related to personal relations and organization for innovation presents a critically important. The organization itself can be changed through innovation. As such, the driving factors are intimately related to technological innovation in the case of organizational changes.

In creating a favorable attitude towards the company's innovation leadership at strategic level has an important role, especially when at promoting innovation is a member of management. That explains why a number of smaller companies have made innovations with more success than their larger competitors. However, those who spend most technology companies are large, because organizational structures are more complex involving more rigorous plan for creating a climate in which innovation can develop. For example, "Ericsson" - large international trust telecommunications annually spends 8.5% of its total revenues on research and development, which is by 2.5% more than IBM's. However, IBM spends about 2 billion dollars for research and development, compared with "Ericsson", which spends about 220 million U.S. dollars [3]. Also this company uses about 10% of their turnover on research and development in integrated circuits and advanced communication technologies [4].

![Figure 3. Guidelines for the management of various C and D and the marketing creates a barrier to communication.](image)

3. **FUNDAMENTAL RESEARCH AND APPLICATIVE AS SOURCES OF INNOVATION**

Demarcation between basic research, applied and development is not always easy to achieve, because in reality there is permeability, a steady stream of them, C and D as a whole in which each element is dependent on that which precedes it and at what I follows. It may even consider leaving a stream of "pure research" to the market and can be qualified as an autonomous and current bottom, in reverse, which may be called induced, the role of "feedback" (fig. 4). It is difficult if not impossible, to determine where the investigation ends and where the industrial application starts.

![Figure 4. Links that are created in the research.](image)

In general, the distinction between fundamental research and applicative place under the more reasons than the content - offering basic science and extend knowledge applied research use of knowledge acquired.

Both fundamental research and the applicative seek - and find in the end - knowledge for knowledge broadening horizon. This forms the background of their joint scientific activities.

Kapital P. L [5] shows that the separation between fundamental research and applicative be considered artificial in many respects. It is difficult to indicate where one ends and where another begins. Differences between these two approaches to knowledge are, by some experts, such as more historical.

In a few decades, the difference between these two types of research was clear, and methods, the "man of pure science" and the "engineer" different.

Between "free basic research" - a result of intellectual curiosity - and "targeted basic research" - which seeks to obtain new knowledge to some practical purposes, but which can
simultaneously contribute to scientific and general - there is a connection, particularly useful.

The influence of technology on basic research is in the form of active devices required advanced fundamental research.

Vigor contemporary science depends, in part, of intellectual collaboration between researchers who are establishing some science "pure" science other "applied". Otherwise, the same man may sometimes be "engineer", sometimes "a man of pure science", even when working on the same problem using different methods or attacking its different sides.

During a work of scientific research is going to meet a difficulty that can sometimes be resolved by empirical. Sometimes however, the shortest path problem is to seek a deeper understanding of the phenomenon, which implies an attitude of fundamental research.

Progress, for example, the plastic was due theoretical knowledge obtained from the top laboratories in industry, who have not hesitated to address and formulate theories on the complex phenomena they encountered, without which the chemistry of plastics would have remained long unknown.

Similarly, in the basic research opens many avenues for applying scientific discoveries made and those not hesitate to browse them.

Collaboration or even interaction between the scientist and technicians contribute to technical innovation, especially in industrial areas of science where the influence is strong (Figure 5).

In those areas it is recommended so-called "coupling" - that is the formation of mixed teams of basic scientists and technicians.

The collaboration between basic scientists and species representing applicative research is a criterion for the classification of "couplings" in:

"A" - "indirect coupling", characterized by the absence of direct dialogue between those who generate and use new knowledge (technology he realizes that the scientific information detected is likely to influence the problem and makes a synthesis of existing literature documenting). Indirect coupling is not adequate to support a program aggressive development in areas that have made many scientific discoveries;

"B" - "passive availability", characterized the situation in which scientists are tackling the consultation by technologists, but they have no special initiative to foster dialogue. Technologists choose the domains where they think they can get support basic research and then determine the appropriate contacts. This process can be stimulated through the establishment of joint collective of scientists and technologists, both for selecting areas of research and collaboration to solve research problems;

"C" - "participation" in project scientists as consultants or advisers establish bilateral involvement. It allows mixed groups to promote knowledge of interdisciplinary problems.

Exchanges between experts from universities and industry may prove useful.

4. CONCLUSIONS

The organization itself can be changed through innovation. Driving factors are intimately related to technological innovation in the case of organizational changes being decided factor in the realization and implementation of innovation in an organization.

Universities have been and remain the inexhaustible reservoir of ideas and original creations.

5. REFERENCES

1. Crişan Ion, Drăgănoiu,Gh.,Predoi,Aristide, Sisteme flexible de montaj cu roboţi şi manipulatoare, Editura Tehnică, Bucureşti, 1998
INQUIRY-BASED APPROACH TO ENHANCE STUDENT LEARNING. CASE STUDY IN FOOD ENGINEERING EDUCATION

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ABSTRACT: In this paper, an application in the food engineering higher education of an inquiry based method, named Learning-By-Design method (LBD), is presented. The students are asked to develop individually new sugar-based products following some steps distributed on four levels. The first level has as main direction to establish the basis knowledge and rules in working at the obtaining of a new sugar-based product. At the second level, after a preliminary training with the teacher (when all the steps are presented, discussed and simulated), team of students work alone at the production of their own new product by concept development, product and technology design, product obtaining and analysis, labelling and packaging. During the third level, each team presents the final products to the colleagues who analyse and discuss the concept, the product itself and the marketing approach. The assessment is realised at the four levels and is focused on the analysis of the behaviour in the context of the group, the use of prior knowledge and of science terms. The results show that the LBD approach is suitable for teaching the students to solve of a complex problem, the obtaining of a new sugar-based product, with improvement of the behaviour in the context of the group, of the use of prior knowledge and of self-checking and control. The use of science terms is not stimulated by this approach.

1. INTRODUCTION

A major goal of engineering education is to prepare students for time management [1] and flexible adaptation to new problems and settings [2].

Although many specialists show the superiority of guided instruction [3] [4], modern techniques based on inquiry are successful used [5] [6] [7]. Inquiry based approaches to education focus on student constructed learning as opposed to teacher-transmitted information [8].

For developing competence in an area of inquiry, students must have a foundation of factual knowledge, understand facts and ideas in the context of the conceptual framework and organise knowledge in ways that facilitate retrieval and application [2]. According to [9] scientific inquiry is a systematic and investigative performance ability incorporating unrestrained thinking capabilities after a person has acquired a broad, critical knowledge of the particular subject matter through formal teaching processes. Proponents of the new inquiry approaches to teaching engage students in a variety of different activities for constructing a knowledge base in the subject domain [2]. Such approaches involve both a set of facts and clearly defined principles. The teacher's goal is to develop students understanding of a given topic, as well as to help them develop into independent and thoughtful problem solvers [10] [4].

A special case of inquiry learning is Learning by Design (LBD), a project-based inquiry approach to science learning with roots in case-based reasoning and problem-based learning [11]. Science learning is achieved through addressing a major design challenge; class members develop designs, build prototypes, gather performance data and use other resources to provide justification for refining their designs, and they iterative investigate, redesign, test and analyse the results of their ideas [12].

In this paper, we present an inquiry-based approach to enhance the students learning capacities based on the LBD concept. The students have as task to develop a concept for a new sugar-based food product, to design the product, to establish the technology, to obtain and analyse the product, to find a packaging system and finally to realise a market study. At the end of this exercise, their performance is examined in order to measure reasoning, understanding, complex problem solving and team working.

2. METHOD FRAMEWORK

This work fits within a broad constructivist framework and engages students in meaningful activities, typically cooperating with peers, to develop their conceptual understanding at the development of a new food product. This specific approach utilises LBD instructional techniques identified by previous investigators [12] [13] [14].

The key characteristic of this approach is that teams of students practically design, produce and sell a product in the laboratory classes rather than following a highly prescribed laboratory procedure. All the time, the teacher is with them, asks to the questions and makes direct observations, but doesn’t coordinates or helps directly the students, letting them to solve the organising and practical problems.

The entire work is structured on four levels, as presented in Figure 1. First, a preliminary meeting with all students is organised (level 0). At this level, the general knowledge and skills are tested, analysed and then improved.

At level 1, each team has access at his work, with possibility to change ideas and experience with the other teams by organising small meetings and discussions.

After finishing the conceptual and practical activities, all team have access at the level 2, where they collaborate to analyse the results and to realise the market study.
The teacher assesses the individual participation at each action from levels 1 and 2 (level 3). Descriptive statistics are used to examine changes in students’ conceptual knowledge before and after the inquiry-based activity.

3. IMPLEMENTATION

The problem given to the students is to obtain a new sugar-based food product. The solving is achieved using the LBD method which is implemented at the levels presented before.

Level 0 is not directly included in the assessment process, its main goals being:

- to establish the prerequisites;
- to give learners specific guidance on the knowledge basis of each student;
- to establish the security rules for the development of a safe food product (rules on food hygiene, nutrition and food additives).

Concretely, for the case study presented in this paper, the prerequisites are: food chemistry; physical-chemical analysis of food; food technology; starch, sugar and confectionery technology; food hygiene; nutrition; food additives; food packaging and design. All these courses are available in the first three years of study at the specialisation Food Engineering from the Faculty of Agricultural Sciences, Food Engineering and Environmental Protection, “Lucian Blaga” University of Sibiu, Romania. In this way, the students have a systematic knowledge basis in the area of food engineering which can be used to solve specific tasks, as those proposed in this paper.

During the stage at level 0, the teacher establishes and explains to the students the security rules for the development of a safe product. These rules refer especially to food hygiene, nutrition and food additives (admittance and doses).

At level 1, students are first shared in groups of two to maximal four students (when their initial number is high) depending on the product type chosen to produce: high-boiled sweets, caramels, toffees, fudges, jellies, aerated confectioneries or chocolate-based products. The teacher communicates the working steps from level 1 (see Figure 1) to each group. In the first step, Identify desired results, the teacher provides instructional guidance on the concepts and procedures by explaining and giving examples to the students on all the next steps. This measure is a little bit different from the concept of minimally guided approach used in LBD, but the former experience of the authors showed that in this stage the students should not be left to discover those procedures by themselves because of the possibility to find wrong solutions or to expense too much time or resources for solving the problems. In this first step, the students are learned how to develop a concept, to design a new product and a new technology, to obtain, to analyse, to label and to pack the product.
In all other steps from level 1 and at level 2 the students are left to work in teams, without teacher intervention.

For the presentation of the new product, each team has to prepare a document and an oral presentation.

The market study is realised during the final meeting of all students. Each team has to arrange a presentation stand for the new product and try to sell it. The time distribution of the entire LBD process is:

- 4 hours: 1-th session at the level 0;
- 4 hours: 2-th session at the level 1 stage Identify desired results;
- 4 hours: 3-th session at the level 1 stages Develop the concept, Design the new product and Design the technology;
- 4 hours: 4-th session at the level 1 stage Product obtaining;
- 4 hours: 5-th session at the level 1 stage Product analysis;
- 4 hours: 6-th session at the level 1 stages Product analysis (continuation) and Labelling and packaging;
- 4 hours: 7-th session at the levels 2 and 3.

The 4-th, 5-th and 6-th sessions must be organised in short time (three days consecutively) because the product characteristics could change during the storage. Depending on the composition, some products must be obtained short before the market research in the 7-th session (for example, aerated products with white egg as beating agent).

In parallel with the LBD method described before, a classical method was used. The differences were that in the classical method the students received a clear task (which type of product to be improved) and the concept, the design of the product and technology, the analyses to be maid, the product to be improved) and the concept, the design of the method the students received a clear task (which type of method was used. The differences were that in the classical method, where the students didn’t use correctly the prior knowledge in both types of methods used.

The indicator a2 has also high values in the case of using the LBD method, which shows that the teams are organised and the members of each team receive specific tasks. Practically, was observed that at the use of both methods, the teams behaved quite different: in some cases, a leader coordinated the activity, the work going better; in other teams, one to two colleagues dodged or refused other tasks as he was habituated to do. Anyway, the classical method gave worse results as LBD approach.

Also students’ skills to show evidence of using prior knowledge to solve the problem (indicator b1) are improved by using LBD, compared with the classical approach, approximate half of the students mentioning prior events or concepts related to the problem. As the values of the indicator b2 shows, the students don’t use correctly the prior knowledge in both types of methods used.

Compared with the classical approach, LBD seems to give unsatisfactory results regarding the use of scientific terms (indicator c1). Also, the students show worse skills to use the previous practical knowledge (c2). These results could be due to the absence of the discussions with the teacher during the experimental part of the project; the students learn much better to use the scientific terms when the classical method is applied.

In all cases, at the use of LBD method the teams realise self-checking during the session, they question several aspects of the procedure and makes the needed change. This characteristic is less stimulated in the classical method, where the students are waiting for instruction fast all the time.

For all the assessed characteristics, notes from 1 to 5 are given, as detailed described in [13].

5. RESULTS AND DISCUSSIONS

Figure 2 presents the results obtained at the use of both methods, LBD and classical, on a group formed by 20 teams, each with 3 students. 10 teams used the LBD method and 10 teams the classical method. The results are presented as mean value of all notes received.

Figure 2. Assessment results at the use of a LBD and classical method for the production of a new sugar-based food product.

As Figure 2 shows, the behaviour in the context of the group improves at the use of LBD method, compared with the classical method. The indicator a1 is very high (around 4.2) , indicating that the LBD approach offer to the students a better alternative to discuss and question aspects of the procedure and in many cases fast all members of the team have a contribution and decision making is consensual. Contrarily, the classical method doesn’t stimulate this behaviour.

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In all cases, at the use of LBD method the teams realise self-checking during the session, they question several aspects of the procedure and makes the needed change. This characteristic is less stimulated in the classical method, where the students are waiting for instruction fast all the time.
6. CONCLUSIONS
The data reported herein presents a n approach of the LBD method by structuring the work on levels with different tasks and which allow the direct teaching (level 0 and first step at level 1) the team working (level 1), the interaction with the other students (level 2) and the assessment (level 4).

Students work in small groups to address a scientific challenge (the obtaining of a new sugar-based food product). The results indicate that the LBD approach is suitable for teaching the students by putting them to solve a complex problem.

This method is suitable for students which have already a good knowledge basis and which need only to enhance their abilities to communicate and interact. So, the students improve their capacity to discuss and negotiate and to distribute their efforts and tasks, together with the ability to use prior knowledge to find solutions. Also, the LBD method allows the improvement of controlling and self-checks during the work.

7. ACKNOWLEDGEMENTS
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8. REFERENCES
DEVELOPMENT AND OPERATION OF ALTERNATIVE LEARNING ENVIRONMENTS FOR PERSONAL AND PROFESSIONAL DEVELOPMENT OF FUTURE GRADUATES

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ABSTRACT: The value of traditional on-campus learning is reviewed, analysed and discussed in relation to the recognition of evolving learning environments such as workplace learning, home-based learning, community-based learning and other such lifelake learning environments. Detailed consideration is given to the impact of the learning environment if the learner is in a paid or unpaid work role. It is reported that the main focus over the last decade has been on the operation of workplace learning where learners are in paid employment. It is concluded that both the traditional on-campus and the paid work environments deprive learners of a negotiated approach to learning and thus do not provide the base of knowledge upon which learners can arrive at their own decisions. It is shown that if learners do not develop an ability to take responsibility for their decisions they make, then they fail to develop critical competence in exercising independent judgment. This competence is considered essential and core to professional development. It is further proposed that essential to the successful use of alternative learning environments, is the need for the personal and professional autonomy of the individual to be core to the learning model. Environments such as the non-aid workplace, the home and the community are considered in relation to effectiveness for the development of personal and professional autonomy. We describe here, a model based on using off-campus life places combined with negotiated learning to enable informal and non-formal learning to be recognised through assessment and the award of credit where appropriate. The model has at its core, development of competence in independent judgment. It is concluded that this approach to learning is the essential way forward to achieve effective learning results for the future and should be recognised alongside traditional on-campus learning.

1. INTRODUCTION
The Scottish Enterprise and Lifelong Learning Committee (1) indicated that the governing principles for a lifelong learning strategy should include promoting a learner-led system of education that is flexible and responsive to the needs of the individual and society and the enabling of everyone to access appropriate learning. We believe that the current and continuing concentration of educational institutions on traditional on-campus learning is unlikely to realise this strategy, and whilst work-based learning has seen significant growth over the past decade, much of the development has been about employer-led organisational outcomes rather than about a learner-led system which is responsive to the individual learner.

Chisholm and Burns (2) reported on research regarding the use of all off-campus learning environments where the learning does not necessarily have to be related to specific subject disciplines but where trans-disciplinary environments support tacit and explicit learning involving skills, competencies and outcomes deriving from the study of a number of interacting disciplines. They also proposed a new learning paradigm called Lifeplace Learning (LPL) which would be highly flexible, learner-led and based in life places such as the non-paid workplace, the home and the community. Davis and Chisholm (3) continued to research this paradigm and this has led to a number of recent publications and to the establishment of LPL as a successful working concept, which has at its core, the recognition of all learning regardless of where, when or how it is achieved. This supports the idea of negotiated learning in a learner-led system reported by Chisholm (4).

The main factors relating to the accreditation of LPL were reported earlier by Davis and Chisholm (5) and in a global research survey conducted by Blair (6) it was found that little or no consideration had been given to the practice of accrediting learning through a range of life place environments. The survey also found that where such environments had been considered in theory the learning was regarded as informal with little or no attempt being made to recognise or value it. It was further reported (Chisholm, and Blair (7) and Blair and Chisholm (8)) that much of what has developed as theory and practice in relation to paid work-based learning has transferability to other life place environments such as the home, the community and geographical locale.

The research undertaken suggested that a useful way forward would be to recognise all informal or even unintentional learning through a quality assurance system which would facilitate assessment and subsequent credit. This is considered a prerequisite for future learning systems because early 21st century society is increasingly concerned with the delivery of learning which can be measured and awarded credit. On this basis, Blair and Chisholm (8) took forward the LPL model where all the informal and unintentional learning could be quality assured, put through valid assessment and the award of credit made where this was a desired outcome by an individual, group or organisation.

Fundamental to the development of the LPL model is the belief that the most effective learning, in terms of the development of knowledge, skills and competencies, is the recognition of the personal and professional autonomy of the individual learner as reported by Luegenbiehl (9). Whilst this concept is deeply embedded in our western philosophical and political tradition, there is little evidence of the recognition of this concept in the
traditional on-campus education of engineering and business students, where the curriculum is taken forward in a highly educator controlled learning environment that inevitably involves coercion of thought and action. This traditional learning environment does not provide a knowledge environment where the engineering and business learners can arrive at their own decisions and develop competence in independent judgement. The case for personal autonomy in learning is strongly supported by the Kantian notion that “individuals are by their very nature as rational beings deserving of autonomy” Luegenbiehl (9) and it would seem to us that this is also a skill that we would want our graduates and employees to master.

Earlier research studies by the authors revealed successful results where the learner was recognised as having personal autonomy to define and negotiate their derived learning outcomes across whatever range of life place environments underpin their achievement of new knowledge, skills and competencies through explicit and tacit learning. Some learners who initially resisted this approach, due to perceived difficulty, reported at the end of their lifeplace studies that this was a superior way to learn when compared to the traditional on-campus approach. LPL as a model is usefully defined by Blair (6) as “Learning that encompasses knowledge, skills, behaviour and attitude, being acquired or to be acquired throughout life, irrespective of when, where, why and how it was learned”.

2. LIFEPPLACE LEARNING AND EMPLOYABILITY

Over the past few years, the term employability has had an increasingly significant part in the revision of educational programmes such that the employability profile of the learner is enhanced to ensure compatibility with the world of work. Essentially, employability is less about having a job, but more about having the requisite profile of skills, abilities, competencies and knowledge to enable the learner to obtain a job of choice. Employability as a concept is something with which, and in which, many of the current learners do not properly engage. In our mass education system many students come and complete a course but often without the focus of a planned career built around employment of their choice. When a job becomes available it may well not be that of their career choice, particularly in an increasingly competitive global economy. With educators increasingly facing the problems of teaching an overcrowded curriculum at undergraduate levels, and dealing with a range of requirements from income generation to research, many staff have still to grasp the importance of personal development planning, career planning and the issues associated with employability that need to be addressed through the curriculum. At the core of employability is the need for the curriculum to provide for the array of key skills and competencies that will underpin the learners in achieving a career of choice. We believe that key general skills and competencies could be effectively achieved using the LPL approach combined with a range of extra curricula activities designed to support the already overcrowded discipline-based requirements of programmes of study. Employability is also, in a global world of work, concerned not only with developing the required skills and competencies but also about developing competencies in the contexts of a global information society, social responsibility and social justice. Much of this is difficult to achieve in the traditional, restrictive, on-campus environment and even more difficult in such an environment, is the integration of tacit and explicit knowledge. We believe that this aspect of integration is much more able to be developed in the wider and less restrictive life place environments.

3. LIFEPPLACE LEARNING: DEVELOPING THE MODEL

On the basis of research done during 2003-2006, an LPL project was successfully achieved through the Socrates/Grundtvig E.U. programme (10) where, in collaboration with educational institutions in Germany, Estonia, Finland and Spain, the LPL model was tested. The project, entitled Lifelearn, was approved for the period October 2006 to September 2008. The project was based on the LPL concept that individuals live the majority of their lives in a range of life place environments such as the home, the community, the workplace and social environments and that much valuable learning is gained in these various places. The objective was to formally recognise the learning that can be achieved in these life places instead of driving all formal learning through the on-campus classroom and purely in a subject discipline fashion. The approach was to see how the participants in each institution could capture these learning opportunities by structuring them to enable them to be compatible with formal learning frameworks. It was anticipated that using the model established earlier by the authors, that each partner would be able to put in place LPL within the context of their own educational system and culture. Success in this project would support widening access and social inclusion across Europe alongside recognising new forms of informal knowledge, inclusive of formalisation of unintentional learning. In this respect, the project in the longer term can be expected to make significant contributions to the European Qualifications Frameworks by facilitating the accreditation of informal skills, knowledge and competencies achieved in lifeplace environments. The model supports an innovative, new and entirely novel practical route to support and recognise learning in any environment which can operate alongside the traditional on-campus classroom learning.

LPL as a concept is not intended to replace the traditional learning model but to strengthen the learning system by integrating it with the on-campus model. While paid work-based learning over the past ten years has shown that off-campus learning can be successful, the LPL model, based on similar concepts, is much more radical and is concerned with exploring intentional and unintentional learning that occurs outside the formal work environment, arising from an individual's lifelong role in the home, community and the unpaid workplace. The partners in the Lifelearn project have worked collaboratively and trans-nationally to share ideas on how best to achieve the objectives and outcomes and develop and test a working infrastructure to measure and assure the learning involved. While it is accepted that the lifeplace model is a challenging concept, particularly to traditional educationalists, nevertheless it is the next logical step in off-campus learning. In terms of widening participation, it will provide evidence to those who have not formally undertaken courses, and to those needing confidence and motivation who have joined courses, that they have indeed been learning throughout their lives and generally it can be expected to provide new motivation for learning.

The basis of the project was as follows;

- To review existing national practice in work-based learning and LPL to determine common European issues and approaches and trans-national good practice and provide staff
with a common understanding of coaching, facilitation and mentoring.

- To plan and develop LPL models consistent with the target groups, including assessment methods, quality assurance systems and learning support utilising a range of media sources including support methodologies.
- To trial and evaluate LPL through the complementary range of modules/courses/programmes with partners to document and disseminate as case studies.
- To complete an impact and evaluation of the LPL modules/courses/programmes in relation to learning by target groups, staff, pedagogical approaches, sustainability, quality assurance and the value of technology and other media based resources as support techniques and learning media.
- To disseminate and encourage interest in LPL in all sections of education nationally and trans-nationally to achieve sustainability.

Critical to the project was a move away from the traditional lecturing role to using a mixture of facilitation, mentoring and coaching to support the negotiation and implementation of an individual’s learning programme. A common approach was established at an early stage in the project to help learners set up goals that were congruent with what is important in their lives. The approach also provided a methodology to operate at an holistic level and recognise that life and learning are interconnected. All of this supports the move to trans-disciplinary learning that would provide an effective way forward for engineering and business educators. It would provide the mechanisms to take a new, effective and innovative way to establish the profile of skills and competencies in learners to ensure sustainable employability.

The Lifelearn project also supported innovative methods of assessment relevant to the LPL model and when the outcomes critically show how effective these methods are on a trans-national basis. What was not in question was the fact that traditional assessment criteria had to change to allow lifeplace learners to demonstrate their chosen learning outcomes. To date, the authors have found that permitting learners to negotiate assessment methods suitable to their own learning objectives, has proved to be highly effective. It is considered that this aspect will be of key importance if engineering and business learners are to achieve quality assured employability skills and competencies using the lifeplace approach.

Ultimately, and after full analysis of the data accumulated over the past two years, we believe that answers can and/or will be provided to the following:

- How can the individual flexibility of the model be sustained while maintaining standards?
- How best can consistent quality assurance systems be achieved that will ensure the confidence of educators, employers, learners and government?
- How can trans-national transferability be achieved across very different quality and educational systems?
- What process, techniques and support approaches can best assist the life-place learners?
- How can the use of technology be optimised to build and support communities of learners?

Clear answers to these core questions will support the strategy for future impact and sustainability of LPL for all levels of learners regardless of individual profile. Such a system will provide an effective way forward for engineering and business learners to achieve a skills and competency profile relevant to employability at any given point in their career. The LPL system will augment the traditional on-campus classroom model that is not best designed for the achievement of competencies relevant to employability. Equally, as engineers and business professionals progress in their careers, a return to the classroom learning model is far from acceptable. Achieving relevant skills and competencies in their life places, including their work places, is much more liable to be acceptable and provide the right levels of motivation to ensure sustainability of employment of choice. We also anticipate that the lifeplace project results will contribute to extending trans-national learner opportunity. In the new evolving European and global knowledge-led society the knowledge worker increasingly requires learning to be life long and take place in real world trans-disciplinary environments where key skills and competencies can be gained. This is particularly true of engineering and business learners who increasingly need to develop a set of competencies as part of their development at undergraduate and postgraduate levels, and during their continuous professional development. The opportunity to engage in the LPL model based on the reported earlier research and that by Davis and Chisholm (11), now also supported by the ongoing outcomes derived from the Lifelearn project in Europe, will make a major contribution to achieving effective learning outside the traditional classroom based approach.

4. LIFEPLACE LEARNING – RESULT CONSIDERATION

We took forward the Lifelearn project (as lead partner) hosted by the School of Engineering and Computing at Glasgow Caledonian University, Scotland. The early research and the recently completed research within Lifelearn were based on students completing LPL modules as part of a negotiated BA/BSc degree programme. The lifeplace modules were available at all four levels of undergraduate study in the Scottish system. The content of a given module was based on negotiation between the learner and the facilitator (staff member) but was clearly learner-led with the content being based on past experience and/or current life place roles and/or new learning goals. The learner was able to propose the topic to be covered, the syllabus, the learning modes and the assessment strategies, subject to the approval of the facilitator. The outcomes needed to be in accordance with the current Scottish Qualifications Framework level requirements for study, at either level 1, 2, 3 (Degree) or level 4 (Honours Degree). In negotiation with the facilitator, the learner had to complete a personal module descriptor, relevant to the appropriate level. The content of the module descriptor contained the following:

- An overview of learning from past experience;
- A description of the student’s current roles and responsibilities and the learning arising from them;
- The student’s anticipated future roles and responsibilities and the learning required to carry them out;
- The subject area and the rationale for its choice;
- A defined aim or research question;
- The intended outcomes to be achieved during the module;
- The syllabus (content) of what will be studied in the module;
- The research/investigation methods and data analysis methods:
  - The assessment methods and marking criteria;
  - The level of facilitative support and assistance required;
  - A plan for completion and execution of the learning content.
The modules were of fifteen weeks duration and learners were encouraged to choose an area of learning that had implicit value for them and that would assist them with their own personal and professional development. The only mandatory parts of the assessment were two assignments, each worth 15% of the final mark for a given module. One assignment related to the completion of the personal module descriptor and the other related to the completion of a reflective analysis of the learner's unintended learning deriving from the studies carried out to achieve the module outcomes.

As can be seen from the foregoing, the learning is primarily learner-led, directed, managed and assessed but there is facilitative support in the form of mentoring, coaching and facilitating to assist the learner in completing the module at the level specified. One important outcome built into the modules is that of recognising any unexpected but relevant and valuable learning consistent with the goals of the module. This is a particularly novel and important aspect of the lifeplace learning module.

To date, including the Lifelearn project, about ninety students have undertaken the LPL modules, covering a very wide range of subject matter and an extensive range of outcomes. The studies have varied from level 1 to level 4 of the BA/BSc programmes and the results to date show how the LPL model supports students in devising their own negotiated learning in a life place environment other than the traditional on-campus classroom learning environment. While the content of some of the modules was subject specific, many of the topics related to more generic development of skills and competencies. The vast majority of the learners found the experience stimulating and enjoyed the learner-driven approach. A number of learners initially found the concept difficult but at the end of the module, they indicated how their views had changed as they had progressed. The recent results obtained in the Lifelearn project again confirm these views. The learners utilised both past and current experience alongside future skills requirements in completing the modules. The results to date provide conclusive evidence that lifeplace learning can be accredited, effectively assessed and credit awarded.

5. DISCUSSION AND CONCLUSIONS

The LPL model developed to date offers learners of all age groups the facility to have learning in any life environment recognised, assessed and given credit which could (but need not) contribute to a qualification. Taking into account the growth of employability requirements for learners, such as engineering and business students, the model offers an effective and sustainable way to achieve the required skills and competencies at undergraduate, postgraduate and post experience levels. Our research to date has clearly shown the value of the LPL environment approach and with around ninety students having completed LPL modules as part of an accredited negotiated degree this is adequate evidence of the effectiveness of the approach.

Above all, the learners have demonstrated how this method of learning developed their individual autonomy as learners, showing that LPL supports development of competence in independent judgment as regards the overall learning experience. The authors are convinced from the work completed to date, including the recent work as the lead partner of the Lifelearn European Project, that the LPL model has transferability to Europe and worldwide. It is anticipated that once the full evaluation and analysis has been completed by all partners, a process which is ongoing, that the LPL model will benefit from a number of modifications and refinements leading to an even more effective model.

It is beyond the scope of this paper to detail how all the employability competencies can be derived using the LPL approach but it can be easily understood form the earlier detailing of the model how learners can choose to deliver a range of competencies using any environment in which they live to the benefit of themselves and their employers.

One powerful result obtained to date that we would like to share now is how learners can chose a leisure environment/activity, such as watching television at home to fulfil the requirements of the module. Having watched the programmes, at a later date and through in-depth reflection on the issues raised within the programmes (even if a fictional programme), can show that they have achieved a number of generic skills that can then be assessed and credit awarded at a given level, by using the LPL model. In this case the subject matter of the television programme is not important, it being the vehicle through which the skills and competencies are achieved. This illustration shows how unintentional learning in a leisure environment can later through reflection be formalised and measured. This creative and novel approach will of course require educators to accept a significant change in mindset if they are to become facilitators of this form of learning.

It is concluded that:

- LPL is an enabling model of learning.
- Development of LPL to date has led to a model which supports learning in trans-disciplinary life environments, delivering mixtures of subject-based learning, skills and general competencies which are not subject specific.
- LPL facilitates learning through having personal and professional autonomy at the core of the learning model.
- The LPL model offers an ideal vehicle for learners at any educational level to achieve a range of employability competencies and skills through real world environments thus relieving the pressures on already overcrowded on-campus curriculum.
- The LPL model appears to have transferability to Europe and Worldwide as a new and novel learning approach that facilitates informal and non-formal learning being recognised through assessment and the award of credit.
- The full analysis and evaluation of testing the model across Europe through the Lifelearn Grundtvig Project should lead to modifications and refinements which will facilitate the interpretation of lifeplace learning in a European context.
- The results and testing to date provide valid evidence that the lifeplace approach could support the personal and professional development of learners to update their employability competencies and skills as they progress through their careers without having to return to an on-campus environment.

6. REFERENCES

ROTORS CASTING FOR AVIATION TURBOCOMPRESSORS

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ABSTRACT: The casted benchmarks as rotors of aviation turbocompressors are made using special methods of precise casting, such as for example massive monolithic ceramic forms with ethyl silicate - namely patent / license Shaw. In the current industrial practices, production companies in this field use permanent metallic models, difficult to execute and at high-costs, for complex parts such as those mentioned and at a small production capacity or unique parts (prototypes). The paper presents the research made in achieving the model armature by stereo lithography techniques (CAD applications = Computer Aided Design) and technological solutions projected by IT & C data procession means (CAE = Computer Aided Engineering).

1. INTRODUCTION

In aviation, there are several types of centrifugal compressors with high flow, having either a simple, or with two sides. But there can be found as well models with two steps, simple, as in the case of the engine developed by Rolls-Royce called Lance (Dart).

As a principle, the rotor is supported in a frame and it is whirled by a high velocity turbine, the air being directed permanently to center of the rotor. Due to centrifugal force, the air flow which exits, along the wall profile, thus the acceleration of the air mass leads to the pressure increase.

Because it must work at high pressure and the air flow should be as large it is necessary that the rotation speed of the compressor to be very high. For this reason it is needed that rotors to be properly designed and manufactured to withstand the very high peripheral speeds of about 500 m/s.

- Monoblock disc blades, active on one or both sides; (Figure 1)
- Stump, embedded with blades, which on the outside can be rigidified with a circular armature;
- Sandwich, with two lateral discs, between which are arranged profiled palettes.

2. SOFTWARE DEVELOPED FOR CAD

CAD applications (Computer Aided Design) have been developed especially in recent years. The first program developed in this sector was the AutoCAD developed by Autodesk American company. The program started back in the 80’s and were developed more than 20 versions, being developed even the 2010 version.

AutoCAD is intended for professional designers in all technical fields, for architects and researchers from different scientific specialties.

Many of the most popular commands, such as generating mechanical components, creation of materials lists are automated. Thus, designers can create with ease and speed of execution both drawings and documentation for digital prototyping.

Another design program is the MicroStation. Generally, MicroStation is used by construction companies, and especially by railroads companies.

Unlike AutoCAD, SolidWorks program the design is done in 3D, being possible to make further details in 2D. In SolidWorks there is the possibility of animation. The project can be done "from the bottom up", meaning that the design of parts and their combination in whole or in reverse, can start from a carcass, and then to be designed the inner parts.

Catia, Unigrafics, ProE are other program from the same range, but are not so popular.

One of the biggest advantages that modern software provides 3D design is the transposition in 2D. In addition, if you later wish to change the size this is done automatically by the program.

Solid Edge is a technical design system with tools for creating and managing 3D digital prototypes. With high flows of molding and production, Solid Edge allows the creation of design projects with accurately and without errors. The Solid Edge instruments of modeling and assembly make it possible
for the design team to rapidly develop a range of great products, from components to ensembles containing thousands of components. [1]

3. WHAT IS RAPID PROTOTYPING?

Rapid Prototyping (RP) can be defined as a group of techniques used to manufacture a quick scale model of a component or a system using data from a CAD (computer aided design, computer assisted design). [2] What is normally considered as the first RP technique, stereo lithography, was developed by 3D Systems in Valencia, CA, U.S.A. The company was founded in 1986, and since then they have been developed also other RP techniques.

Rapid Prototyping refers to the manufacture of independent forms, computer assisted, and as well the manufacture of layers. RP can be used in the automotive field for example to visualize. In addition, RP models can be used for testing, such as when an airplane fuselage is put in an aerodynamic tunnel. RP models can be used to create various tools. In some cases, the RP pieces may even be the final pieces, but normally, RP material is not sufficiently robust or accurate. When the RP material is suitable, for components with complicated shapes (including parts already fitted inside the other parts) can be produced due to the nature of RP.

There are a variety of experimental RP methodologies, either in development or which are used by small groups of individuals. There are many RP techniques developed over the years, as basic principle being similar, but using technology and different materials. In Table 1 are emphasized these techniques.

### Table 1. Rapid Prototyping Techniques developed over time

<table>
<thead>
<tr>
<th>Number</th>
<th>Variant</th>
<th>Technique principle</th>
<th>Principle and technical particularities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stereo lithography (SLA)</td>
<td><img src="image1" alt="Diagram" /></td>
<td>- the prototype is performed in layers, through selective polymerization, an instant photosensitive resins under the action of a laser beam; - layer thickness: approx. 0.25 mm; - precision: 0.1-0.2 mm;</td>
</tr>
<tr>
<td>2</td>
<td>Selective laser sintering (SLS)</td>
<td><img src="image2" alt="Diagram" /></td>
<td>- metal powder with a grain of 0.05 mm; dust of polyamides; dust on quartz or zirconium; - accuracy: +/- 0.1 mm; - minimum layer thickness of 0.05 mm;</td>
</tr>
<tr>
<td>3</td>
<td>Laminated objects manufacturing (LOM)</td>
<td><img src="image3" alt="Diagram" /></td>
<td>- material: paper LOM, ABS; - accuracy: +/- 0.2 mm; - generating system in the smoke;</td>
</tr>
<tr>
<td>4</td>
<td>Fused deposition modeling (FDM)</td>
<td><img src="image4" alt="Diagram" /></td>
<td>- raw materials: acrylonitrile butadiene styrene (ABS) polymer, polycarbonates, polyamides, polyethyleneterephthalates; waxes; - typical layer thickness: 0.1-0.25 mm;</td>
</tr>
<tr>
<td>5</td>
<td>Solid ground curing (SGC)</td>
<td><img src="image5" alt="Diagram" /></td>
<td>- using photosensitive polymers; by strengthening their layers; - compared with the SLA process is more expensive but not as exact;</td>
</tr>
<tr>
<td>6</td>
<td>Techniques jet printing-3D printing</td>
<td><img src="image6" alt="Diagram" /></td>
<td>- precision: 0.1% to 0.020% maximum; - planarity: typical 0.006&quot;; - production rate: between 65-120 sec/layer, depending on installation; - see Table 3 applied to rotor;</td>
</tr>
</tbody>
</table>

4. THEORY APPLICATION FOR A AVIATION TURBICOMPRESSOR ROTOR

As aviation rotors are generally manufactured in small series, it is necessary to find a solution for manufacture by a economical process, fast enough. Thus until now presumed manufacturing technologies used by rotor forging and then processing it with the cars in 3 axes, but the method is quite costly in terms of time and money, which took a large period of time and involved very expensive equipment. Another potential is the casting to be made after a model has been build. But static casting and classic models have important quality problems for which it had to be combined a sufficiently accurate method for casting a model sufficiently economical in terms of costs involved. [3, 4]

In Table 2 are shown the steps necessary to achieve a prototype thru the Rapid Prototyping process.
Once the 3D design is completed, it is used in software that will run through the Rapid Prototyping technology. As the stereo lithography process (SLA) involves manufacturing certain pieces to support the future components, it was elected the three-dimensional printing process. The principle of this method is similar to the SLA process, being needed to generate the layers that will shape the future model, but used as raw material a powder, which is injected on the entire section resulting from cutting the design in layers, a solution which leads to strengthening powder. [5]. Very important in this process is that the „slices” resulted to be close so that the result does not show steps subsequently needed to be processed and therefore the entire model accuracy may suffer. (Dimensions changed). One must verify the irregularities and tolerances, so that the result can be used for the Shaw process.

Table 2. Rotor manufacturing stages thru Rapid Prototyping process

<table>
<thead>
<tr>
<th>Number</th>
<th>Stage name</th>
<th>Stage principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2D rotor design (figure 2);</td>
<td>• The design is made similar to a usual technical design, with information about the drawing’s odds on the final piece;</td>
</tr>
</tbody>
</table>
| 2      | Transfer design from 2D to 3D (figure 3);       | • Because all Rapid Prototyping processes work with solid (3D pieces), this means iges, stl, 3D files processing design is necessary the drawing transformation in these formats.  
• It will taken into consideration the odds, roughness, finite piece design, the raw drawing; |
| 3      | Generating sections and the “slices” of the body that we want to achieve through the Rapid Prototyping process (table 3); | • It sets the number of steps of “printer” according to this parameter resulting the final piece accuracy;  
• Number of sections: 381 layer;  
• Layer thickness: 0.1mm;  
• Printer Type: Z450;  
• Powder Type: ZP130; |
| 4      | Intermediary step in finalizing the piece (table 3); | • If you wish to view the play at an intermediate stage, the program creates a section through the piece, the piece being done specifically until to the intermediate step; |
| 5      | Finalizing the piece (table 3);                 | • After achieving all layers set to point 3, the resulting piece is cleaned, the result being a piece that perfectly convert 3D designs into reality; |
5. CONCLUSIONS

Thru the Rapid Prototyping process can be realized very complicated models of parts that can later be used in various casting processes. Thus are avoided the classic wooden models that can lead to construction errors and poor aerodynamics. The disadvantage of this method is that does not directly get the final piece, but with this model are created more massive monolithic ceramic forms with ethyl silicate - namely patent/license Shawn as for instance thru Shaw process.

6. REFERENCES

5. www.zcorp.com
CLOUD COMPUTING: A NEW CHALLENGE FOR ENGINEERING AND BUSINESS EDUCATION

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ABSTRACT: The paradigm of Cloud Computing offers a growing variety of services available on the World Wide Web and represents an innovative and rapidly developing technology market space. In this paper we discuss new approaches in open education and collaborative learning facilitated by the rise of Web 2.0. Questions to be answered are connected to the relationship between the innovative educational services and the expected outcomes, the ways students approach and use information, how well do such environments currently support and promote collaborative work, at what extend they encourage creativity among users, if they offer services and features that students do not already have in campus halls and labs. A critical understanding of cloud computing is essential to leverage the opportunities and benefits this new computing paradigm offers.

1. INTRODUCTION

- The transition from industrial society to knowledge society is penetrating most aspects of society. Science, politics, economics and culture are being affected as well as many other areas. Knowledge is a wide term used to describe different areas such as technology, science, research, education, organisation and business know-how. The on-going development is unlike other periods of transition due to the high velocity of the transition. But what is the on-going transition all about? Basically it is about turning knowledge into a competitive edge.

- The knowledge economy refers to the use of knowledge to produce economic advantages and benefits. The development of the knowledge society is deeply marked by the process of globalisation. Globalisation processes influence the traditional features of national and regional markets. Such processes open up for competition between markets in different parts of the world that were previously separated. In that way competition stretches over a much larger economic and geographical area. This leads to several interesting effects. One of the most debated is the new international division of labour. Higher Education supplies a great number of highly skilled graduates to the labour force and continues to update their competencies through life-long learning. In this respect universities are key actors in the on-going rise of knowledge intensive industries and businesses. They play a prominent role in the region by promoting life long learning and exploit how to use knowledge in new ways.

2. FACTS AND FIGURES ON HIGHER EDUCATION IN THE CENTRE REGION OF ROMANIA

As mentioned above the transformation from industrial society to knowledge society is characterised by an unprecedented pace. Major changes within technology (computers, electronic entertainment), communication (World Wide Web, e-mails, cell phones), transport (commercial airliners) have happened within the last decades. Research and development accounts for a steadily growing share of value added in production and trade. This is just one sign of a growing knowledge based economy. Among others is the expansion in formal education, the founding of a growing number of Higher Education Institutions (HEIs) alongside with the wide expectations to the advantages of science and research.

As regards the Centre Development Region of Romania several surveys have been carried out within Phare Programmes. One of the outcomes is the Regional Educational Action Plan – REAP- which is the strategic document including also the Contribution of HEIs to the Development of the Centre Region [1].

Among the clearest indications that the knowledge economy is of growing importance is the increase within education. On all levels a remarkable increase can be spotted. More people than ever before attend higher education. The number of higher education institutions has been increasing steadily since the introduction of the knowledge economy - a web of educational options is found in the central Region of Romania.

As mentioned above the time spent on formal education has grown remarkably during the last 20 years.

The number of universities has increased as well to respond to the demand. The majority of the newer universities were established in the last 20 years.

In the academic year 2009 - 2010, within the Centre Region will operate 44 HEIs of which 25 state-run institutions and 19 private HEIs. The new universities have been distributed geographically even in order to create equal educational possibilities for all people in the region.

Figure 1. Percentage of state/private HEIs in Centre Region.
Another important matter is the supplementary training and in-service training for those already a part of the labour force. In order to upgrade the qualifications and supply the labour force with knowledge that can improve their skills this area has been heavily developed. Naturally, knowledge has always been a crucial factor in the development of new products, services and business areas as a whole. All progress implies new knowledge. Thus, the concept of “human capital” is extremely important in the knowledge economy. Below one can see the structure of the population on levels of education detailed also according urban and rural environment and on feminine and male population. The level of average education is very high at all categories of population. That means that lifelong learning and the communication and information technologies are subjects that higher education institutions should focus on.

Figure 2. Distribution of the HEIs in the counties of the Centre Region.

According to a study carried out at the level of the Centre Development Region [1], for three universities (Traslilvania University of Brasov, Lucian Blaga University of Sibiu and “1 Decembrie 1918” University of Alba Iulia) the number of places in technical education has been decreased partly due to the decline of young population and partly to the down economic situation universities have to face at present and in the near future [1].

Among the number of significant job vacancies at regional level in 2007 there have been registered computer science specialists, electronic and telecommunication engineers, construction engineers, specialist in finances and specialists in public administration. Lack of labour force has been registered in the field of mechanical engineering and economics as well, thus, universities have increased the number of places for such specialities [1].

As higher education faces budget restrictions and sustainability challenges, one approach to relieve these pressures is cloud computing. Although distinct definitions of “cloud computing” abound, the concept fundamentally involves delivering technology resources to users over the Internet. With cloud computing, the operation of services moves “above the campus,” and an institution saves the upfront costs of building technology systems and instead pays only for the services that are used. As capacity needs rise and fall, and as new applications and services become available, institutions can meet the needs of their constituents quickly and cost-effectively. In some cases, a large university might be a provider of cloud services. More often, individual campuses will obtain services from the cloud. The trend toward greater use of mobile devices also supports cloud computing because it provides access to applications, storage, and other resources to users from nearly any device. While cost savings and flexibility are benefits to the use of cloud computing, the downside of such service adoption could include possible risks to privacy and security.

3. WHAT IS CLOUD COMPUTING?

While there is a lot of discussion about what “cloud computing” really means we refer here at the definition given by The National Institute of Standards and Technology of what cloud computing “is”.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [2].

From SUN Microsystems’s perspective “cloud computing is the next generation of network computing”.

In simple terms cloud computing enables one to access software applications, hardware, data and computer processing power on the web, rather than loading software onto its own computer or school server. That is, using the ‘cloud’ means using the internet as one’s own personal computer, processor and storage environment, accessing it with any internet-capable device, from any physical location at any time.

What distinguishes cloud computing from previous models? It’s using information technology as a service over the network. The combination of virtual machines and appliances as standard deployment objects is one of the key features of cloud computing. Business organizations have recognized the value of Web-based interfaces to their applications, whether
they are made available to customers over the Internet, or whether they are internal applications that are made available to authorized employees, partners, suppliers, and consultants. The beauty of Internet-based service delivery, of course, is that applications can be made available anywhere, and at any time.

The “cloud computing” trend of replacing software traditionally installed on campus computers (and the computers themselves) with applications delivered via the internet is driven by aims of reducing universities’ IT complexity and cost. The efficiency argument seems to be much stronger for universities in a down economy.

Promises of higher accessibility, availability, and efficiency are prompting universities to consider cloud-based services. Today’s cloud computing providers are offering higher education the opportunity to substitute a presence in “the cloud” for universities’ existing data centers, servers, and applications, replacing these machines’ traditional “physical” presence on campus. For academia, cloud computing lets students, faculty, staff, administrators, and other campus users access file storage, e-mail, databases, and other university applications anywhere, on-demand. This expanded, device-neutral access theoretically lets everyone use information more effectively. Centralizing applications and data in a cloud provider’s data centers is also promoted as affording a high degree of data recovery, particularly for smaller educational institutions, as large service providers can theoretically invest in high-capacity infrastructures and hosting to keep software available in the event of technical issues or heavy traffic.

In practice, cloud service providers tend to offer services that can be grouped into three categories: software as a service, platform as a service, and infrastructure as a service. These categories group together the various layers illustrated in Figure 5.

**Figure 5.** Cloud computing infrastructure as a service [3].

### 3.1. Software as a service (SaaS)

Software as a service features a complete application offered as a service on demand. A single instance of the software runs on the cloud and services multiple end users or client organizations. The most widely known example of SaaS is salesforce.com, though many other examples have come to market, including the Google Apps offering of basic business services including email, word processing, spreadsheets, presentations, etc.

### 3.2. Platform as a service (PaaS)

Platform as a service encapsulates a layer of software and provides it as a service that can be used to build higher-level services. There are at least two perspectives on PaaS depending on the perspective of the producer or consumer of the services:

- Someone producing PaaS might produce a platform by integrating an OS, middleware, application software, and even a development environment that is then provided to a customer as a service.
- Someone using PaaS would see an encapsulated service that is presented to them through an Application Programming interface (API). The customer interacts with the platform through the API, and the platform does what is necessary to manage and scale itself to provide a given level of service.

Virtual appliances can be classified as instances of PaaS. A content switch appliance, for example, would have all of its component software hidden from the customer, and only an API or GUI (Graphical User Interface) for configuring and deploying the service provided to them.

PaaS offerings can provide for every phase of software development and testing, or they can be specialized around a particular area such as content management.

Commercial examples of PaaS include the Google Apps Engine, which serves applications on Google’s infrastructure. PaaS services such as these can provide a powerful basis on which to deploy applications, however they may be constrained by the capabilities that the cloud provider chooses to deliver.

### 3.3. Infrastructure as a service (IaaS)

Infrastructure as a service delivers basic storage and compute capabilities as standardized services over the network. Servers, storage systems, switches, routers, and other systems are pooled and made available to handle workloads that range from application components to high-performance computing applications.

Commercial examples of IaaS include Joyent [3], whose main product is a line of virtualized servers that provide a highly available on-demand infrastructure.

4. CLOUD COMPUTING BENEFITS AND RISKS FOR ENGINEERING AND BUSINESS EDUCATION

The cloud support particular teaching and learning experiences and the software are available, free, and ready to use. For students cloud applications can add richness and variety to their learning experience enabling them to undertake study activities and collaborate with other students outside standard school hours. The cloud enables an individual teacher to exploit new web software applications for learning purposes without the university committing to an enterprise implementation. It enables and supports innovation in the use of new technologies for learning with minimal investment.

A simple example of using the cloud is using of g-mail for teaching staff and students. The use of the cloud means that increases in usage levels can be easily and immediately accommodated – that is, the service provider can supply additional computer processing power or storage capacity at peak periods (during term time), and can reduce supply when it’s not needed (during vacations). That means the institution does not have to buy support and maintain a whole infrastructure to service peak periods. Instead it can utilise the capacity of the cloud.

The benefits of using cloud computing include reducing run time and response time, minimizing the risk of deploying physical infrastructure, lowering the cost of entry, and increasing the pace of innovation [3].

- Reduce run time and response time
For applications that use the cloud essentially for running batch jobs, cloud computing makes it straightforward to use 1000 servers to accomplish a task in 1/1000 the time that a single server would require.

- Minimize infrastructure risk

Higher Education Institutions can use the cloud to reduce the risk inherent in purchasing physical servers. Will a new application be successful? If so, how many servers are needed and can they be deployed as quickly as the workload increases? If not, will a large investment in servers go to waste? If the application’s success is short-lived, will the HEI invest in a large amount of infrastructure that is idle most of the time?

- Lower cost of entry

There are a number of attributes of cloud computing that help to reduce the cost to enter new markets: because infrastructure is rented, not purchased, the cost is controlled, and the capital investment can be zero. In addition to the lower costs of purchasing compute cycles and storage “by the sip” the massive scale of cloud providers helps to minimize cost, helping to further reduce the cost of entry.

Applications are developed more by assembly than programming. This rapid application development is the norm, helping to reduce the time to market, potentially giving organizations deploying applications in a cloud environment a head start against the competition.

- Increased pace of innovation

Cloud computing can help to increase the pace of innovation. The low cost of entry to new markets helps to level the playing field, allowing start-up companies to deploy new products quickly and at low cost. This allows small companies to compete more effectively with traditional organizations whose deployment process in enterprise datacenters can be significantly longer. Increased competition helps to increase the pace of innovation — and with many innovations being realized through the use of open source software, the entire industry serves to benefit from the increased pace of innovation that cloud computing promotes.

However, some of the implications of using cloud computing services need to be kept in mind. Those listed below apply particularly to individual teachers using cloud computing applications with their students — and thus to their universities. While the issues may seem daunting at first glance, a good understanding of the applications being used, the problems that might arise, guidelines for use, communication with students, and risk management and mitigation strategies mean that the cloud can be used to provide students with rich online learning experiences.

Some of the issues and risks the universities might experience with cloud computing are presented below:

- Once universities establish where their data will reside and how it will be secured, they need to carefully consider “availability”. Authorized users need assured access to information, and cloud computing platforms are designed to be a robust, continually backed-up environment for data. A loss of internet connectivity anywhere between a university customer and their cloud provider’s network will cause interruptions of varying severity.

Typical cloud agreements define service level agreements (SLAs) establishing providers’ expected uptime and performance. Universities should have cloud providers define their data recovery and business continuity postures in detail, particularly regarding what they are responsible for during a natural disaster affecting their data centers, for example, or other crises.

- Lack of interoperability and transferability. “Portability,” whether from “cloud-to-cloud” or from a provider to back within campus walls, is another often overlooked and very important consideration.

Cloud computing does not promote aggregation of content as a number of separate services are likely to be used to host and store information and content. Additionally it does not facilitate the establishment of interoperable school administrative and learning systems. Individual cloud providers may have little or no interest in interoperability or transferability as it’s in their interests to keep you tied to their service.

Cloud vendors want to get customers’ data in their cloud platform, but may not be as helpful when it comes to letting them take data out of their infrastructure, in the event the customer decides to end the relationship. A good way for universities to estimate the portability of their data is to consider the nature of what they are contemplating to send into the cloud.

- Potential cloud service customers also need to ask who owns the data. With cloud computing, customers do not own the underlying software. Again, depending on the nature of the service and/or applications in question, universities should read the fine print carefully and approach each service provider from the standpoint of maintaining ownership over not only their raw, unique data, but the valuable results of data processing occurring on the provider’s cloud platform. Such results could include reports pinpointing trends in student performance, or savings potential in contract management or accounting. Because campus leaders rely on managerial reports, more so than raw data, their status and ownership over time is a critical issue. Related to data ownership is the important question of what happens if either the customer or cloud provider cannot pay for, or deliver the service, leading to its effective termination. Is there a means for customers to recover their organization’s critical data when a provider fails? Is a provider obligated to return, or maintain data in the event a customer can no longer pay for the cloud, or suspends payments in a dispute? These are all questions universities should consider up front, before any costly disruptions occur due to providers’ insolvency or other hardships.

- Potential cloud service customers also need to carefully consider the parties’ roles and the allocation of risks and liabilities under the cloud model. Cloud service providers want to plug into universities’ offices as seamlessly as possible, but because they are fundamentally service providers, complying with all applicable laws is ultimately the school’s responsibility. Given this significant fact, educational institutions should seek out providers who can accommodate their specific or unique requirements. For example, whether a cloud computing solution complies with the Payment Card Industry Data Security Standards (PCI)—a requirement for anyone processing credit and debit card transactions—is something of an open question right now. Much depends on certain interpretations of the rules. Therefore, certain cloud computing models might not be as good a solution for campus functions that have to be PCI compliant, at least until that issue gets sorted out. If a campus has to retain these functions and the responsibility for verifying PCI compliance, that could adversely impact the business case for moving other aspects of the university computing to the cloud.

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Formally assigning liability risk is essential for universities and other buyers' faith and confidence in cloud computing, because customers want assurances that as long as they abide by specific rules—ideally tailored to their existing internal policies—providers will shoulder remaining liability. Customers are generally concerned about cloud providers’ liability for things like data breaches occurring on their infrastructures, or a provider’s facing a court-ordered shutdown as a result of patent infringement or other penalty, which could leave customers with disrupted services. Providers, in turn, usually want university customers to assume liability for the placement or copyright-infringing or other illegal material into their cloud platforms.

5. CONCLUSIONS

A critical understanding of cloud computing is essential to leverage the opportunities and benefits this new computing paradigm offers.

The university can be seen as a subsystem for knowledge production, quite different from industrial research and development. For purposes of technical architectural design of the university networks and information system, some of core challenges would be [5]:

- How to manage increasingly permeable boundaries between the university and the world, to enable the higher degree of effective participation in the world that students and faculty can have, while avoiding a fragmentation of the coherent university system;

- How to preserve the practical capability and authority to act in the hands of students and faculty, in the face of pressures to centrally control use in order to avoid “bad” uses, both external (such as copyright violations or security threats) and internal (such as destabilization of the traditional lines of authority in the classroom); and

- How to build platforms for cooperation that enhance the central experience of the university—intense structured discourse around a set of shared values and practices oriented toward knowledge and education.

6. REFERENCES

ASSESSING THE FIRM’S INNOVATION CAPABILITY

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ABSTRACT: Like individuals, organisations have a certain potential of innovation and creativity. The way to achieve the excellence in innovation has three main stages: analysing the current level of the innovation capability; implementing a set of measures to improve it up to the target level; assessing the final level of the innovation capability and measuring the progress made. This paper deals with the third stage. Based on the “European Innovation Scoreboard Report (2008-2010)” – which evaluates the macroeconomic effectiveness of the innovation systems – the authors have developed a complex set of indicators aiming at assessing the firm’s innovation capability. The authors had to overcome the obstacles raised by the frequent changes of the European legislation. The work is supported by an original research on the current status of innovation in Romanian small businesses. The proposed methodology is a useful tool for both engineering & business educators and practitioners to assess the firm’s innovation capability.

Keywords: Innovation, Innovation capability, Innovation capability assessment, European Innovation Scoreboard (EIS), Engineering education

1. DEFINITION OF THE INNOVATION CAPABILITY

In the speciality literature, a series of definitions about the innovation capability of an organization have been done:

- The significant set of the features of an organization that facilitate and support the innovation strategies [3];
- Ability of an organization to adapt and implement successfully new ideas, processes and products;
- Ability of an organization to innovate successfully on a sustainable base. It refers to generation, adaptation and commercialization of the innovations [2];
- A sustainable competitive advantage is at the base of the firm’s performance [1];
- Ability to mobilize knowledge through the employees, to combine them in order to create new knowledge resulted in the innovation of a product and/or of a process. It has a dynamic character in which it reveals the interaction between the internal knowledge of a firm and the demands from the external market.

As a synthesis of these definitions, the following statement can be remembered: the innovation capability of a firm can be understood as the ability of a firm to provide continuously and successfully products at the right time, at convenient costs and at the wanted quality.

In figure 1, it can be seen the requirements of the innovation capability [4].

2. THE EFFICIENCY OF THE INNOVATION PROCESSES

In case of the innovation processes at the level of a firm, we would rather talk about efficiency than effectiveness because innovation is carried on risk and uncertain conditions, the degree of uncertainty being higher so as the degree of novelty of the innovation process is greater. As a rule, only the projects of radical innovation referring to an absolute novelty are carried on uncertain conditions, the other categories of projects are proceeding on risk conditions.

Considering that any economic process, phenomenon and activity have a quantitative determination, it could be appreciate that the efficiency of a process is given by the report between the effect and the effort made for its achievement.

As inputs within the system we can find persons, information, raw materials, equipments and endowments, requirements, capital and so on. A classification of the inputs is shown in table 1. The innovation success depends on the quality of the inputs. (table 1)
Outputs are divided into direct and indirect outputs (outcomes). As direct outputs we can talk about products, processes, patents, knowledge, publications. The indirect outputs, the innovation outcomes are the reduction of costs, the increase of turnover, the improvement of products and processes, the decrease of complaints.

Between inputs and outputs there is a clear connection of direct proportionality. Therefore, if we have an increase of the inputs, this will imply a correction of the outcomes.

### Table 1. Types of inputs

<table>
<thead>
<tr>
<th>Types of inputs</th>
<th>Elements of inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangible resources</td>
<td>Persons, equipments, endowments, spaces, soft, capital, time, capital of risk</td>
</tr>
<tr>
<td>Intangible resources</td>
<td>Information, knowledge, talent, motivation, organizational culture, brand</td>
</tr>
<tr>
<td>External network</td>
<td>Partners, key customers and suppliers, groups of interests, relationships with firms and institutions</td>
</tr>
<tr>
<td>Innovation systems</td>
<td>Systems for recruitment, training, continuous learning and value creation</td>
</tr>
</tbody>
</table>

Figure 2. The process of innovation as a complex system [10]

3. THE IMPORTANCE OF THE ANALYSIS OF THE INNOVATION CAPABILITY IN THE ACHIEVEMENT OF EXCELLENCE IN INNOVATION

Any firm has a potential of creativity and innovation. Generally, people have many ideas which can be at least useful and can lead to the emergence of some really valuable solutions in the effort of a firm to get a certain competitive advantage. The creativity rate of an organization represents a kind of average of the creativity level of the individuals who make up that organization. Of course, even if the creativity potential is significant, it does not mean that the innovation potential of the respective firm is high. Creativity is the starting point in innovation, but the existence of innovation implies also the presence of other factors. It is emerging the question how innovative is the firm and where is it situated, as performances, as against the competition. Therefore, the analysis of the innovation capability represents the starting point in the achievement of excellence in innovation (figure 3).

For the organization, on the whole, to be capable to innovate, the creative initiatives of these have to offer an adequate framework of development and valorisation. The innovation capability of a firm depends on the management capacity to identify the determinant factors that act on the innovation capability and to determine the way they act. It is emerging the
question: What has it to be done to innovate more quickly, better and more efficiently?

The adopted measures of correction have to be continuously analysed and improved.

4. THE EUROPEAN INNOVATION SCOREBOARD

The European Innovation Scoreboard (EIS) has been published annually since 2001 to track and benchmark the relative innovation performance of EU Member States. [9]

After the workshop on Improving the EIS methodology which took place in Brussels on June 2008, a new methodology has been adopted, it includes 29 indicators arranged on 7 dimensions of the innovation. In their turn, they are grouped into three major dimensions of the innovation.

For the EIS 2008 the methodology has been revised and the number of dimensions increased to 7 and grouped into 3 main blocks covering enablers, firm’s activities and outputs.

The purpose of this revision is to have dimensions that bring together a set of related indicators to give a balanced assessment of the innovation performance in that dimension. The blocks and dimensions have been designed to accommodate the diversity of different innovation processes and models that occur in different national contexts.

DIMENSIONS OF INNOVATION PERFORMANCE CAPTURED IN THE EIS

ENABLERS capture the main drivers of innovation that are external to the firm as:

- Human resources – the availability of high-skilled and educated people.
- Finance and support – the availability of finance for innovation projects and the support of governments for innovation activities.

FIRM’S ACTIVITIES capture innovation efforts that firms undertake recognising the fundamental importance of firms’ activities in the innovation process:

- Firm’s investments – cover a range of different investments firms make in order to generate innovations.
- Linkages & entrepreneurship – capture entrepreneurial efforts and collaboration efforts among innovating firms and also with the public sector.
- Throughputs – capture the Intellectual Property Rights (IPR) generated as a throughput in the innovation process and Technology Balance of Payments flows.

OUTPUTS capture the outputs of firm’s activities as:

- Innovators – the number of firms that have introduced innovations onto the market or within their organisations, covering technological and non-technological innovations.
- Economic effects – capture the economic success of innovation in employment, exports and sales due to innovation activities. [9]

5. PERSONAL CONTRIBUTION WITH REGARD TO THE IMPROVEMENT OF THE INNOVATION CAPABILITY

Starting from the innovation definition that is ―To do differently, better than at present‖ and from the various manners of innovation (product, process, organizational and marketing innovation). The difficulty consists in the fact that the innovation process has to be continuously. Therefore, the innovation results are so much different from a firm to other. In the approach of the improvement of the innovation capability, the speciality theory is suggesting ―The innovation card [5]‖ as a starting point, which presents the ten improvement fields of the innovation capability (figure 4).

The model is suggesting that for each field of the ten to build a “sheet of analysis and identification of the improvement opportunities of the activities which generate innovation”. For each of the ten fields there is a series of concepts which the firm’s management is possible to be familiarized. However, there is a long way from the idea to be familiarized till the moment of getting notable results.

The suggested mode of improvement of the innovation capability is looking down a series of steps from the concepts description to the assessment. Therefore, the concepts have to be understood, drawn up, implemented and improved by the firm’s management (figure 4).

Figure 4. Methodology of analysis, improvement and assessment of the innovation capability
5.1. The proposed model of grouping Research & Development & Innovation (RDI) indicators at the level of a firm

In order to express in quantitative terms the innovation outcomes, it is necessary to develop a set of indicators whereby to monitor the organizational performances referring to innovation.

The proposed model (personal contribution) takes as a basis the EIS methodology of assessment the innovation performances at the national level for 2008-2010 (table 2).

### Table 2. Model of grouping Research & Development & Innovation (RDI) indicators

<table>
<thead>
<tr>
<th>Description</th>
<th>The EIS methodology for 2008-2010</th>
<th>The proposed model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role</td>
<td>The assessment of the innovation performances at the national level</td>
<td>The assessment of the innovation performances at the level of a firm</td>
</tr>
<tr>
<td>Major dimensions of the innovation performances</td>
<td>Both methodologies present three dimensions:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enablers</td>
<td>Firm’s activities</td>
</tr>
<tr>
<td>Enablers</td>
<td>Human resources</td>
<td>Financial support</td>
</tr>
<tr>
<td>Firm’s activities</td>
<td>Firm’s investments</td>
<td>Linkages</td>
</tr>
<tr>
<td>Linkages &amp; entrepreneurship</td>
<td></td>
<td>Throughputs</td>
</tr>
<tr>
<td>Outputs</td>
<td>Innovators</td>
<td>Economic effects</td>
</tr>
<tr>
<td>The innovation dimensions</td>
<td></td>
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</tr>
</tbody>
</table>

5.2. Allocation of the representative indicators on the fields of intervention

In the extended research many possible indicators have been identified which can be the basis of the assessments of the innovation performances at the level of a firm, that sum up to 98 indicators grouped on 16 dimensions of innovation (table 2). In their turn, they are grouped into three major dimensions of the innovation.

A simplified alternative of grouping the indicators has a number of 40 indicators in view, which have been allocated for the ten fields of intervention over the improvement of the innovation capability (the innovation card – figure 4).

1. Organizational culture
   - The degree of autonomy of the posts (the number of posts with high autonomy proportional to the total number of posts)
   - The value of the financial rewards for contributions to RDI in the total number of agreed rewards
   - Employee turnover
2. Planning
   - The number of new products/services wanted to be achieved
   - The number of improved products/services wanted to be achieved
3. Resources
   - The aimed degree of renewing products, services and technologies
   - The value of the budget allocated for R-D-I
   - The share of the investments in R-D-I from the total investments
   - The number of the subscriptions to written materials (such as magazines, specialty books) and Internet
   - The number of computers proportional to the number of employees
   - The size of the budget allocated for the market research
   - The size of the budget allocated for communication
   - The size of the budget allocated for commercialization new products/services
4. Knowledge
   - The indicator of the employees’ development
   - The indicator of the employees’ level of education
   - The number of hours allocated for research
5. Technology
   - The value of the expenses with the acquisition of technologies / the number of purchased technologies
   - Productivity per employee
   - The reduction of costs through process innovation
   - The number of purchased patents
6. Project management

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• The number of finalized projects proportional to the ones started
• The average time for carrying out projects

7. Product
• The number of new achieved products
• The number of the improved products
• The average time necessary for launching a new product on the market
• The average time necessary for developing an existing product
• Incomes resulted from the commercialization of the new products and services

8. Process
• The number of the received ideas of improvement per employee
• The time of processing the ideas of improvement
• The number of the implemented ideas

9. Structure & Network
• The number of the projects developed with external entities
• The number of meetings with external entities (institutions of research, of education and so on)
• The number of key customers involved in previous and existing projects
• The number of key suppliers involved in previous and existing projects
• The number of the alterations supported by the organizational framework which turned out to be efficiently
• The number of the new used methods of management

10. Marketing
• The decrease of the complaints number (%)
• The average time of processing the customers’ complaints
• The number of new customers
• Selling to new customers (%)
• The profits resulted from selling to new customers (%)

5.3. Research
This research was carried on June 2008 – December 2008 and it aimed the activity of innovation of the firms situated in Bucharest, where a number of about 150,000 firms were registered in 2008.

As the various required aspects, the complexity of the analyzed subject and the reticence of the questioned persons, a pilot sample of 50 firms was taken into account.

The practical research solution was the survey of the market.

Regarding the branch of activity, most of the investigated firms activate in the field of services, that is 50% of them and in commerce – 41.6%.

Considering the firms’ size, the biggest share within the analyzed companies was owned by the middle enterprises, which represent 41.6% from the total number of the investigated companies, followed by 25% of the big enterprises.

Taken into account the turnover, the biggest share was owned by the companies with a turnover between 10 – 250 millions €, that is 33.3%, followed by the ones with a turnover over 250 millions €, representing 25%.

Considering the nature of the accomplished goods, the biggest share was owned by the companies that carried on both tangible goods and services, representing 50%.

With reference to the innovation assessment, this research has emphasized that the main indicators used by the firms are: new products sales (75%), the increase of profitability (58.3%), profits resulted from the commercialization of new products (50%), selling to new customers (41.6%) and the product life cycle time (41.6%).

6. CONCLUSIONS

The existence of the innovation capability offers a competitive advantage for the company only if the innovation does not take place by chance and it is the result of an intense managerial activity.

Companies have not only to achieve the necessary degree of awareness about the need of innovation, but specially, to adopt effective measures in order to know and develop the innovation capability – the importance of an existing innovation management within the firm.

Acquiring excellence in innovation requires running through three essential stages:

• Analysis of the innovation capability;
• Improvement of the innovation capability;
• Assessment and correction.

7. REFERENCES

NEW OPPORTUNITIES AND THREATS CHALLENGING THE SYSTEM OF ENGINEERING EDUCATION

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ABSTRACT: The globally changing higher education environment is under real pressure to interact with surrounding society where success is increasingly based on knowledge, skills and ability to learn. It is the responsibility of engineering education to build both the necessary structures for renewing engineering curriculum and course structures, and to implement alternative teaching methods and assessment of their effectiveness, raising the status of teaching in society and in institutional hiring and reward policies. The engineering education is facing the challenge of encouraging the co-operation with external stakeholders and of creating common understanding of the target future, by remaking the quality of education so as to facilitate social responsibility and innovation. The aim of our paper is to analyze and improve the Romanian system of engineering education taking into account the global challenges in the Learning Society (new knowledge economy).

1. INTRODUCTION

We are aware of the ever-increasing societal role of engineering in providing the means for the foundation of a comfortable habitat for modern human beings. It is well known that the goal of engineering education (as an activity of teaching engineering and technology, at school, college and university levels) is to train people to practice engineering as a profession and, increase student interest in technical careers through science and math education and lifelong learning [2].

There has been intensive investment in engineering and science education and this has proven to be successful for entire society. However, there are plenty of challenges related to engineering education. Educational planning in a fast changing environment requires flexibility and continuous joint action (cooperation) among stakeholders.

The development of education in a fast changing environment has to be uninterrupted. This means that flexibility and legerity and possibilities for meaningful stakeholder interaction are conditions to a performing education system. The quality of education needs to be re-created, re-engineered and re-assessed continuously by all stakeholders of engineering education. The system should facilitate change, innovation, social responsibility and sustainability. The subsystems for educational design, implementation, management and feedback need to be integrated and interrelated so that they provide opportunities instead of obstructions for development of engineering education. We agree with the idea that engineers have an important role in societal development.

Ten years ago, specialists announced a list about the components of the holistic engineering education of the 21st Century. The new integrative model emphasizes uncertainty emerging from the fast changing environment, technological development and increased ethical and social responsibility. Skills related with continuous learning and creativity dealing with chaos and handling ambiguity, are considered to become increasingly important [4].

2. ROMANIAN EDUCATION SYSTEM

The environment for higher education is changing planetary. Deregulation, privatization and emergent innovative organizational structures are created, implemented globally. There are new private universities, new institutions, increasing amount of corporate universities, university networks etc. Motivations for transformation of traditional structures are common inability of bureaucratic structures to change and interact with surrounding society.

In a society, where success is more and more based on knowledge, skills and ability to learn, the system of education plays a significant role. The whole educational system from kindergarten to higher education and continuous education has to be interconnected. At the same time, while the importance of the system of education is increasing, there are a lot of emerging factors in the environment, diverse opportunities and threats, challenging the system of education to change. Whether factors affecting engineering education are considered to be internal or external for the education system depends on the used definition of engineering education system.

It is well known that Romania has been marked by economic, social and political changes of extraordinary comprehensiveness. The talents, skills and knowledge base of the Romanian population are crucial in this process. The review of education policy of Romania was realized by the Centre for Co-operation with Non-Members (CCNM), and covers the entire system and identifies key directions for the reinforcement of the reforms in light of the challenges faced by officials, communities, enterprises, educators, and students under very dynamic and uncertain conditions. This calls for a more strategic approach to Romanian education policy which should be more responsive to broader human resource development concerns and the developing needs of the economy and society at large [6].

2.1. Human resource as a key component of the education system

No social institution is as dependent on the quality and effort of its personnel for determining success as is education. The improving of the education system in Romania requires a
dramatic upgrading in the quality of human resources. However, this improvement in human resources must occur as part of a broader improvement in the organizational development of the system. Laws, regulations, organizational procedures, and institutional practices will all need to be reformed if the improvement in management training is to have the desired effect. The human resource improvements are divisible into two main categories: improvements in teachers and improvements in managers. The importance of human resources in making the reform a success is reemphasized by the role that greater decentralization and individual decision-making will play in the emerging structure and operation of the Romanian education system.

The goals of the current management enhancement efforts of government consist in: increase the effectiveness and accuracy of MoNE activity in strategic planning (including monitoring, evaluation and accreditation); develop new and more efficient financing systems for education.; refining the role of the inspectorate as a quality assurance office for the system; increasing collaboration (especially on financing issues) between the inspectorate and local authorities.; increasing the autonomy of local school units so that the responsibility for and impact of decisions will be more congruent.; increasing the responsibility of the school administrative council, head teachers and, for curriculum, the teachers council.

Another must in this field refers to the revising of the new curriculum and the shift from the “informative to the formative”, developing the learner’s thinking skills for lifelong learning. A need is seen for education to cultivate sensitivity to human problems and ethical-civic values. Interdisciplinary approaches to teaching and learning are to be introduced, moving away the strict separation of subjects that dominated the past. It is intended that teachers will have greater freedom in shaping curriculum, choosing methodology and teaching materials. This assertion of these values is important and necessary to set and guide the direction of education in Romania. These newly articulated values are certainly more in line with the aims of education systems in most OECD countries.

Effective planning of the Romanian education system requires information on potential labor demand for various specializations. MoLSP is the appropriate institution to engage information on potential labor demand for various specializations. MoLSP is the appropriate institution to engage in recurrent tracer studies of graduates’ employability and economic success and to share this information with planners within MoNE and with institutional personnel in schools, colleges and universities responsible for advising students and designing curricula. However, a dynamic economy such as that of Romania is likely to go through frequent and dramatic changes in the structure of labour demand. Therefore, efforts to improve the predictability of manpower supply and demand estimates should be secondary to the production of more adaptable graduates (based on broader curricular structures or multiple specializations).

Financing issues in Romania are fundamental and profound and will, in large part, determine whether other reforms will have any chance for success. Without adequate resources and incentives for their effective use, no reform effort will succeed. Money obviously will not solve all educational problems, but a lack of funds and inefficient use of available resources will aggravate existing problems and create serious new ones.

2.2. Higher education in Romania

Romania has deficiency at college level education, which should be based on local needs of communities and the special requirements of poorer families who lack the funds required for sending students to a distant institution. However, existing colleges are sometimes perceived, often incorrectly, as institutions inferior to universities, not as distinct institutions offering a different type of quality education [7].

Romania has plenty of newly established private higher education institutions; many such institutions, while they may not receive full accreditation as universities, could evolve into colleges, able to offer short-cycle higher education linked to regional needs and appropriate to local conditions. MoNE should prepare a strategy to stimulate the development of such colleges and MoLSP should agree on the appropriate status of the college graduates and their certificates.

Higher education faces the challenge of developing “new fields” of study during a period of financial and administrative restrictions. Training in areas such as the market economy, democratic processes, civil society and computer sciences can be greatly advanced if the universities and colleges take advantage of the substantial amount of young people being trained abroad or in more creative programs within Romania. Special incentives to recruit, develop professionally and retain such young academics will be a priority for the full transformation and modernization of the higher education curriculum.

The tertiary sector of education must be concerned with five critical issues in the coming years: increased accountability to government and to students; effective exploitation of the new financial authority and autonomy; promoting greater equity in access and attainment; balancing the development of the public and private sectors; assuring that graduates have the skills and attitudes to contribute effectively to the society, political system and economy of the nation. Dealing with these issues successfully will require the continued evolution of MoNE into a centre of expertise that assists, rather than directs, tertiary education and the recurrent assessment of laws and regulations to assure a proper legal framework allowing tertiary education to fulfill its social role. Both management reform and significant investments in information technology and management training will be necessary. However, it is very important that excellence in education is linked to excellence in research.

The Romanian educational system, from pre-school through higher education, is rapidly adapting to changes in learning and communication technology. Financial restrictions may continue to limit this adaptation, but this has been partially offset in recent years by the priority assigned to this area by the international and bilateral support institutions and by local parental support. A national plan for use of communication technologies in teacher training, distance education and other learning activities should be formulated to guarantee that these investments create improved learning and greater, rather than reduced, fairness in learning achievement.

3. ROMANIAN ENGINEERING EDUCATION AND THE NEW KNOWLEDGE ECONOMY

Educational planning in a fast evolving environment is an extremely difficult task. It is practically impossible to prefigure the exact labor market demand of engineers in a certain field of technology during the coming 10 - 15 years. The problem of estimating the labor market demand of engineers in Romanian in future is necessary, because of the fact that the number of Romanian engineering students is internationally compared extremely high.
In Romania, the role of engineers becomes increasingly important, and engineering education becomes an increasingly secured way to obtain guaranteed employment and the means to provide for the family in spite of inherent ups and downs of globalized economy. In our society the role of engineers is taken for granted, and the engineering profession does not offer much glamour and income potential in Romania. Engineering is not a frequent choice of Romanian high school graduates.

There are a number of factors responsible for this reality. In addition to income issue, engineering programs are notorious for scaring potential students by the rigors of math. Many high school math teachers who often had chosen teaching careers because of the same “math scare” perpetuate this phobia among their students. “Math scare” does not end in the university either. Calculus, as a necessary part of the engineering curriculum, is often presented not as a general purpose tool that enables us to understand laws of nature and get access to engineering methodologies, but as a combination of formulas, derivations and theorems that are difficult to memorize.

To address this problem, mathematics for undergraduate engineering students should be taught not by mathematicians but by engineers. Only engineers can address the pragmatism of a Romanian engineering student by starting from the problem that must be solved and then offering necessary mathematical and computer tools for its solution. A practicing engineer must know how to use computer tools implementing the most advanced mathematical techniques.

But how does a graduate of Romanian high school decide to apply to an engineering program? It happens first of all because of personal influence of an engineer, relative, or mentor. Too often, Romanian high schools are not capable of familiarizing their students with modern engineering concepts. A high school graduate, especially from a rural area has very little chance to be motivated to become an engineering student. The Internet era reveals an interesting solution to this problem. We consider that it is time to explore the power of the Internet to offer a new approach enabling both teachers and students of high schools to get valuable insight into the world of engineering. The most intelligent and pragmatic part of high school students could be attracted to engineering by presenting, in a very accessible form, modern engineering concepts and technologies. This is exactly the situation where the Internet-accessible engineering laboratories could be very effective. It includes the development of several remotely operated laboratory setups featuring one of the state-of-the-art technologies, satellite-based laser communication. The choice of this technology is quite purposeful: it allows for the demonstration of various concepts in communication, lasers, satellites, robotics and systems.

For “conserving” the Romanian Engineer, we consider that it is necessary a great effort, jointly funded by Government and industry, aimed at the development of Internet technologies demonstrating advanced engineering concepts thus encouraging early interest in engineering careers among Romanian youth. The social and societal impact of this effort could be dramatic: offered in high schools nationwide, it will reach all social groups of population, teachers, students, and parents, raising interest in science and engineering.

The engineers of the future must have: a solid basic knowledge of the natural sciences, an in-depth knowledge of the engineer’s own field of technology, the ability to solve problems innovatively, good language skills and other skills needed in international connections, the ability to work in a team, willingness to develop oneself and the quality of one’s work, the power to take responsibility and to act as a leader in a constantly evolving environment [5].

Interdisciplinary studies are able to improve an engineer’s judgment and awareness of professional and ethical responsibility. Interdisciplinary studies help the engineer to cope with the evolving social, economical and political conditions that are interrelated with technology and its development. Professional and ethical responsibilities are of crucial importance. Therefore, interdisciplinary studies, especially in humanities and economics should be an essential part of engineering education. The use of information and communication technologies (ICT) to support learning may create significant effects for interdisciplinary studies.

3.1. Cooperation between stakeholders

The engineering education is facing the challenge of encouraging the co-operation with external stakeholders and of producing common understanding of the target future, by remaking the quality of education so as to contribute to social responsibility and innovation.

When considering engineering education, at least six important stakeholders can be identified: engineering graduates, engineering students, representatives of polytechnics and universities of technology, industry and other employees of future engineers, policy-makers and other experts, including representatives from organizations involved in, and promoting research and development. There is no one right definition of the customer and actor in engineering education. All stakeholders are important in maintaining and developing engineering education. Depending on the standpoint the roles and interests are changed and integrated.

Technical education systems must adapt and be in permanent contact with the Romanian industry. It is therefore necessary to involve technical universities in developing partnership relationships with the industry, with direct effects on the rate of absorption of their professional graduates in their field of specialization. Moreover, this would bring increased attractiveness of engineering for those who are in pre-university training.

Worldwide there is a growing need of jobs covering engineering skills, but now there is a gap between employer requirements and the level of expertise of young engineers. This can be remedied by involving universities in real partnerships with the industry, therefore these partnership programs must become a priority. Thus, by initiating and developing advanced collaborations with the industry via bidirectional transfer of knowledge, universities can contribute to increasing technological progress and performance in research.

It is very uncommon that engineers work in an organization with only engineers, and also then they have to be able to communicate with other stakeholders (customers, suppliers, shareholders etc.) of the company. Specialists and generalists need to be able to operate and communicate in the demanding Learning Society working environment that is constantly evolving.

3.2. Lifelong learning programs

It is no longer possible to provide an engineering student with all knowledge he might need when getting in professional practice. Graduated engineers can’t admit that after finishing their studies, they could continue their career until retirement without any need for professional development and continuing
education. The need to update knowledge and skills during one’s career is obvious. However, lifelong learning is not just a new subject to be added to the curriculum. Positive attitudes towards learning and willingness to learn are the key features. And these attitudes are upraised during the engineering studies.

For engineering education, this means that the fundamental objective is to build a good basic knowledge of the natural sciences as well as the ability and motivation to learn new things. It is only with a good basic knowledge of natural sciences that engineers are able to apply their knowledge and skills in new circumstances in a different way, and thus be innovative.

The Program of Lifelong Learning in Romania conducted in the period 2008-2010 has as its main objective to contribute through lifelong learning to the development of the European Union as an advanced society based on knowledge, capable of sustainable economic growth accompanied by a quantitative and qualitative increase in the number of jobs and a greater social cohesion, while ensuring good protection of the environment for future generations. In particular, the program aims to foster mutual exchanges, cooperation and mobility between education and training systems within the European Union so that they become a model for quality worldwide [8].

It is the responsibility of engineering education to create both the necessary structures for regenerating engineering curriculum and course structures, and to implement alternative teaching methods and assessment of their effectiveness, enhancing the status of teaching in society and in institutional hiring and reward policies.

There is a paradigm shift taking place in the academy, in which the focus is moving from faculty and their teaching to students and their learning. Efforts to improve student learning consist in a variety of innovative pedagogical approaches (including first-year design courses, cooperative learning, upper division interdisciplinary courses, technology-enhanced education, and distance learning). Engineering educators are leading the way in many of these areas. Also, the role of students in this transformation process must be recognized. In a number of locations, students are offering leadership in curricular change [1].

4. QUALITY ENHANCEMENT OF THE ROMANIAN ENGINEERING EDUCATION SYSTEM

In competition for the most and best candidates, engineering education institutions should use customer service initiatives to attract students. Teaching students as customers represents a real must for the universities which want to improve educational service quality. Students must be viewed as co-producer in learning, having the responsibility to participate in their education, and not passive recipients. In this context, we have to mention that engineering higher education must respond to the “multi-customer” requirements.

Quality enhancement requires that institutions dedicate themselves to enhancing the quality of their programs and services within the context of their missions, resources, and capacities, and creating an environment in which teaching, research, and learning occur.

Although evaluation of an institution’s educational quality and its effectiveness is a difficult task, requiring careful analysis and professional judgment, an institution is expected to document quality and effectiveness in all its major aspects [9].

Quality enhancement focuses on three elements: quality (relationship between customer orientation and service being performed), customer (student/research and development, consumers, those who need new information), and responsibility (those in charge/each individual). It starts and ends with satisfying customers’ needs by continuous improvement of every process to meet internal and external customers’ needs (internal customers are: faculty, administrators; external customers: students, students’ parents, prospective students, donors, media, community etc.). And, improvement process must include everybody in the institution.

In adapting quality improvement from business to education, quality enhancement has become a hybrid between quality improvement and institutional effectiveness. Institutional effectiveness is the ability of an institution to match its performance to its established purposes as stated in its mission being closely related to planning. In order to reach institutional effectiveness, engineering universities should guide upon the following principles: concise statement of institutional mission and objectives; identification of intended departmental outcomes; means of assessment; assessment of how much/whether of outcomes and objectives; and use of assessment results to improve or adjust institutional outcome or purpose [3].

Quality enhancement and institutional effectiveness are three things in common: both include planning, both use evaluation/measurement, both stress improvement, and both require “buy-in” or participation from various parts of the institution.

We may consider that quality enhancement includes components of institutional effectiveness. Some discussions of quality enhancement actually assume institutional effectiveness as one requirement for achieving quality.

In order to reach quality enhancement, the engineering education system in Romania should follow four steps: 1) Plan - design courses to meet students’ needs; 2) Do - teach courses based on typical students and circumstances; 3) Check - assess how students use learning; Survey students’ opinion; 4) Act - modify according to assessment findings. To be a member of a faculty is to be committed to two principal activities: active engagement in research and scholarship and teaching. The former is the ongoing learning, analyzing and reflecting upon the knowledge of one’s chosen “discipline” as the basis of creating new knowledge. The latter is the synthesis of one’s store of learning to draw the student into the excitement, the wonderment, of that knowledge. The aspiration of the teacher is to transform the learner into a discerning, knowledgeable, respectful, active citizen.

One of the priority areas of the Program of Lifelong Learning for the period 2008-2010 is to improve the quality of education and training of personnel of any type of educational institution, especially for teachers and trainers.

5. CONCLUSIONS

This is an exciting and challenging time in higher education. Engineers excel at the design, analysis, and improvement of complex systems; and education is certainly such a system. In times of rapid change, in Romania it is essential to have in place a nimble and flexible system that can respond appropriately to internal and external factors.

Engineering faculties, therefore, are in an excellent position to play leadership roles in generating a campus-wide response to the challenges that occur today. The key components of the
The engineers who are educated today will become the industrial employees, educators (pre-college and higher education), and researchers of the future. We must ensure that they are ready to face and overcome the challenges (many of which we do not yet imagine) of the next century. In order to be effective in educating students for these increasingly complex roles, while continuing to provide the research leadership upon which economic competitiveness ultimately relies, universities must be far more innovative and have a stronger desire for intellectually success.

The most important issue in developing competitiveness of the Romanian engineering education is not through harmonizing it with other engineering education systems in Europe, but to strengthen its existing strengths and developing new ones. It is necessary a co-operation of stakeholders in Romanian engineering education system. The aim is to negotiate with the future of Romanian engineering education system so that also national aspects and characteristics could be taken into consideration during the obvious transformation process. All stakeholders must take part in interactive research process to create common understanding of desired, possible and threatening future scenarios. The co-operation includes workshops with students, faculty, alumni, industry, Delphi interviews with experts (education experts, industry leaders, politicians government representatives). The steering group with members from all stakeholder groups is actively participating in the research process.

With the focus on student learning comes the opportunity for research in engineering education. There is a new cadre of engineering faculties focusing their research efforts not exclusively on engineering but also on how students learn engineering. These efforts could be strengthened by greater collaboration with colleagues in education, cognitive science who are breaking important ground independently at present. The goals of such work include exploring the diversity of learning styles of engineering undergraduates, experimenting with the use of multimedia materials, and developing a theoretical framework for curriculum design. The results of this work will allow us to more effectively educate the engineer of the future.

6. REFERENCES
PATENTS, ACADEMIC GLOBALIZATION AND THE LIFE CYCLE OF INNOVATION

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ABSTRACT: The analysis of the life cycle of innovation depends on the expansion of intellectual property (IP) rights. Innovation is viewed as a dynamic step by step process in which innovation generated in a stage of development represents the basic input for the next step. This dynamics depends on the openness, expansion and the upstream fragmentation of the patent rights. Dissemination encourages the formation of new R&D clusters and increases the diversity of advanced researchers. Openness give a new freedom for all the actors in R&D and this mechanism add a better engagement in the experiments that broaden the diversity of research lines because of the subsequent impact across a wide range of research lines. An increase of the level of openness of the innovational R&D reduces the costs associated with the explanation of the new instrument along a vertical research line. Based on the life cycle of innovation concept, an economical analysis of the forces and trade-offs at work in a competitive environment with both proprietary and open firms is presented.

Keywords: R&D (research and development), innovation, patent, academic globalization

1. INTRODUCTION IN THE ANALYSIS OF INDICATORS FOR INNOVATION

Patent data played a critical role in the literature of innovation because of their dynamism and the fact that they provide rich, fine-grained detail in technological change of every patented invention.

Based on macro-level evidence, Bessen (2006) demonstrated that formal intellectual property rights (IPR) increase rates of innovation and stimulate growth. The importance of the unobserved heterogeneity in the ways in which IPRs affect and interact with global performances is treated in a similar way by Gittelman (2008) but in a micro-approach focused on the relationship between patents and innovations. Patents are useful indicators, but their utility is limited by the knowledge of the context that matters in this relationship. The dynamical view of technological change is offered by the fact that patents cite other patents and citations cumulate allow to identify highly cited patents with synergic impact on subsequent inventions. Patent data offers a wealth of valuable, easily accessible information and the empirical research on innovation increasingly relies on patent database. Citations are correlated with the value of innovations and there is a large potential usefulness of citations for a variety of purposes: as indicators of spillovers (Jaffe, Trajtenberg, Henderson, 1993; Caballero, Jaffe, 1993), and as ingredients in the construction of measures for other features of innovations, such as "originality" and "generality" (Trajtenberg, Jaffe, Henderson, 1997).

The literature that analyze the using the patent data is based on the early works of Schmookler (1966), Scherer (1982), Griliches (1984). The contribution of Schmookler involved assigning patent counts to industries and Griliches' research entailed matching patents to Compustat firms, but in both cases the only data item used was the timing of the patent (grant/application year), such that in the end the patent data available for research consisted of patent counts by industries or firms, by year. Scherer work involved classifying a sample of 15,000 patents by the textual examination of each patent and the output was a detailed technology flow matrix, that could be linked to other external data (R&D expenditures, productivity growth). The problem of these early researches is the assumption that simple patent counts as indicators of some sort of innovative output. Innovations vary enormously in their technological and economic importance and significance and the distribution is extremely skewed (Schankerman, Pakes, 1986; Pakes, Simpson, 1991). In this case, simple patent counts were seriously and inherently limited in the extent to which they could faithfully capture and summarize the underlying heterogeneity (Griliches, Hall, Pakes, 1987).

The inversion problem refers to the fact that the original data on citations come in the form of citations made (each patent lists references to previous patents), whereas for many of the uses (certainly for assessing the importance of patents) one needs data on citations received and arises when using citations received called for an all-out solution. To obtain the citations received by any one patent granted in year t, one needs to search the references made by all patents granted after year t. Thus, any study using citations received, however small the sample of patents is, requires in fact access to the whole citations data, in a way that permits efficient search and extraction of citations. The latter means in fact being able to invert the citations data, sorting it not by the patent number of the citing patent, but by the patent number of the cited patent. This inherent indivisibility is not treated in the classic literature because of the lack of the other data items contained in the patents themselves. The modern literature should overcome the intriguing possibilities held by patent citations by changing the way of data construction (Trajtenberg, 1990).

2. THE USE OF PATENTS IN THE ERA OF ACADEMIC GLOBALIZATION

Patents represent a rich and fruitful source of data for the analysis of innovation and the use of patent data give some advantages:
The risks and disadvantages of using patent data are related to the fact that:

- not all inventions are patented and not all inventions meet the patentability;
- the inventor’s decision to patent is related to the fact that there is no systematic data about inventions that are not patented;
- is still difficult to handle huge dynamic data.

3. THE DYNAMICS OF INNOVATION IN A COMPETITIVE ENVIRONMENT

The dynamics of innovation should take into account the assumption that there is no natural scale or value measurement associated with citations data and the number of citations received is meaningful only when used comparatively. In this case, the estimation of the patent intensity of innovation can be properly made with reference to some benchmark citation intensity. The determination of the appropriate benchmark is complicated by the fact that the number of citations received by any given patent is truncated in time and there are differences in official practices across time or across technological areas.

The combination of more patents making more citations suggests citation inflation with later citations. Moreover fixed-window comparisons which do not suffer from truncation bias are very difficult to make. In addition to this variation in time, the number of citations per patent varies by technological field. The differences in citations per patent could be indicative of “real” differences in technological impact. The increase in the rate of patenting or the rate of inventions could be estimated by using the changes in the number of citations received by patents and the dynamics of real technological impact of the cited patents.

In the fixed-effects approach, all sources of systematic variation over time in citation intensities are artifacts that should be removed before comparing the citation intensity of patents from different cohorts. The advantage is that it does not require one to make any assumptions about the underlying processes that may be driving differences in citation intensities across groups. The fixed-effects rescaling aims to increase the signal-to-noise ratio in the data and allow comparability of citation counts over time by removing from the data variance components that are associated with truncation and also with possibly artificial aspects of the citations generation process. Unfortunately, there is no way to do so without also removing variance components that might be real. The only way to tune this more finely is to put more structure on the problem, with a model that, under additional assumptions, allows separate identification of different sources of variation. The disadvantage is that, precisely because no structure is assumed, it does not distinguish between differences that are real and those that are artificial.

The quasi-structural approach attempts to distinguish the multiple effects on citation rates via econometric estimation. Once the different effects have thereby been quantified, the researcher has the option to adjust the raw citation counts to remove one or more of the estimated effects. If the assumptions inherent in the econometric estimation are correct, this method permits the extraction of a stronger signal from the noisy citation data than the non-structural, fixed-effects approach. If the citation-lag distribution, the efficiency of different patent cohorts, and the propensity to cite have all been varying over time, there is no general way to identify separately the contribution of each of these to variations in observed citation rates. This approach accepts this reality and simply removes variance components that are likely to be contaminated to some degree. The assumptions used in the literature are: proportionality (the shape of the lag distribution over time is independent of the total number of citations received, and hence more highly cited patents are more highly cited at all lags); stationarity (lag distribution does not change over time and does not depend on the cohort of the cited patent). Stationarity means that it is possible to estimate a time-invariant citation-lag distribution, which tells us the fraction of lifetime citations that are received during any specified time interval in the life of the patent. With proportionality, the observed citation total at a point in time for any patent can then be corrected for truncation, simply by “scaling up” the observed citation total by dividing it by the fraction of the lifetime citations that are predicted to occur during the lag interval that was actually observed. Proportionality and stationarity allow estimating changes in the propensity to cite over time in a way that controls for the citation lag distribution, as well as for changes in the efficiency of the cited cohorts. This allows a researcher who believes that the citing year effects are artificial.

4. ACADEMIC PATENT POOLS AND THE PERFORMANCES OF INNOVATION PROCESS

Patent pools are cooperative agreements between several patent owners to bundle the sale of their respective licenses and could be vehicles for improving social welfare. The incentives to innovate could be analyzed in an ex ante perspective. Participation in a pool acts as a bonus reward on R&D activity, and firm's investment pattern is upward sloping. The mechanism of pool formation is based on the acceptance/refusal propensity of the competition authority to induce overinvestment in early innovations.

The ex ante perspective is useful to identify the trade-offs that determine the dynamic incentives to perform R&D. Firms do anticipate the possibility of participating in a patent pool when they contemplate investing in a R&D program, and therefore attempt to patent. The pooling of patents allows the licensing coordination and increases firm’s return on investment. In this mechanism there is an impact on investment decisions with implications on the formation of the pool.

In the classic literature on the ex ante study of patenting (Reinganum, 1989; Grossman, Shapiro, 1987) incentives to innovate are provided by a prize in case of success and the formation of a patent pool can be beneficial even from a purely ex post viewpoint because it facilitates the diffusion of the innovations.
In the modern literature (Merges, 1999) are presented the organizational forms, contractual provisions of past and current pooling arrangements and their stylized features: (i) the issue of a voluntary process in which patentees request a clearance statement from the regulator by submitting a pool proposal; (ii) the mechanisms for dividing among patentees the royalty stream; (iii) the mechanisms to incorporate the innovations that are patented after pool creation. Ex ante perspective is important because it takes into account the specific nature of the patents they include. Unlike standard goods, patents exist for their incentive properties and every manipulation of their value may change their usefulness as a means to encourage R&D.

In the ex post strategy perspective, the objective is to assess the potential impact of a proposed arrangement among patent holders on the functioning of the market in subsequent periods. In his model, Shapiro (2001) introduced the assumption that welfare is harmed when patents are perfect substitutes, and raise when patents are perfect complements and the objective is to provide the regulator with some means to discriminate among pool candidates. Lerner, Tirole (2004) addresses this problem in a more general framework that describes the full range between the extreme cases of perfectly substitutable and perfectly complementary patents. In this case, the requirement that independent licenses be offered by pool members to third parties can be used as a screening device.

5. A SIMPLE MODEL OF ACADEMIC POOL FORMATION IN A DIFFERENTIAL GAME FRAMEWORK

Patent pooling is a cooperative agreement, which establishes the rules according to which pool profits are shared among individual partner/academy (Reinganum, 1989, Acemoglu, 2007). Let a program where each of the N academia can obtain exactly one innovation that it characterized by the assumption of no substitute and investment in R&D is a continuous time profit-maximization decision. The academia can secure a given flow of results by licensing the innovation. At each point in time, they can decide independently to exert an R&D effort.

The first-order condition for an optimal level of R&D effort implies that

\[ V(0) = \frac{\nu}{r} - c(x), \]

where \( x \) is solution to

\[ \nu - (x + r)c'(x) + c(x) = 0. \]

The first-order condition for an optimal level of R&D effort is

\[ V(0) = \frac{\nu}{r} - c(x). \]

The total flow is actualized, discounted by the probability and equally divided among the initiators. The value of not being among the first K initiators is:

\[ V_{K+1}(0) = \frac{\nu}{r} - c(x). \]

In the pool formation, each partner's expected return from a patent depends on the achievement of other partners to be among the first K initiators which implies that the maximum value of a partner verifies:

\[ rV_k'(0) = \max_x [x(V_k'(1) - V_k'(0)) + X'(V_{k+1}(0) - V_k'(0)) - c(x)]. \]

The first-order condition leads to the following optimal effort strategy:

\[ x_k = (c')^{-1}(V_k'(1) - V_k'(0)). \]

In a symmetric Markov perfect equilibria (SMPE),

\[ V_k'(1) = V_k'(0) \]

and consequently \( x_k = x_k \).

From (6) and (8) it results:

\[ rV_k'(0) = x_k c'(x_k) + (N - k)x_k (V_{k+1}(0)) - c(x_k). \]

In the analysis of the value function associated with a Reinganum game, is computed the value of patenting in the k-th competition, \( V_{fc}(1) \) by observing that during the (k+1)-th competition (the period between the discovery of the k-th innovation until the discovery of another innovation), each of the k patentees receives a flow of results equal to v. In the same period, the event that one of the outsiders succeeds in patenting an innovation can occur with a probability of success and the actualized value of all patents at the issue of the race is equal to the value of innovating at rank \( k + 1, V_{k+1}(1) \).

6. CONCLUSIONS

The analysis of patent data role in the literature of innovation should be done in a dynamic framework adapted to capture the technological change of every patented invention. This dynamic view is inspired from the fact that patents cite other patents and citations cumulate allow to identify highly cited patents with synergic impact on subsequent inventions.

The analysis of the life cycle of innovation is based on two alternative approaches: the fixed-effects approach that involves scaling citations by the average citation count for a group of patents to which the patent of interest belongs and the quasi-structural approach that is capable to distinguish the multiple effects on citation rates via econometric estimation.

Patent data perspective is presented also for the case of an academia pool capable to enhance the speed of R&D. Because
partners value more being among the initial contributors to the pool, the equilibrium pattern of innovative efforts is upward sloping before the formation of the pool.

The impact of timing of the regulator’s review process of patent proposals on the level of R&D efforts and resulting welfare is important because it may induce overinvestment in early innovations and inefficiencies according to a social welfare criterion.

7. REFERENCES

ABSTRACT: The aim of this paper is to analyse the challenges posed by teaching entrepreneurship to engineering students. We will start by outlining some theoretical background to teaching entrepreneurship to engineering students, focusing on the peculiarities of the educational system in Romania. Secondly, we will present the results of a survey we carried out among 208 students of Applied Electronics, Cadastre and Environmental Engineering, aged 19-46. The questionnaires applied aimed at revealing students’ both theoretical/practical knowledge, as well as skills and personality traits pertaining to entrepreneurial education. The interpretation provided was both qualitative and quantitative. Last but not least, we will present pedagogical implications of the results found, by providing suggestions for curriculum design, implementation and evaluation. The approach that we will suggest is student-centred, great emphasis being placed on the autonomous learning dimension and on self-discovery techniques, as well as on the development of critical thinking.

1. INTRODUCTION

The major changes undergone by our world over the last decades, and especially in the European space, have compelled decision-makers to re-adjust their policies and agendas. In 2000, the European Council expounded in Lisbon its objectives in terms of employment, economic reform and social cohesion. The Union sets as one of its important targets to become by 2010 “the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion” [5]. The European Council, further on in 2001, agreed on a strategy for sustainable development and included an environmental dimension in the Lisbon strategy. The Council admitted that there is a huge need for important transformation of the economy, so as to create approximately 15 million new jobs by 2010.

We have witnessed during the last fifty years a shift from large firms to the emergence of small and medium-sized enterprises, the number of business owners in OECD countries increasing from 29 million to 45 million during the period 1972 to 1998. Structural changes in the economy determined Europe’s comparative advantage to swerve towards knowledge-based activities. Moreover, globalisation raised competitive pressure on manufacturing firms in high-cost locations, which not only oriented production capacity towards low cost countries, but also to increasing productivity by utilising technological inputs.

These changes have fostered opportunities for new entrepreneurial initiative, especially in the area of services. The increased complexity of production processes necessitates a whole new set of specialised inputs. Moreover, the reduced costs of spreading knowledge across space make inputs offered by external providers rather cheaper. Improved access to the market gives firms in niche markets the possibility to function on a more European or worldwide scale. Therefore, the ability to adapt to economic changes is an essential requisite for competitiveness.

In our competitive society, an ability to manage change and to seize the best opportunity at hand is probably the best survival tool that both business and non-business students nowadays seek to acquire. Is this ability something that teachers and academic subjects can develop in students? There has long been a conviction that entrepreneurship and innovation are intangible concepts that cannot be taught. Nevertheless, given the growing importance that society nowadays attaches to innovation, initiative and risk-taking, more and more young people are considering starting off on their own, and therefore, more and more universities offer on their curricula courses in entrepreneurship.

2. WHAT IS ENTREPRENEURSHIP?

The Green Paper: Entrepreneurship in Europe (2003) defines entrepreneurship as being multi-dimensional. First and foremost, it represents “a mindset”, encompassing “an individual’s motivation and capacity, independently or within an organisation, to identify an opportunity and to pursue it in order to produce new value or economic success” [3]. In other words, the main ingredients of competitiveness are creativity and innovation. Second, there are some common human traits that all entrepreneurs possess: “a readiness to take risk and a taste for independence and self-realisation” [3]. Third, entrepreneurship can be applied to all sectors and types of business. The working definition of the above mentioned document is the following: “Entrepreneurship is the mindset and process to create and develop economic activity by blending risk-taking, creativity and/or innovation with sound management, within a new or an existing organisation” [3]. It is considered a crucial element of today’s society, as it contributes to job creation and growth, increases competitiveness, boosts and fulfils individual potential, and responsible entrepreneurship serves societal interests.

According to The Global Entrepreneurship Monitor 1999 Executive Report, which analysed the relationship between entrepreneurship and economic growth, by comparing 10 countries (the G7 plus a further three countries - Denmark, Finland and Israel), entrepreneurship represents “any attempt at new business or new venture creation, such as self-employment, a new business organization, or the expansion of...
an existing business, by an individual, a team of individuals, or an established business" [6].

The Global Entrepreneurship Monitor 2008 Executive Report provides data obtained from surveys conducted among 43 countries and assesses the characteristics of entrepreneurship by presenting several indices that measure aspects of Entrepreneurial Attitudes, Activity and Aspirations. The countries which were analysed are ordered according to three phases of economic development as presented in the Global Competitiveness Report 2008-2009 [7]. Sala-i-Martin, et.al. (2008) characterises competitiveness as the set of institutions, policies, and factors that determine the country’s level of productivity. Accordingly, competition includes static and dynamic components classified into open-ended, though interrelated and mutually reinforcing, 12 pillars of economic competitiveness.

Different pillars affect different countries in a different way. Respective sets of pillars, as grouped in the figure, are key factors to corresponding stages of development. Factor-driven economies compete based on their factor endowments, primarily unskilled labor and natural resources. Along with rising wages, countries move into the Efficiency-driven stage and compete based on more efficient production processes and increased product quality. In the last and third stage, the Innovation-driven stage, companies must compete through innovation, producing new and different goods using the most advanced production processes.

Starting from the assumption that different attitudes to entrepreneurship may determine the number of start-up entrepreneurs in different countries, the GEM specialists carried out this survey analysing the way people see opportunities, how they situate themselves vis-a-vis failure, direct knowledge of self-starters (the existence of role-models), how they evaluate their own knowledge and personal skills and their readiness to start on their own in the foreseeable future, along with an analysis of the national-specific attitudes regarding entrepreneurship. The table below presents the GEM indicators concerning individuals’ own perceptions toward entrepreneurship for each of the 43 GEM 2008 nations. As can be seen from the table, some countries display favourable perceptions of entrepreneurship along with low rates of intentional entrepreneurship. This is the case especially in many innovation-driven economies in Europe. This phenomenon means that despite fairly high attitudes and perceptions towards entrepreneurship, the attractiveness of entering the entrepreneurship realm seems to be rather low for many Europeans compared to other possible sources of income.

Romania is an efficiency-driven economy, and according to the table below, although people see good opportunities for starting a business in the next months (45%), fear of failure is rather high (52%). Quite a few consider themselves as fit to start a business (possessing the required entrepreneurial knowledge and skills) (21%), while only 9% see themselves as starting up a business in the foreseeable future. As far as country perceptions are concerned, the situation is even worse – entrepreneurship is not considered as a desirable career choice (probably because of the risks attached to it, and maybe...
to the negative perception of illicit dealings of successful entrepreneurs (who made fortunes overnight). Probably because of the same reason, there is high media coverage of the new businesses in our country.

3. WHY TEACH ENTREPRENEURSHIP TO ENGINEERING STUDENTS?

What characterises successful entrepreneurs is not that different from the qualities of successful engineers. Among these entrepreneurial qualities we can mention intelligence, creativity, risk management, tolerance of uncertainty and persistence in achieving an inner directed goal. Nevertheless, these are also the characteristics all people, engineers included, who bring about innovation. Educating young people to develop an entrepreneurial character and behaviours will also contribute to equipping them for productive careers as true leaders in the engineering profession. “Imbedded in the distinction between an invention and an innovation is a process whereby inventions become applied. This process is central to what we call entrepreneurship” [1].

According to Peter Drucker, what defines an entrepreneur in a business and in any other non-business institution or organisation is their attitude to change: “The entrepreneur always searches for change, responds to it as an opportunity” [4]. Entrepreneurs can only exploit change through the process of innovation. The same scholar defines ‘systematic innovation’ as a “purposeful and organised search of the opportunities such changes might offer for economic and social innovation” [4].

The main challenge of nowadays governments, regulators, public policy makers is how best to balance unlimited technological resources and limited public resources. In these ideas we find the very vision of an organisation as a learning organism where individually and collectively we acknowledge the contribution of an entrepreneurial society to speeding up the pace of change, which in turn will foster further learning and re-learning on a permanent basis.

Particularly because of this strong interrelatedness between entrepreneurship and innovation it is necessary to include in our SET (science, engineering and technology) curricula a course in entrepreneurship. Another factor that needs to be taken into account is that lately we are witnessing a revival of the interest in SET disciplines (a lot of young high school graduates opt for engineering programmes, as they see great potential in this career, while in the immediate aftermath of the 1989 revolution, the orientation was largely towards economics and law schools. This is also the case at “1 Decembrie 1918” University of Alba Iulia, where the SET programmes include: Information Technology (3-year programme), Territorial Measurements and Cadastre (4-year programme), Applied Electronics (4-year programme) and Environmental Engineering (4-year programme).

As far as the academic curricula of the SET programmes at our university, it can be said that little attention is paid to business disciplines. For the Territorial Measurements and Cadastre programme there is just one elective course in the fourth year, 1st semester (History of the European Union or History of the European Monetary Union). For the programme in Environmental Engineering there are two compulsory courses in the fourth year, 1st semester, one in Environmental project management and the second in Environmental economics and politics. As far as the programme in Applied Electronics is concerned, there are two elective courses in the 2nd year, one in the 1st semester (out of Microeconomics, Macroeconomics and Business Law) and the other in the 2nd semester (out of Management and Marketing).

4. NEEDS ANALYSIS

In order to assess our students’ theoretical knowledge, skills and attitudes toward entrepreneurship we devised a questionnaire which we administered among 208 students of Applied Electronics, Cadastre and Environmental Engineering, aged 19-46. They were students either in the first or in the third year of study (16 of the respondents did not reveal this information). 134 of the respondents were male, 67 female and 7 did not reveal their gender.

### Table 1. Distribution of students according to gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of students</th>
<th>Percentage</th>
<th>Valid percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>male</td>
<td>134</td>
<td>64.4%</td>
<td>66.7%</td>
</tr>
<tr>
<td>female</td>
<td>67</td>
<td>32.2%</td>
<td>33.3%</td>
</tr>
<tr>
<td>no answer</td>
<td>7</td>
<td>3.4%</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>208</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

As can be seen from the table above, there is marked preponderance of male students among the respondents (66.7%).

![Figure 3. Distribution of students according to age](image)

Two of the respondents did not reveal their age. The average age was 22.69 years, which may account for their lack of specific knowledge related to entrepreneurship, as they have little, if any connection with the business world.

### Table 2. Distribution of students per year of study

<table>
<thead>
<tr>
<th>Year of study</th>
<th>Number of students</th>
<th>Percentage</th>
<th>Valid percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>119</td>
<td>57.2%</td>
<td>62.0%</td>
</tr>
<tr>
<td>3</td>
<td>73</td>
<td>35.1%</td>
<td>38.0%</td>
</tr>
<tr>
<td>no answer</td>
<td>16</td>
<td>7.7%</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>208</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

The majority of the respondents were in their first year of study. Mention should be made of the fact that at present, there is no course in entrepreneurship taught to SET students at our university, meaning that even if they had some specialist knowledge, it was not acquired through formal education at university.
The questionnaire consisted of ten questions which covered both entrepreneurial knowledge and entrepreneurial skills, attitudes and perceptions. In the following we will present the results obtained and their interpretation.

Question 1: What are the legal statuses of companies in Romania?

A complete answer to this question would have required previous knowledge, especially since the legislation concerning non-incorporated companies in Romania changed in 2008. We have provided in the table below all types of companies in our country, with their literal translation. It should be borne in mind that the legal statuses of companies in Romania are very different from those in UK or the US. The first three types would correspond to non-incorporated companies in UK and the last five to incorporated companies.

<table>
<thead>
<tr>
<th>Types of businesses</th>
<th>No. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA (Persoana fizica autorizata) (litter. authorised</td>
<td></td>
</tr>
<tr>
<td>private individual)</td>
<td>11 (5.3%)</td>
</tr>
<tr>
<td>II (Intreprindere individuala) (litter. individual</td>
<td></td>
</tr>
<tr>
<td>enterprise)</td>
<td>0.0%</td>
</tr>
<tr>
<td>IF (Intreprindere familiala) (litter. family enterprise)</td>
<td>0.0%</td>
</tr>
<tr>
<td>SRL (Societate cu raspundere limitata) (Private limited</td>
<td></td>
</tr>
<tr>
<td>liability Ltd.)</td>
<td>137 (70.0%)</td>
</tr>
<tr>
<td>SCS (Societate in comandita simplex) (Litter. Simple</td>
<td></td>
</tr>
<tr>
<td>limited partnership)</td>
<td>11 (5.3%)</td>
</tr>
<tr>
<td>SNC (Societate in nume colectiv) (Litter. Company</td>
<td></td>
</tr>
<tr>
<td>under collective name)</td>
<td>28 (15.7%)</td>
</tr>
<tr>
<td>SA (Societate pe actiuni) (Public limited company plc.</td>
<td></td>
</tr>
<tr>
<td>SCA (Societate in comandita pe actiuni) (Litter.</td>
<td></td>
</tr>
<tr>
<td>Partnership limited by shares)</td>
<td>131 (69.6%)</td>
</tr>
</tbody>
</table>

The term ‘intreprindere individuala’ was introduced only last year, this legal status was formerly known under the name of ‘asociatie familiala - AF’, hence the confusion made by many of the respondents. However, we did not consider them as correct answers. The same thing happened with the incorrect answers given by 23 respondents with regard to PFA – they left the adjective ‘autorizata’ out - PF. The information obtained reveals that the most common types of companies in our country are the SRL and the SA.

Question 2: What are the stages of setting up a business in Romania?

The results obtained are self-relevant for the lack of specific knowledge about entrepreneurship. Many of the incorrect answers however revealed important perceptions regarding this issue: ‘useless red-tape’, ‘humiliation’, ‘endless queuing at the counters’, etc.

Question 3: What is the start-up capital in Romania?

Respondents seemed more familiar with the start-up capital for private limited companies (SRL). Absolutely no correct answer was provided for SA’s. (SRL: RON 200 / SA: EUR 25.000).

The results obtained are self-relevant for the lack of specific knowledge about entrepreneurship. Many of the incorrect answers however revealed important perceptions regarding this issue: ‘useless red-tape’, ‘humiliation’, ‘endless queuing at the counters’, etc.

Question 4: Which do you consider the strongest entrepreneurial skill? Explain.
The generally expected answers were risk-taking, creativity and/or innovation, tolerance of uncertainty, commitment to achieving an inner directed goal, intelligence, sound management. This was, however, an open-ended question and other answers were relevant as far as the respondents’ understanding of entrepreneurship was concerned. As can be seen from the table below, Romanian students do not consider risk-taking as an important entrepreneurial skill. This might mean that, at least at their age, they do not consider starting up on one’s own as a risky undertaking. This, however, may have a double-edged effect: on one the one hand, this perception would not be a hindrance in the way of entrepreneurial initiative; while on the other hand, it may prove counter-productive, as youth are not fully aware of the implications of private enterprise.

### Table 6. Respondents’ answers to Question 4

<table>
<thead>
<tr>
<th>No.</th>
<th>Entrepreneurial skill</th>
<th>No. of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Risk-taking</td>
<td>10</td>
<td>4.8%</td>
</tr>
<tr>
<td>2.</td>
<td>Management skills</td>
<td>79</td>
<td>38.0%</td>
</tr>
<tr>
<td></td>
<td>- Leadership (incl. HR management)</td>
<td>33</td>
<td>15.9%</td>
</tr>
<tr>
<td></td>
<td>- Communication acumen</td>
<td>31</td>
<td>14.9%</td>
</tr>
<tr>
<td></td>
<td>- Team building</td>
<td>9</td>
<td>4.3%</td>
</tr>
<tr>
<td></td>
<td>- Decision-making</td>
<td>6</td>
<td>2.9%</td>
</tr>
<tr>
<td>3.</td>
<td>Creativity /innovation /inventiveness</td>
<td>7</td>
<td>3.4%</td>
</tr>
<tr>
<td>4.</td>
<td>Intelligence</td>
<td>9</td>
<td>4.3%</td>
</tr>
<tr>
<td>5.</td>
<td>Perseverance /ambition /independence</td>
<td>6</td>
<td>3.0%</td>
</tr>
<tr>
<td>6.</td>
<td>Professional competence</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td>7.</td>
<td>Other (charisma, dignity, persuasion,</td>
<td>10</td>
<td>4.7%</td>
</tr>
<tr>
<td></td>
<td>good Christian, psychically sane, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>126</td>
<td>60.6%</td>
</tr>
</tbody>
</table>

Question 5: Where can you get business ideas from? Explain.

### Table 7. Respondents’ answers to Question 5

<table>
<thead>
<tr>
<th>No.</th>
<th>Sources of business ideas</th>
<th>No. of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Circle of friends</td>
<td>19</td>
<td>9.1%</td>
</tr>
<tr>
<td>2.</td>
<td>Market research</td>
<td>26</td>
<td>12.5%</td>
</tr>
<tr>
<td>3.</td>
<td>Mass-media</td>
<td>29</td>
<td>13.9%</td>
</tr>
<tr>
<td></td>
<td>- television</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td></td>
<td>- internet</td>
<td>12</td>
<td>5.8%</td>
</tr>
<tr>
<td>4.</td>
<td>Business environment (local, national,</td>
<td>17</td>
<td>8.2%</td>
</tr>
<tr>
<td></td>
<td>international)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Personal experience / expertise</td>
<td>7</td>
<td>3.4%</td>
</tr>
<tr>
<td>6.</td>
<td>Other (school, brainstorming, formal</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td></td>
<td>and informal meetings)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>‘I don’t know’</td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>105</td>
<td>50.5%</td>
</tr>
</tbody>
</table>

We wanted to know what areas are considered important as far as getting business ideas is concerned, as this aspect is relevant for the perceptions of the Romanian youth.

Question 6: List some of the business fields that present potential for small businesses in Romania. Explain.

The aim of this question was to assess students’ knowledge /expectations of the potential offered by the Romanian market at the moment. The relatively positive attitude toward ecoagriculture, agritourism, environment protection, alternative energy may be a result of the fact that 22.1% of the respondents are students in environmental engineering.

### Table 8. Respondents’ answers to Question 6

<table>
<thead>
<tr>
<th>No.</th>
<th>Business fields</th>
<th>No. of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tourism (incl. eotourism,</td>
<td>15</td>
<td>7.2%</td>
</tr>
<tr>
<td></td>
<td>agritourism)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Agriculture (incl. ecoagriculture)</td>
<td>18</td>
<td>8.7%</td>
</tr>
<tr>
<td>3.</td>
<td>Constructions (incl. real estate)</td>
<td>21</td>
<td>10.0%</td>
</tr>
<tr>
<td>4.</td>
<td>Services</td>
<td>33</td>
<td>15.9%</td>
</tr>
<tr>
<td></td>
<td>- telecommunications</td>
<td>7</td>
<td>3.4%</td>
</tr>
<tr>
<td></td>
<td>- c-commerce</td>
<td>6</td>
<td>3.9%</td>
</tr>
<tr>
<td></td>
<td>- environmental protection</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td></td>
<td>- fast food</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td></td>
<td>- cadastre</td>
<td>4</td>
<td>1.9%</td>
</tr>
<tr>
<td></td>
<td>- other (car wash, cleaning, etc.)</td>
<td>6</td>
<td>3.9%</td>
</tr>
<tr>
<td>5.</td>
<td>Industry</td>
<td>8</td>
<td>3.9%</td>
</tr>
<tr>
<td></td>
<td>- alternative energy</td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td></td>
<td>- food and beverage production</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>95</td>
<td>45.7%</td>
</tr>
</tbody>
</table>

Question 7: Which are the most important issues to consider when employing and keeping personnel?

### Table 9. Respondents’ answers to Question 7

<table>
<thead>
<tr>
<th>No.</th>
<th>Issues when hiring and keeping personnel</th>
<th>No. of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Financial rewards (including bonuses and</td>
<td>55</td>
<td>26.4%</td>
</tr>
<tr>
<td></td>
<td>perks)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Working conditions and atmosphere</td>
<td>8</td>
<td>3.8%</td>
</tr>
<tr>
<td>3.</td>
<td>Experience/ seniority</td>
<td>9</td>
<td>4.3%</td>
</tr>
<tr>
<td>4.</td>
<td>Knowledge, qualifications, professional</td>
<td>16</td>
<td>7.7%</td>
</tr>
<tr>
<td></td>
<td>training, studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Loyalty / fidelity / honesty</td>
<td>8</td>
<td>3.8%</td>
</tr>
<tr>
<td>6.</td>
<td>Seriousness / trust</td>
<td>10</td>
<td>4.8%</td>
</tr>
<tr>
<td>7.</td>
<td>Other (communication skills, etc.)</td>
<td>4</td>
<td>1.9%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>110</td>
<td>52.9%</td>
</tr>
</tbody>
</table>

Considering that a low salary is the norm in our country, it came as no surprise that on top of the list the answer was connected with financial rewards.

Question 8: Which are the most important things to consider when dealing with customers?

### Table 10. Respondents’ answers to Question 8

<table>
<thead>
<tr>
<th>No.</th>
<th>Issues when dealing with customers</th>
<th>No. of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Achieving customer loyalty</td>
<td>17</td>
<td>8.2%</td>
</tr>
<tr>
<td>2.</td>
<td>Customer service</td>
<td>8</td>
<td>3.8%</td>
</tr>
<tr>
<td>3.</td>
<td>Communication skills and channels</td>
<td>10</td>
<td>4.8%</td>
</tr>
<tr>
<td>4.</td>
<td>Seriousness</td>
<td>7</td>
<td>3.4%</td>
</tr>
<tr>
<td>5.</td>
<td>Persuasiveness</td>
<td>7</td>
<td>3.4%</td>
</tr>
<tr>
<td>6.</td>
<td>Customer-oriented behaviour (incl.</td>
<td>15</td>
<td>7.2%</td>
</tr>
<tr>
<td></td>
<td>respect, trust, politeness)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Price</td>
<td>9</td>
<td>4.3%</td>
</tr>
<tr>
<td>8.</td>
<td>Other (patience, etc.)</td>
<td>4</td>
<td>1.9%</td>
</tr>
<tr>
<td>9.</td>
<td>‘I don’t know’</td>
<td>6</td>
<td>2.9%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>83</td>
<td>39.9%</td>
</tr>
</tbody>
</table>

Question 9: What are the elements of a business plan?

The answers given to this question showed best the respondents’ lack of specific knowledge about entrepreneurship. It was clearly evident that none has ever seen one, let alone draw one up.
Question 10: You need to raise RON 40,000 (approx. EUR 10,000). What would you do?

Table 12. Respondents’ answers to Question 10

<table>
<thead>
<tr>
<th>No.</th>
<th>Raising 40,000 RON</th>
<th>No. of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>From family and friends</td>
<td>11</td>
<td>5.3%</td>
</tr>
<tr>
<td>2.</td>
<td>From the bank</td>
<td>35</td>
<td>16.8%</td>
</tr>
<tr>
<td>3.</td>
<td>From EU funds</td>
<td>17</td>
<td>8.2%</td>
</tr>
<tr>
<td>4.</td>
<td>From personal savings</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td>5.</td>
<td>From sponsors/investors</td>
<td>6</td>
<td>2.9%</td>
</tr>
<tr>
<td>6.</td>
<td>From mortgaging one’s house or selling personal assets</td>
<td>9</td>
<td>4.3%</td>
</tr>
<tr>
<td>7.</td>
<td>Other (working abroad, etc.)</td>
<td>12</td>
<td>5.8%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>95</td>
<td>45.7%</td>
</tr>
</tbody>
</table>

The answers provided show a rather high level of confidence in the Romanian banking system.

5. PEDAGOGICAL IMPLICATIONS

In terms of teaching entrepreneurship to students, the most widely accepted approach is that of entrepreneurship seen as the pursuit of opportunities. It is especially important to guide students towards discovering, evaluating and exploiting opportunities in the entrepreneurial process. This was our aim too in designing an appropriate entrepreneurship course for engineering students. The syllabus suggested below emphasises the autonomous learning dimension and self-discovery techniques, as students have to research, present and discuss different topics on how to become an entrepreneur, screen opportunities, select an appropriate product/market target, obtain the necessary resources, and launch a new enterprise. The following topics are distributed across one semester (28 class work).

7. Basic regulation for becoming an employer. Types of business company structure in Romania.
8. Employing people. Finding the right persons for your objectives. Employee profile. Designing questionnaires, what to expect from a job interview. Staff appraisal and promotion
9. Taxation, insurance, banking. Case studies of Romanian banks’ help for SME’s.
11. Drafting the business plan, adjusted to individual needs and business ideas. Plenary presentations.
12. The concept of SWOT analysis. Board analysis and final evaluation of business plans.
13. Write a report on your achievements and try to plan the future of your business, starting from the previous SWOT analysis. Feedback on course development and outcome. Filling in project report forms.

6. CONCLUSIONS

To sum up, teaching entrepreneurship to engineering students is an essential element that needs to be included in the academic curriculum of all universities in Romania as such a course could provide a global introduction to the process of turning an idea into a successful start-up enterprise. It will also equip students with practical knowledge for the preparation of drafts of business plans for the development of new products, processes and services and for the financing of new enterprises.

7. REFERENCES

CONSIDERATIONS ABOUT THE TRANSDISCIPLINARY KNOWLEDGE SEARCH WINDOW IN MECHATRONICAL EDUCATION

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ABSTRACT: The knowledge search window as a methodological concept in order to explain the bottom-up/top-down mechanism of the teaching-learning process in mechatronical educational paradigm from a transdisciplinary perspective is introduced. The teacher is presented acting from a top-down perspective, while the apprentice from a bottom-up one, the communicators, teacher and apprentices, being alternatively in a symmetrical and complementary interaction states, depending of the context in the negotiation process of the solutions in a creative-innovative way. The mechatronical curricula studies strive to develop in each student a balance between these top-down and the bottom-up perspectives on mechatronical approach of knowledge, studying in depth the key areas of technology on which successful mechatronical design is based and thus lays the foundation for the students to become such true mechatronician, a new synergistic job profiles created as a mix of mechanical, electrical and IT knowledge. Mechatronics as a transdisciplinary technology education holds the potential for teaching all the people involved in the VETS as lifelong learning apprentices getting the skills of problem solving.

Key words: transdisciplinarity, knowledge search window, top-down and bottom-up perspective, teaching/learning process, mechatronics, lifelong learning.

1. INTRODUCTION IN THE EVOLUTION OF THE INTEGRATIVE PERSPECTIVE ON MECHATRONICS

It is very important to know the way mechatronics came in the light as a possibility to achieve knowledge in the context of the knowledge based society. Mechatronics has been associated with many different topics including manufacturing, motion control, robotics, intelligent control, system integration, vibration and noise control, automotive systems, modeling and design, actuators and sensors as well as microdevices, as an electromechanical systems or control and automation engineering. From different combinations of words mechatronics is the most used and finally accepted to define this new engineering field, being focused on servo technology, on information technology, and finally, on communication technology to connect products into large networks, including the production of air bags and other related technologies [1, 2]. There is a significant design trend that has a marked influence on the product-development process, in manufactured goods, using the thought processes of many different outlooks to enhance their research with the use of more efficient tools in a transdisciplinary framework [3, 4, 5]. Mechatronics has become a familiar term in the field of engineering worldwide, but although the foundations for mechatronics were set its full potential is yet only partially expressed. About the future of mechatronics, the transdisciplinary approach opens a new perspective on its development, incorporating more and more ideas which will be accounted to improve the way to live and to do things, innovations and technologies have to be improved and developed with the rapidly changing times. Mechatronics has to be increasingly focused on safety, reliability and affordability, with efficiency, productivity, accountability and control, with a major roll in the medical field, as well as in computerized world and parts of industry-based manufacturing, making the computer a part of the machine that builds a product. Mechatronics gives to the new mechatronical engineer a synergistic perspective on knowledge, so that concepts can be developed more efficiently, the communications with other engineering disciplines being improved, the major goals in the field of mechatronics are being the client and market satisfaction, as well. The most important thing is to know what mechatronics is, what isn’t and how does it work. Mechatronics cannot be a simple discipline, a new postmodern utopia, but it works through the new transdisciplinary educational paradigm by its thematic, exemplifying, interactive, functional aspects (mechatronical epistemology), as a reflexive way of communication (the creative logic of the included third) and through its socio-interactive system of thought, of living and mechatronical action (mechatronical ontology) [4, 6]. At the same time mechatronics is not a simple working methodology, but it works with specific synergistic synthesis methodologies. Mechatronics has not a simple multidisciplinary or a crossdisciplinary character, but a transdisciplinary one, generating new disciplines in a codisciplinary context, with flexible and contextual curricula (robotics, optomechatronics, biomechatronics, etc) [5, 7].

2. TRANSDISCIPLINARY KNOWLEDGE SEARCH WINDOW IN MECHATRONICAL EDUCATION

The knowledge resides in people, not in machines or documents at all, this way determining the spiritual dimension of knowledge [8, 9]. In the knowledge process explicit elements are objective, rational and created “then and there” (top-down level), while the tacit elements are subjective experiential and created “here and now” (bottom-up level) [8]. It is interesting to study the way the knowledge can be or cannot be quantified, captured, codified and stored as well, the predominant aspect in the management of tacit knowledge being to try to convert it in a form that can be handled using the “traditional” approach. There is a difference between know-what (selection the message to be communicated) as an explicit knowledge and know-how (the way the message is codified and transmitted), as implicit knowledge. Procedures are known as a codified form of
know-how that guide people in how to perform a task, so there is a continuous problematical distinction between tacit (know-how) and explicit (know-what) kind of knowledge. The organizational (communion-like) knowledge constitutes core-competency and it is more than “know-what”, requiring the more elusive “know-how” - the particular ability to put know-what into practice” as know-how [10].

In order to explain the achievement of the knowledge is introduced the knowledge search window as a methodological tool to explain the bottom-up/top-down mechanism of the teaching-learning process in mechatronical educational paradigm from a transdisciplinary perspective [4, 5]. The teacher is acting from a top-down perspective, while the student from a bottom-up perspective, the ranks of authority of the teacher and the student being alternatively in a symmetrical and complementary interaction state, depending of the context, in order to avoid potential conflicts, building bridges, avoiding the barriers, working together in an assumed/negotiated harmony, without any possibility to remain in a disharmony state [7]. The top-down and bottom-up search window methodology is working in achieving knowledge process by understanding, learning and practicing mechatronical skills, being based on an active-reactive understanding-learning process, occurring either intentionally or spontaneously, enabling to control information, to question, integrate, reconfigure, adapt or reject it [4]. It is necessary to develop in each student a balance between these top-down and the bottom-up perspectives on mechatronical approach of knowledge, studying in depth the key areas of technology on which successfully mechatronical design are based and thus lays the foundation for the students to become true mechatronicians (mechatronical engineers) in the vocational educational training systems (VETS) [11, 12]. Mechatronics is considered as an educational paradigm, as a reflexive contextual language and as a socio-interactive way of being, as a lifestyle (thinking, living, acting), with a methodology to achieve an optimal design of intelligent products, to put in practice the ideas and techniques developed during the transdisciplinary process to raise synergy and provide a catalytic effect for finding new and simpler solutions to traditionally complex problems [11, 14]. This approach is a top-down evaluation of the mechatronical knowledge perspective, the design process, as a very important component of the new transdisciplinary reflexive language [7], could be finalized only by a team of specialists from different fields who must learn to communicate in a new manner, which means that each researcher must think synergistically rather than sequentially, from his own field of research [12]. The principles of mechatronical education can be applied successfully to all teaching levels, creating the necessary environment for defining the curricular areas with the possibility to switch from a unilateral thinking, based on a single discipline, to a flexible, global thinking, which assures an integrating approach to the educational process [13, 14].

The growing importance of mechatronics, from a multidisciplinary perspective at the beginning, through crossdisciplinary, and more recently as a transdisciplinary approach to engineering, becomes increasingly apparent [3, 5]. The key aims of the mechatronical approach of knowledge are to promote relevant education and training, to support the development of research programs and diffuse information relating to the application of techniques across all industrial sectors [15]. In this way there is the possibility to explain the possibility to approach the mechatronical evolution from a top-down perspective as a philosophy of living with a specific language and with strong educational skills in the knowledge based society. At the same time there is a bottom-up perspective in this approach of reaching knowledge, the integration of new products and systems based on the mechatronical synergistic synthesis with complexity, increased performance, and to achieve skills in a transdisciplinary apprenticeship relation between the teacher and the students as transmitter and receiver of the contextual synergistic message [7, 14]. These advantages have been stimulated by factors including developments in microprocessor industry, new and improved sensors and actuators, advances in design and analysis methods, simulation tools and novel software techniques. Mechatronics is studied at a theoretical and practical level, as well, a balance between theory, an analysis and hardware implementation being emphasized.

The true mechatronical engineer has a genuine interest and ability across a wide range of technologies, and takes delight in working across disciplinary boundaries in a transdisciplinary way, to identify and use the particular blend of technologies which will provide the most appropriate solution to the problems in discussion, being able to motivate others about technologies outside their own, and to promote alternative approaches. In the knowledge based society the information has to be flexible, unlimited, infinitely extensible, assuring as well the fulfillment of the spiritual and the material needs, as well [8]. Mechatronics have lead, in a short amount of time, to the development of new educational principles through the development of systemic thinking, the development of skills for team work, where thinking and action flexibility, designing and production creativity are essential qualities for the researcher.

The integration of mechanical, electrical, computer and information systems for the design and manufacture of products and processes, which can be generated by a correct combination of parameters, so that the final product is better than just the sum of its parts, is a synergistic knowledge process. Without this synergistic combination, mechatronical products could not exhibit performance characteristics that were previously difficult to achieve. A mechatronical concentration area in the engineering curriculum would support the synergistic integration of precision mechanical engineering, electronics control, and systems thinking into the design of intelligent products and processes. Considered as a result of applying information technology to physical systems, consisting of mechanical, electrical, electronic and computer systems as well as actuators, sensors, and real time interfacing, mechatronics use sensors and actuators to transduce energy between high power, usually the mechanical side, and low power, the electrical and computer or electronic side. This is one of the possible bottom-up approaches of mechatronics. Transdisciplinarity as understanding (top-down approach), learning and practicing it (bottom-up approach) is based on an active process, occurring either intentionally or spontaneously, that enables to control information, thus to question, integrate, reconfigure, adapt or reject it [4, 5].

To learn and to understand are the most two important issues of the transdisciplinary mechatronical knowledge in the integrative process through modelling and control in the design of mechatronical systems. To achieve knowledge in
the transdisciplinary mechatronical context, it is necessary to reconfigure the framework of the way the four pillars: learning to know, learning to do, learning to be and learning to live with other people are working [16]. For this reason they are put together, in a new framework, learning as achieving information and knowledge, as an objective extrinsic logical issue, and understanding as an ethic-semantic issue, the subjective spiritual dimension of knowledge. „Learning to learn to know by doing” and „learning to understand to be by living together with other people” are two guidelines to achieve both necessary integrative semiophysical skills in a synergistic communicational context, structural-functional semi-physical system, with its technical efficiency (knowing what and how we know), and ethic-semantic value of semiosycal products in an ethic authoritative context with its axiological coefficient (knowing how and why we live). In this way, every pillar of transdisciplinary knowledge can be integrated in this framework to explain the mechatronical perspective of achieving knowledge in the informational knowledge based society with a new transdisciplinary mechatronical epistemology, a new creative logic of the included middle and a new mechatronical ontology. Transdisciplinary approach becomes an indispensable complement to the disciplinary approach making possible the adaptation to the necessary and continuously changing of professional exigencies, with a permanent flexibility always oriented towards the actualization of the inside [4].

So, transdisciplinary mechatronical knowledge, with its extrinsic active (learning to know by doing) and intrinsic reactive (understand to be by living with others) components can be presented in a new original manner. The knowledge by „learning to learn to know by doing” involves „creativity through adequateness and innovation (to know-what, how, why)”, combined with „action through competence and performance (by doing-who, what, how and why)”, as extrinsic active component, characterized by the efficiency of knowledge process. On the other hand there is the knowledge “by understanding to be by living with other people”, which presupposes „authenticity through integrity and excellence (to be-who, how)”, together with „participation through communion and apprenticeship (by living with-to whom)”, as intrinsic reactive component, characterized by its axiological ethic-semantic parameter [14].

3. EDUCATIONAL MECHATRONICAL INTEGRATIVE KNOWLEDGE FRAMEWORK

Education and training with specific procedures and techniques are crucial in continuously economic and social changes. To fulfil the demands for multi-skilled technicians and skilled workers, vocational educational training systems (VETS) together with industry are confronted with the need to develop theoretical sequences (top-down perspective) integrated with practical learning sequences (bottom-up perspective), as well, all participants being determined to acquire key competences and update their skills as a continuous process throughout their lives. As guidelines for growth and jobs, these objectives can be achieved only by sustainable long term effort in major three areas [17]: (1) raising skill levels, in order to avoid the risk of economic and social exclusion, because the future labour markets in the knowledge-based society will demand higher skill levels from a shrinking work force; (2) lifelong learning strategies, including all levels of education, the qualification frameworks and the validation of non-formal and informal learning, as well, in an innovative learning partnerships and sustainable funding for high quality, efficient and equitable education; (3) the knowledge triangle, education, research and innovation, which plays a key role in boosting jobs and growth, accelerating reform, promoting excellence in higher education and university-business partnerships and ensuring that all sectors of education and training play their full role in promoting creativity and innovation [18, 19].

The capacity of the vocational educational training systems (VETS) to contribute both efficiently and equitable to the modernization of education is reflected in the development of new approaches and policies, by revision of teaching content, the methods used, adaptability of the teachers, extension of compulsory schooling as components of all the educational levels, quality assessments and increasing investments. The fore-coming strategies and the knowledge triangle (education, research and innovation) have to be put in the front of the battle for the continuous modernization of education at every level, with new forms of stakeholder involvements tested, mostly as regards management of higher education institutions, in relation to curriculum development and the definition of learning outcomes. It is necessary to develop a compendium on best practices for the reconfiguration process of universities, with the higher education clusters, for attaching great importance to education, training and skills development. Lifelong learning is imposed as a necessity in the new emergent knowledge based economy, supporting creativity as a contextual innovative process enabling full economical and social participation [17]. In this context vocational educational training systems (VETS), teachers and trainers are challenged by a lot of problems, as: (1) growing heterogeneity of the classes, (2) a demand for new competences, and (3) the need to give more attention to individual learning needs, to achieve basic skills for all the participants. Technology education holds the potential for teaching all the people involved in the VETS as lifelong learning apprentices to get ability in problem solving. In the same time the technology education teachers today have at their disposal the skills, opportunity, experience, ingenuity, expertise, equipment, and environment to greatly improve apprentices’ ability to learn and apply the knowledge they have gained in their academic programs [20]. The technology education can be considered as only logical system for providing an effective performance-based education that prepares the people for the future, so it is necessary to consider that technology education teachers are the key to help apprentices to make the connections between their academic core course material and the real world and they can accomplish much by aligning themselves with academic core teachers in a team-teaching environment, benefiting both the academic core and technology education programs, guiding them to grasp the importance of learning core subjects at all the levels of teaching/learning process to achieve empirical knowledge and skills that technology education offers for facing life in the real world, by incorporating new concepts. So, the mechatronician profession as new technology education has to be made more attractive, only the quality of teacher education being able to influence the performance of the students. The measures imposed to achieve excellence at all levels of VETS, especially in higher education institutions, should focus on education, research and knowledge transfer, the role of
universities in research and innovation, with a strong component university-business partnerships, becoming more common and necessary for reference models to integrate a synergistic education, research and innovation in a competitive basis [18, 19]. The first measure which has to be done is to improve the quality and attractiveness of vocational education and training system (VETS), increasing the relevance of them to the labour market. The second possible work to be done is a renewed emphasis on apprenticeship and work-based learning, and finally, it is necessary to reduce possible obstacles between VETS and other educational systems to integrate naturally the VETS with all the educational existing systems. The implementation of the lifelong learning to achieve efficiency and equity is another big challenge, the concern for both, efficiency and equity, should underpin the development of all research-base on the policy and practice of education and training, so knowledge of the economic and social impact of education and training policies must be strengthened. The increased investment in early education is very necessary because it could produce the highest returns to efficiency and equity, as well, so the transition to the labour market would be made easier, skills shortages being avoided. It is very important to achieve, at all levels of knowledge process, the new mechatronical language, using the knowledge search window methodology to develop creativity [7].

Tasks and problem solving in mechatronics requires cognitive, operational knowledge and practical experience about building systems, diagnosis - and maintenance techniques, a significant challenge being that these tasks are essentially characterized by the use even tele-media systems. Service staff in the professional field needs the ability to achieve their aims in cooperation with others and they should be able to cooperate in virtual and supranational forms of organization, in a transdisciplinary networking systems. To meet these requirements in education and training there is a need to elaborate concepts concerning pedagogical, technical and organizational aspects in a new significant synergistic way that of the transdisciplinary educational paradigm, using the proposed knowledge search window [3, 5]. The computers are used as tools to provide alternative sources of learning material, interactive learning situations and simulation of systems that cannot be used in reality for reasons of cost, size or safety. The use of the Internet is rapidly increasing and seen by some people as the greatest source of knowledge available for learning as well as the use of simulation tools with a number of benefits to education, because the learner is not strictly related with real world, and in the same time is able to explore a range of possible solutions easily and quickly [23]. It is not so clear how much of real experience can be replaced by learning with simulations, so it remains still as a very big problem. The vocational mechatronical training schools have to integrate naturally the VETS, working in so called learning/teaching transdisciplinary fields, with synergistic approach or tasks distributed over time of training with increasing requirements to the learners and to the teachers, as well [24, 25]. Using this new didactical concept is avoided a disciplinary distribution of learning contents into separate classes for different separated disciplines whereas the learners had been left alone to find out the connections between these contents [3, 7]. Changes in the economic system led to a transformation of the labor relations as a phenomenon observed in all economies, the people involved (scientists, teachers, employers and publicists) discussing the importance of identifying promising areas for the development of education in a transdisciplinary way using specific synergistic methods and methodologies. Because professional boundaries are changed or just disappear, in the context of a temporary increasing number of workplaces, it is necessary an adaptation to these new conditions as quickly as it is possible. The changing nature of economical relations, the evolution of organizational forms and the use of the creative laboratory work leads to the need for structural changes in priorities and the content of the training: themes, methods, teachers, disciples, as well [11, 15]. Web-based virtual laboratories, remote laboratory experiences and access to digital libraries are some examples of the new learning enhancing opportunities to increase connectivity. Tertiary institutions with virtual libraries can join together to form virtual communities of learning, helping each other to apply and enrich available open education resources with significant challenges. In this way could be created a more active and interactive learning environment, called “instructional integration” with a clear vision to develop and create the new adequate technologies and the most effective way to integrate them in the design programs and delivery [23, 24]. The combination of the online and regular classroom courses gives to disciples more opportunities for deeper human interaction, developing the social aspects of learning through direct communication, debate, discussion in a synergistic semiochemical communicational context [14]. These requirements are applied also to the design and delivery of distance education programs which need to match learning objectives with appropriate technology support [22]. The new types of distance education institutions and the new forms of e-learning and blended programs meet acceptable academic and professional standards, but a poor connectivity could become a serious constraint in the use of the informational control technology related opportunities, with their limitations. It is very clear that real experience can not be replaced by learning with simulations, being necessary to use complementarily, the virtual tools as design, modelation, simulation and real and the real world representations as prototyping, building smart mechatronical products [15]. Flexibility and adaptability should be characteristics most important to determine tertiary education ability of the institutions to contribute effectively to the capacity building needs of developing knowledge achievement skills. An efficient educational technology at every school level allows to improve the efficiency of learning/teaching material by disciples and to give more attention for the individual and personal growth of them, using both ways of teaching, the passive (reading, hearing words, looking at pictures, watching a movie, looking at on exhibit, watching a demonstration, seeing it done on location) and the active way (participation at the discussions, having a talk, doing a presentation, simulating the real experience, making real things). The very important goal of the education is to promote educators (instructors, facilitators, teachers, mentors) to incorporate engineering concepts into the learning environment and to investigate how experiences of the disciples at all levels have shaped their perceptions of the field of mechatronics to enhance the understanding of the relationship between spontaneous activity of the disciples and to achieve adequate concepts. Therefore, learning and teaching in the synergistic communicational model are considered as activities carried out by professionals (educators and disciples as well), who change mentalities of the people providing them with new knowledge, skills,
values. In a disciplinary educational system there is an obvious lack of flexibility and low level of adaptation to the changing conditions of the environment. There is a need to achieve new synergistic entrepreneurial skills, with flexibility and adaptability, so the educators (mentors, instructors, facilitators, teachers, formators) and disciples (students, apprentices, pupils, adults) are actively responding to the rapid change of economical conditions and increasingly combine practice and theory, to determine the direction of these changes and to offer a tool that will work for promoting competences, bridging both formal and informal learning [5].

To be able to face effectively the challenges of economic development within a global marketplace, it is of a biggest importance to educate the new generation of engineering professionals in a new VETS framework, as a continuum educational lifelong learning program, to develop and strengthen the integrative skills in analysis, synthesis, and contextual understanding of problems and also, to expose them to the latest technologies in different engineering fields and the implications for sustainability of their use. So, the problem-based learning (PBL) approach, open-ended design problem solving by a multi-disciplinary team of disciples in a transdisciplinary context, simulation, modelling, prototyping [3, 11, 23] are integrated altogether with the four dimensions of the sustainability: technology, economics, ecology and ethics [8], considering them as parts of a synergistic approach of knowledge [3, 21, 24]. This method is working in different specific features, at three levels, disciples as receiver (students, apprentices, pupils, adults), instructors as senders (teacher, facilitator, guide, mentor) and methods (experiential selection-know-what, interactive synergistic communication-know-how, functional contextual legitimacy-know-why, working together as in the semiophysical contextual message model) [14]. In PBL method the focus is on what disciples learn, more important being the way the knowledge could be applied [25]. The PBL project maintains the balance between theory (top-down) and practice (bottom-up), creating open-ended problems, taking time and creativity, the support for teaching assistants being essential [7, 24].

As specific synergistic methods used preferentially in mechatronics, Problem Based Learning (PBL) and Team Teaching (TT) methods [20, 25, 26] lead to more self-motivated and independent disciple, these learning methods preparing better the disciples (students, apprentices, pupils, adults, as well) to apply their learning to real-world situations [24, 27]. The need to equip young people with the necessary key competences and to improve educational attainment is an essential part of the strategies for growth and jobs, and sustainable development in the knowledge based society.

The demand for competences presupposes a rapid technological progress which requires high and constantly updated skills, while growing integration and new ways of organizing companies need social, communicative, entrepreneurial and cultural competences that help people to adapt to changing environments. Greater efforts are still required to raise skill levels and to achieve flexibility and security across the labour market through participation in lifelong learning. In the context of a highest demand for high skills and fewer opportunities for the low skilled it is very important to introduce the new methods to achieve knowledge, as transdisciplinary search window top-down/bottom-up approach.

Research and innovation need a broad skills base in the population, so excellence, creativity and learning-to-learn skills must be developed in all systems and levels of education and training, exposing students and apprentices to real working environments in education and training of multi-skilled technicians. For these target demands it is necessary the development and evaluation of a new kind of multi-perspective learning environment for vocational education and training of technicians and skilled workers in the field of mechatronics VETS, they working in an educational transdisciplinary paradigm, with holistic-synergistic problem solving or tasks distributed over time of training with increasing requirements to the learners, in a logical-creative framework. Through this new didactical transdisciplinary concept is avoided the disciplinary distribution of learning contents into separate classes for different separated disciplines, whereas the learners had been left alone to find out the connections between these contents. The new synergistic job profiles created as a mix of mechanical, electrical and IT knowledge is called mechatronical technicians as skilled workers which are to be trained for implementation and service using the education and training of engineers for design and manufacturing of mechatronical devices [11, 15, 18]. Even the mechatronician is a very new profession, there are no sufficient elaborated didactical rules for mechatronical educators and disciples, as well. Enterprises have come to realize that expertise is a vital and dynamic living treasure (learning to understand to be living with others), their desire being meaningless unless an enterprise organization can develop it in ways that respond to its business needs, using a network structure. The experts work in projects (small groups of different professions) to solve problems, learn how to learn and think critically, learn how to understand, identifying the skills needed to meet the requirements emerged (bottom-up learning-teaching) and developing a personal theory of management, leadership or empowerment (top-down teaching-learning).

4. CONCLUSIONS

Mechatronics is in a continuous developing as an synergistic integrative process. Because conventional approaches, even education systems as universities, high schools and elementary schools are not adequate to develop products for the contemporary society, a reformulation is necessary so, many immediate solutions may be available in the theory of engineering design philosophy. Mechatronics evolves and works in a transdisciplinary context through knowledge search window mechanism using a specific knowledge methodology in the new original framework: “learning to learn by doing” and “learning to understand to be by living with together with others”.

Only the transdisciplinarity knowledge achievement can explain the way the creativity, with its synergistic signification, with intentional action through ideas, design, modelling, prototyping, simulation, incorporating the information in mattergy, to realize smart products, sustainable technologies and specific methods to give solution to the emerging problems. Real experiences can not be replaced by learning only with simulations, being necessary to them complementarily, the virtual tools as design, modelling, simulation and the real world representations as prototyping, building smart mechatronical products. Expertise can be attained and promoted only using the new transdisciplinary search window, understanding
5. REFERENCES

EVOLUTIONARY DESIGNS IN ELEARNING VIRTUAL ENGINEERING AND BUSINESS EDUCATION

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ABSTRACT: With its hopeful benefits, eLearning has now enjoyed prevailing adoption not only in higher education but also in corporate training. eLearning has grown from its infancy of merely being a way to access online learning text material into a mature, dynamic, and personalized learning experience provided through powerful and blended tools. This paper is not intended to be a forecast of the future of eLearning, nor did an intensive review of all newly design eLearning tools and functions offered by widely used eLearning platforms. However, this study aims to create a conceptual guideline for future design and development of eLearning tools and methodologies based on some early indications. Moreover, some widely used eLearning platforms are selected by the authors in order to compare their tools and functions.

1. INTRODUCTION

E-learning will only grow in importance once companies view this method of training as a way to foster enterprise transformation. Transformation includes gaining new competencies and launching new products and services while evolving into an e-business. New learning technology plays an important part in improved learning systems for land based industries. By blending traditional learning methods (classroom/on-the-job) with collaborative learning using internet and intranet, companies have documented increased return of investment figures for money spent on competence development.

First generation CBT (Computer Based Training) and eLearning, in the eighties and nineties, was centered on automation and “e” enablement of classroom training in which learning is typically organized as monolithic courses converted to eLearning or WBT (Web Based Training) courses. However, end-users (knowledge-workers) are working in a very fast-paced and fast-changing environment and don’t have time to find specific information when they need it from within these eLearning courses. The time away from work for training classrooms or eLearning courses is constantly shrinking. In addition, the content generation process for classroom training materials or eLearning courseware tends to be very slow and does not match the speed of business processes such as product lifecycles, customer service, channel partner relationship management, etc. First generation eLearning does not match the work or business process context and often does not match the natural learning processes within today’s performance and knowledge-centered work environment. In most cases, the context, relevance, and immediacy of information or knowledge are missing.

Web 2.0 technologies enable rapid knowledge content creation by not just having a one-directional information flow from the instructional designer or subject matter expert to the learner. There is a big push now to encourage participation from the end-users/knowledge-workers - a community-based learning and knowledge management environment. You tap into the intelligence and expertise of practitioners in the field to get the best possible results. You give them tools to quickly capture and share their knowledge. You make that knowledge searchable. The sooner employees grasp the new knowledge, the sooner the new expertise can be applied to a revenue growth strategy. This “time-to-understanding” metric is important for capturing the downtime and opportunity costs incurred during training, especially as more companies consider constant learning an integral part of an employee’s job. Metrics can deliver such proof, which is why Gartner Group estimates that about 30 percent of its e-learning clients use metrics to chart e-learning’s impact on the company’s performance.

How quickly new skills can be applied to revenue opportunities is a metric that might be derived by comparing sales and revenue growth after training in the traditional instructor-led classroom against sales and revenue growth through distributed eLearning. For instance, how long did it take consultants to win new business in a hot management area like business process re-engineering after gaining this expertise in a traditional classroom vs. new consulting e-business wins after e-learning?

2. TIMELINE AND FIRST HYPE CYCLE

First of all, the term “eLearning” means: learning and teaching environment where the teacher(s) and student(s) are not in the same physical location. The learning can be synchronous (i.e. real time interaction) or asynchronous. Through simulation, it is possible to accomplish some important learning objectives, like improved learning through interactivity and system-level insight; also simulator training as a substitute for on-board practice (to some extent) and training adapted to each student pace and knowledge level. While eLearning’s roots are based in traditional instructor-led training (ILT) and computer based training (CBT), the eye of eLearning is on the future - evolving to create second wave training options that didn’t even exist a few years ago [1].

From the timeline we can create a synoptic timestamp as follows:

- Instructor-Led Training Era (pre-1983)
- First Wave eLearning (1994-1999)
- Second Wave eLearning (2000-2005)
- Third Wave eLearning (2006-present)

Interrupting work to attend classroom training - and learning from boring first wave, online solutions that fall flat - have
both become obsolete. The Internet is powering a second wave of training methods that custom fit your work schedules, budget, and training preferences through innovative training technologies, flexible delivery methods, engaging multimedia, and live audio.

Falling stock prices, failed LMS implementations, poor course completion rates, slashed corporate budgets. In the face of all that, will eLearning be remembered as nothing more than a late salvo in the dot-bomb campaign?

There is no doubt that for the first time, eLearning Naysayers is outnumbering the True Believers. As a contrarian, I see this as a very bullish sign. Consider recent history through the lens of Gartner's Technology Hype Cycle, depicting how hype that outpaces technology leads to unrealistic expectations, followed by a period of ambivalence from a weary and disappointed market [2]. Darwinian rules then force unsuccessful vendors to drop out while the strong emerge on top. Buyers and end-users become "enlightened" about which technologies are truly profitable and productive, leading to a period of stability and productivity.

As for the downward slope of the curve, stock prices have more to do with the jitters and lack of long-term focus of investors than with the deficiencies of eLearning. Poor judgment is behind most failed LMS and course implementations.

Due to actual financial crisis corporations always cut training in bad economic times; think of it as deferred maintenance of intellectual assets.

3. E-LEARNING AND SOFTWARE EVOLUTION CONCEPTS

Some of the largest and most successful eLearning initiatives use a learning content management system (LCMS). Where a typical LMS might simply track and organize learners and training, a full-fledged LCMS is designed to manage the creation, storage, reuse, and delivery of eLearning content from a central object repository - everything from conception to delivery [3]. LCMSs are structured environments that are specifically designed to help organizations implement better processes and practices as they go about creating an unlimited number of eLearning courses. They make the creation of content more efficient, avoid redundancy, and they help manage the people - professional developers, subject matter experts, or novices - that are creating the content.

How do LCMSs do this? They often strive to achieve a separation of content from presentation, usually by employing XML tagging of content and/or by following widely used standards (AICC, SCORM, etc.). This allows for the flexibility to publish to a wide range of formats, platforms, or devices such as print, Web, and even hand-held devices. In essence, they are designed to turn an organization into its own eLearning publishing entity.

Online simulations [4] have been touted as the next big wave in training, and for good reason. Learners generally prefer training simulations because they offer complexity, realism, and an opportunity to practice new skills in a risk-free environment. Administrators like training simulations because they result in more motivated students and (perhaps most importantly) higher retention rates. If they're such a win-win solution, why aren't training simulations being used more often?

In the past, simulation training and related content was often extremely expensive and time-consuming to create. Now, however, there are powerful and easy to use simulation development tools available to use on a desktop computer to create simulation content. In addition, there are now custom content providers who specialize in simulation-based content. Perhaps the largest barrier to entry now is a lack of understanding of what is possible in the area of simulation training, tools, and content.

Advanced simulations are a new type of smarter eLearning systems gaining popularity in the eLearning market. These technologies have been a long time coming, often funded by the military. But lower costs, easier-to-use development tools and potentially higher returns in the form of better worker productivity have made smart eLearning technology attractive to a wider variety of government agencies. Today's eLearning programs interact with students, learn about them and even hold their hands, at least metaphorically, when they perform daily computer operations. It is part of a "learn by doing" approach to eLearning that companies insist will improve the rate at which students retain the information they receive.

According to a recently study by Forrester Research, students retain 80 percent of what they learn when they actually do what they're being taught. Merely watching or listening to a lesson results in retention of 20 percent to 35 percent. "If you think about the way people learned to ride a bicycle, they didn't do it by reading a book", said Bjorn Billhardt, chief executive officer at Enspire Learning Inc., an Austin, Texas-based developer of interactive eLearning programs.

3.1. Next step in virtualisation: eLearning through simulation

The Johns Hopkins University [5] Applied Physics Laboratory in Laurel, Md., developed the Mike Simmen simulation the FBI used. Today, Mike Simmen and other simulations are sold by Columbia, Md.-based SIMmersion LLC, which licenses technology from the APL. "Traditional e-learning suffered from a boring factor", said SIMmersion CEO Dale Olsen. "To get retention rates up, students had to be engaged". SIMmersion’s simulations are built using the expressions and body movements of live actors. Their responses to different situations were captured and programmed into the software. The trainee uses earphones and a microphone to interact with
the simulation and, depending on what the trainee says, the simulation will react a certain way. “The character is always different”, Olsen said. “You’ll never have the same discussion twice”.

The term eLearning 2.0 is used to refer to new ways of thinking about eLearning inspired by the emergence of Web 2.0. From an eLearning 2.0 perspective, conventional eLearning systems were based on instructional packets that were delivered to students using Internet technologies. The role of the student consisted in learning from the readings and preparing assignments. Assignments were evaluated by the teacher. In contrast, the new eLearning places increased emphasis on social learning and use of social software such as blogs, wikis, podcasts and virtual worlds such as Second Life. This phenomenon has also been referred to as Long Tail Learning.

The first 10 years of eLearning (eLearning 1.0) was focused on using the internet to replicate the instructor-led experience. Content was designed to lead a learner through the content, providing a wide and ever-increasing set of interactions, experiences, assessments, and simulations. Elearning 2.0, by contrast (patterned after Web 2.0) is built around collaboration. ELearning 2.0 assumes that knowledge (as meaning and understanding) is socially constructed. Learning takes place through conversations about content and grounded interaction about problems and actions. Advocates of social learning claim that one of the best ways to learn something is to teach it to others.

Distance education has long had trouble with testing. The delivery of testing materials is fairly straightforward, which makes sure it is available to the student and he or she can read it at their leisure. The problem arises when the student is required to complete assignments and testing. Online courses have had difficulty controlling cheating in quizzes, tests, or examinations because of the lack of teacher control. In a classroom situation a teacher can monitor students and visually uphold a level of integrity consistent with an institution’s reputation. However, with distance education the student can be removed from supervision completely. Some schools address integrity issues concerning testing by requiring students to take examinations in a controlled setting [6].

Assignments have adapted by becoming larger, longer, and more thorough so as to test for knowledge by forcing the student to research the subject and prove they have done the work. Quizzes are a popular form of testing knowledge and many courses go by the honour system regarding cheating. Even if the student is checking questions in the textbook or online, there may be an enforced time limit or the quiz may be worth so little in the overall mark that it becomes inconsequential. Exams and bigger tests may be harder to regulate.

Used in combination with invigilators, a pre-arranged supervisor trusted with overseeing big tests and examinations can supervise directly. When the Internet became a popular medium for distance education many websites were founded offering secure exam software and packages to help professors manage their students more effectively.

In the relatively new LMS market, commercial vendors for corporate and education applications range from new entrants to those that entered the market in the nineties. In addition to commercial packages, many open source solutions are available.

In 2005, LMSs represented a fragmented $500 million market. The six largest LMS product companies constitute approximately 43% of the market. In addition to the remaining smaller LMS product vendors, training outsourcing firms, enterprise resource planning vendors, and consulting firms all compete for part of the learning management market.

3.2. Education technology paradigm

Technology is an increasingly influential factor in education. Computers and mobile phones are being widely used in developed countries both to complement established education practices and develop new ways of learning such as online education (a type of distance education). This gives students the opportunity to choose what they are interested in learning. The proliferation of computers also means the increase of programming and blogging. Technology offers powerful learning tools that demand new skills and understandings of students, including Multimedia, and provides new ways to engage students, such as Virtual learning environments. Technology is being used more not only in administrative duties in education but also in the instruction of students. The use of technologies such as PowerPoint and interactive whiteboard is capturing the attention of students in the classroom. Technology is also being used in the assessment of students. One example is the Audience Response System (ARS), which allows immediate feedback tests and classroom discussions. Information and communication technologies (ICTs) are a “diverse set of tools and resources used to communicate, create, disseminate, store, and manage information” [7]. These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony. There is increasing interest in how computers and the Internet can improve education at all levels, in both formal and non-formal settings. Older ICT technologies, such as radio and television, have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries.

3.3. Spreading eLearning worldwide

Pedagogical elements are an attempt to define structures or units of educational material. For example, this could be a lesson, an assignment, a multiple choice question, a quiz, a discussion group or a case study. These units should be format independent, so although it may be implemented in any of the following methods, pedagogical structures would not include a textbook, a web page, a video conference or an iPod video. When beginning to create e-Learning content, the pedagogical approaches need to be evaluated. Simple pedagogical approaches make it easy to create content, but lack flexibility, richness and downstream functionality. On the other hand, complex pedagogical approaches can be difficult to set up and slow to develop, though they have the potential to provide more engaging learning experiences for students. Somewhere between these extremes is an ideal pedagogy that allows a particular educator to effectively create educational materials while simultaneously providing the most engaging educational experiences for students [8 and 9].

The use of computers and the Internet is still in its infancy in developing countries, if these are used at all, due to limited infrastructure and the attendant high costs of access. Usually, various technologies are used in combination rather than as the
sole delivery mechanism. For example, the Kothmale Community Radio Internet uses both radio broadcasts and computer and Internet technologies to facilitate the sharing of information and provide educational opportunities in a rural community in Sri Lanka. The Open University of the United Kingdom (UKOU), established in 1969 as the first educational institution in the world wholly dedicated to open and distance learning, still relies heavily on print-based materials supplemented by radio, television and, in recent years, online programming. Similarly, the Indira Gandhi National Open University in India combines the use of print, recorded audio and video, broadcast radio and television, and audio conferencing technologies. The term “computer-assisted learning” (CAL) has been increasingly used to describe the use of technology in teaching [10].

4. CONCLUSION

New learning technology plays an important part in improved learning systems for land based industries. By blending traditional learning methods (classroom/on-the-job) with collaborative learning using inter- and intranet, companies have documented increased return of investment figures for money spent on competence development. Like in the beginning of this paper the Internet is powering a second wave of training methods that custom fit your work schedules, budget, and training preferences through innovative training technologies, flexible delivery methods, engaging multimedia, and live audio. LMS buyers generally report poor satisfaction based on survey results from the American Society for Training and Development (ASTD) and the eLearningGUILD. The ASTD respondents were very unsatisfied with an LMS purchase doubled and those that were very satisfied decreased by 25%. The number that were very satisfied or satisfied edged over 50%. (About 30% were somewhat satisfied.) Nearly one quarter of respondents intended to purchase a new LMS or outsource their LMS functionality over the next 12 months. eLearningGUILD respondents report significant barriers including cost, IT support, integration, and customization. They also report significant effort to implement with a median of 23 months being reported from requirements gathering to implementation for corporations with more than 2,000 employees.

Channel learning, is under-served. For many buyers channel learning is not their number one priority, according to a survey by TrainingOutsourcing.com. Often there is a disconnect when the HR department oversees training and development initiatives, where the focus is consolidating LMS systems inside traditional corporate boundaries. Software technology companies are at the front end of this curve, placing higher priority on channel training.

Most buyers of LMSs utilize an authoring tool to create their eLearning content, which is then hosted on an LMS. Buyers, however, must choose an authoring tool that seamlessly integrates with their LMS in order for their content to be hosted. There are authoring tools on the market, such as Lectora, which meet AICC and SCORM standards and therefore content created in tools such as these can be hosted on an AICC or SCORM certified LMS.

Education encompasses teaching and learning specific skills, and also something less tangible but more profound: the imparting of knowledge, positive judgment and well-developed wisdom. Education has as one of its fundamental aspects the imparting of culture from generation to generation (see socialization). Education means “to draw out”, facilitating realisation of self-potential and latent talents of an individual. It is an application of pedagogy, a body of theoretical and applied research relating to teaching and learning and draws on many disciplines such as psychology, philosophy, computer science, linguistics, neuroscience, sociology - often more profound than they realize-though family teaching may function very informally.

Lifelong, or adult, education has become widespread in many countries. However, education is still seen by many as something aimed at children, and adult education is often branded as adult learning or lifelong learning. Adult education takes on many forms, from formal class-based learning to self-directed learning.

Lending libraries provide inexpensive informal access to books and other self-instructional materials. The rise in computer ownership and internet access has given both adults and children greater access to both formal and informal education.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

ABSTRACT: The correlation between the technological progress and the scarcity of labor (Habakkuk, 1962, Beaundry, 2002, Acemoglu, 2002, Alesina, Zeira, 2006) suggested a faster adoption of new technologies. The aim is to analyze the links between innovation, technological change and labor saving in a DTC (directed technological change) framework. We use a version of Acemoglu’s model (2007) to analyze the effects of supplies of factors on the changing of bias of technology with focus on the implications of labor scarcity on innovation cycle. Based on these results, we find new mechanisms capable to encourage the technological change based on innovation and new strategies for a robust recovery of the high-tech industry after the global crisis.

Keywords: innovation, technology, crisis, DTC (directed technological change)

1. INTRODUCTION

The idea of using a new framework based on multiple indicators is inspired from the work of [15] and [1]. The main advantage is that it enables to identify how much of the variance in each indicator is related to quality and how much is idiosyncratic and it offers the perspective to build a more informative, composite measure of the quality of a patent, conditional on its observed characteristics. This type of indexes can be used to improve measurement of innovation output for studies of R&D productivity and it offers a better capability for measuring the efficiency of innovation via economic growth. The indexes proposed are simple to build, to use and to disseminate and are better related to the decisions to renew a patent and to defend patent rights in court in exploiting detailed patent information to construct an index of innovation quality. The selection of indicators is very important because an improved composite index of innovation quality permits a better performance in the task of explaining the value of innovation and the optimal economic decisions that are related to it.

2. THE USE OF INDEXES FOR MEASURING THE PERFORMANCES OF INNOVATION

The use of indexes in the analysis of the performances of innovation offers a better view of the dynamic evolution and also permits a better comparison of the efficiency in a practical application.

The index for measuring the performances of innovation is based on the following aspects: the degree of coverage of the proposal, duration of protection, the mechanisms for enforcing patent rights), restrictions/ limitations on the use of patent rights, membership in pools/ treaties. For each aspect is attached a normalized score. The overall score for patent rights is the weighted sum of the scores of these categories. Most countries score high on duration, as many countries have recently become signatories to international treaties on IPR. In this case there is low variation in duration and a robust index should explore the breadth of protection rather than the length. There is also relatively less variation in category membership in pools, suggesting the need to incorporate new and important treaties. Most of the variation comes from coverage, enforcement, and restrictions. Many countries, have not found it easy to eliminate compulsory licensing, because this is a sensitive policy instrument that enables a government to exercise leverage over the direction of local technological development. There are clauses in international treaties that allow governments to use compulsory licensing in the event of national emergencies.

The correlation between the Economic Freedom of the World (EFW) index and the patent rights index (PRI), or the Global Competitiveness Report (GCR) ratings is positive. Economic freedom and patent rights tend to move together but in some situations economic freedom is relatively high where patent protection levels are low and vice versa. In this case correlations suggest very little about causality and do not indicate whether stronger patent protection leads to/ reduces economic freedom or whether economic liberalization helps to strengthen/ weaken patent laws. These are important issues to address in light the fact that the benefits of protecting IPR often come at some cost, such as deviations from marginal cost pricing.

Given the lack of formal research on these issues, the analysis of the effects of patent protection on economic freedom and technological progress is difficult issues to address informatively. The analysis should respond first to the desirability of patent rights, the use of social benefits and costs, the optimal level of patent protection, the morality pattern (the rights of the individual inventor versus that of the community), the utility (the effects on productivity growth, innovation, technological diffusion). In a system of patent rights, there exist disagreements about the manner in which patent rights should be allocated or about the efficiency of patent systems in real world. Thus, it is useful to distinguish between the principles of patent rights and the practice. Proponents of patent rights may also be proponents of reform who seek changes or alternatives to current practice. A second aspect is related to the nature of the monopoly power that patent rights create. The patent right is the right to exclude others from exploiting the protected invention and this right is transient. It has a maximum life span and the right must be periodically renewed if it is not to expire. There are some stylized facts: the vast majority of patents granted are simply not commercially viable). The majority of those IPR last fewer and the associated
value computed by using a DCF method is influenced. With some exceptions (patents in chemical and pharmaceutical sectors) the right to exclude extends not to an entire industry or product but to particular parts or components. The more appropriate model for the market structure is monopolistic competition on various close substitutes inventions. In real world, while patent rights create temporary deviations from marginal cost pricing the view that they create pure monopolies is not a correct characterization. Productive debates on the relationship between economic freedom and patent rights should take into account the various institutional aspects of the patent system. It would be useful if future work could also go beyond the raw correlations and study the underlying structural relationship between economic freedom and patent systems.

3. INDEXES FOR THE QUALITY AND VALUE OF INNOVATIONS

In the modern literature there is a substantial information gain give by using multiple indicators to measure the quality of an innovation, and a large payoff to include long term forward citations in a composite index for innovations. There is a wide variety of citations-based measures defined and computed in order to examine different aspects of the patented innovations and their links to other innovations [5]. The quality and value of innovations vary widely in time and a global measure of its expected value in the context of the dynamics of information is welcome and the efficiency of an innovation evolves and depends on the competition, new improvements and markets. CQI (the composite quality index) is a model that estimates the value and technological quality of a patented innovation based on a composite indicator build from the mixing of four technology areas and four indicators: the number of patent claims, forward citations, backward citations and family size.

The relationships between indicators which appear early after innovation discovery and ex post measures of value derived from stock market prices, firm profit accounting or survey estimates ([5] and [6]) give the inspiration to use an early measure that can reduce the unconditional heterogeneity in value. Information about the early expectations can improve the knowledge and optimize the decisions regarding further development and the financing of innovation. In his approach, [1] examines changes in stock prices on the announcement of a patent application but this type of event studies is sensitive to the timing of information. The alternative is to exploit the details of patent data relating to a given innovation at its beginning.

The main indicators for innovation performances in the literature are the following: the number of patent claims [14], simple counts of patents, counts weighted by forward citations [15], years of renewal [10], [11], and patent family size (the number of countries in which the patent is applied for, as in [12]). Another, under-explored, candidate is the number of patent claims. Tong-Frame’s indicator shows that claims-weighted patent counts are more closely related to R&D spending at the national level than simple patent counts. In [8], the model shows that the number of claims is related to the probability to litigate the patents, is litigated. The use of claims data might help account for the very large heterogeneity in the value of patents [9].

The use of CQI give a synthetic information on a range of characteristics for each matched and litigated patent (claims, the number of backward/ forward citations, the number of countries in which a patent application was filed on the innovation). The variables utilized in this case are: number of claims (the essential novel features of the invention), number of citations (these help to define the rights of the patentee), and family size (parallel patents), technology group (technology-based IPC classification), nationality, patent renewals.

The ‘time-zero’ indicators (the number of claims, backward cites and family size) are positively and significantly correlated with each other. Patent family size is more strongly correlated with the other time-zero indicators for domestic-owned patents than for foreign-owned patents. In the literature is suggested that there may be a threshold effect: the information about the quality of the innovation may be in the decision to take out a patent in any foreign country rather than in how many countries. The correlation coefficients between forward citations and the other time-zero indicators are not systematically larger when longer citation spans are used. In [5], it demonstrates that later citation is more strongly related to the market value of firms than are forward citations already occurred. The time-zero indicators are positively correlated with the probability that the patent is renewed and that it is involved in litigation during its life. Patent renewal is correlated most strongly with family size, while litigation is correlated most strongly with the number of claims.

TJH (Trajtenberg, Jaffe, Henderson) index is capable to mix the generality and the originality and is based on the percentage of citations received by patent i that belong to patent class j, out of ni patent classes. In this case, if a patent is cited by subsequent patents that belong to a wide range of fields the measure will be high, whereas if most citations are concentrated in a few fields it will be close to zero. Thinking of forward citations as indicative of the impact of a patent, a high generality score suggests that the patent presumably had a widespread impact, in that it influenced subsequent innovations in a variety of fields, with a high degree of originality. Originality is defined the same way, except that it refers to citations made. In this case, if a patent cites previous patents that belong to a narrow set of technologies the originality score will be low, whereas citing patents in a wide range of fields would render a high score. These indicators tend to be positively correlated with the number of citations made (for originality) or received (for generality). Highly cited patents will tend to have higher originality scores, and likewise patents that make lots of citations would display on average higher originality. If there are more citations, there is a built-in tendency to cover more patent classes but the intensity is to some extent a matter of interpretation. In practice there is a tendency of highly cited patents to have a better impact but it could result potentially misleading inferences, particularly when comparing patents or groups of patents that have different numbers of citations because they come from different cohorts and are therefore subject to differing degrees of truncation. If one views the observed distribution of citations across patent classes as a draw from an underlying multinomial distribution, the observed concentration is biased upward (and hence the generality and originality measures are biased downward), due to the integer nature of the observed data. In conclusion it is likely that many of the classes in which there are only few citations to result a non-zero expected rate of citation.

4. THE USE OF CQI IN A LATENT VARIABLE FRAMEWORK

To investigate the information content in indicators and build a CQI we estimate a one-factor latent variable model.
\[ \gamma_{ki} = \mu_k + \hat{\lambda}_k q_i + \epsilon_{ki} \]
\[ q \approx N(0,1) \text{and } e_k \approx N(0, \sigma_k^2) \]  
where \( k = 1, \ldots, K \) denotes observable indicators, \( q \) is the common factor, and \( \hat{\lambda}_k \) is the factor loading for indicator \( k \).

The one factor model implies the following theoretical covariance matrix of indicators
\[ \Lambda = E[yy'] = \lambda\lambda' + \Phi \]  
where bold letters represent column vectors and \( y \) is the vector of indicators demeaned by nationality and technology group as appropriate. The latent variable and \( K \) indicators have the joint normal distribution
\[ \begin{bmatrix} q \\ y' \end{bmatrix} \approx N(0, \sum), \text{where} \quad \sum = \begin{bmatrix} 1 & \hat{\lambda} \\ \hat{\lambda}' & \Lambda \end{bmatrix} \]  

The posterior mean and variance of the latent variable, conditional on the observed indicators, \( y \), is:
\[ E[q|y] = \lambda\Lambda^{-1} y \]  
and
\[ Var(q|y) = 1 - \lambda'\Lambda^{-1}\lambda \]  

Given a set of estimated factor loadings, (4) provides an estimate of the latent variable for each patent which we will use as a measure of its quality. The conditional posterior mean of the latent variable is a linear combination of the set of indicators, where the weights depend on the factor loadings. Note that the conditional posterior variance of quality is a constant that can be estimated, but it does not depend directly on the indicators. The quadratic form in (5) represents the percentage reduction in the variance of quality due to conditioning on the set of indicators, \( y \). With a suitable redefinition of \( y, k, A, (4) \) and (5) also apply to cases where only a subset of the indicators is available to predict the latent variable.

5. A VALUATION APPROACH FOR FLEXIBLE INVESTMENTS IN INNOVATION

Innovative R&D requires capital investments, and outcomes may take years to be realized. The proper valuation, selection, and management of innovative projects are critical in resource allocation and optimal prioritization according to financial returns, uncertainties and the objectives linked to economic performances.

Investment valuation requires the present-forecasted net cash flows to be discounted so that all NPVs are compared on an equal basis. Predicting future cash flows is a difficult task because the success of an R&D venture in innovative technologies is influenced by many endogenous and exogenous uncertainties (reliability, safety, performance, price, consumer preference, the overall economy, competition, time to market, government policies). The profitability critically depends on the project management because R&D projects are inherently risky and require careful valuation and continuous uncertainty management.

The R&D of innovative products is often staged over an extended period of time. Many decisions need to be made throughout a project's life, according to new information received or the latest business dynamics observed so that potential gains could be capitalized and losses, minimized. The treatment of flexibility to change is inspired from the financial options, exercised only in advantageous conditions, but in this case, the object of transactions is called a real option (because this object is a real asset).

Traditional methods for quantitative analyses of investment in innovative technology are based on analytical techniques such as Monte Carlo simulation, constrained optimization, and binomial approximation.

Black-Scholes options pricing (BS-OPM) and Cox-Rubinstein binomial approximation (CRR-BA) are the main candidates to support the value of real options (flexibility) in real projects/assets.

5.1. The performances of investments in innovations

Traditional capital budgeting methods (DCF) assumes point estimates of future cash flows based on predetermined level of uncertainty but neglect the managerial flexibility and is not possible to respond in different scenarios without changing the value of the projects. The ability to modify an innovative project according to the dynamic evolution adds value because unfavourable scenarios are avoided.

The objective of real options analysis (ROA) is to maximize the value of investment in risk and uncertainty. In project planning, cash flows are influenced by uncertainties in supply, demand, costs and the risk of monetary loss is a direct consequence of these uncertainties. Managers mitigate uncertainties through new information and dynamic revisions. ROA provides a systematic framework that proactively recognizes and incorporates such uncertainties and is a guidance and strategic road map for project selection and management.

Uncertainties are measured by volatility and [8] suggests different methods to calculate the volatility of the underlying asset: a) make an educated guess; b) gather historical data on investment returns in the same/ similar projects; c) simulate the project's cash flows and use Monte Carlo Simulation to synthesize a probability distribution for returns. The volatility (standard deviation) can then be derived from the probability distribution. The greater the volatility, the greater is the discount rate to compensate investors for bearing the additional risk. It is thus important to carefully examine the global environment and relevant data pertaining to innovation, in order to assign a practical level of volatility.

Since uncertainties are explicitly acknowledged and analyzed in valuation, projects can be modified according to how the value of the project evolves over time. The ability to revise the project is a critical attribute of managerial flexibility. It means that managers/ innovators have the ability to abandon, contract, invest, or delay the research when needed. Without such flexibility innovation’s valuation would only rely on point estimates and management intuition and this is suboptimal. Besides flexibility to modify, it is worthwhile to mention the concept of flexibility and robustness as system attributes. In [11], it distinguishes the concepts of flexibility and robustness, while others use them interchangeably, or regard flexibility as one of the desired properties in a robust system.

5.2. Financial options and the inspiration for ROA

An option is a contract giving the buyer the right, but not the obligation, to buy or sell an underlying asset at a specific price on or before a certain date. The paradigm of OPM (Black-
Scholes, 1973) is resumed to a closed-form solution that yields the theoretical prices of financial options. OPM is a solution to the Black-Scholes-Merton (BSM) differential equation. Binomial approximation (CRR-BA) simulates the stochastic behaviour of the underlying asset through different approximations, hence avoiding the need to solve the Black-Scholes-Merton differential equation through Itô Process.

The main assumptions in OPM are the following:

- there is a perfect capital market (it operates in equilibrium, it is perfectly competitive, the existence of risk-free asset, equal access to market, short-selling is allowed, and there are no transaction costs or taxes);
- option price and stock price depend on the same underlying uncertainties;
- trading is continuous;
- prices fluctuations are random and jumps are characterized by a normal or lognormal probability distribution;
- there are no arbitrage opportunities.

They seem very restrictive, but BS-OPM and CRR-BA have proven to be two solid and rigorous methods that produce correct prices for financial options. More importantly, the assumptions such as the stock price behaviour and arbitrage-enforced pricing apply well to financial instruments, for which the historical and observable market data are readily available.

Real options represent opportunities to modify innovative projects through built-in flexibility in the design (to expand, to switch, or to defer the project) or through management action (to abandon, to switch, or to contract the project). This flexibility allows a better decision to capture upside potential and limit downside loss. In contrast to financial options, real options deal with real projects [2]. Real options are often embedded in capital investment projects and can be built into investment opportunities. Real option thinking reflects how value is created in an uncertain environment, and how the R&Ds can strategically design and execute flexibility in project management. They provide much insight into project management because it educates innovators how to deal with uncertainties proactively.

Decision analysis is a structured approach to aid decision-making by systematically examining the alternatives for a decision or a sequence of decisions over a period of time, as well as the uncertainty associated with each outcome. It is based on a tree-like that models each alternative and chooses the best decision. Decision analysis leads to the following results: structuring the problem, which could otherwise be confusing due to the many uncertainties and contingent decisions; defining optimal choices for any period through the expected value calculation; identifying an optimal strategy over many periods of time (de Neufville, 1990). Smith, Nau (1995) demonstrate that in a complete market, a full decision analysis can yield comparable results as the ROA do, and these two approaches can be can be integrated to extend option pricing methods to incomplete markets. In a generalized approach, Brandao, Dyer, Hahn (2004) use off-the-shelf decision analysis software but admit that additional coded algorithms are required to enhance computational efficiency since the proposed approach is computationally intense.

In innovative projects, there are two types of risks associated with an investment, namely private and public risks. Therefore, a hybrid framework could better respond to the modeling of these two risks. It suggest that OPM can be used to simplify decision analysis when some risks can be hedged by trading, and can be used to extend option pricing techniques to problems with incomplete securities markets. It has been used the hybrid approach to value investments in pharmaceutical R&D. In [10] it was propose a hybrid model for risky product development projects and argues that, for financial derivatives, OPM and other extension models are extremely pertinent, but their applicability to real projects is less obvious, for reasons including practicality and information availability. Therefore, the market risk can be modelled using the finance-based methods, and the technical risk should be modelled by using decision analysis.

Monte Carlo simulation follows the following algorithm: model the variables through a set of mathematical equations and identify the interdependencies among variables and across different time periods; select the probability distributions for variables; draw a random sample using a random number generator and then plugged back into an inverted cumulative distribution function to generate another random variants; repeat and calculate statistics of the sample results, such as mean and standard deviation to obtain the estimate.

Merck (2000) used simulation to value its R&D investments in the 1980’s and Schwartz (2007) used simulation to value pharmaceutical patents and R&D. These methods are efficient ways to model the real world. Black-Scholes formula is too simplistic and is not sufficient to reflect the complexity involved in real projects, but a more sophisticated method might require many more assumptions and computational steps. Practitioner’s face many trade-offs when choosing a valuation approach and the selection is based on extensive study of the macro business environment and the circumstances of the project.

6. CONCLUSIONS

The mixing of multiple indicators into a global index offers a new perspective in the analysis of the composite performances of innovation. The principles of building such indexes are based on a set of characteristics like the number of claims, forward citations, backward citations, and patent family size. Individual indicators are likely to be affected by factors other than the quality of the innovation, for example, randomness in the citing process, or firm-level differences in strategies for writing patent claims. The new perspective do not treats these individual indicators and the novelty is based on a latent The advantages offered by multiple indicators framework are: it enables to identify how much of the variance in each indicator is related to quality and how much is idiosyncratic; it offers the perspective to build a more informative, composite measure of the quality of a patent, conditional on its observed characteristics. This type of index can be used to improve measurement of innovation output for studies of R&D productivity, models of economic growth that emphasize successful innovation (Aghion, Howitt, 1997) and other areas in which the output of the innovation process plays an important role.

The indexes proposed are related to the decisions to renew a patent and to defend patent rights in court in exploiting detailed patent information to construct an index of innovation quality. The objective of introducing ROA is to find out the option value of innovation. Assigning a restricted exercise period adds more complexity to this problem, but treating the option as an exotic option reflects greater reality and possibly increases the robustness of the model. The valuation process could also provide clearer insight toward the behaviour of the option. The questions of interest are related to the realistic price to pay for
an innovative R&D program and how would the commercialization affect the results. Future research should identify which indicators are informative, use them to improve the composite index of innovation quality and, most important, examine whether the index helps to explain the value of innovation and economic decisions that are related to it.

7. REFERENCES

INNOVATIVE ENGINEERING BASED ON VISUAL INFORMATION

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ABSTRACT: According to the actual main trends identified by us, globalization and extensive use of visual.Symbolic communication, education technologies should be enhanced in order to take advantage of the minds of the students which are prepared to acquire the information in a new way, which is the visual channel of communication. One can notice the several classes of visual information in engineering, which is useful from several points of view, details presented in the paper. There aren't yet theories regarding the optimization of the learning process by the use of the visual information, the reference being considered the Pimsleur method. Innovative engineering relies today on the creativity of the students that can be stimulated using visual information and visual communication, which should be extensively used in teaching.

1. INTRODUCTION

Until some years ago the basic knowledge learned in the classic education was based on extensive theoretical approaches, with some practical examples and rarely modern information.

At present, students have access to a large amount of information found over the Internet, but they have no experience to discern what information is useful. Moreover, most of the homeworks belonging to some topics can be also found on the Internet and some of the students do not use these sources only to inform themselves.

Figure 1. Symbols replace the text in new software

One can notice that the actual trend, in globalization conditions, is to use extensively symbolic representations instead of the classical text messages. Most of these new graphical interfaces are intuitive and the students are accustomed with this new way to present the information, figure 1, [8].

New learning techniques based on actual trends, such as visual information, are paramount for a modern education which leads to creative solutions in engineering as well as in computer aided modelling, [4], [6], [7], and [9].

2. VISUAL COMMUNICATION

Visual communication is, probably, the oldest method to communicate. We receive and process visual information even we are not all the time aware about it.

The basic idea is that a visual message can inform and educate a person in a more effective way than a simple text or an audio message.

Body language is a basic form of communication and people belonging to different cultures can understand each other using a set of common gestures. Moreover, visual communication is used in atypical operations, such as guerilla/stealth marketing where consumers do not realize they are being marketed.

The use of the colors represents another influence in visual communication. There can be noticed that a, so called, code of colors is used in natural communication where each color has a significance which is widely accepted.

Symbolic communication is another kind of visual communication. Traffic lights, traffic signs, marine flags have an unique and unambiguous message.

Computer based visual communication relies on graphic symbols, pictures, diagrams, photos, videos and presentations. At present, virtual reality is used by both local and web applications in order to present in a realistic way the given amount of information.

To conclude, visual information was a key factor in the intercultural communication and it is the main instrument in the future methods of communication.

3. VISUAL INFORMATION IN ENGINEERING

At present, our students have a strong background as visual information consumers. Starting with the age when they were watching cartoons, most of them became addicted to the visual information. This channel of communication can be used in order to maximize the input of the students.

In engineering there are certain situations when the professor presents some technical information without to show relevant images of the product or of the equipment in question. This is why students become confused, their attention decreases and their presence at classes becomes a problem.
If visual information is used during the classes, the results of a study are expressed in different ways: lists, tables, diagrams, values presented by analogical/digital e-instruments, advanced graphical systems, etc.

The information expressed in a graphical way (i.e. diagrams) has a significant higher relevancy because of the implicit visual synthesis.

Moreover, experiments and the graphical representation of the experimental data are important because they present the connection between the theoretical background and the effective phenomenon considered, figure 2, [3].

Different technical solutions presented at classes make students understand the complex demands of the projects and the creative approaches employed, figure 3.

Different debates may be opened regarding the different aspects of a design in order to stimulate the creativity of the students. Emphasizing the functionalities of a given part or equipment, students must find the criteria employed by the designer to reach a solution, activity which leads to interesting aspects regarding reverse engineering approaches, figure 5.

Several selected pictures are presented to the students, who must noticed the common features, to elaborate upon the theme and to draw synthesizing conclusions regarding the equipments, structures or solutions in question, figure 6.

Phenomena are presented in close relation with other disciplines in order to emphasize the complexity of the real phenomenon and the methods to prevent the failures which might lead to losses and fatal accidents, figure 7. Presenting pictures of the disasters will highlight the importance of the details which are mastered only by the specialists, who must foresee the malfunction of the complex systems.

Using visual information at class, students understand that the theory presented and the problems solved are necessary stages
on the path to the real problems, where solutions must be imagined and applied, sometimes in time shortage situations.

4. VISUAL INFORMATION AS A TEACHING AID

Large amount of visual information may become boring and even annoying for the assistance. The best use of the visual information is by alternating them with the classic methods of teaching. The stages of a course which uses both types of methods are:

- Role of the discipline in the framework of the specialization, figure 8 (visual information);
- Plan of the discipline emphasizing the actual topic which will be presented, figure 9 (visual information);
- Plan of the current topic;
- Usefulness of the topic, practical aspects;
- Theoretical background;
- Educational models – simple case studies;
- Complex models (visual information);
- Design solutions for real products (visual information);
- Debate (functionalities, running conditions, methods to asses the problem, evaluation of the educated guesses, creative solutions, reverse engineering, comparative studies);
- Plan of the next topic to be taught.

Visual information is used to present practical examples and syntheses, not to be included in rigid automatic presentations. Personal touch is important and ad hoc examples are welcome.

It is interesting to investigate if some frameworks employed for visual or alternate (classic and visual) presentations can be designed, based on some principles similar to the Pimsleur method which is used to rapidly learn foreign languages, [12]. If such principles are identified and new methods, based on these principles, are designed, professors will be able to create new educational technologies which will have very effective results, [1], [2], [13], and [14]. It is probably too soon to make suppositions regarding the performances of such an approach, but results should be important for, at least, avoiding the common mistakes which are done today. However, Pimsleur never considered the visual channel of communication in order to enhance the performances in learning a foreign language, so the problem of using visual and classic information is new.

Memorable video examples regarding the phenomenon in question which present creative solutions or unusual aspects may be used in order to stimulate the memory of the students, figure 10.

In order to get the attention of the students, applications to be solved at the seminar and laboratory classes must be connected to the specialization of the students, to the problems they will have to solve at a later stage. As an example, at the strength of materials discipline, students of the Navigation and Marine Transport specialization must solve four problems: geometrical characteristics of an educational model of a cross-section of a hull, free body diagrams for the equivalent beam of the educational model of a hull loaded with gravity and Archimedes forces; diagrams of the normal stresses of the educational model of a hull inclined to the starboard/port side; diagrams of the normal and tangential stresses for the educational model of a hull. Moreover, it must be emphasized that the same calculation methods are employed for the real structures and, as well, they are the ‘backbone’ of the software applications created to solve that problem, figure 11.
Presentations must include open questions in order to allow discussions regarding the technical problem. Analogies with the notions already taught may be employed to make the new aspects easier to be understood by the students.

Apart from the course, students must have access to documentation regarding that discipline, applications to be solved, list of questions for self-testing and pictures of new products, equipments or structures to be discussed. Students are encouraged to take pictures of unusual structures and to surf the web for intriguing examples, as a form of educative entertainment, [15]. E-Learning should be an additional option of the students who can solve the on-line tests.

Last but not least, common sense intelligent humour must be used by the professor in presenting the visual information, fact which will be remembered by the students.

5. CONCLUSION

One can notice the existence of a visual language connected to the technical aspects of a problem, which might be designated as common sense and which expresses the rationality of the design.

Actual teaching methods must take advantage of the actual trends, globalization and visual information being one of the most important aspects.

The wide range of selected pictures presented to the students makes them understand the numerous practical aspects of the theoretical background presented at class, the complexity of the solutions and the creativity of the designers. This visual information motivates them to equally acquire common sense aspects as well as theory and methods to solve practical problems.

Special attention is required from experts in cognitive and educational sciences who must create interdisciplinary collectives of specialists in psychology, art, design, technology in order to elaborate methods to effective use the new visual technologies in the teaching process. As a targeted result, students should understand and acquire all the knowledge at course, being able to give solutions to common sense technical and practical problems in a more facile way.

To conclude, innovative engineering relies on the creativity of the actual students based on teaching skills of the professors which cannot be replaced by the new educational technologies; but an overall advancement will be noticed if visual information will be used in an effective way in nowadays classes.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

11. ***, http://www.imagesco.com/kits/img/bimetall1w.jpg
15. ***, http://www.howstuffworks.com/
INNOVATIVE NEW METHODS FOR BUSINESS EDUCATION - PROBLEM-BASED LEARNING

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ABSTRACT: In the knowledge-based society, business education in educational institutions is experiencing increased competitive pressures. One way to differentiate is by using innovative new methods in business education. This paper presents the advantages of Problem-based learning method that can be applied with distinctive benefits in all educational fields and specifically in business education. This method can present solutions to simple or complex challenging problems that are at the centre of human living experience. Problem Based Learning develops specific skills like the ability to recognize and respond to problems by creative thinking and promotes individual and team work interaction to respond to certain objectives.

1. INTRODUCTION

Problem Based Learning (PBL) is an educational concept that encourages students to learn through the structured exploration of a research problem.

Though the term of Problem Based Learning was first applied in 1960’s in the medical education environment, in Romania is less known and applied in learning institutions. It was first implemented on a large scale at in the medical field of McMaster University in Canada and afterwards it was introduced in European universities. Currently it is used in a variety of disciplines with undergraduates or postgraduates.

Some of the characteristics of PBL are the following: learning is driven by challenging, open-ended problems that have many solutions or no solutions for the problem as defined; students work in small collaborative groups and teachers has the role as “facilitators” of learning.

Accordingly, students are encouraged to take responsibility for their group and organize and direct the learning process with support from a tutor or instructor. Advocates of PBL claim it can be used to enhance content knowledge and foster the development of communication, problem-solving, and self-directed learning skill.

2. ADVANTAGES OF PROBLEM BASED LEARNING

Problem Based Learning provides an environment where the student is immersed in a practical, on-going activity in which he/she receives feedback from other students and the instructor. Secondly, the student receives guidance and support from his/her friends and peers. Learning is not unidirectional (teacher to student), but multi-directional, including other students, tutors, and professors.[1]

According to Gallagher (1997), Problem based learning have the following objectives [2]:

- Foster clinical-reasoning skills, problem-solving skills, or both
- Enhance acquisition, retention, and use of knowledge
- Improve students’ self-directed learning skills
- Develop students’ intrinsic interest in the subject matter and, subsequently, their motivation to learn
- Develop students’ capacity to see problems from multidisciplinary viewpoints, integrating information from many different sources
- Facilitate the development of collaborative learning practices
- Emphasize, for students, the importance of learning for understanding rather than learning for recall
- Improve flexible thought and the capacity to change.

In business education, students have to solve economic problems using their acquired knowledge and in most real situations the problem itself might not be identified. Therefore, the student is first forced to adequately identify the problem, secondly to determine the required time to solve the problem either alone or in teams, and apply or present the solutions of the problem.

PBL engages students in solving real-case problems, stimulating discussion and group work among students and reinforcing learning. A problem-based learning environment develops self-directed learners and is a better learning environment than the classical Romanian undergraduate course in which students only watches, memorize, and repeat orally or in writing what they have been told.
3. EXAMPLES OF PROBLEM BASED LEARNING USE

Group work helps students to process new information and to stay actively involved in learning. In business education students work in small self-directed teams to define, carry out and reflect upon a research task, which can often be a 'real-life' problem. The tutor acts as a facilitator and resource person to whom they can come to for advice or guidance.

Problem-based learning is typically organized with small groups of learners, accompanied by an instructor, faculty person, or facilitator. During this process, a series of problems are provided to learners with guidance early in the PBL process (with introductory problems), and then later guidance is faded as learners gain expertise (Merrill, 2002). Guidance is faded as group members feel more confident with the subject matter and become more competent with the learned procedures.[3]

Mills consider that “one way of using PBL during courses involves holding two linked workshops/seminars, each lasting an hour (or more), usually held a week apart. In the first session the group is given a carefully-chosen “trigger” problem or scenario. This may be a sentence, a picture or even an object - anything which provokes discussion around a topic. Careful choice of a focused “trigger” will ensure that students will explore a research problem relating to the course or module outcomes, or the substantive teaching topic. After appointing a chairperson and a note-taker, the participants brainstorm possible research topics leading out of the trigger. After discussion, the group defines a researchable “problem”; and analyzes ways of exploring different angles to this problem, and then set themselves research tasks leading out of it. The tutor acts as a resource person, suggesting sources of information, but not intervening in the group discussion unless necessary.” The group returns after a period of time to discuss their new knowledge about the topics they’ve set themselves.

The following PBL stages proposed by Mills present one way of using PBL. Stages 1–3 can be used at a first hour-long session, session 4 over the subsequent few days, and Stage 5 at the second session – which may take longer. [4]

- **STAGE 1: DEFINITION** (10 mins)
  a) Appoint chairperson and notetaker. Discuss first reactions to trigger provided by tutor.
  b) List them what possible research problems lead from the trigger.

- **STAGE 2: ANALYSIS** (30 mins)
  c) ‘Brainstorm’ the possible research problems.
  d) List explanations or interpretations about these problems.
  e) Identify which explanation/interpretation seem most useful and why.

- **STAGE 3: RESEARCH AIMS** (15 mins)
  f) Formulate the key research problem /hypothesis for investigation.
  g) Decide what further knowledge the group needs to explore this problem.
  h) Define three specific research tasks to be completed. Divide up tasks.
  i) Agree on how the group will work together during the week (for example email or messenger contact).

- **STAGE 4: RESEARCH** (Set a limit to time for independent work, eg three hours)
  j) Acquire knowledge in relation to research questions

- **STAGE 5: SYNTHESIS** (In a second session, usually 1-2 hours long)
  k) Group or individual research over the week, limited to 3 hours

  l) Complete task (eg preparation of an annotated bibliography of material related to the problem).

- **STAGE 5: SYNTHESIS** (In a second session, usually 1-2 hours long)
  m) Review the newly acquired knowledge within the group.
  n) Pool findings - do they help an understanding of the research problem?
  o) Final group response to the trigger.
  p) Reflections on the learning process.

Merrill (2007) suggests beginning with worked examples and then later, introduces students to smaller less complex problems. But as the process progresses, problems can be changed by adding components to make them more realistic. Other PBL specialists consider the use of realistic problems from the start is a better approach [5].

Another example of applying Problem Based Learning is based on Ommundsen’s (1999) example for studying Biology [6], applicable for studying business economics or engineering disciplines. The example is suitable to any class size and educational level.

The teacher form small groups of 3-5 people and present the students with a brief problem statement (preferably on a printed work sheet), e.g., “Causes of 7.5% inflation rise in the previous semester”. In some cases a video clip or newspaper selection might be used as a trigger. Students must acknowledge that they are dealing with an authentic problem. According to Ommundsen, the instructor/teacher should previously review the case history and progressively provide data as the case proceeds. The students should not be given bibliography or references, as the objective is to solve a problem, not to read a solution. The groups brainstorm possible causes of inflation rise and each group will have to discuss, review, or investigate possible causes of inflation rise. The students will help each other understand the basic components that influences inflation rate. PBL students must reflect upon macroeconomic mechanisms rather than just memorize facts (as might occur in some traditional lecture-only courses). The instructor circulates among the groups, providing assistance but not solutions. The groups may well explore avenues unanticipated by the instructor. This is highly desirable and should not be discouraged. The instructor should avoid controlling the agenda of the groups. Each group ranks its hypotheses in order of priority and prepares requests for more data. Feedback is very important and the instructor should ask for a representative from each group to place their top priority hypothesis or data request on the chalkboard. If is already entered by another group, the representative should place their second choice, etc. If this is not practical, ask for oral suggestions from the groups when the small group work is halted and the class is reconvened. Student suggestions may include the following.

Inflation represents the rise of prices that causes the purchasing power of a nation to fall. There are many causes for inflation rise, depending on a number of factors. For example, inflation can happen when governments print an excess of money to deal with a crisis. As a result, prices end up rising at an extremely high speed to keep up with the currency surplus. This is called the demand-pull, in which prices are forced upwards because of a high demand. Another common cause of inflation is a rise in production costs, which leads to an increase in the price of the final product. For example, if
raw materials increase in price, this leads to the cost of production increasing, this in turn leads to the company increasing prices to maintain steady profits. Rising labor costs can also lead to inflation. As workers demand wage increases, companies usually chose to pass on those costs to their customers. Inflation can also be caused by international lending and national debts. As nations borrow money, they have to deal with interests, which in the end cause prices to rise as a way of keeping up with their debts. A deep drop of the exchange rate can also result inflation, as governments will have to deal with differences in the import/export level. Finally, inflation can be caused by federal taxes put on consumer products such as cigarettes or fuel. As the taxes rise, suppliers often pass on the burden to the consumer. An important observation would be that once prices have increased, they rarely go back, even if taxes are later reduced [7].

At this moment, the small group work can be stopped and the instructor can briefly discuss the ideas with the entire class. It is important to value every contribution, to assist the students in analysis of the economics involved, and to provide further information like figures or statistics of the central bank. The students can be prompted for data requests: “If you could ask for just two types of economic indices values in order to predict the future trend of inflation, what indices they would be?”

It is not likely that the students will solve a problem on the first pass, and the feedback from the instructor motivates the next round of small group work.

The key to managing a PBL session is providing continual feedback to maintain student enthusiasm while simultaneously prolonging the resolution of the problem to ensure that adequate learning occurs.

When a reasonable number of groups have solved the problem, you might request a brief written analysis from each group describing the economic theory involved in the case. Students may be asked to include certain key words in their reports.

Effective problem-solving requires an orderly approach. Students should use the following heuristic: DENT: Define, Explore, Narrow, Test.

1. Define the Problem Carefully. Students must specify what exactly are they trying to determine and whether the problem have several components. If there are several, they should be stated separately. Teams need and seek participation and input from all members [8]. Traditionally, the leader of a group is seen as the authority, the one who makes the final decision, generates member interaction, sets the agenda, and provides direction [9]. As a consequence, team members may become reliant upon the group leader, and may not function well without his/her presence. A student team which operates this way usually can not be productive when a “student leader” (or tutor) is absent. Therefore, it becomes necessary for all team members to be able to lead the team. This can occur when responsibility for the operation of the team is shared. The technique is called role-sharing. Shared leadership leads to shared accountability and competencies. The leader of a team should focus on the process rather than the content of the problem solving process. The leader performs more of a facilitator role, working to encourage and manage communication, participation, and consensus [10]. The leader functions to manage and implement dialogue and discussion appropriately, as well as resolve conflict judiciously as it arises. Most importantly, the leader keeps the team functioning within a problem solving process. When students overtly share the leadership or facilitator role, they are more attentive to team maintenance issues when they reassume a team member status because they can empathize with the team leader’s responsibilities [11]. Effective leadership skills allow students to become more self managed. The leader should ask whether every member in the group agree with the way the problem has been framed.

2. Explore Possible Solutions. Students have to brainstorm ideas that may contribute to a solution. Each of them must be able to justify own ideas to group members. The instructor has to clarify for them the economics involved and to listen carefully to the ideas of other group members in order to give positive feedback.

3. Narrow Choices. After developing a list of hypotheses, students have to sort them, weed them, and rank them. List the type of data required to test each hypothesis. Priority should be given to the simplest, least costly tests.

4. Test Your Solution. Students should seek from their instructor the data they need to test their ideas. If all the possible solutions are eliminated, the cycle begins again: define, explore, narrow, test. When students encounter data that confirm one of their hypotheses they can be asked to write an economic explanation of the solution and to justify it using the available evidence.

A third example of applying Problem Based Learning is related to Republic Polytechnic (RP). They are attempting to implement problem-based learning to all the courses in various fields - applied science, technology for the arts, engineering, sports, health and leisure, communication technology, hospitality, and communication. Since inception in 2002, the polytechnic in Singapore has adopted the pedagogy and customized it to support learning in a One-Day One-Problem framework. Students in a class of not more than 25 are presented a problem likely to happen in a real scenario. A facilitator guides the students through three meetings throughout the day and helps with discussions and generating problem-solving skills. In the third meeting, students team up in groups of five, present their findings and suggest ways to solve the problem. The facilitator explains the “ideal” solution after the students have all presented and students are encouraged to raise their opinions. Students are graded daily in this continuous assessment system. Four understanding tests are conducted in one semester [12].

**4. CONCLUSIONS**

Problem Based Learning is an innovative student-centred educational strategy in which students, grouped in teams, solve problems and reflects on their experiences. Characteristics of this concept are:

1. Learning is driven by challenging, open-ended problems.
2. Students work in small collaborative groups.
3. Teachers take on the role as “facilitators” of learning.

Students are encouraged to take responsibility for their group and organize and direct the learning process with support from a tutor or instructor (teacher).

In this paper was mentioned a brief literature review on Problem Based Learning. There were also exposed several opportunities and advantages of Problem Based Learning method. Further, the three examples of implementation of this
modern concept in the educational environment reveal the potential of the positive impact on students’ development.

5. REFERENCES

5. Merrill, M. D., idem.
TRAINS FOR RESEARCH IN ENGINEERING STUDY PROGRAMMES

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ABSTRACT: This article is intended to draw attention to some problematic aspects related to the research training component in engineering study programmes, aspects that are reflected in students’ research skills and in the quality and quantity of their scientific products. The subject has significant relevance nowadays, when a major purpose of higher educational system is to enhance the employability of graduates, when students are primarily interested in acquiring knowledge and skills necessary to be successful practitioners and when engineering professional career increasingly requires certain generic research-related attributes and a rapid and efficient use of complex scientific methods in engineering applications. Taking into consideration these conditions, it is obvious that we need to find solutions for ensuring a solid research training component in engineering study programmes.

1. INTRODUCTION

Most students enter the faculty with the purpose of acquiring the knowledge and skills necessary to be successful in the labour market [1]. The research field does not raise a great interest among the entering students, the main reasons for this being that they lack information about the research process and its relevance, lack a basic sense of efficacy as researchers and, hence, they lack motivation to approach this field. Still, research is an integral part of undergraduate education and research experience is becoming essential in engineering where technology increasingly requires a rapid and efficient use of complex scientific methods in engineering applications. Moreover, research skills provide engineers with effective instruments to cope with the ever-changing demands in the workplace during their professional career.

Employees expect graduate engineering students to have certain generic attributes, namely:

- the ability to apply knowledge of basic engineering and science fundamentals;
- the ability to communicate effectively;
- the ability to understand problem identification, formulation and solution;
- the expectation of the need to undertake lifelong learning and capacity to do so [2].

These expectations can only be met through an engineering education that encompasses two critical components: (a) transfer of theoretical knowledge and (b) training academic research skills – that is using the informational resources in order to expand the knowledge base, to solve particular problems and develop new products, methodologies, and to uncover previously unknown facts or principles [3]. This structure of university programmes focused on enhancing the employability of graduates is consistent with one major objective of Lisbon strategy’, namely to equip Europe with the skills and competences necessary to succeed in a globalised, knowledge-based economy. This objective can be achieved through an innovative curriculum, teaching methods and training/retraining programmes which include broader employment-related skills along with the more discipline-specific skills [4].

The educational environment needs to aim at changing students’ attitude towards research. This change isn’t achievable just by teaching research, although a good command of these skills is vital to enhancing students’ sense of effectiveness as researchers. The training needs to go beyond the skill level and influence students at a motivational level. We need to show them how research can be exciting and rewarding and help them experience the excitement and rewards. As part of this effort, study programmes need to be planful about what research experiences are offered, when and how, such that our chances of affecting students’ research attitudes are maximized. Most programmes offer standard research courses and experiences (statistic courses, research seminars, theses), but few seek or explicitly state enhancement of students’ research attitudes to be a training goal. Even the experiences that are offered or required can fail to achieve their purposes, depending on the quality of teaching and advisement, the timing of offerings in relation to students’ skill level, and the extent to which the research experiences are integrated with other student experiences (e.g., practice sessions).

As research skills represent such an important component of higher education programmes, we need to assess the extent to which the objective of training academic research skills is accomplished, what are the problematic areas, which are the factors contributing to research-enhancing (and retarding) and what solutions can be applied in order to ensure a research training environment in our universities.

2. OBJECTIVES

This article is intended to draw attention to problematic aspects related to the research skills identified in our practice with engineering students and also, to advance potential solutions for improving these problematic areas.

3. METHODS

In order to identify students’ level of research skills, we used the methodology of case study. Subjects under study were engineering students from authors’ didactical practice. We have analysed their research-related attitudes and performances in the context of typical educational activities: seminars, laboratory work, project assignments, elaboration of their final thesis. The variables considered were the skills necessary in order to efficiently and successfully perform scientific
activities: knowledge of the research methodology, ability to conduct a literature search, to define a problem, to perform an investigation (elaborate a research design), to collect and analyze data, to draw conclusions and to present the findings. We have also analyzed students’ motivation to engage in research activities.

The research involved observational methods, content analysis and unstructured interviews.

4. RESULTS

Our analysis indicates that, as far as research methodology is concerned, students possess basic theoretical knowledge at a satisfactory level, but have difficulty in transferring this knowledge into practice.

The ability of conducting a literature search is insufficiently developed. Most of the students look for information exclusively on internet, libraries (more specifically, books, scientific journals) representing an option just for few of them. They tend to pay attention mostly to resources of general, superficial information, rather than domain specific and complex ones. Even though access to scientific data basis has been facilitated in our faculty, this resource is scarcely exploited by students.

The ability to critically analyze and synthesize information is also impaired. Even when students manage to gather relevant information on their subjects of interest, they have difficulties in structuring the material, accurately defining the problem and using the information in order to support their investigation. Their knowledge and experience of research design elaboration is limited as well.

Communication skills, both verbal and in writing, represent another aspect requiring improvement. Students have difficulties in clearly stating the results of their research, formulating conclusions based on their practical experiments, emphasizing the relevance of their findings. Apart from these content deficiencies, we have also identified problematic aspects concerning the format in which research results are presented: poor command of Word and Power Point tools or other editing and presentation software, lack of knowledge related to how bibliographical citations should be made.

Another finding would be that an increasing number of students seem to lack basic concepts of research ethics, “copy/paste” technique and lack of information source references representing frequent problems.

As far as research-related attitudes are concerned, students seem to have a rather modest level of motivation for engaging in research activities. Their implication and responsibility is moderate, some of them holding the belief that school assignments (and even their final thesis) are just partly their task and expecting a high level of implication from the advisor professors.

5. DISCUSSION

The results of our investigation suggest that the research skills of students assessed meet only at a satisfactory level the standards higher education establishes. The satisfaction of the students themselves in regard to research activities is medium, as showed by the results of a survey conducted in 2008 in our university [5]. The convergence of these separate investigations supports the idea that the research training component of our study programmes necessitates adjustments. The areas identified as problematic are: ability of conducting literature search, ability to critically analyze and synthesize information, research design elaboration, communication skills, transfer of theoretical knowledge into practice and level of motivation.

Clearly we need to identify which are the factors underlying these deficiencies and this could be done in the context of future more specific studies. For the moment we will advance theoretical propositions about educational environment components likely to influence students’ attitudes towards research, their interest in doing research and the value of research in their future careers. Understanding these research-enhancing factors and their assessment at the level of the study programmes our faculty offers will allow us to explain the problematic aspects identified and come up with solutions for improving the research training environment.

According to Charles H. Gelso [6], a positive and stimulating research training environment for graduate students would be ensured by the presence of the following elements:

1) faculty modelling of appropriate scientific behaviour and attitudes;
2) positively reinforcement of scientific activity, both formally and informally;
3) students’ involvement in research as early as possible and in a minimally threatening way;
4) emphasis during training on the fact that all research studies are limited and flawed at some extent;
5) varied approaches to research;
6) the integration of science and practice, as a major objective of the training programmes.

Faculty modelling of appropriate scientific behaviour and attitudes represents probably the most important research-enhancement component of a study programme [7]. This would involve that the teaching staff of the faculty themselves need to be involved in research. As university’s annual report on research activity shows, our faculty’s global implication in research projects is quite good, but a close analysis of the number of projects reported to the number of faculty members indicates rather modest performances of the teaching staff [8]. Consequently, this is an aspect that requires improvement.

As mentioned previously, one of the goals of higher education programmes is to change students’ attitude towards research. This goal could be achieved if the educational environment would provide positive reinforcement of students’ research efforts. Sources of reinforcement may be many and varied: facilitating students’ participation to conference presentations (travel monies, diminished taxes), access to scientific information resources, recognition of research-related activities in departmental newsletters, student research awards. Faculty members’ responses (or non-responses) to students’ research accomplishments may also be a powerful reinforcement. Our faculty provides students with research opportunities like: access to scientific data basis, annual research awards, periodical sessions of scientific communication, but still there are aspects that would require improvements, since the number of students attending these research-related events is small and the quality of their scientific products is sometimes only satisfactory.

It is important that students be involved in both didactic and experiential components of research as early as possible. Beginning research seminars, participation in research teams and collaboration with faculty members on research projects
are examples of possible experiences that would ensure such an involvement. For most of our engineering students their first research-related experience is a statistics course which provides them with theoretical tools to reach a certain level of understanding of research methodology, but offers insufficient opportunities to apply the statistics and a limited emphasis of research principles’ relevance for their future careers. A possible solution to eliminate these deficiencies would be a more actively engagement of students in activities like data collection and analysis, design and implementation of empirical investigations. An early and active involvement of students in this kind of activities would facilitate their familiarization with the research field, allow them to form and exercise research skills and would reduce the anxiety they are feeling about themselves as researcher and scientists.

The acknowledgement of the flawed and limited nature of every research study, as component of a research training environment, stems from the idea that each and every empirical study has inevitable limitations and that the solution to given methodological problem themselves created other problems [9]. Students should be aware of this reality of research studies in order to be able to counteract the frequent belief that they need to do flawless research, belief that has a significantly diminishing effect on their interest and motivation for research activities. Additional messages should be transmitted to students along with the inevitable limited nature of research methodology. First, despite the inevitable limitations of single studies, knowledge is advanced by research, especially when that research is programmatic. Such programmatic research may consist of a number of studies, each with its own set of methodological problems. Convergent findings under varying methodological conditions and limitations allow for powerful conclusions about the investigated phenomena. A second message is that single studies can indeed have an impact by adding useful data to the existent body of knowledge. So far, the emphasis has been mostly on the successful aspects of the research activities and not on communicating also the problematic elements (failure, limitations). A change of attitude might be taken in consideration, since is preferable to learn from other mistakes, rather then repeating them.

If one of the aims of graduate education is to enhance research attitudes and students’ sense of effectiveness as researchers, then it is important to familiarize students with a wide range of methods and to facilitate students’ use of varying methodologies. Teaching varied approaches to research (quantitative or qualitative, experimental or correlational, manipulative or naturalistic, traditional or modern), will give students the greatest degree of freedom in fitting the method to their research questions and will ensure that, at the completion of their studies, they possess a wide range of competencies regarding the use of methodology. Although we have members embracing such a complex didactic approach, there still are changes to be made in this area, maybe through programmes “training the trainees”.

The integration of science and practice, as a major objective of the training programmes, is a crucial research-enhancing element of the educational environment [10]. Students should understand the practical relevance of the theoretical knowledge faculty provides them with, should be offered opportunity to apply this knowledge in practice and should be able to transfer what they have learned to their professional careers. This view is convergent with one of the main expectations of Romanian students from higher education, which is to be provided with the knowledge and skills necessary to be successful in the labour market [1]. As far as our faculty is concerned, the integration of science and practice component is one necessitating improvements, since both students and teaching staff consider that there isn’t enough emphasis in our study programmes on the practical relevance of the theoretical knowledge and that insufficient opportunities of practical applications are offered [5]. Positive changes in this problematic area can be achieved through actively engaging students in on-going activities related to research such as: projects aimed as solving problems they confront with in every-day-life, data collection and analysis for research studies faculty members perform, design and implementation of empirical investigations, literature reviews.

6. CONCLUSIONS

As pointed out by our analysis, the engineering educational environment has certain problematic areas related to the research training component. The deficiencies identified are reflected in our students’ academic research skills and in the quality and quantity of their scientific products. Taking into consideration that one of the major purposes of higher educational system is to enhance the employability of graduates, as well as the fact that students attending university courses are primarily interested in acquiring knowledge and skills necessary to be successful in the labour market and that nowadays engineering professional career increasingly requires certain generic research-related attributes and a rapid and efficient use of complex scientific methods in engineering applications, it is obvious that we need to find solutions for ensuring a solid research training component in our engineering study programmes.

7. REFERENCES


ASPECTS ABOUT INFORMATION TECHNOLOGY EDUCATION IN UNIVERSITY ENVIROMENT

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ABSTRACT: Digital technology transforms every aspect of human life. Using the Computer in education has become a necessity in the accelerated development of information technology. For the new generation of students familiar with the avalanche of multimedia, the concept of assisting the educational requirement of a computer is intrinsic. In the university environment, the use of computers has an important role both in the transmission of information from the teacher - student and in terms of assimilation of knowledge by students. The article describes some aspects about new methods for engineering on high level education.

1. INTRODUCTION

Integrating ICT in education is a necessity imposed by the new requirements of upgrading the education. Computer programs, teaching lessons on computer, Internet- are just a few basics of the activity elements essentials in education. Computers integration in our current activities is normal if we are preoccupied of our continual improving. The problematical learning computer assisted can be understood by analogy with the tuition schedule. The service quality supplied by computers has been revealed, whereas offers some suggestive conclusions: the capacity of supply faster and without mistakes a big volume of asked information.

1.1. Educational procedures computer assisted

Providing learning support, the computer can perform a number of important educational operations:

• The Applications of the assisted person;
• Questioning the learner and identifying the gaps;
• Correcting mistakes and eliminating gaps by providing relevant information;
• Systematic control of knowledge;
• Self supporting efforts of the learner;
• Actions to achieve a review of themes, subjects or modules;
• Exercises to stimulate creativity, phenomena simulation, some experiments and their interpretation.

1.2. Types of softwares

A classification of used software types would be:

• Games and simulation programs (designed to be used as commercial games, training schools, with educational themes to related careers);
• Programs of “Implementing correlation”, search and choose from a list of jobs the appropriate occupation (profession) for a client depending on his characteristics;
• Personal profiles obtained by self-evaluation: programs that "prepare" a psychological profile based on questionnaires;
• Programs for searching information: programs to (re) find the data using certain criteria in database, with variable size and complexity, programs witch provide information for the purpose of awareness of opportunities.

• Programs for information on the schools and institutions of education and training;
• Programs to support decision-making: programs that help individuals to analyse the factors influencing or to be taken into account in making a decision, proposing or alternatives and ways to follow;
• Programs to support the improvement of a Curriculum Vitae (CV), drafting a cover letter, or filling in forms
• Skills development programs of a job search
• Cross-curricular applications
• Psychometric tests to determine certain skills, personality tests, etc.;
• Multimedia systems: Complex programs that include multiple categories of data (sound, image, text). [1].

2. THE ICT ROLE IN EDUCATION

Technological advances make their imprint on all areas of life. The most spectacular developments between of millenniums are that of information and communications technology. This has radically changed most aspects of life, strongly affected the social and economic administration, resulting in the emergence of virtual organizations. Education can not remain outside the development. Information technology and communications has strong penetrated and found in education, particularly in higher education, a proper ground for manifestation and development. Penetration of ICT in education tries to adapt to current needs, first by reducing costs and length of training, on the other hand by increasing the training quality and effectiveness. The most visible exponent of the evolution of ICT, computer happens to change from the object of study in higher education in an indispensable tool in any domain. Information and communication technology is used in the education primarily as a tool for increasing productivity: collecting, storing and manipulating data, email and internet access, word processing etc.

Using the processes of instruction in itself is lower, but this is currently changing with the emergence of innovation (electronic books) and educational software. The complexity of contemporary society makes the use of ICT to be not only possible but also inevitable and sometimes necessary to ensure the effectiveness of training processes in a world dominated by complex machines with complicated instructions for use and strict requirements of security.
The necessity of training by testing is determined in the information society through the use of virtual reality and reality reasoned.

The Evolution of ICT enables the elimination of barriers of space and time in education. The possibilities of multimedia communication conduct to the disappearing need of simultaneous teacher and student presence in the same room to conduct training activities.

Removing these barriers has led to the formation of institutions with virtual educational purpose, called virtual schools or virtual universities.

The virtualization level of activities carried out vary from institutions where to the students presence on campus is required for some activities (usually evaluation, and synthesis of lessons), to completely virtual institution, where all activities take place through ICT means, without the students ever to be present on campus.

The globalization and the proliferation of ICT exercise strong pressure on education and training systems which may lose their effectiveness and importance. The value of ICT in education has been referred to the decision-makers level.

The development programs at national, regional and European levels include provisions relating to the widening use of ICT, increase the level of the masses in the use of ICT and how to use these influence education purposes.

3. THE SUCCES OF USING ITC IN EDUCATION

The successful use of ICT in education requires certain skills from the instructors and from the learners. The instructors must pursue certain objectives in the processes of on-line learning, implementation witch requires special training:

Access and motivation: The instructor should help students to access the virtual learning. They should feel welcomed, motivated and guided through the necessary resources of the system.

Socializing on-line. The Instructor role is to enable efficient collaboration for the purpose of learning. He should build "bridges" through which students make the transition from classical learning environment, “face to face’ to the on-line learning environment. This process creates a virtual "community" which includes students and instructors.

Receipt and transmission of information: Searching the data required can be quite frustrating in the volume of information available. Instructors should play the role of guidance in research, helping students to identify and retrieve the information sought.

Building knowledge. Instructors and students must learn to work together to create new cognitive processes and new meanings. Instructors should provide incentives and facilitate interaction. Construction of knowledge takes place when students explore the themes studied, discuss them and express their opinions based on arguments, reflecting and reassessing their views.

Development: The Learner needs to find independence in the virtual environment. The Instructor role is to encourage and to provide access to resources and to support the individual development of the learner. As students become more independent the instructors “withdraw”, even if not entirely.

The instructor participating as learner in different courses is one of the ways in which they can better understand the needs and obstacles for prospective students.

Not only instructors but also students need certain skills to successfully participate in learning environments based on ICT. It is absolutely necessary for a certain level of technical knowledge: the students have to get comfortable with computers and their possibilities, with the virtual learning environment and with the participation in virtual communities. Often these skills are developed during the course and not before, consuming a large part of the study. For the more, technical knowledge are necessary but not enough. In the absence of the physical presence of an instructor, they must develop their own discipline and motivation for independent study. They have to “learn how to learn.”

Have been analyzed five levels of skills required and the specific problems:

- Articulation and reflection: Due to the novelty, some students have problems in achieving an appropriate level of articulation and reflection. The students have to learn a new language (the network slangs of communication with computers), they have to develop new skills and they all charge so much time that remains too little material for reflection, analysis and for revise their performance.

- Skills planning: Is not easy to do a realistic planning time. Students are not prepared for the technical problems witch can come across, they do not know in advance how much time to allocate in resolving the problem or how it will take them to solve the problems correctly with the computer help.

- Study skills: In the virtual environments students have less time to acquire the necessary skills. Besides training, they must learn how to acquire social skills, such as creating a virtual circle of friends, teamwork, ability to participate in dialogues etc. All this can be developed in traditional education, too but in virtual environments this skills become strategic skills of critical importance.

- Finding and using resources and best examples. It is a difficult task due to large amount of information available; it’s a labyrinth in which students must find their own way. Students must learn how to find information and then to assess its quality, using criteria such as accessibility, reliability, coverage, accuracy, timeliness, etc.

- Self-evaluation: Even in the traditional environment self-evaluation is difficult to achieve. In virtual environments will be more difficult to obtain a correct self-evaluation. The main reason is the variety of resources and ways chosen by the study participants. For this reason, is a must to create methods of evaluation for each particular class to study the existing way.

Tracking the development of these skills and the student’s progress is an important activity, but very complex and highly time consuming. It is not easy to track the students’ problems and their technical skills level because sometimes they feel embarrassed and they avoid discussing this in public. Also is difficult to asses the individual and group cooperation and progress.

Using ICT in education, specially training assistance, presents a number of positive effects, the most often mentioned in literature are:

Increasing independence and individual student learning. This is a beneficial factor because: sometimes learning is a repetitive process, especially in early stage. Even at advanced
level, learning can be a time consuming process and the instructor is unable to pay attention to each student individually;

CAT can reduce teachers' request, providing an alternative form of teaching; the computers can access the information in less time than a man, offering a huge number of examples regarding that subject. In addition, every person has a good prior knowledge of different learning styles, different interests and different motivations. The classical teaching systems recognize these issues but can not treat them properly. In the assisted training system based on ICT, the learner can choose their own path of learning. A considerable reduction of failure on tests is resulting.

The virtual environments can lead learner in an interactive virtual world where he can practice the accumulated knowledge itself. In these environments, learner has an active role, and the interaction supports the processes of creative learning through discovery.

CAT can increase student interest and the reasons, and voluntarily they will allocate time and effort for learning.

A well-designed program can increase the quality and quantity of work.

The integration of different fields stimulates a greater interest of students and encourages multidisciplinary projects.

Changes in teacher status: reduces time for teaching. The teacher is no longer the main vector for information transmission, his role in moving in the area of organizational training.

Changes in the organizational framework: flexibility offered by ICT has the effect of organizational changes that are going to study variability formatilior to virtualization of the education system through the emergence of institutions (universities, schools) virtual.

Changes in technique evaluations: training and testing can be done simultaneously as a continuous process which can be adjusted on the go, depending on needs.

Changes in the organizational framework: the flexibility offered by ICT has the effect of organizational changes that are going to study variability of full system virtualization educational institutions through the emergence (universities, schools) virtual.

Any new technology, besides advantages it also brings negative aspects. Learning in virtual environments allows a combination and a nearly perfect balance between individualisation, flexibility and structure, reflection and articulation, complexity and transparency, non-linearity and recursively, all contributing to the creation of a incentive training – oriented towards student. However, finding a balance between these elements is hard to find. In addition to old problems, become visible new risks of virtual learning environments. Some of the most frequently mentioned risks are:

**The Anonymity:** Is already accepted the fact that learning in virtual environments, the students may lose their identity and may suffer from anonymity. The basis of this statement lies in the assumption that people can comprehend their identity only through direct meetings. Information technology appears to make this type of communications outdated. Personal interaction requiring physical presence is increasingly being replaced by the new generations of computers.

However, currently is a risk of anonymity until we learn how to live and behave in virtual environment.

**Individualization:** In virtual learning environments, students are connected to each other and with their instructors only through electronic media. They are not “on their own”, there are adequate means of synchronous and synchronous communication that facilitates collaborative learning. Built in the wrong mediums, may occur cases of too strong individualization, conducting to lack of collaborative activities.

**Social distance.** One of the biggest challenges of E-learning is to eliminate the social distance that separates trainers and learners. The traditional style of teaching in the class always has created a “social gap” between the instructor who speaks in front of the class and the students as passive listeners. Learning from the physical distance wills not necessary widens these differentiations. Rather, the available means of communication choose to reduce the track. However, it is necessary as both instructors and students to gain the necessary skills for an effective use of those resources.

Other negative aspects associated with the use of ICT in education, cited in literature are:

- **Lack of adequate resources.** In many cases is a lack of facilities with computers and other equipment (sometimes is a total absence).
- **Lack of appropriate software.** Software packages are often considered inadequate. They fail to demonstrate the advantages over traditional methods of instruction. Some instructors even consider that they limit the learners’ creativity, instead of boosting it.
- **Lack of adequate space.** General overcrowding is manifested even in educational institutions, where it is difficult to find and book a space for this type of activities.

- **Difficulties in assessing the software before purchasing** and the highest costs of the new software together with the instructor’s inability to use the best tools, it’s also prevented use of the best softwares.
- **Possible elimination of human element from the training process** where a better communication is one of the purposes of education.
- **The induction of wrong habits, in some areas - for example** in the formation of accents or ways of pronunciation errors in the case study of a language or dialect.

Technical difficulties in creating CAT packages. In some areas it is difficult to interpret and assess the student responses automatically (e.g., the accuracy of pronunciation in a foreign language).

In conclusion, CAT is very effective, used in conjunction with traditional methods of learning. The strengths consist of the opportunity to assist instructors, especially in the time consuming processes which they can not perform (e.g., processing of information with great speed). However, these programs can not replace teachers. The quality is the main factor of these programs; they must be carefully developed to maintain the interest of students. The utilisation of too simple packages does not have an interest but in the same time the too ambitious packages can cause more problems than solve them.

Computer Assisted Training (CAT) can reduce costs; issuing time resources and giving us the possibility do more with fewer resources. Future trends in this area are:
The coalition of institutions to develop and to use training packages on-line;
• Courseware that adapts to the needs and learning style of learner etc.

4. ISSUES REGARDING THE PERSPECTIVE OF ACHIEVING THE OBJECTIVES SET AT LISBON FOR ICT IN 2010

In Europe is a permanent concern for identifying the major trends in ICT development, elements which are relevant for the construction society based on knowledge development and exploring the scientific importance, the economic and social situation of these trends, and the potential implications on the nature of legal and ethical achievement.

INFOSOC Program—Information Society Technologies: presents the following research objectives:

Methods and tools for specific Information Society (teleworking, electronic commerce and business teleservices);
For telematic services (public administration, research and development engineering, education, health, culture, public information services);
Advanced information technologies in economy: in management, engineering and manufacturing (including virtual enterprises), in energy, transport, environment, agriculture;
Standards and tools for knowledge representation and engineering: cognitive models, natural language processing (including multilingual);
High performance computing systems: (hardware and advanced communication systems: mobile and personal communications, compatibility and interoperability of services and communication infrastructure with the national international network structures, methods and modules for security systems, communication and quality services communication, multimedia technologies for education, museums, libraries and archives).

The MATNANTECH Program presents the following research objectives:
The development of new technologies: micro and nanostructures for photonic communications, nano-particles and nano-structured composite nanostructures with selective properties, nano-structured materials and nanostructures for applications in electronics, mechanics and metallurgy, nanostructured materials for biomedical uses.
The development of new materials:smart materials with applications in electronics, biomedicine and construction, advanced materials and multi-functional, stable and biocompatible materials used for diagnosis and therapy.

From this study results are:

The main impediments for the development of Information Society Technologies software (TSI) in Europe (problems created by social inequality that determines the different levels of access to the TSI, the creation of new professional skills and expertise, lack of appropriate funding requirements for innovation.)
The areas on which attention should be focused on being effective and benefit the company TIS (institutional and social innovation, reducing the level of differentiation in terms of access to technical IST, improving communication infrastructure);
The fields of application of the TIS to achieve EU objectives: education and training, public welfare, government, labour organizations, cultural diversity.
After analysing, the advisory group of the Information Society Technologies has announced that the Lisbon goals could be hindered by the following factors:
Self-satisfaction for achievements and the fragmentation of scientific communities at national and at EU level;
Insufficient links between research and industry;
The absence of integration of major components of an economy based on innovation;
Suboptimal performance of the 10 new Member States of the EU FP6;
Lack of contacts, information, experience and understanding of the importance of research-development-innovation;
Lack of competence in research, of a "social intelligence", a social environment conducive to business.

In Romania there is a continuing concern to achieve targets set by the Lisbon 2010.
The estimation of potential selection was made after criteria that provide a visionary character for a period of 10 years and is based on fundamental research and engineering in several areas of computer science, both hardware and software, and enable the integration of various technologies. The researches revealed the following priority areas of ICT research.
Advanced technologies and ICT models (cognitive technologies, human-machine interfaces, distributed computing environment, advanced management knowledge);
Infrastructures and innovative methods of ICT: development of intensive software systems, modeling and simulation systems, communication technologies for new generation, nano-electronics, sensory systems and architectures.
In the Romanian research, for an economic integration in society based on knowledge has not been done any critical analysis to see the impediments that hamper the integration and the factors that favours the integration, also, which are the weights in developing the Romania’s applications in Information Society Technologies.

5. REFERENCES

LEARNING LASER CUTTING OF METALLIC MATERIALS ON CNC MACHINES

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ABSTRACT: Industrial environment is essential in student’s professional education. Working with CNC machines and advanced technologies, the student is educated for engineering jobs. The learning objectives are to increase the awareness of laser technology, for its industrial applications, CNC programming and maintenance activities.

1. LEARNING CHARACTERISTICS

Learning is improved by combining physical movement with intellectual activity and use and coordination of human senses. The learning components are SAVI (Somatic – learning by moving and doing; Auditory – learning by talking and hearing; Visual – learning by observing and picturing; Intellectual – learning by problem solving and reflecting) [1].

The practical activities for students is an important component of education process, therefore students must accommodate in the industrial environments, for which they are preparing.

During this practical activities students use SAVI components to increase its education by:

- visiting industrial plants during the first year, in order to observe the industrial machines, to talk to engineers and/or industrial responsible, who guide the visit;
- lectures on site are didactic activities, which helps a direct coordination between theoretical and practical notions;
- executing simple parts on CNC machines and using advanced technologies in order to create abilities to handle machines and solve handling problems.

Studying in different environments, like learning environment, inside the university, and the industrial environment, in the production companies, students change their focus from teacher to subject of learning [2]. As much as student is involved in actually production activity it realizes the importance of his study, therefore comes the motivation of learning.

In order to have an optimal usage of advanced technologies, students and teachers should use advanced technologies inside and outside classrooms, universities must have equipped laboratories, students must be able to adapt to globalization and become active in the society [3].

2. LASER CUTTING PROCESS

The industrial cutting process of sheet metal materials can usually be done by laser or water jet technology. For laser technology, the cutting process use a high energy laser beam, which vaporizes and melts the metallic material, while a pressurized assist gas removes the molten material from the working space, called kerfs.

There are some limits regarding the thickness of the materials, starting from minimum 1 mm, up to 12 mm, according to cutting machine’s specifications [4].

The cutting process is done by melting metallic materials, which is removed by a pressurized inert gas, oxygen, nitrogen or air.

Oxygen is used for cutting of mild steels, producing square, dross free edges and sharp corners.

Nitrogen is preferred for cutting stainless steel with high quality edges at high cutting speeds.

Air is sometime used in cutting aluminium and other non-metals materials. Air must be filtered before its insertion in the cutting head. Its contaminants can reduce the life time of the focusing lens.

2.1. Laser optical system

Usually a laser system [Figure 1] contains the following components:

- a laser oscillator, used for laser beam generation;
- a circular polarization mirror, used for light polarization at material’s processing on curved surfaces;
- a couple of bent mirrors, used for direction change of the laser beam, in order to avoid obstacles or important components of the laser machine;
- a cutting head, used for synergy of melting effect, caused by the laser beam, and displacing effect, of the molten material caused by gas pressure.

Figure 1. Laser setup.
The cutting head [Figure 2] is the part of the machine that must concentrate the energy and produce a high pressure on the material’s surface in order to blow the melt material. The concentration of the laser beam is realized by a focusing lens.

![Image of cutting head](image)

**Figure 2.** Cutting head – courtesy of CNC Machines Intl.

### 2.2. CNC Programming

CNC Programming can be done for two purposes, to guide machining process in XOY coordinates and to control the primary and auxiliary technologies using tools. Therefore, the CNC programming of laser cutting machine contains work coordinates, rapid feed of cutting tools, laser control functions, assist gas pressure control, reset and rewind commands. - G-codes are the codes that position the tool and do the actual work;

- M-codes, that manages the machine;
- T-codes are tool-related codes;
- S and F are tool-Speed and tool-Feed,

and finally

- D-codes used for tool compensation.

#### 2.2.1. Laser control functions – G82

Laser operations for the industrial cutting process of metallic materials usually starts with piercing operation, followed by machining operation.

On CNC laser cutter machines the G82 is used to output the intensity of the laser beam over the material’s surface.

For example G82 P2000 Q1500 R90 F1500 means:

- P – laser peak output 2000W
- Q – Pulse frequency 1500 Hz
- R – Pulse duty ratio 90%
- F – Feed-rate 1500

P,Q, and R words must be specified for the first G82 command, when the program starts running. They may be skipped for the following G82 commands, but and error occurs if P,Q and R words were not specified in the first G82 command.

Laser emission does not occur when G82 command is executed, unless the discharge button is activated and the shutter opened.

#### 2.2.2. Focal position control – G87

To establish the focal position of the laser beam, the G87 command is used, according to material characteristics: thickness, chemical composition, etc.

The G87 command determines the cutting laser head’s position near the machined material. For example G87 P57 means:

- P – offset value of the focal position (-99 ~ +99)×0.1mm

When executing G87 command, the gap length is changed according to profiler adjustment, therefore the focal position is also changed, as seen in Figure 3.

Depending on profiler type, the offset varies between some limits; any values beyond these limits could trigger an alarm.

![Image of focal position control](image)

**Figure 3.** Focal position control.

#### 2.2.3. Assist gas pressure control

To specify and change the assist gas pressure, the G88 command is used.

For example G88 P50 means:

- P – the assist gas pressure (1 ~ 99) × 0.1 kg/cm2.

### 2.3. PROGRAMMING EXAMPLE

**MAIN PROGRAM – 3000**

G90 G92 X2620. Y1260.; work coordinates system settings
G52 X25. Y25.; local coordinates system settings
G00 X40. Y25.; moving to machining position by rapid feed
M98P3001; call a subprogram for start machining
G61; exact stop mode (cutting mode settings)
G41D4; beam diameter interpolation
G01X50.Y25.F3000; geometry of the cut
Y50.;
X0.;
Y0.;
X50.;
Y25.;
M98P3002; call a subprogram for end machining
G28X0. Y0.; zero-point return
M30; program reset & rewind.
3. SAFETY CONDITIONS

Learning about safety issues for industrial laser processing of metallic materials could improve the quality of the engineer.

Laser technology has specific safety issues. The risks of using a laser machine can lead to electrocute, press and burn injuries, therefore the laser cutting machine has safety equipments: protective covers, beam shutter, limit switches, stop dogs, interlocks and so on.

Goggles and protective screens are usually used in order to protect the laser operator, according to safety class of the laser resonator. There are 4 classes of safety: class I, class II and class II.a, class III.a, III.b and class IV, for older equipment, and class 1 and 1M, class 2 and 2M, class 3R and 3B, class 4, as specified in the revised IEC 60825-1 standard [5].

Laser oscillators have been classified based on wavelength and maximum output power and on whether the lasers were continuous or pulsed.

The old system, IEC 825 was adopted in the US during the 70’s.

Class I lasers are safest equipments with no possibility of eye injury, because of a low output power (not even after long exposures), or due to an enclosure preventing user access to the laser beam during operation.

Class II lasers allows the human operator to blink to prevent the eye injury. The output power can reach the maximum power of 1mW. Lasers in this class emit only visible light.

Class II a are low power lasers with 1000 seconds of continuous viewing to produce eye damage.

Class III a lasers are mostly dangerous in combination with optical instruments that can change the beam diameter or power density. Usually, the output power does not exceed 5 mW.

Class III b are dangerous if exposure is direct to the eye. The output powers vary from 5 to 500 mW. A diffuse reflection is not dangerous, but specular reflections are dangerous at direct exposures. It is recommended to wear protective goggles. High power lasers can also be a fire generation risk or can lightly burn skin.

Class IV lasers have output powers of 500 mW or more and can cause severe, permanent damage to eye or skin without being magnified by optics of eye or instrumentation. Diffuse reflections of the laser beam can be hazardous to skin or eye. Many industrial, scientific, military, and medical lasers are in this category. The wear of protective goggles is mandatory.

The new safety classification use also 4 levels, but symbols used have combined characters of number and letters.

Class 1 lasers are safe in all normal conditions of use. It includes high-power lasers within an enclosure that prevents exposure to the radiation and that cannot be opened without shutting down the laser.

Class 1M lasers are safe for all conditions of use, except when passed through magnifying optics. These equipments produce large-diameter beams, or beams that are divergent.

Class 2 lasers are safe because the blink reflex will limit the exposure to less than 0.25 seconds. Laser pointers are usually class 2.

Class 2M lasers are safe because the blink reflex if not viewed through optical instruments. Similar with class 1M, this applies to laser beams with a large diameter or large divergence, but the amount of light passing through the pupil should not exceed the limits for class 2.

Class 3R lasers are considered safe if handled carefully, with restricted beam viewing. Class 3R visible lasers are limited to 5 mW.

Class 3B lasers are hazardous if the eye is exposed directly, but diffuse reflections from matte surfaces are not harmful. Protective eyewear is typically required where direct viewing of a class 3B laser beam may occur. Class-3B lasers must be equipped with a key switch and a safety interlock.

Class 4 lasers include all lasers with beam power greater than class 3B. Class-4 lasers can burn the skin. Also, it can have devastating and permanent eye damage as a result of direct or diffuse beam viewing. These lasers may ignite combustible materials, and thus may represent a fire risk. Class 4 lasers must be equipped with a key switch and a safety interlock. Many industrial, scientific, military, and medical lasers are in this category.

Learning safety classification, students can avoid hazardous situations and learn about protective equipments specific to the field of laser processing of metallic materials.
4. CONCLUSIONS
For a good industrial engineering education, students must have a good awareness of the advanced technologies, CNC programming, machine handling, machine maintenance, and safety conditions.

Learning about laser cutting on industrial CNC machines should use educational SAVI components and make the student aware about laser phenomena, programming CNC machines (using ISO/EIA languages) and safety conditions and equipments used in the industry.

5. REFERENCES
A MATHEMATICAL MODEL OF THE INOVATION INDICATOR

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ABSTRACT: The aim of the present paper is to set forth a thorough mathematical model for the innovation indicator (the innovative degree) of any type of organization or a country as well. In this respect, we plan to study and measure the complex process of innovation. Similar studies [7] have been performed so far for certain countries included in the EIS. The model set forth in the present paper has been created in the context of non-existing critical situations (earthquake, pandemic, flood, etc) and it can also be applied in the current global economic crisis. Mention should be made that this model requires some fundamental arithmetical and logical operations that can be performed by engineers, economists, and not by mathematicians only.

Keywords: innovation, EIS (European Innovation Scoreboard), entrepreneurship.

1. INTRODUCTION

In the context of a knowledge-based economy, innovation represents an essential element for increasing the output or the efficiency of organizations.

Therefore, the innovative strategy should represent a national priority and also a top priority for the leaders of such organizations. The quality of their activities, sustainable development, can only be attained provided they are grounded on a mathematical model of innovation, thus determining the measurement of the innovative process and the efficiency of innovation.

Innovation can be defined as a complex process, dynamic and difficult to measure, at the same time, which also explains the lack of any model that might describe it. The European Innovation Scoreboard (EIS) provides an innovation tool, at the initiative of the European Union, meant to measure the innovative efficiency regarding the European Union member-states, as well as for some other highly efficient states, in view of enabling an objective, thorough comparative approach. Though a helpful instrument for innovation measurement, EIS has been subject to criticism as it is not able yet to include all relevant dimensions of the process. Currently, the process is undergoing improvement [7].

Entrepreneurship, as the activity meant to promote innovation, is the safest way to thrive in a rapidly and continuously changing world. Our contemporary society has become a global one, based on knowledge and information, whereas education at all levels has to adapt to the challenges of the society, civilization and world. We all need to possess abilities and master competencies for lifelong learning and for capitalizing the results of recent scientific development in such a way that each of us can efficiently contribute to the sustainable development of economy, innovation and general welfare.

The strengthening, expansion and renewal of the relationship of any organization, either industrial or non-industrial, including universities and social communities, with society at large, represent issues for learning.

Strengthening the partnership between organization / university on the one hand and society on the other, associated with an ongoing adjustment to the challenging and quick dynamics of the evolution of the requirements of a sustainable social development, require a continuous re-design of innovation, scientific research and academic social actions.

Genuine entrepreneurship has become a feature as well as a generator of excellence, thus encouraging risk taking, tolerating failure and stimulating innovators to protect their project until final completion. It creates a flexible structure enabling creative/innovative employers to generate new successful projects. [5]

Entrepreneurial adjustment is the only way to turn threats into opportunities, and to make the end into a new beginning, thus representing the solution to withstand unforeseen challenges, to promptly adjust to market requirements, to gain competitive advantages well suited to the hypercompetitive environment and to capitalize the novelty of changes. Innovation, control, information dissemination as well as discovery represent the entrepreneur’s essential vision of the economic environment, or the guidelines to an entrepreneurial approach to market processes.

Specialized literature [1], [8] defines the economic and social indicators, however there is no mention of the innovation indicator.

2. A MATHEMATICAL MODEL OF THE INNOVATION INDICATOR

The technique of mathematical modelling proves to be useful in all scientific fields. It is well known that a qualitative description of any phenomenon subject to study as well as the expression of certain laws are not enough unless they are associated with a thorough analysis of the quantitative laws governing the respective phenomenon. Therefore, we wish to measure whatever can be measured as well as to make measurable whatever has not been measured yet.

A mathematical model [4] can be defined as the mathematical problem associated with any topic undergoing analysis. This model is not necessarily the most accurate or the most appropriate.

The study of dynamic systems, for instance, shows that the fundamental component of a mathematical model of any dynamic process (economic, educational, social, biological,
chemical, etc) represents a set of equations connecting the variables and parameters that describe the state of the particular system or a purpose function, on the variables subject to limitations (restrictions).

In the process of selecting variables the researcher will always make a compromise between the complexity of the system and the manner of objective representation of the features considered essential to its analyses. The role of the parameters is to represent the control mechanism of the process as well as to adjust the model curve for experimental data.

In a dynamic process, the time variable, \( t \), is always included, implicitly or explicitly. In this context, we can distinguish:

- short-term or long-term behaviour models;
- continuous or discreet models;
- the lack or presence of delayed effects in certain models.

Mathematical models are the result of an interdisciplinary study, performed continuously and consistently. There is no general method of drawing up a mathematical model.

The present mathematical model aims to generate an innovation model that might lead to hierarchy and which can also justify the choice of the indicators defining the innovative process.

We are going to refer to the following indicators in our analysis of the innovative influence:

- \( x_1 \) is an indicator that measures human resources, labor force that is highly qualified and trained, thus considered a key element of innovation;
- \( x_2 \) - is an indicator that reflects the funding of innovative processes; it refers to the degree that these and other innovative processes are supported by the European Union, state, ministries, various authorities, companies;
- \( x_3 \) - is an indicator that expresses the investments of any type of organizations, that is their effort in view of supporting innovation, their investment for generating new products and processes;
- \( x_4 \) - is an indicator related to entrepreneurship, this reflects enterprise and collaboration among innovative organizations;
- \( x_5 \) - is an indicator that reflects performances, measures intellectual property rights resulting from the innovative process;
- \( x_6 \) - is an indicator that expresses the gross average salary resulted from the innovative units / gross average salary in the overall economy;
- \( x_7 \) - indicator reflecting payment corresponding to the work factor

\[
x_7 = \frac{\text{total expenses entailed by innovators salary}}{\text{turnover}}
\]

\( x_8 \) - indicator reflecting the awards percentage of the total amount of gross salary;

\[
x_8 = \frac{\text{total amount of innovation bonuses/awards}}{\text{total amount of accomplished gross salary}} \times 100
\]

\( x_9 \) - indicator of the percentage reflecting development and training expenses of the total amount of salary

\[
x_9 = \frac{\text{training-related expenses}}{\text{total amount of accomplished gross salary}} \times 100
\]

\( x_{10} \) - indicator of the number of hours devoted to professional development and training of the total average recorded number of employees \( N_s \)

\[
x_{10} = \frac{\text{total number of hours devoted to professional development and training}}{N_s}
\]

\( N_s = \frac{\sum N Z}{Z} \)

where: \( N \) is the number of daily recorded number of employees;

\( Z \) - the number of days preserving the respective recorded number of employees.

- \( x_{11} \) - indicator of staff mobility within innovation teams

\[
x_{11} = \frac{I + E}{L}
\]

where: \( I \) represents the incoming staff in the innovation teams;

\( E \) - the outgoing staff from innovation teams;

\( L \) - the total number of staff in innovation teams.

- \( x_{12} \) - indicator reflecting the performance criteria of innovation units (number of scientific papers published in reviews + number of patents + number of products and technologies resulting from research/innovation activities, based on patents, patent acknowledgement or personal innovation + scientific papers presented at international conferences + number of physical, experimental, functional models, prototypes, norms, procedures, methodologies, regulations and technical plans).

- \( x_{13} \) - indicator expressing professional recognition of the innovation units (number of international awards + number of national awards by the Romanian Academy + number of doctoral advisors in the field, members of the research/innovation teams);

- \( x_{14} \) - indicator of data reflecting human resource training within innovation units (number of PhD and MA students working in the innovation units + number of doctoral theses);

- \( x_{15} \) - indicator reflecting innovation infrastructure (number of innovation centres and laboratories);

- \( x_{16} \) - indicator reflecting work efficiency:

\[
x_{16} = \frac{C \times A}{N} \quad \text{(direct expression)}
\]

where: \( CA \) is the turnover

\( N \) is the average number of employees

\( C = C + P \times I \)

where: \( C \) is the turnover-related cost
PB - gross profit

\[ CA = C \cdot q \cdot p, \] (9)

where: 
q is the quantity of sold products
p is the selling price

or

\[ CA = C \cdot q \cdot p = NZW_Hk, \] (10)

Where: 
N is the total number of employees
Z - number of working days
H - number of working hours/day
W_Hk - hourly output

\[ x_{16} = \frac{T}{N_A} \text{ (indirect expression)} \] (11)

where: 
T is total time required for accomplishing turnover (CA);

\[ x_{17} - \text{ indicator reflecting the percentage of employment in high tech;} \]

\[ x_{17} = \frac{\text{number of employees involved in high tech}}{N} \cdot 100 \] (12)

\[ x_{18} - \text{ know-how indicator (specific acquired knowledge)} \]

\[ x_{19} - \text{ indicator of the percentage of newly sold products on the market} \]

\[ x_{19} = \frac{\text{new product value}}{\text{total turnover}} \] (13)

At the level of any organization (including universities), at the level of any country, each \( x_{i} \), \( i = 1,19 \) indicator can be expressed on a Likert scale thus generating the following matrix:

<table>
<thead>
<tr>
<th>Levels</th>
<th>Indicators</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( x_1 )</td>
<td>( a_{11}^{(k)} )</td>
<td>( a_{12}^{(k)} )</td>
<td>( a_{13}^{(k)} )</td>
<td>( a_{14}^{(k)} )</td>
<td>( a_{15}^{(k)} )</td>
</tr>
<tr>
<td></td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
</tr>
<tr>
<td></td>
<td>( x_i )</td>
<td>( a_{14}^{(k)} )</td>
<td>( a_{15}^{(k)} )</td>
<td>( a_{16}^{(k)} )</td>
<td>( a_{17}^{(k)} )</td>
<td>( a_{18}^{(k)} )</td>
</tr>
<tr>
<td></td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
</tr>
<tr>
<td></td>
<td>( x_{19} )</td>
<td>( a_{19,1}^{(k)} )</td>
<td>( a_{19,2}^{(k)} )</td>
<td>( a_{19,3}^{(k)} )</td>
<td>( a_{19,4}^{(k)} )</td>
<td>( a_{19,5}^{(k)} )</td>
</tr>
</tbody>
</table>

(in a \( T_k \) country;

for any type of \( O_r \) organizations, belonging to the same branch, including universities)

\( a_{ij}^{(k)} \) represents the number of organizations, of any type, including universities, from the \( T_k \) country which is at the level \( N_{ij} \), \( i = 1,19 \), \( j = 1,5 \) during a given time interval.

The indicator vector is \( \{x_1, x_2, \ldots, x_{19}\} \).

Here is the definition of the innovation indicator for the \( T_k \) country, on the \( r \) branch (for \( O_r \) organizations):

\[ I_r^{(k)} = \frac{\sum_{i=1}^{q} \left( a_{11}^{(k)} + 2 \cdot a_{12}^{(k)} + \ldots + 5 \cdot a_{15}^{(k)} \right)}{15} \] (14)

\( \left( \text{partial innovation indicator} \right) \)

The average innovation indicator for the \( T_k \) country is:

\[ I_r^{(k)} = \frac{\sum_{r} I_r^{(k)}}{r} \] (15)

\( \left( \text{global innovation indicator} \right) \)

We can calculate an average value of the innovation indicators for all countries \( T_k \), \( k = \overline{1,M} \) (or all organizations \( O_r \) belonging to the same branch from several countries:

\[ M = \frac{\sum_{r=1}^{Q} I_r^{(k)}}{n} \] (16)

minimum value

\[ m_1 = \min_{k=1,M} I_r^{(k)} \] (17)

maximum value

\[ m_2 = \max_{k=1,M} I_r^{(k)} \] (18)

The result is the following scale:

<table>
<thead>
<tr>
<th>( m_1 )</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
<th>m2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

\[ l = \frac{m_2 - m_1}{5} \] (19)

\[ A = A(m_1) \] (20)

\[ B = B(m_1 + \delta) = B \left( \frac{m_1 + m_2 - m_1}{5} \right) \] (21)

\[ C = C(m_2 + 2\delta) = C \left( \frac{m_2 + 2m_2 - m_1}{5} \right) \] (22)

\[ D = D(m_1 + 3\delta) = D \left( \frac{m_1 + 3m_2 - m_1}{5} \right) \] (23)

\[ E = E(m_1 + 4\delta) = E \left( \frac{m_1 + 4m_2 - m_1}{5} \right) \] (24)

\[ F = F(m_1 + 5\delta) = F(m_2) \] (25)

The AB interval includes all countries or organizations evincing an unsatisfactory innovative performance;

the BC interval includes all countries or organizations evincing a satisfactory innovative performance;

the CD interval includes all countries or organizations evincing an average innovative performance;

the DE interval includes all countries or organizations evincing a good innovative performance;

the EF interval includes all countries or organizations evincing a very good innovative performance;
It is obvious that:

\[ x_i = x_i(t), \quad i = \overline{1,n} \]
\[ I^0 = I^0(t), \quad k = \overline{1,m} \] (26)

Where \( t \) stands for time, usually expressed in years. We can refer to 2009 as the starting year.

On the basis of the following formula

\[ p^0 \sigma^0 = \frac{x_i}{\overline{1,n}} \quad p^0 \sigma^0 = \frac{x_i}{\overline{1,n}} \] (28)

We can calculate the percentage of the \( x_i \) indicator in \( I^0 \) or \( I^0(t) \), leading to comparisons, interpretations, predictions.

Another hierarchy of the countries or organizations in keeping with \( x_1, x_2, ..., x_{15} \) indices as well as (partial or global) innovation indices, shall be performed according to the following algorithm: where \( B = (b_{ij})_{m \times n} \) matrix of “accomplishments” of the respective countries or organizations:

<table>
<thead>
<tr>
<th>Organizations</th>
<th>Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x_1 )</td>
<td>( b_{i1} ) ... ( b_{ij} ) ... ( b_{im} )</td>
</tr>
<tr>
<td>( x_2 )</td>
<td>( b_{i1} ) ... ( b_{ij} ) ... ( b_{im} )</td>
</tr>
<tr>
<td>( x_n )</td>
<td>( b_{i1} ) ... ( b_{ij} ) ... ( b_{im} )</td>
</tr>
</tbody>
</table>

Step 1. Shall be determined:

\[ \alpha_i = \max_{j=1,n} b_{ij} \] (29)

for each indicator \( X_i \), \( i = \overline{1,n} \).

Step 2. Shall be determined

\[ \beta_j = \min_{i=1,n} b_{ij} \] (30)

for each \( O_j \), \( j = \overline{1,m} \).

Step 3. Shall be calculated

\[ \alpha_{\sigma^0} = \min_{i=1,n} \alpha_i \quad \omega_{\sigma^0} = \max_{i=1,n} \beta_j \] (31)

and

\[ \beta_{\sigma^0} = \max_{j=1,m} \beta_j \quad \omega_{\sigma^0} = \max_{i=1,n} \beta_j \] (32)

Step 4. Shall be calculated

\[ y_{ij} = |b_{ij} - \alpha_{\sigma^0}|, \quad i = \overline{1,n}, \quad j = \overline{1,m}; \quad F = (\gamma_{ij})_{m \times n} \] (33)

Step 5. Shall be calculated

\[ y'_{ij} = |b_{ij} - \beta_{\sigma^0}|, \quad i = \overline{1,n}, \quad j = \overline{1,m}; \quad F' = (y'_{ij})_{m \times n} \] (34)

A top-down hierarchy of the countries or organizations shall be performed, according to \( y'_{ij} \), \( i = \overline{1,n} \) values of the \( F' \) matrix.

Thus, if \( y_{ij} \geq y_{ij} \), therefore \( T_i \leq T_j \) or \( O_i \leq O_j \) (\( T_i \) or \( O_i \) evince a poorer innovation than \( T_j \) or \( O_j \)).

Within the same country or organization, an optimal accomplishment of indicator hierarchy can be thus interpreted:

if \( y'_{ij} \geq y'_{ij} \) then \( T_i, O_i \) performed a more efficient innovative activity in relation to \( x_{ji} \) indicator rather than the \( x_{ij} \) indicator.

Comments:

1. A particular case might be represented by \( \alpha_{\sigma^0} = \beta_{\sigma^0} \), when the \( T_j \) country or the \( O_j \) organization evince an optimum innovative degree compared to other \( T_i \) countries or \( O_j \) organizations subject to analysis.
2. The algorithm can be programmed (e.g. in C and C++)
3. Some indicators are significant for certain organizations, some others not. Other indicators may be designed and added to the above-mentioned model.

3. OPEN TASKS

- genuine, accurate hierarchy of the states of the world or organizations, on the above-mentioned thorough scale; the study of their chronological (yearly) evolution represented on this scale;
- achieving correlations among indicators (e.g. in SPSS);
- applying the techniques of operational research and mathematical statistics in the application of the model. For instance, there might occur certain optimization problems, that will be solved by the simplex algorithm [1], [2], [4] or statistical analyses of data may also be performed;
- calculating the inefficiency degree as opposed to the innovation indicator.

We consider that the inefficiency indicator \( I_{\text{Inef}^0} \) for the \( T_i \) country or the \( O_j \) organization may be expressed by means of a functional relation as follows:

\[ I_{\text{Inef}^0} = h(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11}, x_{12}, x_{13}, x_{14}, x_{15}, x_{16}) \] (36)

where:

- \( x_1 \) is an indicator of the efficiency of research-related expenses
- \( x_2 \) indicator reflecting the efficiency rate of total expenses
- \( x_3 \) indicator reflecting the efficiency rate of total expenses

\begin{align*}
\text{Step 1.} & \quad \alpha_i = \max_{j=1,n} b_{ij} \\
\text{Step 2.} & \quad \beta_j = \min_{i=1,n} b_{ij} \\
\text{Step 3.} & \quad \alpha_{\sigma^0} = \min_{i=1,n} \alpha_i, \quad \beta_j = \max_{i=1,n} b_{ij} \\
\text{Step 4.} & \quad y_{ij} = |b_{ij} - \alpha_{\sigma^0}|, \quad i = \overline{1,n}, \quad j = \overline{1,m}; \quad F = (\gamma_{ij})_{m \times n} \\
\text{Step 5.} & \quad y'_{ij} = |b_{ij} - \beta_{\sigma^0}|, \quad i = \overline{1,n}, \quad j = \overline{1,m}; \quad F' = (y'_{ij})_{m \times n} \\
\end{align*}
\( x_{23} \) – indicator reflecting the percentage of bonuses (seniority, difficult/dangerous/toxic working conditions) of the total amount of salary

\[
x_{23} = \frac{\text{total accomplished bonuses}}{\text{total amount of accomplished gross salary}} \times 100 \quad (42)
\]

\( x_{24} \) – total number of staff involved in the research-innovation activities (number of degree 1,2,3 researchers + number of research assistants + total number of employed auxiliary staff);

\( x_{25} \) – indicator of organizational wellness;

\( x_{26} \) - indicator of the encouragement for generating new ideas (brainstorming, focus group, etc).

Therefore:

\[
\begin{align*}
\text{Indef}_i^{(0)} &= x_{9}^{-\alpha_9} x_{10}^{-\alpha_{10}} x_{11}^{-\alpha_{11}} x_{12}^{-\alpha_{12}} x_{13}^{-\alpha_{13}} x_{14}^{-\alpha_{14}} x_{15}^{-\alpha_{15}} x_{16}^{-\alpha_{16}} x_{20}^{-\alpha_{20}} \\
\text{Indef}_i^{(0)} &= x_{21}^{-\alpha_{21}} x_{22}^{-\alpha_{22}} x_{23}^{-\alpha_{23}} x_{24}^{-\alpha_{24}} x_{25}^{-\alpha_{25}} x_{26}^{-\alpha_{26}} x_{17}^{-\alpha_{17}} x_{18}^{-\alpha_{18}} \text{ and } \alpha_i \geq 0, i = 1, \ldots, 15 \quad (43)
\end{align*}
\]

\[
\sum_{i=1}^{15} \alpha_i = 1,5 \quad (44)
\]

- creating a mathematical model of the inefficiency sources, creating certain optimization problems (mathematical programming) where the purpose function depends on the inefficiency sources and thus be minimized;
- determining new, significant indicators for a Tk country or an Ok organization;
- building up innovation teams on several innovative trends at the level of a Tk country or Ok organization;
- building new innovation laboratories (centres);
- comparisons among innovation indicators calculated in keeping with age or gender groups, departments, specializations, organization as a whole, as well as setting forth concluding remarks regarding the dissemination of results and suggesting solutions for the optimization of result dissemination.

4. CONCLUSIONS

The mathematical model set forth in the present paper helps to achieve an accurate, thorough measurement of innovation, to perform genuine reports on the innovation degrees of an organization, to compare among similar types of organizations, having the indicator of innovation as the common denominator and criterion.

It is imperative that universities promote genuine academic value, focus on educational management strategies, sustainable development management, quality management, research management and quality; therefore it is a must for universities to encourage entrepreneurship and innovation.

Academic entrepreneurship can be defined as applied intelligence and intellectual mobility in the management of all the aspects that might contribute to the accomplishment of the major objective of training future generations with professional competencies, entrepreneurial abilities and aptitudes, with an innovative goal [3,5,6].

The concluding remark formulated by the authors is that the innovation model set forth in the present paper is worth being implemented on the basis of the following considerations:

- the necessity of innovation measurement;
- scientific foundation of hierarchical processes.

5. REFERENCES

5. Oprean C., Vanu M.A., Considerations regarding the academic entrepreneurship 16th International Economic Conference IECS 7-8 May 2009, Sibiu, Romania
8. Teodor H., (1999), Finantele agentilor economici din România, Ed. Intelcredo, Deva
COLLABORATION IN ENGINEERING AND BUSINESS EDUCATION
CONNECTING ENGINEERING EDUCATION TO THE BUSINESS COMMUNITY REQUIREMENTS BASED ON THE ACTUAL UNDERSTANDING OF THE MANAGERIAL COMPETENCES

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ABSTRACT: The paper is addressing the complex challenges of academic environment in the framework of technological education. A "sine qua non" condition for creating an appropriate teaching environment that allows technical students to acquire useful business and managerial competencies is to deeply understand the business community needs. Thus, the authors have conducted a comparative study aimed to bridge the gap between the offer and the demand with respect to business and managerial competencies ensued by engineering education. Based on the research results, the authors share their views regarding how both academic environment and business community could take advantage of building innovation networks. This network aspect of the innovation processes fosters "cluster of innovation" and cooperation between teams of students, educators and entrepreneurs. In this way all parties involved will benefit from networking opportunities with respect to initiate collaborative projects and share information, knowledge, and experience.

1. INTRODUCTION

Globalization, as the major business trend, has led to important changes in the European environment, creating both opportunities and challenges for global business. Within Europe, there have been made many efforts to encourage cooperation and partnership between different regional economies in many areas, such as technology, education, ITC, etc.

In this context, it is worth to be pointed to the Bologna Process, launched in 1999 with the aim to encourage and enhance the exchanges of experiences in the areas of science, technology, and information communication technology in order to bridge the gap between different European countries.

Romania, as a full European Union Member State, has been taken the appropriate steps towards complying with the principles of the Bologna Accord. Consequently, based on the recommendations articulated in the new education law, Romania has reorganized the entire education system to assure academic standards that have to improve the quality of European higher education. As a "new entry" country in European Union, Romania is facing with a very competitive European higher education. A "sine qua non" condition for creating an appropriate teaching environment that allows technical students to acquire useful business and managerial competencies is to deeply understand the business community needs. Thus, the authors have conducted a comparative study aimed to bridge the gap between the offer and the demand with respect to business and managerial competencies ensued by engineering education. Based on the research results, the authors share their views regarding how both academic environment and business community could take advantage of building innovation networks. This network aspect of the innovation processes fosters "cluster of innovation" and cooperation between teams of students, educators and entrepreneurs. In this way all parties involved will benefit from networking opportunities with respect to initiate collaborative projects and share information, knowledge, and experience.

2. THEORETICAL BACKGROUND

Today, more and more employers are looking for graduates trained in business skills. This subject is of increasing interest especially for engineering students who are encountering a highly exposure to managerial responsibilities. As a consequence, understanding the competence concept becomes a key condition for a proper education environment.

In the scientific literature, the term competence has been treated as an entity of an organization. This approach explains why a certain leader is not necessarily competent in another organizational environment [1]. In the same light, other specialists have introduced the core competency concept as something that the organization owns, being in fact the cumulative competence of organization. Based on this idea, the core competency is any knowledge, skill, trait, motive, attitude, or other personal characteristic essential to perform a job [2].

Another interesting attempt in this matter has treated competencies of employees, defining job competency as "an underlying characteristic of a person which results in effective and/or superior performance in a job" [3]. Within this model, the researcher highlights that the underlying characteristics could be a trait, skill, social role or a body of knowledge.

According to the literature, organizational and employees’ competences are tightly connected in the sense that personal core competences are said to be derived from the values and core competencies of the organization [4].

Further developments in the field have seen the competency as "an underlying characteristic of people that is causally related to criterion-referenced effective and/or superior performance in a job or situation" [5]. The background idea emphasizes the underlying, unseen structures and processes inside a person that explains why each person’s behaviour tends to be relatively similar across different situations, yet also different from other person's behaviour. In other word, the individual's competency indicates the ways of thinking and behaving in different situations, being characterized by five elements such as motives, traits, self-concept, knowledge and skill necessary for successful job performance.

Another valuable contribution to exploring the competency concept has defined it as both the possession of knowledge and the behavioral capacity to act appropriately. The researchers proposed an interesting concept, named behavioral complexity, as the ability to act out a cognitively complex strategy by playing multiple roles in an integrated and complementary way [6]. Thus, developing competencies has required mastering knowledge and having the opportunity to practice the skills. In this light, researchers also defined the skill concept as a hypothetical concept which explain why behavior is changed
through experiences and learning, and why some individuals are more effective than others [7].

Concerning the managerial competences, valuable researches have distinguished six factors that appear to be critical to the success of managerial employees, such as leadership skills, customer focus, result orientation, problem solving, communication skills, and teamwork [8].

In the area of managerial competencies two key aspects are noteworthy: management knowledge and managerial behaviour. Management knowledge is only one element of competence and means knowing and understanding a wide range of management concepts. In today's context where technology, globalization, and frequent changes combined create a highly complex and challenging environment, the significance of management knowledge is substantially increasing. Thus, it has to integrate different perspectives and disciplines in a cohesive whole that enables individuals to accomplish managerial jobs, successfully.

As for managerial behaviour, it can be observed and measured because requires to apply the knowledge by actions. This is the most difficult aspect, because the competency is manifested through concrete actions in the ability to act effectively in a certain situation. According to the scientific literature, there are a lot of variables affecting managerial behaviour such as attitude, skills, and experience [9].

Finally, after a documented research in the scientific literature, the authors have focused on approaching managerial competence as an integrated result of two key factors: management knowledge and managerial behaviour, which enable managerial employees to accomplish good performance in certain situations. As a consequence, figure 1 presents the managerial competence approach used for our study.

As specialists argued in their studies, developing engineers as future managers has a significant importance. In this context, the development of new engineering management talent is crucial for the survival and growth of their companies’ business [10].

Needless to say, Romania, as EU member state, is part of the European Higher Education Area. It started a significant restructuring process for adjusting the curricula according to Bologna Process. Initiated in 1999, the Bologna Accord, signed by the ministers of education of 29 European countries, explicitly recognized the importance of Quality Assurance in Higher Education. They established joint objectives for Quality Assurance as a means to ensure, measure, and improve the quality of European Higher Education by making academic degree standards more comparable throughout Europe. Moreover, subsequent ministerial meetings, Prague (2001); Berlin (2003); Bergen (2005) and London (2007), increased the number of objectives for developing a coherent and cohesive European Higher Education Area by 2010.

Therefore, to ensure the compliance with European Higher Education Area, the Romanian universities began starting the academic year 2005-2006, to offer new academic curricula. The technical universities have taken the appropriate steps towards the reduction of the studies from 5 to 4 years and restructuring the engineering education curricula, accordingly.

Consequently, the Management Department form "Politehnica" University of Bucharest (U.P.B.) was involved in restructuring the academic curricula for engineering education. In the pursuit of adopting changes, the team from Management Chair focused on approaching two levels of technical education [11]:

- Bachelor level, by offering a large number of subjects/courses in management area;
- Master level, by developing new post-university management programs addressed mainly to engineers.

The development of the framework for engineering education has taken into account a set of competences provided by the post-university management programs. Table 1 presents a synopsis of the courses currently offered in management area by the Management Department.

4. RESEARCH METHODOLOGY

Deciphering the engineering managers’ mind-set through a constant effort of research is a requirement of professional responsibility. The main benefit of this empirical research is that it may yield clues about our community management practices. Although by no exhaustive means, the characteristics set for analysis – management knowledge and managerial behaviour – obviously yields clues about the engineering credential for becoming managers and leaders.

Based on this background, the authors have conducted a pilot study in an attempt to investigate which managerial competencies are currently being possessed by engineers as part of their management work. The target group consisted of graduates of technical higher education which are currently involved in the post-university management programs at the Management Department form "Politehnica” University of Bucharest (U.P.B.). Since many of the master students were employed as engineers with managerial functions within a variety of local organizations, it was felt that these students and their perspectives would provide a suitable sample for a pilot study.

Under these circumstances, the empirical research has addressed the following objectives:

- to investigate to what extent engineers with managerial responsibilities are well trained for certain managerial functions.
- to develop recommendations for enhancing the curricula of the engineering higher education.

![Figure 1. The managerial competence approach](image-url)
4.1. Variables Measurement

The authors have set out two types of variables: nominal and attitudinal. The nominally scaled variables consisted of demographic, situational, and educational information. Addressing the problem of measuring the managerial behaviour for engineers that took on managerial responsibilities involves designing multiple-item scales. As researchers argued, developing a multi-item scale is a complex procedure due to the abstract nature of the characteristic that has to be measured [12]. As a summary, Table 2 shows the structure of relevant variables of the research.

<table>
<thead>
<tr>
<th>Managerial competency</th>
<th>Description</th>
<th>Types of courses offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication competencies</td>
<td>The capacity to understand: - the human behavior - the human resource within the organization system</td>
<td>Psychology &amp; Sociology Communication &amp; Negotiation Public Relations Human Resource Management Business Communication Management Information System</td>
</tr>
<tr>
<td>Leadership competencies</td>
<td>The capacity to influence the human behavior to achieve the organization objectives</td>
<td>Organizational Behavior Leadership</td>
</tr>
</tbody>
</table>

| Table 1. The synopsis of managerial competency ensued by post-university management programs |
|--------------|-----------------|
| Variables Measurement | |
| Research variables | Conceptual description |
| Demographic variables | Gender |
| Time from graduation | Managerial experience |
| Managerial level | |
| Nominally Scaled Variables | |
| Organization type | Organization size |
| Educational variables | Management knowledge |
| Attitude Rating Scaled Variables | Managerial behaviour |
| Attitudes dimension | Skills dimension |

The qualitative questions were measured using a five-point Likert scale, whereby 1 - Strongly Disagree, 2 - Disagree, 3 - Tend to Agree, 4 - Agree, 5 - Strongly Agree. Each respondent was asked about his/her degree of agreement or disagreement concerning the items designed to assess the managerial behaviour.

The process of developing the content of each item concerning the research variables assessment has drawn knowledge from the relevant scientific literature. The specialists argued in their studies that engineers who aspire to become managers have to pay a careful attention to the problem of attitude as a key aspect for developing an effective behaviour [13].

Thus, the attitudes’ dimension was measured by asking respondents to express their general opinion regarding the following items: engineering management, power base, and assertiveness. The items assessed the extent to which engineering managers are willing to apply management functions of planning, organizing, leading, and controlling in their work. Furthermore, the items measured the degree in which engineering managers must nurture the ability build personal power by technical know-how, experience, and networking. Also, the engineering managers should demonstrate the ability to be assertive in exercising judgement and making decisions [14].

Developing the items aiming at assessing the skills dimension has been taken into account important research insights about the fundamental differences between the work done by engineers and that performed by managers [15]. Under these circumstances, the skills level was measured using a hybrid three-point Likert scale, whereby 1 – Unsatisfactory Skills, 2 – Good Skills, 3 – Great Skills. Examples measured the extent to which respondents were able to behave as professionals in the field, such as honesty and individual integrity, the ability to make tough decisions, and the willingness to enhance personal professional competence.

Interpersonal communication and entrepreneurial skills were assessed developing items grounded in the work of the Badawy [16]. Examples included the extent to which engineering managers are flexible in dealing with a diversity of issues and people. Also, the items measured the entrepreneurial spirit of
respondents by evaluating the willingness to take new risky approaches in making managerial decisions.

4.2. Data Collection

The questionnaire had an adequate pattern, starting with questions to evaluate the engineering managers’ management knowledge base and their managerial behaviour, and finishing with questions for respondents’ demographic characteristics. The questionnaire was distributed to 152 postgraduate engineering students who took on managerial responsibilities in their work. Only 80 respondents have filled the questionnaire.

Statistical methods were applied in order to create demographic profiles of the sample, and examine the managerial competencies of the respondents. The central tendency was calculated taking into account the way in which the variables were measured: the modal group for nominal scale and arithmetic mean for interval scale (table 3 and 4).

Overall, the structure of the sample in terms of gender was rather unbalanced (20% women and 80% men). Respondents’ age was mostly of 30-35 years (45%); 30% were up to 40 years; 15% were of 41-45 years, and only 10% were older than 46 years.

From the managerial experience standpoint, 40% of the respondents were less than one year experience as engineering managers, 20% was between 2 to 5 years, 20% were between 6-10 years experience, and other 20% were more than 10 years experience.

Most of the respondents graduated 10 years ago (55%), and only 5% of the sample was mostly less than one year experience as engineer.

The structure of the sample in terms of management levels was as follows: 20% of respondents from strategic level and 80% from operational level.

The respondents came from different organization types such as: 15% form budgetary organization, 55% from private capital, and 30% from public capital organization. From the organization size point of view, 25% of respondents have worked in small enterprises with less than 50 employees; 20% in medium-size enterprises; and 55% have employed in large organizations with more than 250 employees.

As regards the theoretical engineering education, the respondents weighed the following courses’ subjects as the highest level of significance: Interpersonal communication (85%); Management Knowledge (65%); Technology Knowledge (60%); Informatics (55%). Beside these, the medium weighed courses’ subjects were: Economics (75%) and Legislative (65%).

As reflected in their responses, the graduates of the higher engineering education with managerial responsibilities (engineering managers) seem not to be experts in the following management areas: Process Management, Financial Management, Quality Management, Stress Management, Risk Management, and Environmental Management.

It is also interesting to note that respondents seem to possess adequate knowledge in broader management areas, such as: Product Management (55%); Customer Relationship Management (50%); Consumer Behaviour (50%); Business Communication (65%); Motivation & Influence Techniques (60%).

Throughout the engineering education, the respondents were exposed to the major aspects of other management courses, such as: Project Management, Sales Management, Merge & Acquisition, Strategic Management, Marketing, and Leadership. From the theoretical standpoint, the respondents seem to understand well the value of management knowledge, but when it comes to practice there are a lot of difficulties. In other words, a true understanding of management knowledge comes from comprehending how the different management concepts, tools, and techniques interact one each other to determine a cohesive whole.

5. RESEARCH FINDINGS

The results of data analysis point out that respondents place great importance on the managerial knowledge within the theoretical engineering education. Although, most of the respondents graduated 10 years ago (55%), they seem to be aware of the usefulness of management courses within engineering education.

Even though, starting with the academic year 2005-2006, the engineering curricula and syllabi have evolved in accordance with the new requirements, the research results highlight the need for further improvements. From an educational perspective, the knowledge of management is almost as important as technology knowledge. Thus, the actual management education of engineers should be based on topics of top importance such as: Process Management, Financial Management, Quality Management, Stress Management, Risk Management, and Environmental Management.

The assessment of engineering managers’ attitude concerning the key predictors for success in managerial positions yields important clues about the cultural values of our society. The attitude theory suggests that the ultimate behaviour of a person is a function of three attitudinal components: affective component, cognitive component, and behavioural component. It is worth to be noted here that behavioural component refers to how one intends or expects to act toward someone or something [17].

Considering the research results (table 3), Romanian engineering managers ranked on the first place an engineering management mindset (4.5), followed by assertiveness (4.17), and the power base formation (3.71). These results emphasize the lack of power bases approach in the engineering education that include the lack of willingness to take on challenging tasks and the fear to capture the opportunities to exercise power. It becomes important, therefore, that the engineering curricula should cover these aspects of managerial behavior through complementing the technology education.

Obviously, the attitude is an important part of managerial behavior, but the skill – the ability to act effectively – is also important. Therefore, the research has focused on assessing the managerial skills developed by engineering education (table 4). The data analysis reveals a serious lack of managerial skills occurring during the engineering education stage. The main types of managerial skills lacking from the technical education are professional responsibility, interpersonal communication, and entrepreneurship spirit skills.

Based on these, the technical higher education should be more oriented to practical approaches that enable engineering students to practice managerial skills until the preferred behavior becomes a second nature. Indeed, many rules of thumb are derived from experience. A practical oriented educational environment assures students to learn the skills and capabilities to shape their own attitudes, and to acquire the
attributes needed to become good engineering managers. This requirement shows the necessity of changing the methods of teaching and promoting new methods that stimulate creativity and risk taking, professional responsibility, and teamwork. From this standpoint, the engineering education should make the best use of case studies method with examples from Romanian business community, and inter-disciplinary projects that stimulate communication and cooperation skills.

Table 3. The key attitudes for managerial behaviour assessment

<table>
<thead>
<tr>
<th>No.</th>
<th>Predictors for success</th>
<th>Arithmetic mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An engineering management mindset</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>to be capable to think in terms of management functions</td>
<td>4.55</td>
</tr>
<tr>
<td></td>
<td>to be willing to work with people</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>to be a communication facilitator</td>
<td>4.65</td>
</tr>
<tr>
<td>2</td>
<td>A power base formation</td>
<td>3.71</td>
</tr>
<tr>
<td></td>
<td>to be willing to take on challenging tasks</td>
<td>3.75</td>
</tr>
<tr>
<td></td>
<td>to capture the opportunities to exercise power</td>
<td>2.65</td>
</tr>
<tr>
<td></td>
<td>to be ready for promotion to managerial positions</td>
<td>3.75</td>
</tr>
<tr>
<td></td>
<td>to nurture the ability to build personal powers</td>
<td>3.95</td>
</tr>
<tr>
<td></td>
<td>to cultivate a broad business relationships</td>
<td>4.45</td>
</tr>
<tr>
<td>3</td>
<td>Assertiveness</td>
<td>4.17</td>
</tr>
<tr>
<td></td>
<td>to be informed of the best practices in the field</td>
<td>4.45</td>
</tr>
<tr>
<td></td>
<td>to be assertive in exercising judgment and making decisions</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>to be aware of the best success factors and other benchmarks in the field</td>
<td>4.45</td>
</tr>
<tr>
<td></td>
<td>to be proficient in resolving technical conflicts and people problems</td>
<td>3.4</td>
</tr>
</tbody>
</table>

6. CONCLUSIONS

This study provides a starting point for investigating the business and managerial competencies ensued by the technical higher education system. As the engineering education takes into account the analysis of management practices, the research results will play a significant role in improving the curricula of the technical universities. By appropriately redesigning the engineering curricula, the technical universities should seek to enable students to develop those managerial skills required by the business environment.

Considering the research results, there are several conclusions with respect to business and managerial competencies ensued by engineering education:

- There is a gap between the demand and offer with respect to managerial competencies ensued by the engineering higher education
- There is a lack of the systematic research of business environment in order to find out the changing requirements and provide feedback to the higher education environment.

Table 4. The key skills for managerial behaviour assessment

<table>
<thead>
<tr>
<th>No.</th>
<th>The managerial skills developed by the engineering education</th>
<th>Arithmetic mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Professional Responsibility</td>
<td>1.64</td>
</tr>
<tr>
<td></td>
<td>to behave honestly in interpersonal relationships</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>to be guided by a set core of principles</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>to enhance the professional life</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>to be aware of professional responsibilities</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>to be creative in handling problems</td>
<td>1.6</td>
</tr>
<tr>
<td>2</td>
<td>Interpersonal Communication</td>
<td>1.53</td>
</tr>
<tr>
<td></td>
<td>to facilitate the exchange of information</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>to be capable of oral and written communication</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td>to diplomatically deal with people</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>cross-cultural communication capacity</td>
<td>1.25</td>
</tr>
<tr>
<td></td>
<td>teamwork capabilities</td>
<td>1.45</td>
</tr>
<tr>
<td>3</td>
<td>Entrepreneurial Spirit</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>capability to take on initiatives</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>capability to identify and capture new opportunities</td>
<td>1.45</td>
</tr>
</tbody>
</table>

In order to overcome these challenges the authors propose several recommendations based on the research results:

- The management education of engineering students has to complement technology education by adequately consider new courses in management area as Process Management, Financial Management, Quality Management, Stress Management, Risk Management, and Environmental Management. Therefore, it becomes important to offer a large number of management courses to engineering students. Innovative approaches in the field are needed to help engineering students to understand the new concepts and to be aware of the dynamics in the business environment, advancement of technology, and competition in the marketplace.
- The technical universities must incorporate new teaching methods, successfully (e.g. the use of case studies method is an effective means of introducing students to business situational learning; and experiential learning through group projects that encourage students to experiment).
- The technical universities should carefully take into consideration the development of innovative networks between academic environment and business community. These networks provide an excellent context for exchanging ideas and learning by sharing knowledge and experiences. More specifically, developing an interconnected educational environment requires to attract experts from business
community to give academic lecturers. When properly done, both parties – academic and business – learn from each other, and the students have a significantly learning experience.

Based on the research conclusions and recommendations, the authors have placed great emphasis on business cases development that focuses on the challenges of engineers as managers and leaders.

Another authors’ concern is keeping engineering students abreast of the new developments in management fields. Theoretical improvements will be incorporated in the management courses with the aim to properly prepare engineering students to fulfill managerial responsibilities and acquire useful managerial competencies to meet the challenges in the new millennium.

Even thought, this study has several shortcomings such as sample selection, industry, and number of respondents, further research will be performed in order to capitalize on these findings and provide feedback to the technical university decision makers.

7. REFERENCES

ABSTRACT: Pivotal to every political discourse on development, the idea that investments in knowledgeable human resources go hand in hand with economic performance and competitiveness places the education of teachers at the core of any attempt to reform and develop educational systems and explains the emphasis on the importance that a highly trained, theoretically informed and pedagogically agentic teaching working force is invested with. In this paper the focus is on exploring the implications of collaboration as both learning strategy (pedagogical tool) and ethos for teacher education within distinct systems of activity located in two programs of pre-service teacher education aiming at training teachers for science and engineering, both set up as inter-institutional partnerships between university and school but located in different socio-cultural settings: one in Romania the other in England. The paper presents the results of a comparative analysis between the two systems of activity pursued with the analytical tools provided by the cultural historical activity theory (CHAT).

1. INTRODUCTION

In a world of ‘flexible transformation (...) of people, practices, markets and institutions’ [1], curricular offers building on disciplinary expertise, knowledge and culture delivery models of teaching and learning seem to fail in the attempt to insure education’s responsiveness to the expectations and demands of the reality outside the school. Opposite, interdisciplinary visions and approaches to learning along with initiatives aiming at building spaces of practical action where professionals-to-be have the opportunity to develop their ability to align their individual initiatives and resources to those of the other more or less experienced colleagues in the process of engaging with the object of their profession (i.e. the learning and developmental trajectories of the pupils for programs of teacher education[2]) seem to function as the most relevant prerequisites for any educational program aiming at actually fostering learning. That being said, admitting that ‘thinking and reasoning are inherently social (...) also inherently distributed’[1] helps configuring learning as an activity for which participation and collaboration are key principles.

Translating these theoretical coordinates in the practice of pre-service teacher education programs set up as school-university partnerships is far from a simplistic enterprise; searching for and then delivering ready-made recipes for inter-institutional sets of didactic actions, learning contents and pedagogical objectives to be pursued won’t cut it. The landscape of educational actions generated in activity systems set up as inter-institutional partnerships for pre-service teacher education needs deeper understanding and pedagogical initiatives that pay serious attention to every aspect that may function as facilitating or inhibiting element for learning.

2. SETTING UP THE STUDY

2.1. Purpose

By compulsory national curricula, heavily relying on behaviourist approaches to learning, schools are bound to preserve an educational climate where contents delivery and didactics that place the teacher at the centre of any pedagogical action are the common grounds. The goal is to ‘embellish’ pupils with the disciplinary knowledge that make them compatible with an economic system still relying on elitist views on knowledge production [3]. On the other hand, universities are increasingly faster moving away from the privileged status of the sole locus of excellence in knowledge production [4], and aim for approaches to research more and more grounded in an entrepreneurial view, where the status of a partner in the generation of knowledge is vital [5]. This may create an important hiatus in the conceptions about knowledge and expertise production and enactment that both school and university bring to life within the partnership for teacher education. This hiatus may be even more complicated by the difficulties most institutions of education in Europe have in attracting and maintaining highly qualified human resources. In this picture of practical and ideological constraints, political discourses are filled with imperatives to set up collaborations between schools and universities for the highest level of practical and theoretical training of teachers for which a systematic vision of how could the two types of institutions commit to a dialogue on the complementarities of their responsibilities within the educational programs they ought to generate within the partnership is – in most cases – simply missing [5].

The comparative analysis presented in this paper aims at eliciting a deeper understanding of the relationship between the nature of the partnership and the activity of learning within two different pre-service teacher education programs set up as inter-institutional partnerships located in different cultural settings – one in England (the PGCE program), the other in Romania (the DPPD program). In our analysis the notion of collaboration was used with two distinct meanings. The first names a pedagogical strategy (collaborative learning) based on the principles of a greater degree of freedom for agentic input of learners in planning, organizing, implementing and assessing learning roles and responsibilities for themselves and their colleagues in peer learning settings. The other reveals a particular manner of setting up school-university partnerships (collaboratively), to which Engeström [6] attaches three levels of structure and functioning: collaboration as ‘co-ordination, co-operation and communication’. Co-ordination is considered the least demanding form of working together and presumes an agreed script or set of rules of working which co-ordinates the
behaviour of each practitioner. There is no questioning or contributing to the script and there is no attempt to developing new rules as a result of the joint work. The co-operation form implies ‘modes of interaction in which the actors, instead of each focusing on performing their assigned roles, focus on a shared problem, trying to find mutually acceptable ways to conceptualize and solve it. The participants go beyond the confines of the given script, yet do it without explicitly questioning or reconceptualizing the script’ [6]. The third level of collaboration, named communication involves ‘disruption to the rules, division of labour and social practices in an organization and the new forms of collaboration that arise are accompanied by new linguistic and material tools to allow the new work to be done’ [idem].

Furthermore, to the semantic takes on the concept proposed by Engeström [6]. Furlong et al. [5] adds on by studying forms of school – university partnerships and observing that different degrees of responsibility and structure may take the partnership from stages of acting in completely separate components of the same program located in distinct institutional spaces (university vs. schools) where interactions are formal and sporadic, to stages of authentic collaboration – relying on negotiation and accountability of responsibilities and roles, where both partners are present in all stages of planning, implementing and assessing the educational program. With Furlong’s [5] analysis the concept of collaboration enlarges and allows subtle widening in the semantic sphere of another concept – that of learning – which shifts from the perspective of activity located at inter-individual level to the more encompassing one of institutions participating and learning. Institutions, partnerships and people are systems bound to transform within the collaborative setting. When the transformation opens ‘radically wider horizon of possibilities than in the previous mode of the activity’ [7] then learning takes the shape of systemic expansion [idem].

2.2. Methods

The proposed comparative analysis employs understanding of learning drawing on second generation CHAT ideas: learning is no longer an activity located at the level of the private individual human mind (as it was the case in the activity theory developed by Vygotsky in 1920’s). The unit of analysis is thus considered a system within which one ore more subjects (participants in the activity system) act upon an object of activity which helps differentiating between human activities and gives them direction [8]) - i.e. the development of professional identities in pre-service teacher education students – with the purpose of generating certain results (i.e. debutant teachers capable of competent pedagogical action). The subjects’ actions upon the object of activity are mediated by cultural tools (artefacts objectified in material – i.e. syllabuses, textbooks, portfolios, etc – or mental shape – i.e. jargon, methods, learning theories, etc). These actions are highly contextualized, a feature that implies the existence of a community who’s presence within the action is mediated through a set of rules and through pre-existent ways of dividing labour.

Despite both educational programs being organized as school-university partnerships employing more than one institutional system present in the activity of learning – which would suggest that a third generation CHAT approach would be more relevant - I propose locating the analysis at the level of second generation CHAT, a conceptual framework that makes the two programs comparable and creates an opportunity to study the partnerships as systems of activity arising in particular cultural contexts and baring distinct histories. Third generation of CHAT [7] - a theoretical framework building on Vygotsky’s ideas of cultural mediation of actions - informs our analysis in that attention will be paid to exploring the extent to which the partnerships allow learning that arises within the ‘changing mosaic of interconnected systems’ [7] of object-oriented, collective, culturally mediated activity, function as loci for pluri-discursivity (of traditions, stances, interests, knowledge – all incorporated in the available artefacts, etc) and are bound to transformation and expansion for which the contradictions are the main source of change.

The analytical and interpretative discourse will thus employ the CHAT language and pursue a course of dynamic consideration of all systemic components engaged in the activity systems of the pre-service teacher education programs studied.

The data generation process was carried out during the university year 2007/2008. For each of the two pre-service teacher education program that make the object of comparison in the analysis presented in this study a separate approach to data generation was pursued. The two programs were considered for comparison on the grounds of their major similarities: they’re both pre-service educational programs, organized as school-university partnerships aiming at preparing student-teachers willing to work as teachers of Science and Technology.

Historically the first context for exploration, the DPPD case (located in Romania) started off as an attempt to understand the relationship between the collaborative learning strategies (used as teaching tools employed in seminar activities within the university-based component of the program) and the development of student-teachers’ conceptions of teaching and learning. A quasi-experimental research design helped diagnosing the apparent lack of correlations between the two variables (teaching tools and learning results) on a short-time period of observation (14 weeks – the duration of a university semester and conventional length of one compulsory subject within the national curriculum for pre-service teacher education). Quasi-experimental results lead to two new levels of exploration: that of the educational policies enacted at institutional level (within the space of the particular teacher education program) and further – at the one of the national system of teacher education.

The second context for exploration, the PGCE case (located in England) was pursued in an opposite, top-down approach: from studying the historicity of policies concerning teacher education in England, an institutional case of a collaborative partnership was later identified with the help of recent English teacher education literature [10,11] where the relationship between collaboration and learning was explored at the level of institutional ethos, and further at the level of actual pedagogical praxis employing teachers and students in action. The methodological repertoire for data generation consisted of analysis of documents, systematic observations, interviews and analysis of conversations between participants to weekly formative assessment sessions between teacher-mentors and interns (institutional lingo for student-teachers) recorded on voice-recording devices – all spread throughout the length of one academic year (2007/2008).

In this comparative analysis, data and results generated in the studies conducted within the two programs for teacher education are used selectively based on their relevance for exploring broader understandings of the relationship between collaboration as both institutional ethos and teaching tool employed in pre-service teacher education.
3. FINDINGS

The comparative analysis of educational policies mirrored by legislation and institutional documents are indicative of distinct epistemological and political orientations for each of the two Science and Engineering pre-service teacher education programs studied here. Although both are inserted to the common European space for political and socio-economical development, and are part of national systems of education that signed the Bologna Declaration, the manner in which the institutions employ their pedagogical traditions in the process of teacher education is significantly different from one cultural space to another. Using the second generation CHAT conceptual framework, these differences can be pointed out as outlined below:

The differences are important when considering who the subjects are in the two activity systems. For the Romanian program, DPPD has more of an delivery role in relation to the national policies for pre-service teacher education, by holding the responsibility of managing available resources in order to implement the national curriculum for initial teacher education [12]. Hence, the one responsible for the curricular decision, and therefore the actual subject in the activity system, is not the DPPD (with all university and school – based teaching staff and students engaged in teaching and learning) as it is the Ministry of Education, Research and Youth (MECT). As part of the larger reform process taking place in the national system of education, the activity of DPPD becomes the object of regulation and strict orientation by normative means (governmental bills, ministry orders and laws) under the jurisdiction of MECT who is directly responsible for establishing the contents, structure and delivery mode of the national curriculum for teacher education. Structured as such, the activity of DPPD becomes to a certain extent representative for every program of pre-service teacher education delivered through homologue state universities departments in the country.

In the school-university partnership MECT [12] placed the coordinating role on the part of the university and attributed a similar function to the School Inspectorates in the Counties in relation to the participation and roles of the schools in the partnerships concerning delivery of the national curriculum for pre-service teacher education. The Inspectorates are hence the institutions responsible for selecting ‘model’ schools – able to host learning experiences that would facilitate student-teachers exposure to all the ‘representative teaching and educative activities that fall under the teacher’s responsibilities” [13]. The school-university partnership is thus configured as a system where the activity is structured in two temporally distinct sequences of action, located in different institutional settings: first within the university, then within the school. Direct inter-institutional dialogue is lacking, as the intermediary in selecting ‘model’ schools is the Inspectorate.

Things are very different in the PGCE case. Here working on the object of activity within the program of teacher education is an enterprise that engages in partnerships members of the university staff, teachers in partner-schools and even student-teachers who are progressively capacitated to identify and make use of all available opportunities to enhance their pedagogical agency. The tendency to centralization of national teacher education policies is visible here too, but to a different extent than in the Romanian case. Inserted in a legislative context that passed during the past 50 years through stages of investing universities (as main spaces for scientific and theoretically grounded initial teacher education) and then schools (expected to transfer to the debutant teacher the much needed practical knowledge and skills the university alone failed to) with the responsibility of running the pre-service teacher education programs, the PGCE is presently set up as a school-university partnership where collaboration is a prerequisite for each planning, implementing or assessing action within the program. The school-university partnership is the institutional formula for which the English legislation expresses preference too and stipulates expectations concerning partners co-sharing the responsibility for planning and managing the curriculum and for selecting, teaching and assessing student-teachers [14].

In the Romanian case, the law prescribes to universities the role and coordinating responsibilities concerning initial teacher education taking place within the university component of the program, then within the one located in school, where students are expected to pursue practical sessions within the context and curricular prescriptions of the corresponding discipline in the national curriculum. The nature of school-university collaboration remains inexplicit within the legislative text leaving room for the university (in its coordinating capacity) to come up with institutional policies and strategies for collaboration. For DPPD this translates in configuring parameters (i.e. role dimensions, mediating instruments for assessment) for university tutors - school mentors collaboration within the practical sequence of the curriculum. The university however, remains the sole responsible institution for the admission (entry) and graduation (exit) components of the teacher education program. School are thus reduced to a more ‘guest appearance’ type of contribution to the educational program.

Admission in the PGCE program is an action mediated by a national institution – the Teacher Training Agency (TTA) – that candidates send applications to, stating three preferred programs where they would like their pre-service teacher education to take place. Admission is interview based, where university tutors and mentor-teachers from partner schools form panels to meet and select candidates for the program. Collaboration is thus an ingredient of the partnership from the early stages of student-teachers admission (entry) component of the program. Also a difference in structuring collaborative input of partners (subjects) in the activity of the two programs of pre-service teacher education is the presence – only in the PGCE case – of a set of Standards for pre-service teacher education (those of TTA). This is the level at which the national authority restricts it’s centralizing input; the road to reaching the standards with all the who, when, where and how aspects of the decision making processes remain in the sole responsibility of the partners, making the university, the school and progressively more agentic the student teachers to be the actual subjects in the PGCE activity system for pre-service teacher education.

A number of differences can be outlined in the manner in which programs conceptualize their objects of activity. For the DPPD case, the object worked upon in the system of activity is a national curriculum for pre-service teacher education for which MECT holds full decision-making responsibility in curricular aspects (selecting and organizing disciplinary learning contents, time-framing the teaching, learning and assessing processes and establishing summative assessment procedures) leaving universities and schools a mere delivery role of a pedagogical fix [15] heavily building on a behaviouristic epistemology of teaching and learning. The generative and transformative resources entailed in the encounter of distinct systems of activity that school and universities as institutions entail, are reduced to a minimum.
The potential for innovating the program by proposing pedagogical innovations grounded in the most recent research findings is reduced insular actions within the space of the university-based component of the program and the formative effects of isolated attempts to innovative pedagogy are restricted to the limits of the formal curricular parameters of the law-bounded national program for teacher education. The experience of a quasi-experimental attempt to validate collaborative learning strategies (being used in the space of the seminar sessions in the Pedagogy I section of the pre-service teacher education national curriculum) as an efficient teaching tool for pre-service teacher education was indicative for the difficulties in setting up successful learning experiences that lead to durable developments in students’ conceptions of learning and teaching.

Opposite to the Romanian case, the PGCE program configures it object of activity - the pre-service teacher education curriculum – as an agora where partners are continuously engaged in questioning and exploring new generative resources for the improvement of current ways of reaching the TTA standards. Structured as such, the actions of the institutional partners in this program borrows something from the activity of research-development laboratories described by Engeström [7]: the unit of analysis is no longer located in one or each of the two institutional spaces forming separate systems of activity, but in the creative space between the two working on an object (problem space) in continuous transformation. The pre-service teacher education program generated in the negotiations and elaborations arising in a school-university partnership built on an epistemology of collaboration is a space for explorations opened to innovations and developments for which all partners are responsible. Collaboration itself becomes a part of the object upon which subjects in the activity system constantly work – a dimension of the PGCE program visible in both institutional [16] and national [14] policies for teacher education. On a detailed, comparative perspective on different structural aspects of the objects of activity generated in the two programs for pre-service teacher education:

**Aims: (DPPD)** - a national agreement on a set of professional standards for teachers of Science and Technology working in lower and upper secondary education is lacking. The aims of the program are fragmented in behaviourist educational objectives attached to the learning contents of six compulsory disciplines. (PGCE) - aims are outlined through the guiding set of standards for qualifying as a teacher (TTA’s).

**Learning contents: (DPPD)** - The national curriculum for pre-service teacher education is organized in six disciplines to be studied in the order of : Psychology of Education, Pedagogy I (Introduction to Pedagogy. Theory and methodology of Curriculum), Pedagogy II (Theory and methodology of instructing and assessing), Didactics of the Discipline, Practical sessions, Optional course (to be selected by the university from a recommended list approved by MECT). (PGCE) - Selecting and organizing the learning contents fall in the responsibility of the university -tutors and school mentor – teachers. Learning contents are integrated by a practical problem-solving principle (around major problems identifiable in the classroom practice and specific to the current reform directions in secondary education) and interdisciplinary (within the curricular area of Science)

**Structuring learning actions: (DPPD)** - The six disciplinary learning contents of the national curriculum are organized as 2h/week lectures and seminars within the university based component (four semesters) of the program and in 4h/week observatory and skill and drill sessions within the school (one semester). Selection of the teaching methods within this framework of activities is the responsibility of the university staff and of the mentors. (PGCE) - Leaning activities are organized to progressively empower student-teachers to take charge of their learning through all the contexts (university or school based) they are actors in. For most part of the program (24 out of the 36 weeks of the one year program) students are present in the school context, where they are expected to take increasingly expanding responsibilities specific to the teaching role (within classroom, department, school and community). University based learning units spread throughout the hole year and are intertwined with school -based learning units. Collaborative teaching is often used in both the university and the school based components of the program.

**Assessment: (DPPD)** - Forms of assessment throughout the program (at the end of each disciplinary learning unit), distribution in time, duration and structure of activities (leading to obtaining the Study Certificate for initial teacher education – Level I) are set up through the national curriculum for pre-service teacher education. (PGCE) - Assessment is considered a continuous process, guiding learners’ and teachers’ actions towards the intended pedagogical results. Students are participants in the assessment processes. In the professional – development dimension of the program, assessment is a process involving through written protocols and viva sessions all teachers (from university and from the school) the student-teacher worked with. Self-assessment is encouraged as well. In the curriculum-development dimension of the program, assessment is structured in three important moments throughout the year, when students are expected write essays on pedagogical issues relevant for their capacity to question and for their critical thinking and creative teaching abilities. TTA is responsible for the only pencil and paper type of assessment testing students’ level of pedagogical knowledge. The test is individual, compulsory and can be taken online as well. The results condition student-teachers’ employment on vacant teaching positions.

**Ties with the community of practice: (DPPD)** - Through its structure the program aims at developing student-teachers’ cognitive abilities and teaching skills in a delivery & role play type of approach to learning. The role play is for the most part of the program located in a context outside the classroom practice. The classroom based learning experience takes the shape of an insular attempt to provide student-teachers with a fragment of ‘model’ teaching. The whole program takes the shape of an apprenticeship experience where the students are introduced to a minimum of the current systemic practices. Ties with the community of practice are thus, reduces to a minimum. (PGCE) - Students’ progressive responsibility taking and professional role covering within the space of the schools where they act as interns for 2/3 of the program are guarantees for tying the learning experience within the program to the community of practice students are becoming members of. The program is, however, preventive of locking up the formative process within the space of an insular ethos: instead of being interns in just one school, student-teachers have to spend the later part of the program (last 6 weeks) within a second school where they are asked to perform increasingly complex educative roles and to reflect and compare activities in the two schools they’ve been interns throughout the program.

In a configuration of the activity system that allows locating the responsibility for conceiving, innovating and reforming the pre-service teacher education program in the encounter between institutional partners, not only the object of that
activity is bound to transformations but the very tools (cultural artifacts) available in the space of the partnership (for which collaboration at all levels of action becomes mandatory). This is the case of the PGCE program where studying how collaboration is structured at the levels of a) the inter-institutional partnership and b) the inter-individual learning encounters taking place in this particular type of partnership revealed that in certain types of collaborations (those structured as opened opportunities for exploration and collegial engagement with the problem spaces arising in the context of the teaching activities) the set of tools that mediate the subjects’ actions with the object of activity are themselves susceptible of questioning and innovation. Given the structural connections between the instrumental –actional – normative levels of the activity system, the system as a whole becomes susceptible of transformation and expansion at the pace of artifacts being worked upon through exploration and questioning in the hands of the participants to the activity. In the process of validating available teaching tools they come across within the system of activity, novice student-teachers question current usances and didactic implications that pedagogic artifacts (curricular documents, teaching methods, technologies, etc) elicit and by that, the current rules and divisions of labour in the system of activity. As a consequence, the novices’ explorations of available tools could be seen as a legitimate opportunity for systemic expansion – by either (re)confirmation of the structural and functional pedagogic status quo by means of new proofs of its efficiency, or by alterations of the systemic tools and rules and by creating new ways of structuring actions within the system of activity.

By excluding in the presumption of a pedagogical fix the object of activity – the curriculum for teacher education – MECT deprives the institutions working as deliverers of the national program of all the opportunities for systemic expansion that collaboration and shared responsibility entail. The manner of structuring the object in this particular activity system reveals a vision of learning for which students a mere receptors of pre-established sets of learning contents, who enter the program as tabula rasa and are simply uncapable of using the available pedagogic tools in any other way than those prescribed by the national curriculum. Tools are thus never to be questioned, explored, validated or innovated outside current prescriptions of usage. Learning is conceived as though it is possible as mere internalization[18] of an unchallengible didactic de facto.

Actions in the activity systems take place within the space of a relevant community of reference. The community areas to which the system of activity directly refers to when structuring its actions and functions can be to a certain extent considered correlative to the quality policies within the system. In the case of DPPD, the comunity is more restricted to the normative space between hierarchically structured state institutions: level 1 of authority: MECT – level 2: universities and County School Inspectories – level 3: schools. Indirectly and with no direct possibilities to interfere with the actions within the activity system – the society at large could be considered a relevant community, by sharing the sistemis interes in the object and results aimed for.

The PGCE program offers diverse possibilities for the system of activity to interact with various areas of societal activity. The parents community in the schools where interns work with pupils, public and private institutions (such as Museums) may just as well transform into spaces for formative action where student-teachers develop as educators. Direct insertions in and from the community at large make the system of activity visible and accountable for its actions and responses to the quality requirements, the needs and interests stated in the community in reference to the results generated in the system of activity.

When looking at the divisions of labour in the two programs, differences are once again relevant. The inter-institutional partnership set up in the PGCE program is accompanied by efforts to outline roles and responsibilities clearly for each party and every aspect and sequence of the program. Constantly reflecting on the partnership and collaboration themselves is one responsibility shared by both partners. Roles are transformable on the grounds of improving their responsiveness to and covering of all responsibilities within the teacher education program and within the collaborative partnership. Opposite to the openness and flexibility of roles and division of labour strategies in the PGCE program, the DPPD activity system remains locked in the formalism of setting up didactic loads (in all its aspects: number of teaching hours per week/ university teacher or school teacher, number of students/ class) an aspect which contributes considerably to the fragmentation of the learning process. Learning is imagined as a succession of dispersed actions and with no direct connection to one another that could be efficiently outlined, verified and strengthened between the university (theoretical) and school-based (practical) sections of the program.

The disjunction in the structuring of formative actions between the university and school is also maintained in the DPPD activity system at the level of systemic rules. The documents analysis focused on educational policies at national and institutional level indicates normative sets that celebrate the subordination of the university and schools to MECT, but as separate institutional instances for pre-service teacher education. For the university rules concern insuring the quality of the learning taking place within the space of this institution, by following the national curriculum parameters of structure and content of learning. The quality of learning within the space of the school is aimed for through the selection (by the Inspectorate) of ‘model’ schools where student-teachers can observe and acquire models of teaching. The PGCE program leaves the rules of the activity system open for transformation up to the level of professional standards – a level prescribed through TTA recommendations. In the open normative space all participants in the activity system of the PGCE program become responsible for preserving the ‘respect’ for the collaborative nature of the partnership – a desiderate that the program states within it very mission[16].

4. DISCUSSIONS AND CONCLUSION

Although very generative when looking at inter-institutional partnerships where learning is the activity in which expansion and transformation of the object being worked on unravels generative resources for the subjects identities (individual or collective-institutional ones) and for the partnership structure itself, the analytic compass of third generation CHAT says too little about the structure, actions and functions of the complementary [5] school-university partnership – where partners’ roles are conceived as separate from but complementary to one another. In the comparative analysis presented in this study such a difference in conceptions of learning observed in the institutional cases of two school-university partnerships for pre-service teacher education located in different cultural spaces lead to opting for the second generation CHAT as the analytical framework making possible a comparative view of the two; This lead to observing that within the space of pre-service teacher education school-university partnerships the notion of ‘expansive learning’ [7] loses something from the original significance. The objectivist
historically familiar with tendencies to ultra-centralization of educational policies and programs. Romania aims - somewhat confused when it comes to the professional standards aimed for – at full European integration whilst maintaining under strict ministerial control the actions of all educational agents and actors – within the spaces of the universities or the schools. Pedagogical innovations and questioning are, within this context, insular attempts with little or no effects outside the space of the disciplinary syllabuses and time-units. Rhetorical question marks and passivism (integrated to learning by memorizing, observing and imitating the given) remain the key dimensions of pre-service teacher education initiatives, whether they are located within the space of the university or that of the schools.

The intentions of a comparative analysis that makes opposable two educational systems developed in such different cultural and historical contexts - as this one focusing on the Romanian and the English programs for pre-service teacher education - are far from measuring and putting together hierarchies on the value-laden axis of good and bad. Exposing by comparative analysis diverse ideologies and practices arising in different activity systems and analyzing their effects appears to be a relevant enterprise along the lines of political desiderates like full participation to European reforms and development processes engaging all EU members. Collaborative work becomes essential for the fulfilment of such desiderates and, in the hope of it, outlined differences bring to light boundaries and therefore make identities visible; their honest recognition and valorisation could then entail important generative resources for identity and systemic expansion at any level.

5. REFERENCES

12. Ordinul Ministerului Educației și Cercetării Nr. 4343/17.06.2005 privind aprobarea programului de studii în vederea obținerii certificatului de absolvire a Departamentului pentru Pregătirea Personalului Didactic;
16. PGCE Course Handbook, University of ENGL (UK), Department of Educational Studies, (2007).
17. Ordinul Ministerului Educației Naționale 3312/1998 privind înființare a Departamentelor pentru Pregătirea Personalului Didactic;
**FACTORS FORMING COLLABORATION WITHIN THE KNOWLEDGE TRIANGLE OF EDUCATION, RESEARCH AND INNOVATION**

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ABSTRACT: A proper combination of education, research and innovation is provided by varied cooperative networks. However, the success of collaboration within a multicultural environment requires that the key factors enabling synergy between education, research and innovation have to be considered. Aim of the following paper is to identify and to analyze these key factors within the knowledge triangle of education, research and innovation. The meaning of the key concepts of education, research and innovation is studied within the search for factors forming collaboration. The results of the paper reveal the factors forming successful collaboration to become more mobile, to learn from the experiences of others and to work in a qualitative way.

1. INTRODUCTION

The knowledge triangle of education, research and innovation contributes new and better jobs in new industries and offers potential solutions for the quality, maintenance and sustainable development of public services, social-security and health-care systems, and as a basis for prosperity and economic development in the European Union. Synergies between education, research and innovation are created through active collaboration [1, p. 4]. Aim of the paper is to identify and to analyze factors forming collaboration within the knowledge triangle on the pedagogical discourse. The search for factors forming collaboration within the knowledge triangle involves a process of analyzing the meaning of key concepts, namely, knowledge triangle, collaboration and factors forming collaboration. The study would show a potential model for development indicating how the steps of the process are related following a logical chain: defining knowledge triangle → factor definition → factors forming collaboration.

The remaining part of this paper is organized as follows: Section 2 introduces the components of the knowledge triangle. Collaboration within the knowledge triangle is studied in section 3. Factors forming collaboration will be analysed in section 4 and 5. The associated results are presented and interpreted in section 6. Section 7 provides some concluding remarks. Finally, a short outlook on interesting topics for further work is given in section 8.

2. DEFINING COMPONENTS OF THE KNOWLEDGE TRIANGLE

The components of the knowledge triangle are determined as education, research and innovation [1, p. 2].

Education provides the appropriate skills and competences for innovation and creates new knowledge within the knowledge triangle of education, research and innovation. Research supported by data sharing is to identify, to define, to measure and record learning outcomes [1, p. 3].

Innovation is defined as the process and the outcomes of this process through which new ideas respond to societal or economic demand and generate new products, services, or business models that are successfully introduced in an existing market or that are able to create new markets [1, p. 14].

Thus, the relations and synergies between education, research and innovation are the main drivers of the global knowledge economy [1, p. 2].

3. DEFINING COLLABORATION WITHIN THE KNOWLEDGE TRIANGLE

Collaboration is seen as a strategy to put the components of the knowledge triangle, namely, education, research and innovation, into mutual interaction contributing to societal well-being through increasing understanding and promoting economic growth as well as improving societal cohesion. However, collaboration is formed by factors.

4. DEFINING FACTORS

Factor is defined as a reason of the research subject change [2, p. 7]. They are considered to be as external and internal [3, p. 36, 40].

External factors in pedagogy are determined as surroundings and resources. Internal factors in pedagogy are seen as the aims of the student’s activity, motivation, interest and skills, experience. Thus, factors form collaboration to enable synergy between education, research and innovation.

5. FACTORS FORMING COLLABORATION

The analysis of external and internal factors in pedagogy as well as the definition of collaboration within the knowledge triangle allows considering the following factors on the pedagogical discourse:

- factors forming communication,
- teacher’s purposeful activity as an external factor [4, p. 31] and
- learning factors.
5.1. Factors Forming Communication

Factors forming communication are determined by K. Shumin as follows [5, p. 8]:

- aural medium,
- socio-cultural factors and
- non-verbal communication system.

5.1.1. Aural Medium

During interaction, every speaker plays a double role – both as a listener and a speaker. Speaking feeds on listening which precedes it [5, p. 9]: one person speaks, and the other responds through attending by means of the listening process. The main potential problems of listening comprehension are determined as follows [6, p. 11-21]:

- hearing the sounds,
- understanding intonation and stress,
- coping with redundancy and "noise",
- predicting,
- fatigue,
- understanding different accents and
- using visual and aural environmental clues.

5.1.2. Socio-cultural Factors

Socio-cultural characteristics, namely, social-economical status, religion, language, address (urban, country, more or less prestigious area), interests, abilities and talents, also form communication where the shift has changed from focusing on macro-cultures to micro-cultures (family culture, school culture, class culture, professional culture, gender culture, culture of interest groups, political groups/parties, generation) [7, p. 102-103]. Also, each language has its own rules of usage as to when, how, and to what degree a communicator may impose a given verbal behaviour on his/her conversational partner where due to influence or interference of their own cultural norms, it is hard for non-native speakers to choose the forms appropriate to certain situations [5, p. 9]. Thus, all groups/classes are understood to be multicultural. It has led to a new perspective: people behave being influenced by identification with different groups, not only one group [7, p. 102-103].

5.1.3. Non-verbal Communication System

Moreover, communication involves a very powerful non-verbal communication system (gestures such as the language of gazes, the language of poses and bodily movements; interaction through the use of their bodies, faces, hands, legs, eyes, mimicry, intonation, space management, dress code, gift giving) adding meaning to verbal judgments, which sometimes contradicts the messages provided through the verbal listening channel. A lack of familiarity with the non-verbal communication system of the target language often leads to misunderstanding [5, p. 9].

Out of all types of non-verbal components of communication it is significant to concentrate on the description of several aspects of mimics and gazes that constitutes a separate language, the so called “kinesic gaze”.

Mimicry is often considered to be the most universal way of communication. The representatives of different cultures express six main human feelings – fear, disgust, fury, astonishment and happiness – in a similar way. Facial expression is a “mask”, a mask that at the same time reflects the emotional state and certain cultural predispositions or customs of an individual. It is common knowledge that in order to function in society successfully one has “to put up a proper face” to show proper attitude towards particular situations, to observe etiquette.

Another important element in the process of non-verbal communication is the glance. The importance of eye contact in the process of communication differs so greatly from culture to culture, that it is customary to distinguish between contact and non-contact cultures. Contact cultures, namely, Spanish, Italian, Arabic, Latin American and some others, expect participants of non-verbal communication to follow the expression of the eye contact and the face of another person in order to receive additional information. A person with an open face and a straightforward look is considered to be frank, honest and dependable. On the contrary, someone who tries to avoid eye contact or make the observation of his face difficult is often defined in negative tones. For non-contact cultures (the Scandinavian countries, India, Pakistan, Japan, etc) it is more natural to avoid eye contact with another person.

Cultural and regional differences often influence non-verbal aspects of human communication and therefore they should constitute part of its analysis: Latvia is a “middle contact” type of culture. Latvians would make eye contact with the person they interact with, but this look would not be long or expressive. Latvians employ the smile to express feelings of pleasure or approval. They do not view it as part of formal etiquette or a tool for hiding reality. However, since the history of their country seldom left them pleased or satisfied, they do not smile often. For a Latvian it is difficult to understand American “smile” way of life as it is for Americans to see the importance of seriousness of Latvian national character. One has to conclude that Latvians smile, glance and gesticulate in their own distinct way. This way is not better or worse than that used by the other cultures, it is just different, and should be accepted as such. However, those specific kinesic features can and very often do create difficulties in the process of communication between Latvians and representatives of different cultures who are typically unaware of those features and their true meaning. At the same time, non-verbal communication skills exhibited by the young generation of Latvians are virtually free from the clichés. They easily adopt west European standard of communication.

5.2. Teacher Activity

In order to organise teaching activity, teacher needs to take into consideration several areas [8, p. 75]:

- careful preparation of material including specifically chosen lexical areas and seeking repetition of information,
- careful clarification of the task before undertaking it,
- planning whether the activity should fit into the general progression of the syllabus or whether it should be an independent activity aimed at satisfying the study purpose of certain individual learners,
- finding out whether it fits in with other and parallel teaching situations,
- negotiating a balance between task needs and individual or group needs,
- planning how varied the types of activities should be,
- competition as a stimulus and not as a hostile activity,
- scoring the activity results to help the learners to be aware of their progress and
- ensuring sensitivity to any emotional or cultural blockages which might interfere with the learners’
Thus, the teacher is identified in a number of roles that relate to the process of organizing teaching activity [9, p. 26]:

- assessor,
- corrector,
- organizer in giving instructions for the pair work, initiating it, monitoring it, and organizing feedback,
- prompter while students are working together and
- resource if students need help.

Correction is made up of two distinct stages [10, p. 106]:

- teachers show students that a mistake has been made and
- teachers help the students to do something about it.

There are a number of different ways how to show incorrectness [10, p. 106-107].

Repeating: here we can ask the students to repeat what they have said.

Echoing: we repeat what the student has said emphasising the part of the utterance that was wrong.

Statement and question: we indicate that something has not quite worked saying That is not quite right, or Do people think that is correct?

Expression: when we know our classes well, a simple facial expression or a gesture (for example, a wobbling hand), may be enough to indicate that something does not quite work. This needs to be done with care as the wrong expression or gesture can, in some circumstances, appear to be mocking or cruel.

Hinting: a quick way of helping students to activate rules they already know (but which are temporarily “disobeyed”) is to give a quiet hint: for example, we might just say the word “tense” to make them think that perhaps they should have used the past simple rather than the present perfect or “countable to” to make them think about a concord mistake they have made. This kind of hinting depends upon the students and the teacher sharing metalanguage (linguistic terms) which, when whispered to students, will help them correct themselves.

Reformulation: an underrated correction technique is for the teacher to repeat what the student has said correctly, reformulating the sentence, but without making a big issue of it.

Recording mistakes: most teachers write down points they want to refer to later; teachers can also record students’ performance on audio or videotape. Another alternative is to divide students into groups and have each group watch for something different – for example, one group focuses on pronunciation, one group listens for the use of appropriate or inappropriate phrases, etc. Another possibility is for the teacher to transcribe parts of the recording for future study.

After the event: teachers might want to give an assessment of an activity, saying how well the teacher thought the students did in it, getting the students to tell us what they found easiest or most difficult. Teachers can put some of the mistakes they have recorded on the board and ask students firstly if they can recognise the problem, and then whether they can put it right. Another possibility is for teachers to write individual notes to students, recording mistakes they heard from those particular students with suggestions about where they might look for information about the language – in dictionaries, grammar books, or on the Internet.

In case students do not know or understand what the problem is because it is dealt with an error or an attempt that is beyond the students’ knowledge or capability the teacher will want to help the students get it right [10, p. 106-107].

If the student is not able to correct him/herself, or respond to reformulation, we need to focus on the correct version in more detail. The correct version emphasizes the part where the problem is (e.g. Flight 309 GOES to Paris) before saying the sentence normally (e.g. Flight 309 goes to Paris), or we can say the incorrect part correctly (e.g. Not “go”. Listen, “goes”). If necessary we can explain the grammar or a lexical issue. We will then ask the student to repeat the utterance correctly.

We sometimes ask students to correct each other. We might hope that other students know the correct version of the utterance – after which the student who made the mistake should be able to say the sentence, question, or phrase accurately.

Student-to-student correction works well in classes where there is a genuinely cooperative atmosphere; the idea of the group helping all of its members is a powerful concept [10, p. 107]. Nevertheless it can go wrong where the error-making individual feels belittled by the process, thinking that she/he is the only one who does not know grammar or vocabulary: there is a need to be exceptionally sensitive here, only encouraging the technique where it does not undermine such students.

S. Thornbory concludes that a practice activity which is good for knowledge improving will have these characteristics [11, p. 92]:

Attention to form: the practice activity should motivate learners to want to be accurate, and they should not be so confused on what they are saying that they have no left-over attention to allocate to how they are saying it.

Familiarity: learners need to be familiar with the subject that they are trying to get right.

Thinking time: monitoring for accuracy is easier and therefore more successful if there is sufficient time available to think and reflect.

Feedback: learners need unambiguous messages as to how accurate they are – this traditionally takes the form of correction.

Teachers need to respond to the content not just the language form; teachers need to be able to untangle problems which students have encountered or are encountering [10, p. 107].

Discussing the role of teacher as resource it is important to remember that students are also resources [12, p. 5]. In order to have sufficient subject-specific knowledge, Popova [13, p. 14-15] suggests to keep in touch with other students’ subject teachers. She claims that it is a time-consuming task but it pays. It gives you information about:

- what they have already studied,
- what they are studying now,
- what sources they need to consult for subject-specific information and
- what the subject teacher can help you with in terms of diagram reading, equivalents of terms, specific skills that students need to develop in relation to their job prospects.

If the teacher has all this information, s/he can [13, p. 14-15]

- draw on students’ former knowledge and experience,
- teach those aspects that will help them acquire subject-specific information,
- make use of what each student is good at for classroom activities and tasks and

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boost his/her self-confidence by relying on expert information and consultancy.

Another way that can be suggested is to contact other teachers doing the same work. That reveals the necessity to emphasize on more general social and political theories such as democracy, social justice, equality and legitimacy in order to be able to [14, p. 4-5]

work with information, technology and knowledge,
work with their fellow human beings – pupils, students, trainees, adult learners, colleagues, and other partners in education and
work with and in society – at local, regional, national, European and broader global levels.

There is also a discussion on the issue of a European Teacher [15, p. 10] where common European teacher’s principles are as follows [14, p. 5]:

- a graduate profession with three cycles,
- a profession placed within the context of lifelong learning,
- a mobile profession and
- a profession based on partnerships.

5.3. Learning Factors
There is a range of learning factors learning achievements depend on [5, p. 8], [16, p. 42]

- age of students,
- affective factors,
- motivation and
- learning experience.

5.3.1. Age
Age is considered as one of the most commonly cited determinant factors of success or failure in learning [5, p. 8]. For example, beginning to learn a foreign language in early childhood through natural exposure gives higher proficiency than those beginning as adults.

5.3.2. Affective Factors
The affective factors related to learning are emotions, self-esteem, empathy, anxiety, attitude and motivation [5, p. 9]. Also, the tendency to be sensitive to perceived views of themselves by others is a worry about personal images of great personal importance for everyone thereby developing extreme anxiety as a variable of emotional responses where seven categories of anxiety are emphasized [1, p. 20-21]:

1. comparison of myself with other students,
2. emotive responses to the comparisons described above,
3. the desire to outdo the other students,
4. emphasis on tests and grades,
5. the desire to gain the teacher’s approval,
6. anxiety experiences during the class and
7. withdrawal from the learning experience when the competition was overpowering.

In order to overcome ethnocentricity as an attitudinal variable there is a need to build positive attitudes to the subject study through motivating content and tasks [9, p. 20].

5.3.3. Motivation
Then, a significant aspect in the learning/teaching process is seen as motivation defined as that we have to want to do something to succeed at it [10, p. 51].

Motivation can be

- extrinsic that is caused by a number of outside factors and
- intrinsic motivation that comes from within the individual and is especially important for encouraging [10, p. 52].

Intrinsic motivation consists of six components [17, p. 50]:

- enthusiasm,
- feeling when you can control situation yourself,
- rejoice when you have some achievements,
- own experience in interesting learning process,
- an ability to estimate your achievements and
- any support from environment.

Motivation is ensured by

- earning a living,
- intellectual stimulation,
- a feeling of satisfaction and fulfilment and
- receiving recognition.

There are three areas where teacher can attract students’ continuing participation [10, p. 53]:

- goals and goal settings,
- learning environment and
- interesting classes.

A way to motivate students is to focus on creating successful employment prospects for students [9, p. 23-24]. A new outlook emphasizes focusing not on today’s problems or contradictions but on student’s desires where desire is a subjective component of motivation. Moreover, individuals are especially motivated if they can control their own learning process, set their own goals, take responsibility for their learning, are able to work independently, are able to evaluate their own learning process and continue to improve their skills [16, p. 39].

5.3.4. Learning Experience
Also, drawing upon the experiences of individuals is important; both life-experiences as well as abilities that may be dormant [16, p. 39]. The following description of language acquisition/learning illustrates the role of experience in learning:

Acquisition

- Native Language (L1)
- Second Language (L2)

Learning

- The First Foreign Language (L3)
- The Second Foreign Language (L4)
- The Third Foreign Language (L5).

The model of first language acquiring outlines two dimensions:

- the universal (born condition in order to learn a language)
- and the learning environment that is an investment a child takes life-long (everything that is around the child during his/her life can influence it (people, circumstances, possibilities, etc.)).

The process of second as a foreign language learning already involves three more factors:

- native language experience,
• private life experience and
• learning experience, including motivation.

In accordance with the ideal model of foreign language learning, the next foreign language learning becomes easier [16, p. 43]. But real life reveals problems that appeared in the process of previous language learning and make next foreign language learning difficult: even creating ideal circumstances for foreign language learning, teacher cannot be sure about learning ideal results because there is a student who acquire a new language therefore it is more important to pay attention to what the student get from different types of activities in the classroom [16, p. 43].

6. RESULTS

The search for factors forming collaboration within the knowledge triangle involves a process of analyzing the meaning of key concepts, namely, knowledge triangle, collaboration and factors forming collaboration. The study shows a potential model for development indicating how the steps of the process are related following a logical chain: defining knowledge triangle → collaboration within the knowledge triangle → factor definition → factors forming collaboration.

7. CONCLUSION

The identified and analyzed factors allow forming productive collaboration within a multicultural environment that enables synergy between education, research and innovation.

8. OUTLOOK

Further research on factors forming productive collaboration within a multicultural environment that enables synergy between education, innovation and research is considered to include criteria, indicators and levels of forming collaboration, a relevant set of methods to evaluate each criterion and empirical studies.

9. REFERENCES


13. Popova, D., How to make the Teaching/Learning of ESP Teacher/Learner Friendly. ESP SIG Newsletter, No. 7, (1996)


MULTI-DISCIPLINARY MODELLING KNOWLEDGE AS A PRAGMATIC SOLUTION IN ENGINEERING AND BUSINESS EDUCATION

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ABSTRACT: Some conclusions of the international workshops realized by the article’s authors in the University of Pitesti, in the last two years, entitled Exploratory Domains of Econophysics. News (EDEN I and II), are pragmatically the main motivations of this paper. Its structures aims a detailed presentation in its introductory section, of a number of scientological aspects, intending to give reasons for the ever more significant part played by multi-disciplinary approaches in the collaboration between Engineering, Physics, Sociology, Mathematics, Statistics, Econometrics and Business education. The second section of the paper develops the contemporary concept of multi-disciplinary modelling, also identifying major principles of the multi-disciplinary models and the coverage of these models in academic research and education. In some final remarks state some conclusions connected with a number of interdependences between science and culture, research and education, underlying the obsolete tendency of isolation in mono or unique discipline model and the contemporary unifying one of multi-disciplinary model. Thence, the culture of multi-disciplinary modelling remains a practical issue, not certainly in as far as that culture is regarded only as a product of academic life, but life (academic education) having become, in that sense, a consequence or an imprint of engineering and business culture at the same time…

1. INTRODUCTION

The term science, in the sense of knowledge, is derived from Latin \textit{scientia}, and can be circumscribed as a systematic ensemble of knowledge connected with nature, society, and thinking. Sciences or scientology currently represents the science of science, an investigation into the way in which the study of nature through observation and reasoning has evolved all through several millennia of human activity. The expansion of contemporary science has multiplied their number to over 1,000 independent sciences, especially within borderline areas (e.g. econophysics, situated at the border between physics and economics, sociophysics – at the border between physics and sociology, etc.). Science emerges when at least three elements are joined together: a distinctive theory, a segment of reality as a specific object, and a model interposed between theoretical investigation and its object of study. Sciences have their own characteristic models and laws, acquired mainly thanks to their inclination for measuring their object of study. From the tetragrams of the ancient Chinese culture to abstract or geometrical figures in ancient Greece, from the first music syllable systems to the everyday languages used by calculus programs, all these types of presentation laying special emphasis on the logical element of a visual nature have been, and are still, simplified alternatives to modelling. In a relevant way, the model and modelling have been situated, through their initial practical uses, close to geometry, than any other scientific domain. The appearance of the term as such is linked to the year 1868, when the mathematician Eugenio Beltrami managed to construe an early Euclidian model for non-Euclidian geometry. For the first time, he was turning the model and modelling into a concept, studying, by their agency, “a domain, a phenomenon, an object inaccessible to direct research”. The geometry-inspired model became “a coagulant factor” for scientific thinking, a continuous process of pondering, represented, symbolised and conveyed, no less than the tetragrams were to Gottfried von Leibniz the inductive solution to the mechanic system of his own calculating mechanical device. At a higher level of elaboration, models are scientific representations, or representations of scientific theories.

Contemporary human sciences are more and more distinctive, beginning with psychology, up to cognitive science, from sociology, to Economics, from political science, to anthropology, etc. The special humanistic sciences were previously known as moral sciences, and, at the same time, the human sciences have a tradition of drawing analogies with ideas from the natural world and the natural sciences. For instance, there are a great diversity of schools of economic thought: Austrian economists, Institutionalists, Marxists, social economists, behavioral economists, chaos theorists, Keynesians and post-Keynesians, Neo-Ricardians, Agency Theorists, the Chicago school, Constitutional political economists, Public choice theory (the rational choice theory is already at the centre of the discipline, in neo-classical equilibrium Microeconomics and also Macroeconomics).

Physics was born fundamentally in a demonstrative or reductive way of thinking and then, with Newton, also universal. What is fundamental? Can there be unity without fundamentality? The form that unity, especially in Physics, takes and should take is a controversial matter that has led to pluralism within the Physics community (v. the \textit{Stanford Encyclopedia of Philosophy}). Physics developed a real universe of labour between theoretical and experimental work. This process has led to disunity within Physics of one kind, but also to a more complex set of interactions within Physics and, as it has become a fundamental science, with other disciplines such as engineering, Economics and management. A distinctive feature of the economical sciences is that, while they share with Physics the descriptive and explanatory application of mathematical statistics – in population and probabilistic interpretations – it seems to lack strict and universal laws of the sort “recognized” in Physics. To understand the complexity of a contemporary model, we can describe a potential model of real economic convergence, using multidisciplinary approaches, many variables, and including international migration. This difficult activity is starting from a
number of models of real economic convergence already considered classical, combined with the new generations of crisis analysis models, (beyond the first generation, belonging to the Krugman type, the second generation, belonging to the Obstfeld type, the third generation, of the Krugman–Roubini et al. type, and even the fourth generation, belonging to the Williamson type), turning to account the available data regarding the price of the oil barrel over the last century, and the classical technology, of the fourth Kondratieff cycle, and finally also introducing, as a significant variable, international migration, whose importance and impact has become major over the last decades, the project proposes, as a research topic, a multidisciplinary short- and medium-term modelling in the analysis of real economic convergence, taking advantage of an extended kind of logic, through the intermediary of Econophysics or Sociophysics, and the Science of Complexity. In the last two or three decades new multi and interdisciplinary approaches to social science have been developed by natural scientists. A simple aspect as the distribution of unemployment seems to be, also required a new understanding of society, or of the dynamics of social systems. These aspects have been gradually introduced by W. Weidlich (1972) and H.E. Stanley (1992) and a thermodynamic approach to social problems has been favoured by D. K. Foley (1994), J. Minikes (1995), A. Drăgulescu and V. M. Yakovenko (2001). For a better understanding, there are detailed some multidimensional models of spreading opinions within a human population. Serge Galam was the first who have modelled the spread of opinions within a population and gets an equation of the inertia of democratic systems against changes. In the last twenty years, the new multi-disciplinary models and ways of thinking have introduced a series of multidimensional models. These could be divided in different general classes, which deal with: opinion dynamics; income or wealth spreading and concentration; decision making; competitions/conflicts; fragmentation versus coalitions; residential segregation; migration dynamics; cultures and languages evolution; friendship and love; internet and world wide web evolution; religion spreading; social networks dynamics; traffic dynamics; democratic voting in bottom up hierarchical systems; terrorism spreading, etc.

Using these original models several major real political social and religious events were successfully predicted (from the victory of the French extreme right party in the 2000 to the voting at fifty-fifty in Germany or Italy). The models are real important tools for a reasonable perspective and make Sociophysics a predictive solid field. Some general biological aspects will also be included, and derived behaviourally, which are comparatively ignored and omitted in contemporary scientific knowledge-based procedures, such as emergence and teleonomy. Emergence, or the appearance of a new organ or new properties, of a superior order, a form of the process of change seen as an effective birth of something altogether new, marks even phenomena of community extension, together with teleonomy, in its capacity as a specific feature of living organisms – such as the human organisation of any economy actually is, which includes causality, finality, but also the development towards differentiated and functionally superior structures. The model needs the three great intellectual faculties, perception, imagination, and reason, and most of all he needs imagination, to put him on the track of those events which are remote or lie below the surface, and of those effects of visible causes which are remote or lie below the surface. (Alfred Marshall).

The model validity is generated by its genuine approach that covers the gaps in classical approaches and also by the academic level in Economics, Engineering, Statistics and Physics, Econophysics, Sociophysics and the Science of Complexity researches and the multidisciplinary risks are minimum (as Econophysics, Sociophysics and the Science of Complexity solutions can replace successful traditional econometric approaches in the banking and financial world).

2. MULTI-DISCIPLINARY MODELLING

Logical representation is the solution preceding the model. From the tetragrams of the ancient Chinese culture to abstractization through geometrical figures in ancient Greece, from the first music sol-fa systems to the everyday languages used by calculus programs, all these types of presentation laying special emphasis on the logical element of a visual nature have been, and are still, simplified alternatives to modelling.

A model is an abstraction that behaves somewhat like a defined “system”. The model is less exact and less all encompassing than the original “system” (otherwise the model could be the system itself).

The model accepts always a set of Input values and transforms them into Output values, but in the characteristic way of thinking developed by a science as Economics, Physics, Engineering, Biology, Sociology etc.

At present, modelling is simultaneously recognized as a method, and a component part of that triad making up sciences (i.e. theory – model – object of study)

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At present, modelling is simultaneously recognized as a method, and a component part of that triad making up sciences (i.e. theory – model – object of study)
• the profundness, the intensity, and the depth represent the third condition of representation through models (the oscillation between analogy and the convention-symbol);
• the efficiency of the transposition, or the translation of the theory into the reality of the world under study seems to be another condition, the superior models becoming themselves objects of research and re-modelling.

In keeping with the reasoning of modelling, as maximum fidelity translation or transposition, any theory corresponds to a model, and any model, when validated through the agency of reality, will correspond to reality. However, the closer the model will draw to the point of intersection of several sciences, the more correct the transposition/translation. Even the exclusive answer to the question “what is a model” constitutes a difficult undertaking, and needs many-sided approaches. Below are some illustrative variants:

• in the optima of physics, a model is a calculating instrument, with the help of which one can determine the answer to any question concerning the physical behaviour of the system in question, or else a precise pattern of a certain segment of the physical reality (two examples, which are today as well-known as to become banal, are the modelling of the inertial reference system, and the atomic model);
• in the vision specific to chemistry, the model becomes a structural concept that attempts to explain the properties found experimentally, or a support in deductively passing from the general to the specific, a knowing instrument that forecasts facts and “indicates the numbers” (as in the memorable example of Mendeleev’s table of elements, or the periodicity of chemical elements);
• in the approach of biology (genetics), a model is considered a natural modality – reproduced experimentally – of genetically differentiating the populations (the model of DNA being, in this respect, a commonly cited example, and a relevant point in case);
• in the perspective of mathematics, the model is superposed to a certain type of measuring methods, specific to mathematical research, with a view to explain, in an objective manner, the “manner in which the micro-components and their mutual interactions, either interpreted individually, or grouped in subsystems, generate and explain the whole of the system” (Octav Onicescu and the model of informational energy), or a “definition and non-contradictory description of a number of processes and phenomena”, of the theses, postulates and axioms, as well as their logical-mathematical correspondence;
• from a logical point of view, within the structure of the model, the causes equalize the effects (Anton Dumitriu);
• from a behaviourist standpoint, the model presupposes a number of participants gathered in a formal way, who “maximize their utility by starting from a stable set of preferences and accumulate an optimal amount of information in a variety of markets” (Becker’s model);
• along the lines of the semantic, linguistic and explanatory dominant, the model is a theoretical or material system by means of which one can study, indirectly, the properties and transformations of a different, more complex system, where the first system exhibits an analogy (according to the explanatory dictionary);
• in its statistical acceptation, the phase-directed sense of the concept of model is that of a link in an integrated process of knowing, and is made up of a hypothesis, a schematic representation of a process (phenomenon), the statistical testing, and the resuming of the process in a general theory;
• in keeping with modern sciences, the multi-disciplinary model becomes the optimum instrument for solving a number of complex general problems, and modelling turns into a series of means meant to disclose the real nature of the problems, where the isolated vision does not allow one to formulate characteristic laws.
• the statistical- or physical-mathematical type of modelling is a mathematical transcription of a number of simplified hypotheses about the state or evolution of a social-economic phenomenon, or physical system under the factorial influence of variables that are physical or can be assimilated to the physical ones.

The multi-disciplinary model turns to account the language and methods of mathematics, testing and statistical decision, the pattern of physics in assessing (quantum, thermodynamic, acoustic, etc.) reality, as well as the real variables of the segment subject to research (money flow in the economy, human behaviour in sociology, etc.)

How can one manage to practically construct a model?

The starting point is direct experience, or unmediated contact with reality. In order that a theory could be turned an experiment, or into an “organized contact with reality”, a theory is formulated, which is subsequently represented by a material, intuitive or symbolic model, as a filtered reflection of reality.

Louis Pasteur would elegantly underline the primacy of the theory, through the agency of the well-known formula: “luck favours only the well-prepared minds”.

Tiberiu Schatteles used to synthesize the likeness between theory and modelling through the phrase “the dogmatic of isolation”. In order to illustrate a phenomenon, the theory isolates it from the contingent, very much as the experiment is underlain by a type of material (i.e. laboratory) isolation. Studying a phenomenon in isolation also presupposes defining the framework of the isolation through postulates or axioms as “something that goes without saying”.

Modelling, as a complex iterative process, oscillates between simplified variants like the “trial” (formulating a hypothesis, collecting the experimental material, and verifying the hypothesis), and excessively detailed variants (formulation of the initial model followed by the forming of repartition classes, gathering the experimental material or the data, choosing a particular repartition, checking the degree of concordance of the repartition chosen with the real situation and formulating the hypotheses that explain the random mechanisms that have generated the data).

The typological diversity of the models results from the great number of the scientific theories that they reproduce. Seen from the angle of the aim they were created for, the models fall in two major types: the category of the rational or theoretical models, and the category of the operational models, or prediction (decision-making) models.

Through comparison with the time variable, modelling is static or dynamic. A major classification of modelling according to the typology of the explanatory variables reveals the deterministic type of modelling in the past (evolution of phenomena, determined solely by the mechanical, or simply causal variables) and modern probabilistic modelling (which contains perturbing variables, in keeping with the probable effect of some uncontrolled factors and unspecified variables). An isolated workshop led us to the idea that modelling can be uni-disciplinary, but it will remain isolated in the past, as well
as modern, i.e. covering reality, and, implicitly, multidisciplinary.

For a succinct description of multidisciplinary modelling, a few clarifications are in order, relating to the various stages, its architecture and paradoxes.

The concrete stages of modern modelling are the following:
- the structural defining of the system (isolating the phenomenon, formulating the questions, identifying the major interest variables),
- the preliminary formulation (sets of hypotheses and conclusions concerning the relationships between the variables), collecting the empirical (relevant) data,
- the estimation of the parameters and of the functional forms,
- the preliminary (gross) testing,
- the additional testing (based on the new data),
- the decision – accepting or rejecting (in conditions of predictions conforming or failing to conform to the available empirical evidence).

The architecture of multi-disciplinary modelling capitalizes on:
- minimal simplification through hypotheses, or the existence of a minimal number of propositions not connected mutually, and undemonstrated propositions (“out of two interpretations of a phenomenon, the interpretation having fewer suppositions or simplifying hypotheses is preferred”);
- the simple alternative (the highly intricate models failed to lead to categorically better results, as against the simple extrapolation formulas – Koopmans T.C.);
- the value certified through the dialectical reasoning (a model facilitates the discussion, clarifies the results and limits the reasoning errors);
- the cultural component (if the humans’ economic and social actions were independent of their cultural inclinations, the enormous variability of the economic and social configuration in point of time and place could by no means be accounted for);
- shifting from one- to multi-disciplinarity, through successive models (improvement through imitation, through analogy, and through passing from one type to another).

Multidisciplinary modelling is a process having a paradoxical content.

The paradox of the infinity of the multivariable system is revealed by the infinite number of factors, which cannot be classified in a direct manner, in proportion to the particular model construed out of a finite number of essential factors.

The paradox of the “relative reduction of one system to the next” proceeds from relative reductibility, centred on the translatability of the languages concerning various fields of reality, and manifests itself as an antithesis between the functional and the substantial.

The paradox of the “unique community” can be translated through the antinomy holding between the correlation of the action of several models, and the building up of a unique model for a given problem.

The paradox of the “double idealisation” concerns the phases of simulation, and respectively, of the assignation and interpretation of information within the model. Multiplied, information is not lost from the model, very much as, fragmented, it is nothing but information.

The “double idealisation” consists in treating information as “signification” of information in the model of attribution, whereas in the interpretation model it is treated equally as signification and as sense. Synthetically, the relationship between completeness and precision/accuracy generates specific models:

<table>
<thead>
<tr>
<th>Degree of completeness of the data</th>
<th>Degree of precision of the data</th>
<th>Typology of the model</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum</td>
<td>maximum</td>
<td>deterministic</td>
</tr>
<tr>
<td>relatively low</td>
<td>relatively high</td>
<td>probabilistic</td>
</tr>
<tr>
<td>relatively high</td>
<td>relatively low</td>
<td>fuzzy</td>
</tr>
<tr>
<td>relatively low</td>
<td>relatively low</td>
<td>intuitive</td>
</tr>
<tr>
<td>minimum</td>
<td>minimum</td>
<td>indeterministic</td>
</tr>
</tbody>
</table>

The algorithm of the model has three characteristic features: determinism in point of performance, succession in point of operation, universality in so far as the spatial, temporal and structural entries and limitations are concerned. Modelling exhibits three main ways of analysis:
- using the equilibrium equations between the factors (from Leontief’s input-output balance, to the fuzzy ones and to those of quantum physics, thermodynamics, etc.);
- identification of the extreme values as the model of the “catastrophes”, or of R. Thom’s “critical points” – which is the frequently cited example in point;
- construction (simulation) of conflict situations through strategic games with incomplete information (i.e. concurrent situations), or complete information (i.e. open situations).

The uncertainty of decision-making is paramount, all the way from Wald’s (prudent or pessimistic) model, characterized by choosing the maximum profit variant, or the minimal loss cost wise, in the most unfavourable situation, to Laplace, which selects the higher average-profit variant, or the lower average-loss, in the hypothesis that the states have the same occurrence probability, to Savage, where an option is made for the lowest possible regret (i.e. the usefulness lost as a result of selecting a different variant than the optimal one, in conditions of complete information), and to Hurwicz, whose coefficient of optimism re-enters, through its real-value interval, the vast realm of the probabilities, namely [0,1].

To illustrate the above, multi-disciplinary modelling maximizes the capacity of reducing the degree of imprecision / inaccuracy and of assessing that imprecision / inaccuracy through statistical testing and testing in terms of probability theory, whereas even mathematical modelling approximates, while failing to express reality exactly as it is, because reality is not “exact/precise”, but subject to the stochastic laws or to the action of the law of great numbers. Some of the general goals of modeling are:
- a model is a way of thinking and reasoning about systems;
- the tendency is nearly always to simulate too much detail rather than too little.
• a simulation of a model means to accumulate variables contained within each model and each object in the system;
• the interfaces between subsystems allow the entire system to pass and process information in a good model.

To express in a multidisciplinary manner how inaccurate a model is, is more important than modeling in a unidisciplinary, hence sophisticated, isolated manner, lacking the power of specificity.

The perspectives of the field of model-construction astonish through the rigour of a new concept, namely that of the system of multidisciplinary models, which presupposes the following ways of thinking and reasoning:
• the human decision has the fundamental role in its functioning;
• the construction is a logical succession, and also a process of arrangement in time, in keeping with the principle of economy, or the law of parsimony;
• the separation and combination of the individual models occurs in procedure-based chains;
• the system stays open, thus facilitating the adding / the deletion of restrictions and variables;
• the physical-mathematical structure is independent of the manner of utilization;
• the architecture is modular, hierarchial and dynamic;
• the information-based and logical connections are, in turn, part of cooperative, hierarchical, mixed models;
• although including different types of models, the database if unique.

In the natural harmony of the multidisciplinary approach to modelling, the contribution scored by discovering of an original model is to be considered much higher than knowing a new phenomenon or process. The limits of unidisciplinary modelling are obvious:
• no unidisciplinary model can consistently and substantially incorporate the residual variables and areas (which can occasionally be quite considerable in point of proportions and significations);
• both human behaviour and other random variables like the climate, the radical political evolutions such as the revolutions, etc., as soon as they are modelled, bestow an increased amount of uncertainty to the respective model;
• the model has evolved in a credible manner along the coordinates of the chronological series, and less so, however, along those of the territorial series, of the associated / correlated series, in the specific situations of value optimizations, or concerning verisimilar, attainable targets developing programmes.

Finally, a model can be said to represent an image of a specially selected part of reality, with the aid of which answers can be given to various questions, or problems belonging to an assortment of fields in the area of scientific knowledge can be solved, with a certain degree of realism and a certain limit of error.

The main disadvantage of the uni-disciplinary model, if one resorts to the example provided by the very econometric one, is revealed by the lack of accuracy of their prediction, by the representatives of the neoclassical Austrian school of economics Ludwig von Mises and Friedrich von Hayek.

The sad balance of the predictions made by the econometric models over the past few years, for all the modern calculation equipment added to the sophisticated uni-disciplinary models, is nothing but an additional confirmation

3. TWENTY PRINCIPLES OF MULTI-DISCIPLINARY MODELLING

Certainly, any research admits, like Socrates, the impossibility of absolute modelling knowledge. The famous “ignoramus et ignorabis” (we don’t know and we shall never know) belonging to Emile du Bois-Reymond is a statement containing a relative truth. Yet, as truth always thrives on liberty, let us enumerate a few of the principles of multidisciplinary modelling, as they appeared in the papers presented at EDEN I and II in the researchers’ dialogues:

1. There is a harmony of modelling disagreements, a concord of discordances, a diversity revealing of the unity of the model.
2. The developmental cycle is the axis of the cyclical development in the model.
3. The motion through an apparent state of rest, and the state of rest of the motion are the realities of all the cases of modelling. As a paraphrase to one of Schlozer’s dictums, science remains history at rest, very much as history becomes science in motion. And the scientific modelling knowledge of the multidisciplinary type seems to be defining a solution to the famous “ignoramus et ignorabis”.
4. The identification of the leap, or the unpredictable transformation, in the sense of the paradox of the arrow, or of the tortoise which overtakes Achilles, represents the spirit of modelling.
5. Communication, as an aim of getting out of information isolation, constitutes the message of the types of modelling.
6. The relativity of the global interdependencies and of the local ones derives from the logic of the systems modelled, namely when the sum of the parts is greater than the whole.
7. The infinite, as part of the finite, and the finite as part of the infinite, describe the structures of the model.
8. The finality of the inductive through deduction, and the validation of the deductive through induction bound the reasoning of those who do the modelling.
9. Knowledge is the limit to the ignorance of the act of modelling, no less than ignorance eventually becomes the result of knowledge.
10. The rebirth of theory through experiment brings about the demise of experiment in the theory of modelling.
11. The faith in critical science becomes similar to the neutrality of ignorance in the acts of modelling.
12. Coherent superposition brings together the amplitudes as limits, while incoherent superposition unites only the intensities through modelling.
13. Finding nuances is a solution of probabilistic thought, and based on the possibilities of modelling.
14. Convergence through divergence contributes to the emergence of the models.
15. The incompleteness of incompleteness adds to the completeness of incompleteness in modelling.
16. The compensation of the reactions confers equilibrium to imbalance.
17. The duality of the acts of modelling is a reflex of the equivalence causes-effects.
18. A fixed multidisciplinary modelling method is no method.
19. A model has always its non-model inside.
20. Science is nothing else but a long succession of models.
4. A FINAL REMARK

In contemporary scientific thinking and education, it looks to the interrelatedness of things as essential to comprehending what they are and therefore seeks to put an end to the impoverishment of every discipline through its disconnectedness with other disciplines.

The multi-disciplinary modelling recognises the ascending levels of complexity in the organisation of matter and the emergence of novelty in the evolutionary process, such that each level is rooted in the preceding level without being reducible to it. The multi-disciplinarity is unifying, while uni-disciplinarity isolates.

It is not a retreat to an undifferentiated unity, recognising always that uni-disciplinarity modelling has been necessary to the development of the sciences, but that multi-disciplinarity thinking must be transcended in a higher synthesis that gives full scope to both the relatedness and distinctness of the specific areas. The way of thinking in each discipline needs to open out to the others and be revitalised and reconstructed in the interaction with the goal of integration of knowledge in view specific in multidimensional models. One thing that is essential to the process is an integrative new thinking capable of encompassing many related sciences, in a specific domain of knowledge, while giving each its due. Is this happen in the contemporary research and academic education? Fortunately, I think yes. But there must be more enclaves of this multi-disciplinarity thinking and modelling.

Thence, the culture of multi-disciplinary modelling remains a practical issue, not certainly in as far as that culture is regarded only as a product of academic life, but life (academic education) having become, in that sense, a consequence or an imprint of engineering and business culture at the same time…

5. REFERENCES

OPTIMAL IMPLEMENTATION OF A TECHNOLOGICAL PROCESS

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Abstract: The sequence of operations performed within a technological process can be modelled with the help of a directed graph. It is obvious that all the operations have to be performed for the technological process to be completed and the final product to be accomplished. This condition is equivalent to determining the Hamiltonian paths from the attached graph. We first have to build the adjacency or Boolean matrix attached to the graph which represents the links between operations, and then the terminal adjacency matrix or path matrix which represents a sequence of links between any two operations. This matrix helps us to analyse whether the technological process is complete or whether corrections have to be made. Moreover, in case the technological process goes through all the operations (the graph admits Hamiltonian paths) it is from the analysis of the same matrix that we can find out whether the attached graph is cyclic or acyclic and thus establish the algorithm determining the Hamiltonian paths and the sequence of operations within the technological process referred to. The present article introduces a computer application for the analysis, correction and determination of Hamiltonian paths in a graph, useful for the optimization and projection of complex technological processes.

1. INTRODUCTION

The technological progress and the use of new technologies in the fabrication process is essential if labour productivity and products’ quality are to be increased and products to be offered on the market at competitive prices. The new technologies have also entailed the use of more complex equipment, a fact with implications not only on labour force training but also on price establishment.

Given the increased complexity and high prices of the equipment currently used in military operations, it has become necessary to make an optimal use of it in theatres of operations [1]. This can only be achieved through the application of adequate models [2], [3], [4], the Romanian Army and not only having already manifested their interest in this respect, by making use of modelling and simulation in military operations [5].

The implementation of a technological production process is a complex issue that needs to follow several stages in order to be improved. The use of implementation optimization models and methods becomes essential given the costs inherent to such a complex approach. The objective of this study is to present an optimization model and specialized software for the implementation of a complex production system (and not only). This model can be used for process optimization and relies on a thorough analysis of operations and links between them, the purpose being to create a whole as the sum of its parts.

Thus, the present study offers a useful tool for the optimization of a complex technological process implementation, by identifying and ranging the stages that have to be followed for the process to work at full capacity.

2. MATHEMATICAL MODELLING

For the implementation of a technological process to be done correctly, the following stages have to be considered:

• describing the complex system and its sub-systems;
• identifying the optimal operating parameters;
• identifying both the operations that have to be performed and the links between them;
• optimally ranging the sub-systems so as to accomplish the technological process;
• creating the Gantt chart and scheduling project activities (by emphasizing parallel operations).

As previously mentioned, such a process can be modelled with the help of the graph theory. The models offered by this theory can be used to [6]:

• build drinking water networks (power or thermal power supply systems), stations and substations;
• build access routes linking isolated points;
• develop strategic games;
• make decisions;
• predict the evolution of a system starting form an initial state;
• build radial telephony networks and electric relay networks;
• connect a great number of computers by setting up a network;
• draw up flowcharts;
• study electrical circuits in electrical engineering (flow-graphs, etc.);
• design block charts of computer programs, etc.

As far as the problems that can be modelled with the help of graphs are concerned, we are interested not only in finding out whether there are links between the components represented thorough nodes but also in measuring their value. This value is numerical, is associated to the arc describing the link referred to, and can stand for [6]:

• road length between two localities;
• costs associated to covering the route described by the arc;
• length of time associated to covering the route referred to;
• quantity of merchandise transported on that route;
• route’s full capacity;
• gain resulting from passing from one state to another;
• power needed to pass from one state to another;
• score, etc.
Sequencing the operations that lead to the implementation of a complex system is an important part of the technological process we are studying and should see to the accomplishment of each and every operation of the system. The model to be used in this respect is that of Hamiltonian paths in directed graphs. We chose to use directed graphs because all the operations are developed in the same direction. The Hamiltonian path is the path which visits all vertices and sees the accomplishment of all operations necessary to achieve the final product. The algorithms we have used are the Foulkes algorithm for cyclic graphs [6] and Chen’s algorithm for acyclic graphs [7], [6] (a cycle is a path in which the initial and final vertices coincide).

The software we have designed allows us to identify the Hamiltonian paths regardless of the situation we find ourselves in, the paths being emphasized after introducing the matrix attached to the graph (Boolean or adjacency matrix):

\[ C = (a_{ij})_{n \times n} = \begin{cases} 
1, & \text{if there is an arc from } x_i \text{ to } x_j \\
0, & \text{otherwise}
\end{cases} \]  

where the graph \( G = (X, \Gamma) \), \( X = \{x_1, x_2, \ldots, x_n\} \) are the vertices of the G graph and \( \Gamma \) is a multivalued function defined in \( X \) with values in \( X \). Depending on the structure of the adjacency matrix, we can have one or several Hamiltonian paths.

\[ T = (t_{ij})_{n \times n} = \begin{cases} 
1, & \text{if there is a path from } x_i \text{ to } x_j \\
0, & \text{otherwise}
\end{cases} \]  

This matrix offers us information on the problems and discontinuities that might occur in the system, as well as on the optimal correction. An important characteristic of this software relies in the fact that it can be adapted, enabling us to determine both minimum and maximum Hamiltonian paths only by adding the cost matrix attached to the graph.

### 3. System Presentation

As an exemplification we have chosen to optimize the technological flow of a set of assembly operations in the production of a special complex vehicle and of a set of assembling-disassembling operations in the maintenance process, level 5 (RK).

The basic characteristic resides not in how complex the assembling process is but in how heavy the assembled parts are since it is based on the latter’s weight that we determine the need of auxiliary equipment (crane); the necessary parts are listed in table no. 1.

#### Table 1. Components needed for the production of a special complex vehicle

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<td>1</td>
<td>Support element</td>
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<td>Ring O</td>
<td>0.01</td>
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<td>1</td>
<td>Balance lever</td>
<td>22</td>
<td>12</td>
<td></td>
<td>18</td>
<td>I Ring</td>
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<td>2</td>
<td>Slide block</td>
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<td>19</td>
<td>Support 1</td>
<td>10.5</td>
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<td>3</td>
<td>Slide block</td>
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<td>12</td>
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<td>20</td>
<td>Bearing disk 1</td>
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<td>4</td>
<td>Labyrinth</td>
<td>1</td>
<td>12</td>
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<td>21</td>
<td>Torsional</td>
<td>18.5</td>
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<td>5</td>
<td>Gasket 1</td>
<td>0.003</td>
<td>12</td>
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<td>22</td>
<td>Limiter</td>
<td>0.5</td>
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<td>6</td>
<td>Gasket 2</td>
<td>0.003</td>
<td>12</td>
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<td>23</td>
<td>Labyrinth ring</td>
<td>1.2</td>
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<td>7</td>
<td>Lid</td>
<td>1.5</td>
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<td>24</td>
<td>M 56 nut</td>
<td>0.49</td>
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<td>8</td>
<td>Gasket</td>
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<td>24</td>
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<td>Fuse</td>
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<td>36</td>
<td>No. can differ</td>
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<td>13</td>
<td>Cork M 8</td>
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<td>30</td>
<td>Lubricator /</td>
<td>0.05</td>
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<td>14</td>
<td>Pulley Φ 8</td>
<td>0.009</td>
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<td>31</td>
<td>Bearing box</td>
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<td>15</td>
<td>Pin Φ 10 x 15</td>
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<td>12</td>
<td></td>
<td>32</td>
<td>M 8 screw</td>
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<td>96</td>
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<td>16</td>
<td>Safety pulley</td>
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<td>48</td>
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The assembling order and the handling (preparation/finishing) and assembling times are presented in table 2. The measurement unit is the centesimal hour which has 100 minutes.

Therefore, the real-time transformation relation is \( 1 \text{ min}_{100} = \frac{36 \text{ sec}}{60}, 0.1 \text{ hour}_{100} = 6 \text{ min}_{60} \):
Table 2. Preparation, assembling and finishing times of operations in the production of a special complex vehicle

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<td>31</td>
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<td>Crane</td>
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The sub-sets are as follows:

A : 19, 22, 32, 27 – limiter ;
B : 31, 27 – balance lever support ;
C : 1, 4, 28, 29 - balance lever ;
D : 13, 2, 8, 3 – slide block ;
E : 21 – torsional stabilizer;
F : 5, 6, 9, 10, 11, 12, 7, 20, 23, 17, 18 – balance lever – slide block assemble (C+D) ;
G : 26, 24, 25 – B assemble;
H : 24, 21 –A assemble;
I : 15, 16, 14, 30 – end of assembly.

This study optimizes the technological flow between great sub-systems to build the special combat vehicle. The analysis that we performed on the entire fabrication system can also be performed on each individual sub-system.

The sequencing of operations performed in order to build such a system, is presented in figure 1.

![Figure 1. Links between sub-systems](image)

Figure 2. The graph attached to the technological flow

The O vertex is the initial vertex, where the production/maintenance operations begin. The lengths of arcs from O to A,B,C, and D represent the preparation and assembling times of A,B,C, and D operations. The lengths of arcs from G and F to I and E represent the accomplishing times of G and F operations. The lengths of all the other remaining arcs represent the finishing times of the operation from the initial vertex plus the preparation and accomplishing times of the operation from the final vertex.

Let us reiterate that all concomitant operations are represented in a single graph node, in figure 2. The workload for the solution to such a problem is very high, but it can be decreased with the help of a specialised software which also offers the possibility to adjust the technological flow.
4. DETERMINING THE OPTIMAL SOLUTION

In the program we can use the Boolean or adjacency matrix and the adjacency cost matrix attached to the graph which presents the necessary time to prepare and assemble the components and can be attached to the chart presented in figure 2 (the difference between the Boolean matrix and the adjacency cost matrix is that in the latter the value 1 is replaced by the value of the arc). The values of the cost matrix C’ attached to the graph presented in figure 2 are presented in the figure below:

![Cost matrix attached to the graph](image)

In our computer application we can introduce either the data from matrix C or from matrix C’. If we introduce the data from the Boolean matrix we will obtain all the Hamiltonian paths whereas if we introduce the values from matrix C’, besides obtaining all the Hamiltonian paths we will also be able to see which are the optimal ones (minimum or maximum). The program will display the current situation (whether the graph is cyclic or acyclic) and will provide us with the following information:

- if the graph is acyclic, the program will display the Hamiltonian path (if there is one) and will make the optimal corrections for the graph to admit at least one Hamiltonian path;
- if the graph is cyclic, the program will display the classes of equivalence, all the Hamiltonian paths, the optimal Hamiltonian path and its value (minimum or maximum); if the graph does not admit Hamiltonian paths, the program will make the optimal corrections for the graph to admit at least one Hamiltonian path. By running the graph presented in figure 2 through our program, we will obtain 30 Hamiltonian paths. The Hamiltonian path of minimum length (of 31.49 metres) is presented in figure 4.

![Optimal production/repairing flow](image)

5. CONCLUSIONS

Our study reveals the importance of using adequate analysis models when studying processes and phenomena. Moreover, it also points to another problem we are confronted with once the best-fitted model is identified. This problem refers to the huge amount of workload we will have to cover, and can be solved by using a specialized software. The software that we have developed can be used in all the fields of activity for all the problems that can be modelled with the help of graph theory. It can be adapted so as to determine the Hamiltonian paths of maximum and minimum length, depending on the problem considered for analysis.

6. REFERENCES

ENGINEERING EDUCATION AND RELATED EDUCATIONAL PROGRAMS-CASE STUDY “CONCEPT” CONSULTING AND TRAINING CENTER

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ABSTRACT: This paper presents a way to involve the engineer, as a specialist, in activities that are important in terms of efficiency and performance of the human resource. The “Concept” Consulting and Training Center is accredited under Agenda with the revised Lisbon, Community Strategic Guidelines on Cohesion 2007-2013, The Operational Program-Human Resources Development 2007-2013 (POS - DRU), adopted by the European Commission Decision C (2007) 5811/22.11.2007.

1. INTRODUCTION

Continuing adult education and professional training have become more important than ever in determining people to choose the way of permanent success in their careers. Lifelong learning opens the perspective to an accomplished life, a life full of satisfaction with positive effects upon the economic and social environment.

Continuing adult education and professional training, whether within a formal system or not is the key to a successful career and personal development. Continuing adult professional training is crucial both to the transformation of labor, being the main tool through which labor may adapt to new requirements, thus facilitating mobility between different fields of activity. The accumulation of new knowledge and skills facilitates the improvement of people’s position on the labor market and the improvement of productivity. Investment in training brings benefits both to individual persons and to society as a whole. The orientation towards a society based on knowledge involves investment in human resource in order to encourage employers to acquire new skills and accept occupational mobility. Individual productivity triggers the success of the entire system. The decisive feature of qualified labor is the fact that workers are not labor but capital.

Health and safety at work is currently one of the most important and developed aspects of EU occupational and social business policy. Within the framework of the Lisbon strategy, the Member States recognized the major role played by quality assurance and productivity in work in promoting economic growth and occupation of labor. The lack of efficient protection of health and safety at work may entail employee sickness absence as a result of accidents at work and occupational diseases, and also permanent invalidity.

The new EU strategy for 2007-2012 has set ambitious objectives, such as the decrease by 25% in the total rate of accidents at work per 100,000 employees until 2012 in EU-27, by improving the protection of health and safety at work, thus contributing to the success of the strategy.

Every year, millions of people in the EU suffer from injuries at work or they health is seriously damaged at their work place. That is the reason why risk assessment is so important, as the only way to safer and healthier work places. Risk assessment is a dynamic process which allows organizations to implement a proactive risk control policy. That is why all organizations should regularly conduct risk assessment processes. A correct assessment of risks involves focusing on all relevant risks (not only those that are immediate or evident), checking the effectiveness of implemented safety measures, recording the results and reviewing the assessment on a regular basis in order to be able to update it continuously.

The most important European regulation for risk assessment is the Framework Directive 89/391. This Directive has been implemented into national legislation. However, Member States are entitled to introduce new elements to improve the protection of their workers. Risk assessment in occupational health and safety will enable the employer to perform actions that may reduce or eliminate risk. Risk assessment is crucial to the decrease in accidents and occupational diseases and is the starting point in the risk management process. This enables employers to become aware of the measures that must be taken for the improvement of safety and health at work, as well as productivity. The cut in accidents at work and occupational diseases through a better assessment of risk is the objective of high-risk sectors especially small and medium-sized enterprises. Employers are responsible for ensuring their workers’ health and safety during all activities related to their work. The aim of risk assessment is to enable employers to implement the necessary measures in order to protect the safety and health of their workers. When risks cannot be removed they must be at least reduced and residual risks must be controlled.

The CONCEPT Consulting and Training Center provides its students, in partnership with the “Hermann Oberth” Faculty of Engineering, with the following adult continuing training postgraduate programs:

1. Masters program: The Management of Work Safety, Health and Relations
2. Postgraduate training program: Occupational Risk Assessment
3. Postgraduate training program: Work Safety and Health Audit

Moreover, the Center collaborates with specialist from the following institutions:
1. Labor Inspection Bucharest;
2. The National Research and Development Institute on Occupational Safety – INCDPM "Alexandru Darabont" – Bucharest
3. The University of Petroșani;
4. Territorial Labor Inspectorate Sibiu, etc.

2. THE BUSINESS BENEFITS OF GOOD OCCUPATIONAL SAFETY AND HEALTH

Occupational safety and health (OSH) is good for business as well as being a legal and social obligation. Enterprises appreciate that OSH prevents people from being harmed or made ill through work, but it is also an essential part of a successful business, figure 1.

Figure 1. OSH an essential part of good business

Occupational safety and health-advantage:

1. helps demonstrate that a business is socially responsible,
2. protects and enhances brand image and brand value,
3. helps maximize the productivity of workers,
4. enhances employees’ commitment to the business,
5. builds a more competent, healthier workforce,
6. reduces business costs and disruption,
7. enables enterprises to meet customers’ OSH expectations, and encourages the workforce to stay longer in active life.

Every enterprise can enjoy significant benefits by investing in OSH. Simple improvements can increase competitiveness, profitability and the motivation of employees. The implementation of an OSH management system provides an effective framework to prevent or minimize accidents and ill health.

2.1. Key OSH principles

Commitment and leadership to improve OSH in effective OSH policies and procedures in proactive risk assessment programs in trained and competent workers in Effective risk control measures in ongoing monitoring and review processes.

Although the principles of good OSH apply to every organization, the commercial drivers can be very different for large and small organizations.

2.2. Productivity and efficiency

A central EU commitment from the Lisbon strategy (2) is to give equal importance to increased employment and productivity through greater competitiveness. The cost of accidents at work and occupational diseases in the EU-15 ranges from 2.6% to 3.8% of gross national product. As well as reducing accidents and ill health, production and efficiency benefits can follow as a result of:

1. enhancing the levels of motivation, cooperation and morale in the workforce,
2. more productive workers and more efficient working methods,
3. minimizing unplanned costs through effective business continuity planning,
4. improving the quality of employee recruitment and retention,
5. cutting insurance premiums, and
6. reducing the potential exposure to criminal or civil litigation.

Returns on investment as high as 12:1 (EUR 12 profit for every EUR 1 invested) can be achieved through investing in good OSH.

“There is a clear and direct relationship between the social behaviours of a corporation and its reputation, sales, brand and indeed overall value. This correlation (and these consequences) get stronger as both the size of the business and the value of the brand increase.” Leipziger (1).

2.3. Small enterprises

Many small and medium-sized enterprises are also beginning to recognize the costs of poor OSH, and the benefits of good OSH performance. These are most noticeable in terms of:

1. meeting the OSH requirements of business clients in order to win and retain contracts,
2. avoiding business disruption and loss of key staff,
3. motivating staff and retaining their commitment, and
4. the availability and affordability of insurance.

New and growing enterprises seeking to achieve sustained business growth and stability are realizing how their OSH performance can contribute. This is most noticeable in terms of satisfying the OSH requirements of clients.

‘Not only do we now have higher staff morale and lower sickness, it also significantly benefits the retention of existing customers, and it is a real differentiator when winning new business and helping the company to expand.’ John Purnell, Regional Director, Cougar Automation Ltd. [1].

The need for corporate businesses to act responsibly also leads to demands being placed on their suppliers. Investing in good OSH standards boosts the competitiveness of the enterprise, which also increases the potential to retain clients and win new business.

2.4. Results:

2009 – The organization of the session Safety and Health at Work of The 4th International Conference on Manufacturing Science and Education, which will be organized in Sibiu, Romania, on June 4-6th, 2009; 37 authors, from 14 institutions from Romania and abroad, presented 22 papers in the field.

2003: the organization, in partnership with Labor Inspection Bucharest of the National Conference titled “Perspectives of Occupational Safety and Health,” during the European Week of occupational safety and health dedicated to the utilization of hazardous substances in the working environment;

More than 400 students, of which 100 female students, have graduated from the Occupational Risk Assessment program; more than 700 students, of which more than 300 female students have graduated from the Masters program The Management of Work Safety, Health and Relations. These figures represent the evidence that the Center has implemented an effective equal opportunities policy.

Moreover, since 2009, the Center has started a project funded by the European Social Fund through the Sectoral Operational Programme for the Development of Human Resources 2007-2013, Priority Axis No 3, Increasing adaptability of workers and enterprises, Major Intervention Area 3.2 “Professional training and support for enterprises and employees for promoting adaptability,” titled “Professional training in the field of occupational safety and health.” This project involves training specialists in the field of occupational safety and health in the counties of Alba, Brașov, Târgu Mureș, Harghita, Covasna and Sibiu.

3. SAFETY AND HEALTH MANAGEMENT – MODEL DEVELOPED IN THE CONCEPT CENTER

Economic activity involves the consumption of energy, material, human, information and knowledge resources. The information society based on knowledge has brought in the spotlight the human resource, the workforce. The evolution of human society, of the living standard, has triggered major changes in the working conditions. The continuous improvement of working conditions is made through additional measures imposed by the company management, especially through legislation constraints which regulate occupational safety, and which are specific to different fields of activity. There are fields of activity with toxic working environments which pose a threat to workers’ health and work capacity. Equipment and accessories have been recently developed for the protection of the human operator. Moreover, regulations implemented in many countries require the economic agent to take certain preventive, protective measures. The costs entailed by such activities depend to a great extent on the field of activity in which a particular economic agent is involved. These costs may be significant and sometimes continuously increasing.

In order to maximize profit and perform a fast and accurate analysis of its evolution, economic agents must conduct surveys on the quantity of workforce, the number of employees.

Figure 2 presents the graphic model developed by the CONCEPT Consulting and Training Center, which describes the economic effects of protective measures. The two axes of the model represent the unit price of the product and the quantity of products produced and delivered on the market.

The graph represents a model, and thus by changing certain factors such as cost of the protection equipment, employee wages etc., other factors of the model will change. The Legend presents the symbols used in the model. According to the graphical representation the model starts from a market of a product, represented by the demand \( D_X \) and supply \( S_X \). The two elements determined the market price \( P_X \) and quantity at the market price \( Q \). The demand determines the workforce demand, in proportion to \( D_X \) [2]. The initial workforce supply is \( S_L \), and it depends on the competition on the workforce market. When the company management offers protection for the workforce, additional costs may occur; this will be reflected by the final price of the end products. The improvement of the working conditions entail an increase in the workforce supply, i.e. the same personnel are willing to work for a slightly smaller wage and the quantity of products will increase. At a company level, the microeconomic environment adapts to the external constraints due to the labor protection measures which have been implemented.

Regulations which are set by the government require the company to take certain protective measures for the reduction of immediate or long-term hazards (toxic environments, tedious tasks, position at work etc.). The price paid by the company for protection equipment is reflected in the hourly pay of the employee. As shown in figure 2, \( S_L \) is the cost of the protection equipment. A first effect of protective measures will be the increase in workforce supply, i.e. supply \( S_L \) becomes \( S_L^{'} \). The combined effect of such changes will be the change of goods supply from \( S_X \) to \( S_X^{'} \) and the consumer price will increase from \( P_X \) to \( P_X^{'} \).

The supply for protection equipment is \( S_S \) and thus the price for the protection measures is \( P_S \). When the company provides
its workers with protection equipment, they are willing to work for a slightly lower wage, and thus the labor supply will change from A to B, effect which will be less significant than the cost for the protection equipment CQ, showing that workers will not see the benefit represented by the protection equipment as equal to the costs incurred, which will entail the change in the supply of goods to $S_X'$, and the end price of the product will increase from PX to PX'. This happens due to the fact that the cut in wages for the initial number of employees is lower than the increase in the protection costs, $S_X$ moves to $S_X'$, while $S_X' = f(SL' + SK + SS)$ [2].

The total unit cost of the quantity of goods Q shows that that particular industry is not able to cover its own costs for the initial price and the effect will be the reduction of supply to Q1, and of the price to $P_X'$, where the new supply-demand balance will be too, the difference in price will be paid by the buyer. If the worker will receive a wage equal to the distance BQ, plus protection, he/she will feel the positive effect, approximately identical to the situation before the implementation. AB representing the cut in wages due to protection.

In general, the decrease in the quantity of goods produced generates a decrease in the number of employees on supply $S_L'$ and eventually the wages will be $FQ_L$, lower than BQ. The salary will decrease more than the protection perceived by the employee. The net final cost of the action will be paid by the worker and by the consumer.

The economic profit $\Pi$, depends directly on the sale price of the product $P_a$, on the average cost $C_{vm}$ and the quantity Q, as show in equation 1.

$$\Pi = P_a \cdot Q - C_{vm} \cdot Q$$

As a result of the price rise to $P_X'$, figure 2, when the average variable expenses ($C_{vm}$) decrease more than the benefits perceived by the employee, the profit will not decrease, and the net costs will be paid by the worker and buyer.

4. REFERENCES

8. Rotaru, M., Cioca, L. I., identifying dangers and assessing risks for the administrative personnel at “hermann oberth” faculty of engineering, sibiu, romania, the 4th international conference on manufacturing science and education, june 4-6th, 2009, Sibiu, Romania, ISSN 1843-2522, pp. 333-336, 2009;
11. Cioca, L. I., Darabont, D., Nicolae, D., Modular System for OH&S Auditing, XVIII World Congress on Safety and Health at Work, June 29-July2, 2008, Seoul, Korea (nr. AB050), 2008;
ABSTRACT: This paper will outline the partnership between an educational establishment and Clinical Technologists a Health Trust to meet the agenda for change to support the regulation of Clinical Technologists

1. BACKGROUND

Clinical Technologists are part of the Healthcare Science workforce within the NHS. Staff employed currently have titles such as Clinical Technologist, Medical Engineer, Medical Physics Technician, Rehabilitation Engineer, Medical Electronics Technician, Dialysis Technician, and others.

Fully qualified and trained technologists are currently qualified academically to at least HNC level and have a number of years of additional healthcare equipment or healthcare service training and in-service experience. An increasing number of new entrants are degree qualified. At the more senior levels, staff often have additional formal qualifications, sometimes related to their supervisory and management roles and in some cases, they have an MSc qualification in Clinical Engineering.

The government has promoted the increase in the statutory registration of a variety of healthcare professions, originally through the Council for the Professions Supplementary to Medicine – CPSM (which included the original registered professions such as Radiographers and Physiotherapists). In 2002, the CPSM was replaced by the Health Professions Council (HPC), and further professions have been added to the register.

The HPC sets standards of education and training that have to be achieved before a person can be admitted to the Register. Standards of practice, conduct and continuing professional development are also set. The legal framework is such that certain healthcare professional titles are now protected. It is, for example, illegal to describe one’s self as a Chiropodist, a Physiotherapist or a Clinical Scientist unless one is registered with the HPC, whether one is working in the NHS or in private practice or industry. Within the NHS, employment in these registered professions is dependent on achieving and maintaining registration. The HPC has powers to investigate and hear complaints against registrants and to take disciplinary action against them, up to and including striking them off the register.

2. PROGRESS TOWARDS REGISTRATION OF CLINICAL TECHNOLOGISTS

At present, Clinical Technologists are not one of the registered professions, but are seeking to become so. A Voluntary Register is in existence to which most Clinical Technologists have subscribed. This was set up jointly by the Institute of Physics and Engineering in Medicine (IPEM), the Institution of Incorporated Engineers, and the Association of Renal Technologists and is know as the Voluntary Register of Clinical Technologists (VRCT).

Officers of the VRCT have been in discussion/negotiation with the Chief Scientific Officer at the Department of Health and the HPC about taking forward the statutory registration of Clinical Technologists through HPC. The most significant aspect of these discussions is a clear requirement that all registered professions should be at least honours degree based as the minimum educational achievement. It is recognised that there are two streams to the knowledge base required by Clinical Technologists, one clinical engineering oriented and the other medical physics oriented.

3. THE DEGREE PROGRAMME IN CLINICAL TECHNOLOGY

The Institute of Physics and Engineering in Medicine and the Association of Renal Technologists, on behalf of the VRCT, have developed a degree programme outlining learning outcomes and indicative content to support the regulation of Clinical Technologists. It is to meet the educational requirements for engineering oriented Clinical Technologists that this UWIC based programme is aimed.

However, it is vitally important that there is flexibility in the pathways towards the attainment of a degree in Clinical Technology because the NHS needs to be able to recruit qualified, competent and experienced technologists from outside to bring in skills and knowledge that can usefully be applied within the NHS. Furthermore, the medical equipment industry recognises that where they are providing medical equipment services to NHS equipment, their staff will be expected to be Registered also. This programme addresses both these issues.

This programme provides for an Anatomy and Physiology module at Level 1 and a Biomechanics module at Level 2 and for specialist modules in three out of four of the engineering oriented specialities, Medical Engineering Technology, Rehabilitation Engineering and Renal Technology. These latter will be taught in conjunction with appropriate NHS based specialists. Most of the remainder of the programme is based on existing engineering module already in use in UWIC. This is a positive approach because, in essence, what the NHS needs is engineering technologists with a broad engineering education, supplemented by specialist medical/clinical application aspects. Structured clinically oriented project will form a significant portion of this programme.
4. CLINICAL PRACTICE

Clinical practice will be undertaken for part-time students in their place of work and full-time students in partnership with a local health trust within the following modules:

- Project (level 2 and 3)
- Negotiated studies (level 2 and 3)
- Work based Experience (level 2)

The negotiated studies module enables students to undertake areas of study which are of particular interest and relevance to them. The module is research based and the students themselves are required to employ a range of suitable resources in order to meet the aims and objectives of the module. To this end a learning contract is agreed between each individual student and an appointed academic supervisor. The supervisor is responsible for the close supervision of the students’ progress and to ensure that the student meets the module aims and objectives. The module is assessed by means of a written report which the student is required to submit and which enables the student to demonstrate that he/she has gained the required skills and knowledge as detailed in the learning contract.

Additional clinical practice, especially the full-time route, will need to be undertaken after the completion of the academic degree as continual professional development in line with IPEM existing criteria. All the assessment within all modules will be focused, as much as possible, on live and work related examples and case studies. Assessment of clinical practice will be carried out by both the University’s academic staff and clinical supervisors. This was achieved by programme being devised by academic staff and staff from the Cardiff and Vale Health Trust based on the suggested programme by The Institute of Physics and Engineering in Medicine and the Association of Renal Technologists.

5. PROGRAMME DESCRIPTION

The BSc (Hons) Medical Technology programme is offered in full time study mode and leads to BSc (with honours). There is the exception for those students who are direct entry at level 3 with advanced standing.

Students whom are direct entry at level 3 will be able to elect to study by part time or full time modes hence allowing flexibility for Continual Professional Development. Only part-time students undertaking one of the Systems Engineering courses will be able to elect to register for the award of Ordinary degree Study is undertaken at three levels in a modular structure. A student requires 360 credits for an honours degree.

Modules have a credit value that is a multiple of 10 credits with some double or multiple modules according to the subject and nature of learning. The credit rating is pro-rata. The notional study time of each single 10 credit module is anticipated to be 100 hours. Modules are assigned to a particular level according to the academic demands of the subject.

- Level 1 modules contain substantial elements of theory and concentrate on the more fundamental aspects of electronics technology, laying the foundations on which following modules are based.
- Level 2 modules add greater depth to the subject material and are more applied, practical, investigative or analytical in nature.
- Level 3 modules extend or expand on work covered in Levels 1 and 2

6. PROGRAMME SYLLABUS SATISFIES THE IPEM CRITERIA FOR BREADTH AND DEPTH IN THE KNOWLEDGE BASE OF THE STUDENTS

The programme was devised by both academic staff and staff from the Cardiff and Vale Health Trust. The programme is based upon the suggestions as given by The Institute of Physics and Engineering in Medicine and the Association of Renal Technologists, on behalf of the VCRT who have developed a degree programme outlining learning outcomes and indicative content to support the regulation of Clinical Technologists.

7. SPECIAL FEATURES OF YOUR PROGRAMME

Project areas will be undertaken in collaboration with local health trust for live and realistic problems in the areas of Rehabilitation, Clinical Engineering and Renal Technology (Burns and Holifield, 2002).

Assessments will utilise the specialist equipment used within the local health trust due to the collaborative nature of the designed course (Holifield and Thomas, 1999). Flexible and blended learning is widely used within the course with all module materials and assessments available on the University’s virtual learning environment (Blackboard). Learning via the work place is a strong feature of the course to ensure the validity of the subject matter is appertaining to the industry.

The programme is also design that various stand alone modules can be used for Continual Professional Development through negotiation (Chisholm, 2003). The programme will follow the academic content set down by IPEM degree proposal over a three year period (full-time) and the additional clinical practice will need to be undertaken by full-time students after completing the BSc to fully comply with the suggested vocational degree of 4 years (Doderidge and Holifield, 2002). On a part-time basis the additional clinical practice should be undertaken as normal every day work practice in their current positions. Programme designed in conjunction with the local health authority and a Memo of understanding that engineers from the local health trust will assist in the delivery of the programme (Holifield et al 2008).

8. OUTCOMES

The project will provide training for a number beneficiaries over numerous years of the project to enable beneficiaries to gain various qualifications between levels 4 to 6 (HNC, HND and BSc.) and softer skills qualifications at the appropriate level. These skills will include - Time Management Skills, Communication Skills, Team building Skills, Confidence building skills, Problem Solving, Motivation, Self esteem, personal and career aspirations thus setting up a learning organisation (Garvin, 1993) These non accredited programmes will be assessed by UWIC to establish whether or not they can be accredited to a formal qualification either as a single unit or a combination of units. This will ensure that the skills and qualifications are recognised not only by their current employer but also by any future employer as well, thereby increasing the employability of the beneficiary.

The project could also lead to various Management level employees gaining a customised degree aimed at their own specific clinical engineering subject specification. The project...
will also lead to increased productivity due to all staff having the skills and knowledge to complete their roles in a more efficient and effective manner. The project will help develop the employed workforce, in terms of upskilling and supporting adaptation to economic change, thereby increasing levels of business and employment.

To address and deliver the outcomes then the lecturing staff need to be educated in the different approach to learning and teaching (Chisholm, 2006)

9. CONCLUSION

The concept of the Project is to offer a lifelong learning approach to education and training which is innovative in its delivery model. It will offer an improved way of giving individuals the opportunity to develop work-based skills to help keep them employable now and in the future. One of the essential outcomes of the project is that the beneficiaries can understand the importance of education and training in their lives, and the importance of keeping up to date with their skills to help them succeed in life. The project will offer skills, which are transferable into future career development paths and further education. One of the biggest challenges to widen access to learning is for all three learning providers to make it easier for people to learn. This will be achieved by encouraging people to have higher expectations of themselves and of others, providing learning at a time and a place to suit the individual or Company, ensuring that all learning has high standards of teaching of training, providing information and advice to people to clear a way through the jungle of jargon and initials, making learning welcoming, giving people the support they need in order to learn, providing qualifications for adults that are easily understood and recognising that over time, the way of doing things will need to change in response to the needs of learners.

The project also promotes widening access to learning opportunities by offering up to level 6 qualifications through work based learning and also the chance to gain a customised degree. The project ensures that employees of all levels have equal opportunity to develop themselves and gain more qualifications.

The project directly addresses the need for improving the quality of learning by ensuring those Companies and their employees receive what the project promises, get them to their goal and take them as high up the ladder of achievement as they are able to go. In order to raise standards the project will aspire to meet individual learners needs and aspirations, promote high quality teaching, set, publish and meet targets for improving achievement over the life of the project, identify and deal with any weaknesses, undergo objective external assessment and ensure good value for money.

The project strengthens co-operation, collaboration and partnership across South Wales and further afield. There is a commitment from all parties to work together to provide a high quality provision to all beneficiaries and to continue to promote the concept of lifelong learning to all. The outcomes of the project will be disseminated as widely as possible to encourage other networks to set up. In offering this framework, the partnership is demonstrating its policy of inclusiveness and its commitment to widening participation and encouraging lifelong learning. It is making it possible for individuals and groups to engage in negotiated approved studies delivered in flexible ways to match their work and life styles and to maximise their study time by focusing on workplace projects where they can learn through work.

10. REFERENCES

4. Doderidge M and Holifield, D., Matching Sections to meet the educational requirements for Incorporated Engineer Status IEE Symposium on Engineering Education London 2002
9. Holifield D, Pole G and Hartry K, Partnership approach improve engineers by bringing real-time projects into the undergraduate curriculum UALL Work Based Learning Conference, Cardiff 2009

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ABSTRACT: While the Information Systems represent an integral part of the modern society, there is an increasing demand for a new specialization area: the Information Systems Architecture. The people currently engaged in this new, highly specialized domain have usually an academic formation in either business or IT area, completed, by personal training efforts and practical experience, with knowledge and skills from the other specialization. This paper presents the rational for the promotion of the IS Architecture as an interdisciplinary, yet self-consistent, academic program. First, we present the typical components of an Information System, from both (business and IT) perspectives. Second, we highlight the main requirements for an IS Architecture curricula.

1. INTRODUCTION

Labels like Information Society or Information Age are part of the common vocabulary nowadays. Moreover, we usually think about Information Technology (IT) in connection with the above terms. In this paper, we argue that the design and development of information systems implies first of all a good understanding of the meaning, or semantics, of information – which requires, primarily, 'business' knowledge in the corresponding domain. IT is nothing else than a tool which enables the automation of the information processing.

However, the IT community has done over the last decades important steps on the field of information modelling, which, is, rather, a business-related issue. The business people should stop seeing information systems as a technical domain, and should make a necessary junction with the IT field. Sooner or later, as the IT tools will become easier to use, i.e. will raise their level of abstraction, the background of their users will switch from engineering to business.

The academic education has difficulties to follow this evolution. Both business and engineering education avoid the intersection area of the two domains (i.e. the information modelling, or the creation of formal specifications with maximum business semantic preservation), while this area is in fact the most important for the success or failure of the resulted information system. The IT engineers don’t get the necessary business knowledge to understand the scope and the bottom line of the systems they are building, and the business graduates consider the information systems as black boxes developed and maintained by people with high technical expertise. If this was true thirty years ago, this is not the case anymore.

The purpose of this paper is to emphasize the interdisciplinary nature of information systems, and to identify the most important knowledge, capabilities, and skills for anyone working in this field.

Section 2 shortly describes the Zachman Framework for Enterprise Architecture [14], as a set up for the following discussion. Section 3 analyses the business view over the information systems, while Section 4 considers the IT perspective. In Section 5 we propose the main common topics related to information systems architecture, which we consider mandatory for the professional background of anyone (business analyst or IT engineer) involved in the field. We conclude in Section 6 with some proposals for the integration of an IS Architecture curricula in current academic programs.

2. A SET UP FOR OUR DISCUSSION – THE ZACHMAN FRAMEWORK

The increasing complexity of the information systems has led to the distinction between the different perspectives from which a system is viewed. The Zachman Framework [15] identifies six different perspectives for any information system. We present here a slightly modified version from the original proposal, in compliance with the Architecture Framework defined in reference [8]:

- **The Scope Perspective** – the understanding of the enterprise mission, strategies, and broad business purposes. It establishes the universe of discourse, and defines the boundaries of the system. Describes the business at the strategic level.
- **The Owner’s Perspective** – defines the required characteristics of the end-product (i.e. the information system). Contains the description, in business terms, of the enterprise, including its structure, processes, procedures, business rules, human resources organization. Describes the business at tactical level.
- **The Architect Perspective** – (re)defines the model of the business contained by the owner’s view, in a more disciplined fashion, suitable for automation. However, the conceptual models resulted are not technology dependant. They are equally valid regardless which technology (or commercial product) is used to manage data, to build the application, or to set up the communication technology and security protocols. The Architect Perspective defines the Information System at a technology-neutral level.
- **The Designer’s Perspective** – represents the design plans drawn by system engineers, in accordance with the technologies chosen for system development. This level depends on the theoretical foundation of every technology (e.g. relational, network, hierarchical, or object-oriented databases, third- or fourth-generation programming languages, etc.). The deliverables issued at this level are valid for classes of technologies, but they do not depend on specific commercial
implementations of any particular technology. The Designer’s Perspective considers the Information System design at a technology-class level.

• **The Builder’s Perspective** – represents the detailed representation of the system, according with the technical specifications of the particular tools employed in system development. The Builder’s Perspective considers the Information System design at a technology-specific level.

• **The Functioning System Perspective** – represents the end product itself. Unlike the previous perspectives,

The second dimension of the Zachman Framework employs six independent variables which should be considered in connection with all the above perspectives of the enterprise architecture. In a graphical representation of the framework, these variables will constitute the columns of a matrix with thirty six cells (see Figure 1):

<table>
<thead>
<tr>
<th>The Scope Perspective (Business Strategic Level)</th>
<th>The Builder’s Perspective (IS technology-neutral level)</th>
<th>The Designer’s Perspective (IS technology-class level)</th>
<th>The Functioning System Perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>What (Data)</td>
<td>How (Function)</td>
<td>Where (Location)</td>
<td>Who (People)</td>
</tr>
<tr>
<td>List of Things Important to the Business</td>
<td>List of Processes the Business Performs</td>
<td>List of Locations in which the Business Operates</td>
<td>List of Organizations Important to the Business</td>
</tr>
</tbody>
</table>
| Business Vocabulary | Business Process Model | Business Logistics System | Organization Chart | Master Schedule | Business Plan-
tactics, policies, rules |
| Databases | Programs | Communication Facilities | Trained People | Actual Business Events | Enforced Rules |

The table from Figure 1 was completed with some examples of business and IT documents employed by the information systems development projects. They are not intended to be exhaustive, nor prescriptive. Their purpose is just to illustrate how an architecture framework can help us to conciliate all the different angles from which an information system (like any complex product) can be viewed.

### 3. THE BUSINESS VIEW

Before any discussion about the business view vs. the IT view of the information systems, it has to be said that the architecture framework’s main purpose is to provide a classification scheme for descriptive specifications of complex systems. It is not intended to be a methodology, and does not require the completion of all the thirty six cells. It just reminds us that, if we don’t have structured, written specifications for all the cells, it’s because we have chosen to elude them in our development methodology.

In fact, it is possible to build a functioning system (Row 6) using just the Row 5, i.e. the builder’s perspective about the system. In this case, the builder keeps in his/her mind all the previous four rows of the architecture, even if there are no written specifications for any of them. Obviously, this approach becomes inappropriate when the level of complexity is rising.

Traditionally, business people consider the enterprise information system as the IT department’s responsibility. For this reason, even when they elaborate business documents which address some cells of the first or second row of the Zachman Framework, those documents are not structured to serve as requirements for the information systems. Thus, the information systems are usually built by IT specialists, with far too little involvement from the people on the business side.

The solution for this state of affairs came, naturally, from IT people with a technical background, forced to take simultaneously the role of IT system designers, information system architects, and business analysts. We refer specifically
to the business rule approach [1,12,13], which focuses on the
development of a business model for the enterprise, created
primarily by business people, but which should provide, in a
structured manner, the business requirements of the Row 2 of
the architecture framework. This will put back in control the
users of the information system, and will provide the systems
designers with the necessary business model, in order to build a
better tailored system to the actual requirements of its users.

This is how the business rule methodology addresses the six
abstractions of the architecture [13]:

- **Motivation (why):** by the creation of a Policy Charter,
  which outlines the business goals and tactics, including the
core business rules.
- **Function (how):** by the development of business process
  models.
- **Data (what):** by developing a standard business
  vocabulary, organized into a Concepts Catalogue.
- **People (who):** by defining the organizational roles and
  responsibilities.
- **Time (when):** by examining the stages and states of the
  core concepts.
- **Location (where):** by building a Business Connectivity
  Map indicating the business sites and their communication
  links from a business perspective.

Like Zachman Enterprise Architecture, the Business Rule
Methodology is just an example for the structuring effort
needed to design and develop an information system. Even if
we use other names for the above concepts, we finally arrive at
similar solutions. The business requirements at the strategic
level (Row1) or at the tactical level (Row2) of the enterprise
will still have to be structured, using a set of standard models
for business vocabulary, processes, rules, events, and so forth.
For this reason, the business people, especially those working
at the tactical level, should have the necessary knowledge,
capability, and skills to develop and to permanently maintain
these standard models, in accordance with the business needs
of the organization. In fact, this is the typical profile of the
business analyst, arguably one of the most important roles in
the 21st century organization.

4. THE IT VIEW

If we look at Figure 1, it is clear that row 4 and row 5 of the
architecture are, completely, the IT people responsibility. Row
2 and row 3 are most often covered by people with an IT
background, but with the required business knowledge for an
accurate capture of the business semantics in the functioning
system. In fact, the conceptual models specific to the row 3
don’t (have to) use any technical terminology. They remain the
same, regardless the degree of system automation. The only
thing specific to the engineering field, at this level, is the rigor
required by the system automation.

It follows that, in order to be able to access the Architect’s
Perspective, i.e. the row 3 of the Figure 1 architecture, IT
people should be familiar with the business concepts and
terminology contained in the conceptual models. Moreover,
they should have a clear idea about the enterprise policies,
rules, strategies, and core values. It is important to realize that
we cannot design and build a system, unless we know exactly
which is its final purpose.

When the IT engineers will understand that the continuous
change of the business requirements is by itself a business
requirement, they will escape from the frustration of ‘never
ending projects’. An appropriate perception of the business-
driven nature of the information systems should provide the IT
specialists with the means for building better tools, designed to
facilitate rapid business changes.

5. MANDATORY TOPICS FOR ANYONE IN
THE FIELD

If we look again at the Figure 1 architecture framework, the
common sense will tell us that anyone engaged in one specific
row of the framework should be able to deal with the concepts
and the deliverables employed in at least two other rows, in
both directions: up or down in the table. In other words, the
board of the company does not need to know too much about
the IT-related rows (i.e. row 4 and row 5), but it would be
useful to understand the models related with the second and the
third row of the framework. Similarly, an IT engineer working
at the row 4 level, may successfully accomplish his or her daily
tasks without too much knowledge related to the enterprise
strategies, policies, rules, value chain, or competitive
environment.

But the great majority of the individuals involved in
information systems projects are working in some fields related
to the second, third, or fourth rows of the framework. The
conclusion is straightforward: they all need to ‘know’ the row 2
and the row 3 of the framework, while a general idea about row 1
is always a plus.

It is important to emphasise that, if the Zachman Framework
preserves its validity over time, the methodologies used to ‘fill’
its cells are continuously evolving. This is why we propose
here an open list with current methodologies and modelling
techniques, which is subject to subsequent changes and
completions:

- **General Business Issues**
- **Business Strategy, Vision/Mission, Core Values**;
- **Enterprise Management Architectures**;
- **Marketing Strategy, Value Chain Analysis**;
- **Core IS Architecture Issues**
- **Business Process Management, Business Process
  Reengineering, Business Process Modelling Notation [9]**;
- **Supply Chain Management, Customer Relationship
  Management (CRM), Business Logistics Management;
  Business to Business (B2B) Solutions**;
- **The Business Rule Approach, Semantics of Business
  Vocabulary and Business Rules (SBVR) [1,2,5,6,10,12,13]**;
- **Information Modelling, Conceptual Data Modelling,
  Entity Relationship Diagrams [7,8,3]**;
- **Application Architecture, Data Flow Diagrams**;
- **Unified Modelling Language notation [11]**;
- **Technical Issues**
- **Database Design, Relational Model [4]**;
- **Applied Mathematics, Set Theory, Logic**.

6. CONCLUSIONS

Our entire society is relying in a growing measure on
information technology. In this context, information systems
architecture becomes a key specialization, which requires
highly trained persons, with a mixed background of business
and IT competencies.

At the same time, a short review of the must-know topics
enumerated in the previous section will reveal the fact that
some consistent working experience is needed in order to fully
understand the underlying concepts. It follows that a graduate
(e.g. master) program is probably the best suited for the
formation of Information System Architects. The corresponding curricula should consider the same class of topics like those proposed in Section 6.

At the current stage of the industry, in which the main modelling techniques and methodologies of the field are coming from the IT world, a Master in Science in a technical university and an MBA with emphases in Information Systems appear like quasi equivalent options. However, when the business field will assimilate these tools (i.e. row 2 and row 3 of the Architecture Framework), Information Systems Architecture will become rather a business speciality.

7. ACKNOWLEDGEMENTS

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8. REFERENCES

THEORETICAL PERSPECTIVES AND OUTCOMES OF THE COLLABORATION BETWEEN AN ACADEMIC INSTITUTION AND AN ENGINEERING ORGANIZATION

CASE STUDY – “LUCIAN BLAGA” UNIVERSITY OF SIBIU – CONTINENTAL AUTOMOTIVE SYSTEMS PARTNERSHIP

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ABSTRACT: The aim of the paper is to set forth the win-win partnership between Continental Automotive Systems and “Lucian Blaga” University of Sibiu, as a successful illustration of the cooperation between an engineering organization and an academic institution. The topic of the present paper is highly topical as it discuss both the theoretical dimension and practical implications and results of the interaction between engineering education, on the one hand, and engineering research and development, on the other; as well as an integrated system of education that facilitates undergraduate and postgraduate engineering training in keeping with the latest requirements in the field.

Keywords: university-industry cooperation; win-win partnership; education-research/development – production/accomplishment; keeping up with current European educational requirements.

Motto: “Universities today have recently become institutions whose performances can influence technologies, current statutes of economy, efficiency of administration and relevance of culture in today’s society. However, they can only perform their genuine part of centres for innovation and renewal provided that they are subject to reform. It is imperative to implement in our country such a reform: comprehensive, realistic and well-supported.” [5]

„Universities need to set as a mission goal the improvement of the nexus between research and teaching. ...The aim is to increase the circumstances in which teaching and research have occasion to meet.” [4]

1. THEORETICAL BACKGROUND

The phrase „future shock” was coined by Alvin Toffler who first used it in 1965 in an article in „Horizon” in order to define the “shattering stress and disorientation” felt by individuals subject to too much change in too short a time; in other words, this is a „disease of change”. Preparing for the future represents one of the most demanding tasks of humankind at the beginning the 21st century. The choice we make, both personally and nationally, i.e. resistance or adaptation to change, will define the response both at a personal and social level, and it will definitely affect the quality of life. [8]

The concept of quality of life has been recently included in the social sciences vocabulary and it can be defined by its relation to sustainable development – that type of development that ensures the meeting of current needs and requirements without compromising the possibility of future generations to meet their own needs, it represents an economic increase that satisfies the short, medium and especially long term needs of society. [7]

Lester Brown pointed out the fact that: “we need a new moral „compass” to guide us through the 21st century, a compass based on the principle of sustainable meeting of human needs.” [2]

In this context, mention should be made of certain documents and instruments that illustrate the process of European Union’s adaptation to current changes and challenges. The Lisbon Strategy also called the Lisbon Agenda or Process has set out the aim of making the EU “the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010.”

The main fields included in this strategy are: economic, socio-environmental renewal and sustainability. The Lisbon Strategy is heavily based on the economic concepts of: innovation as the motor for economic change; the learning economy; social and environmental renewal. The learning economy is a relatively new concept whose core idea is knowledge as an essential element for the development of both society and economy, thus entailing a new and more dynamic vision of society.

Therefore, university and industry seem to function on an increasingly interdependent basis especially that the university has been of the called an “industry of the future” whereas the new economy has become a “learning economy”. It is imperative to re-examine and re-structure the mission and role of academic and business communities with an emphasis on public-private partnerships in the age of a knowledge-based society where innovation and production of knowledge represent the currency of the future. We should draw a distinction between knowledge and information; the mission of industries is to develop research and production, whereas the mission of universities is to foster knowledge by means of education and research.

Another relevant instrument is the European Research Area created in 2000 with the purpose of increasing the competitiveness of European research institutions by bringing them together and encouraging a more inclusive way of work.
as well as increased mobility of knowledge workers and deepened multilateral co-operation among research institutions.

In order to define the concept of knowledge worker one must be aware that businesses should improve communication and engage in collaboration to survive. This is a modern concept triggered by businesses dependence on information technology and it further laid the foundation of Knowledge Management (KM). The term was first coined by Peter Drucker (1959) and later developed by Toffler (1990) and Nonaka (1991) focusing on knowledge creation and innovation within organizations. Both companies and universities are focused on innovation fueled by knowledge, therefore the natural outcome is an alliance of public and private teams to solve problems.

The changes occurring at increasingly rapid rhythm in the politics, culture, economy and technology of the 21st century have engendered the academic reform on the background of the knowledge revolution meaning that wealth is based upon the ownership of knowledge and the ability to use that knowledge to create or improve goods and service. This is the third revolution following the previous waves of change i.e. the agricultural the industrial revolutions. Contemporary higher education faces unprecedented transformations generated by three factors:

- Communication and information technologies, heralding the entry to the „digital era” as well as an acknowledgment of information and knowledge as fundamental sources of social and economic development, have inevitably contributed to the expansion of globalization. The effects of such technologies have a profound impact on the academic world.
- Increasing individual demand for higher education has led to the notion of mass education. Education used to be selective and addressed to an elite; academic degrees ensured higher social statute and prestige; this is contradictory to the effect of „massification”. Thus intellectual elitism that marked the research revolution and focused on fundamental and applied opposes egalitarian trends of mass education.
- The market for higher education – institutional diversification in the public-private area and the increase of individual demand for higher education have led to fierce competition among universities.

The concept of education reform, according to Professor Andrei Marga, former Minister of National Education in Romania, includes the following components:

- minimize the curriculum and adaptation to European standards;
- transformation of education from reproductive to creative and placing scientific research at the center of academic studies;
- improvement of infrastructure and expansion of electronic communication;
- initiating a partnership and interaction between universities and the economic, administrative, cultural environment;
- performance and competitive-oriented management;
- integration in the new structures as well as the international network of higher education institutions. [5]

Reform can be considered both an opportunity and a threat, but one cannot deny that it will have an impact on the education system at all levels: teaching staff, students, administration and auxiliary staff, curriculum.

Since Romania’s accession to the European Union it has become a pressing need that LBUS „focuses all its academic efforts on establishing itself as a well respected member of the European Space of Higher Education. Thus, development in the main academic areas: research and teaching are imperative.” - Prof. Dr. Werner Schal, President of LBUS [10]

According to the Operational Plan for Institutional Development of the Lucian Blaga University of Sibiu, education and research shall be promoted in keeping with the requirements for integration to the knowledge society in view of active participation to the European Space of Higher Education and the European Research Area. In this respect, LBUS has undertaken the mission of:

- promoting teaching and research in keeping with the requirements of a society based on knowledge and continuous learning, integrated in a European and global context;
- contributing to local, regional and national development from a social, economic, cultural and political perspective by means of active participation to the environment and community;
- systematic knowledge and providing original contribution to major fields of science and technology at the dawn of the 21st century, associated with flexible, comprehensive, interactive and continuous learning;
- promoting and supporting, in its capacity as public institution, within the local, regional, national and international community, the development of a culture of proactive and participatory attitude, of personal development and of integration to diversity and globalization;
- openness to the interaction with the economic, social and academic communities at local, national and international levels.

History has fully testified that the Humboldtian university tradition represents the most successful solution, and now more than ever the main principles (of the newly founded University of Berlin) set forth by Wilhelm von Humboldt in his writing “On the internal and external organization of the higher education institutions in Berlin” (1810) are as relevant and topical today as they were at the end of the 18th century and contributed to the further growth of ‘research universities’ in Germany throughout the 19th century:

- the freedom as well as unity of research and teaching (guarantee of academic freedom for faculty members)
- the close nexus between research and teaching
- academic self-governance
- the unity of science and scholarship (Einheit der Wissenschaft)
- the principle of formation of the personality through scholarship (Bildung durch Wissenschaft), i.e. the primacy of ‘pure’ scholarship over specialized professional training

As Lydia Hartwig pointed out in her lecture “Is Humboldt still relevant today? Notes on the relationship between research and teaching from a German perspective” [on the occasion of the International Colloquium Policies and Practices for Academic Enquiry, at Marvell Conference Center, Winchester, 19/21 April 2007]: “The Humboldtian University model served as a cornerstone of Germany’s advancement in science and research in the late 19th century and is regarded as the historical inspiration for the modern ‘research university’”.

Nowadays, teaching and research are integrated within the role of the professor as well as the institution at large; you can become and be promoted a university professor only by outstanding performance of both functions: fundamental research and academic teaching.
The mission of universities is to foster and disseminate knowledge and at the same time academic institutions need be alert to the changes occurring in society and public life and abreast of the latest trends, developments and discoveries. Universities should be both responsive, i.e. receptive to what society expects from them, and responsible, i.e. the ambition to guide reflection and policy-making in society; the place of the university in society.

At this stage, it is imperative to refer to the current status and challenges of higher education:

- the strength, prosperity and welfare of a nation in a global knowledge economy will demand highly educated citizenry; it will require institutions with the ability to discover new knowledge and transfer it to the market-place through entrepreneurial activities.
- traditional institutions are being challenged by the powerful forces characterizing the global economy: hypercompetitive markets, demographic change, increasing ethnic and cultural diversity, disruptive technologies, etc.

Therefore, we have provided some evidence for the necessity for a public-private partnership, in view of a joint research- or technology-based initiative, as the matter-of-course outcome for survival in an age marked by both the value of knowledge and money.

New markets and the overwhelming globalization present both opportunities and challenges both industry and university and their most important characteristic – in order to gain competitive edge – is adaptivity, defined as the ability to respond promptly and unhesitatingly to various stimuli and be open to upcoming changes that further lead to progress.

The current financial and economic crisis represents a major challenge addressed to the automotive industry as well as to the higher education system; our duty is to make this crisis a seemingly unsurmountable challenge into a prospective opportunity and preserving competitiveness; a crisis has a potential for opening up minds, thinking ahead on the basis of efficient coordination of efforts.

“Experience has shown that an organization is the result of maintaining balance in the context of major turbulences triggered by internal and external constraints in pursuit of profit – the output of organizational process that justifies survival... Organizations need to invest much effort in order to attain this level of competitiveness in a highly competitive economy, where supply greatly exceeds demand.” [6]

2. CASE STUDY

This partnership - based on the cooperation contract concluded between Lucian Blaga University of Sibiu and Continental Automotive Systems - has successfully brought together academia and industry to foster development and transfer of ideas and to provide specialized and special-focused training for undergraduate and graduates enrolled at LBUS and CAS employees, as well.

A university-industry partnership means a capitalization of teaching – research – manufacturing, as well as a successful merger of fundamental research mainly undertaken by university and applied research, performed by the Research and Development Department / the Engineering Center at CAS.

A significant outcome of this partnership has materialized in the setting up a new study program of “Applied Electronics” beginning with the academic year 2007/2008. The sponsorship of a professorial chair represents a step further in the successful collaboration between LBUS and CAS, besides additional substantial support of academic endeavours - for both teaching and research, mention should be made of:

- attracting and retaining the very best academic talent for further collaborative research between university and industrial partners;
- supporting “Robosib” competitions
- supporting student performances by scholarships
- internship programs
- preparing diploma projects at CAS premises

On the other hand, the input of LBUS teaching staff to this collaboration includes:

- providing an extracurricular optional course “Embedded Control for Automotive Systems”
- delivering a course on “Digital Control”
- preparing the teaching material for delivering a course on “CAN Communications”
- preparing courses to be delivered to CAS employees by LBUS teaching staff: electrics, electronics, pneumatics, mechanics and fine mechanics

The goal of this ongoing partnership has been achieving institutional appeal and corporate sustainability by means of a balance between economic requirements, market challenges on the one hand, and expectations from target groups (i.e. undergoing education and training programs).

We can definitely state that both Lucian Blaga University of Sibiu and Continental Automotive Systems are mature and self-standing organizations able to make full use of their resources (human and material) so that they can keep up with the ongoing changes and demands of society. Thus, the team made up of congenial partners preserves the qualities of uniqueness of participants and strength of coordinated action without losing distinct individuality.

It has been acknowledged that traditional research and academic institutions have been subject to complex forces that have an impact on global economy, at large: hypercompetitive markets, new technologies with a disruptive impact on sciences, and the knowledge-based economy requires substantial and continuous investment in educational development. Higher education and academic research may explore and capitalize the essential contemporary issues, such as: economic, political and environmental sustainability. [apud “The Globalization of Higher Education”, Glion Colloquium]

3. CONCLUDING REMARKS

The fundamental research work conducted at the Lucian Blaga University of Sibiu contributes significantly to the applied research performed in the Engineering Center, especially in the fields where Continental Automotive Systems has complementary skills, under the aegis of a “win-win” partnership.

This present study illustrates the successful case of an industrial-academic cooperation involving a university and an automotive company, both enjoying local, national and international recognition, thus promoting excellence in the processes of teaching and research, as a full proof of the motto: winning the future together.

Developing constructive relationships between business and academic communities may be a challenging but equally rewarding task and such collaborations are gathering
momentum throughout the developed world. [apud “Best Practice in Business-University Collaboration”, Glion Colloquium]

The academic institution can improve the quality of education by learning from the good practices and applied research of undertaken by business and engineering organization, whereas the company may enhance its performances by motivating its employees to further their education (graduate studies) and participate in training programs provided by the teaching staff.

4. REFERENCES
1. Androniceanu, Armenia, Managementul schimbarilor, All Educational, Bucuresti (1998)
10. Profile of LBUS, 2009
SOME RESULTS OF THE PRACTICAL EXPERIMENTS USING NEW METHODS OF WORKING WITH IMAGES IN DIRECT RELATION TO THEIR TEXTURE ANALYSIS

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ABSTRACT: In this paper the authors try different methods of working with images in direct relation to their texture. To find a better solution, the authors have treated the subject simultaneously as engineering and as business education’s problem. Finally, the adequate approach was a statistical one. In many natural surfaces, the texture is always exposed and a successful visual system must be able to work with the environmental textured world. The methods of texture examination proposed in this paper could be and are indeed used in a wide range of domains such as: medical picture processing, automatic inspection of surfaces, documents processing, distance viewing etc. The texture’s analysis was intensively used also in classifying and finding distance images (satellites etc). In this kind of images there are also a lot of homogeneous regions with different type of textures that must be identified (for instance a texture analysis could identify different types of fields: water portions, earth, cities, grass, etc.) and different methods are more or less adequate to a proper texture analysis. For the experiments the authors have used soil, water and grass samples. The final remark details the inferences from the samples’ experiment to the world of engineering and business education, through images and Computer’s performance. [COLLABORATION IN ENGINEERING AND BUSINESS EDUCATION]

1. INTRODUCTION

For optimizing the educational system, the usage of all the imagine information retained in the multimedia database can constitute a real possibility with major results and immediately impact. Multimedia can extend the existent applications but can lead to revolutionary re-finding, at information processing in many fields such as: economy, art, science, education and engineering. Multimedia database – realizes the union between the objects of re-finding information and managing the databases.

The achieved study can be used in various fields like:

- in information - multimedia is the most fast, efficient and cheap mode comparing it with other information fields of those who study, containing electronic encyclopaedias;
- the management of documents and recordings – in the educational and experimental process of the data obtained from various domains, these need various documents, depending on their specific;
- in education ad instruction – re-finding of the materials for preparing all the persons;
- medicine – the alphanumeric and imagistic information is used in assistance with the clarification of the document, in research or medical education;
- the control and monitoring of the processes in real time – together with the active databases, the multimedia presentations of information have an affective role in monitoring and control operations in the transport systems, surveillance of the patients, etc. With the purpose of realization the laboratory works.

For realization of all these applications in optimum conditions, the multimedia databases apart from providing a minimum access time to data must guarantee their security and independence.

The information’s decoding transmitted by these images is done by the people witch watch them and are the final users of the application. From this point on, the images have a better and better resolution for a much better representation of the details. The colour numbers is also bigger and bigger for the representation of the fidelity to be sustained from this point of view.

2. MATERIAL AND METHOD

2.1. Visual search based on contents, comparing the images and techniques of describing them

One man can easily recognize an object. He can’t explain the used method for recognition with the purpose of transposition of it in an algorithm, for the computer. Because of the human intuition, of the learning and generalization capacity, the human can recognize objects witch he never recognized before. Some objects hadn’t been seen, they can’t be confounded with another by human. In the visual search based on contents, the recognition is realized by identifying the recognized object, by one resemblance or a similitude with an initial learned object. One of the most elementary operations witch we can do with images is to ask: "how similarly can be two images?" If we can respond in a reasonable way at this question, we open the possibility of many applications: searching of images in Internet, digital libraries nor recognizing objects (by comparing with a prototype image), witch permits much more sophisticated applications. Although the question may seem simple, even for a human the response isn’t always obvious. Actually, for responding, we must clarify witch is our measure for “approach” or “distance” between two images. Plus, different applications will probably have different notions of “approach”: one herbalist will consider two images who contain a bush with roses likewise, even if the rose is in a flowerpot and the other one somewhere in the garden, one specialist in interior decorations will consider the two images being very different (probably will be bugged by the idea of...
having as an ornament a rose bush). Algebra permits the efficient solving a part of the problem. For every image “we measure” in a way a series of parameters with are important for the classification. Every parameter will have a value. Some examples of parameters:

- the magnitude of the image in pixels;
- number of colours or different gray hue;
- the dimension of the biggest “stain” of mat colour from the image;
- the number of points from an colour;
- medium number of consecutive points from a colour on a given direction;
- average of the image colours;
- the maxim and minimum intensity of the image points.

2.2. An algorithm for processing the multimedia information

In describing the images, indexing and recovering it bases on a descriptive scheme of a texture-colour-form texture. Colour, distribution saturation, combination, etc., reflect the ensemble perception of the image which is considered as being the most important human classification criteria. For the texture we don’t have a clear definition. It bases on the transposition in formulas of linguistic terms like: delicacy, regularity, contrast, orientation. The form bases on:

- calculus of distribution of structural characteristics – intensity of contours, corners or others primitives of such forms, orientation;
- calculus of particular form descriptors, obtained by segmenting the image or identifying the interest region.

Shape information can be covered by adequate describe of the texture, on the other side it bases on a specific approach of every application or problem.

![Diagram](image.png)

**Figure 1.** The algorithm for indexing and retrieval of similar images
3. AN EXPERIMENT BASED ON THE VISUAL SEARCH BASED ON CONTENT USED IN THE EDUCATIONAL PROCESS

The study can be used in the educational process in varied areas. As medicine is the area in which human are involved, errors must not be present when taking such decisions. That's why we present the application of this system in this way. In research as in education and practice the decision is very important when a diagnosis is confirmed and set. This proposed method not only can confirm this thing but can give instructions in the decisions taken by re-finding a similar case in the database.

To do a comparative study the following experimental steps must be followed:

1. Two data bases are created.
2. Every image in the data base is changed before the interrogation begins. This thing is important because it requires time and for this reason it's not wise to be executed in the same time as the interrogation.
3. A target image is chosen and a human observer arranges the images considered relevant for the respective interrogation.
4. Every relevant image for the interrogation has been utilized one at a time to interrogate the data bases with images.

The performance of the re-find operation is measured with the help of three parameters:

• speed;
• redial;
• precision.

The precision and redial represent an average of the values of every image taken as an interrogation – image. In this experiment the target is an endoscope image of a possible esophagusitis (the image in the first row). The resulting images of the search process help the specialist or future specialist in establishing a correct diagnosis. All surfaces that describe visual patterns with homogeneity proprieties have as propriety texture. In other words the texture indicated the physical composition of a surface. The tincture has the following characteristics: coarseness; contrast; directionality; line-likeness; regularity; roughness. For the texture must be perceived a bi-dimensional matrix in made by decoding the image file (jpeg, bmp).

Statistically the texture is characterized using the statistical properties of the grey and colour areas, of points/pixels that belong to the surface of the image. For experiments we used the matrix of co-occurrences is and the matrix of iso-segments of the grey or colour levels. These methods are based on the processing of the images at pixel level and the construction of a matrix with information about certain spatial positions of the pixels. The resulting matrices will be further analyzed and based on the existent information the characteristic vectors will be calculated. Every method will be studied taking into consideration the pixels of the image files of certain directions and situations.

The distinction between different textured can be made mainly by inspecting the co-occurrence matrix, by viewing it in a three-dimensional medium.

\[ M_{t}(a,b) = \text{Card}\{ (x, x+t) \in \mathbb{R} \times \mathbb{R} | f(x) = a, f(x+t) = b \} \]  

\( M_{t}(a,b) \) will be the number of pixel pairs from the R area (region), separated by the offset vector t, which have the value of the grayscale or color levels equal to a and b.

![Figure 2. The co-occurrence matrix](image)

For a fixed orientation (direction) \( \theta \), an iso-segment matrix can be determined: the elements \( M_{\theta}(a, b) \) represent the number of segments that have a given length equal to b, formed from pixels of a given grayscale or color level, and orientated on the \( \theta \) direction.

\( M_{\theta} \) – the iso-segment matrix.

\( M_{\theta}(a,b) \) – the number of iso-segments

unde:

\( \theta \) – fixed orientation
a – the gray level of the pixel
b – the length of the segment

![Figure 3. The iso-segment matrix](image)

The resulting matrix has L lines, and a number of columns equal to the maximum segment length on the given direction (\( N_{\theta} \)).
Figure 4. Visual search using the texture descriptor on medical images

Relevant image used for interrogation – diagnosis esofagita

1) yes (interrogation) 2) yes 3) yes 4) yes 5) yes

Results regarding the co-occurrence at 0 degrees

1) yes (interrogation) 2) yes 3) yes 4) yes 5) yes

Results regarding the co-occurrence at 45 degrees

1) yes (interrogation) 2) yes 3) yes 4) yes 5) yes

Results regarding the co-occurrence at 90 degrees

1) yes (interrogation) 2) yes 3) yes 4) yes 5) yes

Results regarding the co-occurrence at 135 degrees

1) yes (interrogation) 2) yes 3) yes 4) yes 5) yes

Results regarding the iso-segments at 0 degrees

1) yes (interrogation) 2) yes 3) yes 4) no 5) yes

Results regarding the iso-segments at 45 degrees

1) yes (interrogation) 2) no 3) no 4) yes 5) yes

Results regarding the iso-segments at 90 degrees

1) yes (interrogation) 2) no 3) yes 4) yes 5) yes

Results regarding the iso-segments at 135 degrees

Figure 5. Relevant images for esofagita diagnostics

4. CONCLUSIONS

Beyond the theoretical informational general premises, 4 significant hypotheses are born that generated the inner architecture of the research done, and finally are the validated conclusions.

The first hypothesis is that of a veritable “ informational law of the decreasing utility of images” similar to the one of polish thinker Lukasiewicz with the sense of selecting from the informative volume based and structured on images of a decreasing sample with useful images that contain real terms all or almost all essential characteristics of classical information.
The second logical hypothesis is spawned from existence premise in the present of a series of administration systems of databases capable of coordinating all types of media many of these systems based on indexation re-finding structured information after traditional techniques. This second hypothesis has generated the inclusion of a statistic on the evidence of the main systems of indexing and search in multimedia data bases, regarding the visual identification of images.

This premise is followed in informational plan by the premise of re-finding the images in any database. This fact has shaped a 3rd hypothesis by describing the methods and algorithms to interrogate the multimedia data bases. The interrogations have been described after the essential characteristic but after the nature of the image.

The premise of informational efficiency and the pragmatism of shaping delimited in conceptual plan a forth contain hypothesis consisting in realization of superior performance in the process of recovering by increasing searching speed.

6. REFERENCES

1. Enescu Florentina, Algorithms and methods of processing information distributed through multimedia, PhD thesis 30. 06.2008
MODERN METHODS OF STUDY AND RESEARCH IN MECHANICAL ENGINEERING APPLIED TO MEDICINE

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ABSTRACT: This paper aims to present modern interdisciplinary study and research in engineering and medicine. For this the authors have focused on assessing the quality of restorative oral treatments, which ensures the success of restoring and maintaining health system stomatognathic tissue. The goal of this paper is to review the modern methods of reverse engineering applied to dental restorations, namely: scanning 3D in vitro tissue dental scanned using CAD-CAM systems of the same tissue and reconstruct 3D models as images obtained from CT. Authors makes a comparison of these methods and analysis using finite element models obtained in order to identify the behavior of these tissues. An understanding of the fundamental principles of biological, physical, mechanical, is important in learning and training of students in both fields.

1. INTRODUCTION

This paper presents modern methods of study on mechanical loading and not just in the field of dental medicine. An important role in learning new methods in both, mechanical and medical study, is using computer for study of complex space models. In the last decades, was developed many applications that can be found at the border between the two fields (mechanical and medical). Today we can’t study the mechanic problem of various dental structures without to use numerical simulation programs. Of all these, the finite element method emerges as the main method of calculating the mechanical loading. This is not possible without the help of advanced computers and without the geometric model of studied structures.

The main difficulties encountered in studying the mechanical loads of teeth or dental works are related to their geometrical shape. In present, there are many ways of achieving 3D model of the tooth or dental structures. The best known methods are:

- **Geometric modeling using a commercial CAD software:**
- **Scanning model using a 3D laser scanner,** followed by the import of the model thus obtained in a CAD or CAE programs;
- **Using a CAD-CAM equipment dedicated to getting teeth or dental structures of zirconium and other materials to obtain three-dimensional models;**
- **Geometric model reconstruction using 2D images obtained after imaging analysis of MRI or CT and converting them into three-dimensional models in order processing in CAD and CAE programs.**

2. GEOMETRIC MODELLING

2.1. CAD Modelling

Geometric modelling using commercial CAD software (Catia, Pro-e, Solidworks, Unigraphics) is generally used just for "parts" with a simple shape.

In CAD and CAE programs there are two established methods of modelling are: modelling of bottom to top and modelling of top to bottom. The first one refers to the building model in which simple entities during the modelling an after this we add other entities. In the second model is built which will contain the final part and with Boolean’s operators we remove the material in excess. For modelling teeth and dental work that is recommended by the second methods because it is simpler and easier to use.

For the modelling in commercial CAD programs are used three types of strategies:

- **Oriented on edges modelling (wireframe modelling)** model which is described on the basis that delimiting edges. This strategy is useful only in simple models that are analyzed mechanical behavior;
- **Oriented on surfaces modelling (surface modelling)** model which is described on the surfaces that border. This strategy allows the description of bodies void of substance. Based on this strategy have developed standards and import between different CAD programs (IGES, VDA);
- **Oriented on volume modelling (volume modelling)** that fully describe the model. By attaching the characteristics of the material model is prepared for analysis by finite element method, using CAE software.

In terms of models describing bone or tooth is recommended last modelling strategy because this strategy allows a complete description of the model.

Geometric modelling using commercial CAD software presents following advantages:

- **Geometric model is realized very fast when is not necessary a high accuracy of shape and dimensions of the model;**
- **Is easy to use, because the commercial CAD programs are very popular and many users know how it’s works these software;**
- **Is not necessary to repair the model after the import or scanning operation;**
Export of the geometric model is very easy for the other CAD programs or for the other programs whence simulate the mechanical behavior using finite element method.

Disadvantages modelling using a commercial CAD program are:

- Coarse approximation of shape due to lack of measuring methods to all dimensions of the real model (Figure 1);
- Commercial CAD programs do not have dedicated functions needed to generate the complex surfaces which meet in the teeth or dental structures;
- Difficulty to generate different density areas and also is difficult to attachment different properties of the material for this areas.

Figure 1. Tooth model: canine (a), incisive (b), molar (c)

As a conclusion, we appreciate that this type of modelling may be used only if you accept the use of approximate shape of the model to study that allows only a qualitative assessment on the state of stresses and strains of the studied model.

2.2. Scanning using 3D laser scanners

This technique used to build complex 3D geometric models came in same time with the concept of reverse engineering.

Reverse engineering (RE) is the process of discovering the technological principles of a device, object or system through analysis of its structure, function and operation. It often involves taking something (e.g., a mechanical device, electronic component, or software program) apart and analyzing its workings in detail to be used in maintenance, or to try to make a new device or program that does the same thing without copying anything from the original.

Reverse engineering has its origins in the analysis of hardware for commercial or military advantage [1]. The purpose is to deduce design decisions from end products with little or no additional knowledge about the procedures involved in the original production. The same techniques are currently being researched for application to legacy software systems, not for industrial or defense ends, but rather to replace incorrect, incomplete, or otherwise unavailable documentation [2].

Although it seems somewhat defiant this idea to study, disassembling, measure and collects all information about a product already criticized by many experts as a "theft of intelligence" is only an entirely subjective and restricted from all points of view.

Also is necessary allow for, to the advantage in that the producers of different effects they have in the process of remodelling and studying all the options accepted by the market more interested in good quality with new high parameters and small prices.

There are absolutely advantages for "models" or situation without a defined geometry (plants, human body, and natural creations) in the study and 3D modelling. Geometric modelling of the early years '60 and '70 with the CAD software does not provide such options or possibilities, but with the development of processing information/data and technological development of electronics parts has enabled finally tackling everything from the other points of view.

As computer-aided design (CAD) has become more popular, reverse engineering has become a viable method to create a 3D virtual model of an existing physical part for use in 3D CAD, CAM, CAE and other software [3]. The reverse-engineering process involves measuring an object and then reconstructing it as a 3D model. The physical object can be measured using 3D scanning technologies like CMM’s, laser scanners or structured light digitizers. The measured data alone, usually represented as a point cloud, lacks topological information and is therefore often processed and modeled into a more usable format such as a triangular-faced mesh, a set of NURBS surfaces or a CAD model.

These CAD models describe not simply the envelope or shape of the object, but CAD models also embody the "design intent" (i.e., critical features and their relationship to other features). An example of design intent not evident in the shape alone might be a brake drum's lug bolts, which must be concentric with the hole in the centre of the drum. This knowledge would drive the sequence and method of creating the CAD model; a designer with an awareness of this relationship would not design the lug bolts referenced to the outside diameter, but instead, to the centre. A modeler creating a CAD model will want to include both Shape and design intent in the complete CAD model.

For modelling using a 3D scanner is needed through several stages (phases), shown in Figure 2. The most important of them are:

Figure 2. Stages (phases) of modelling using a 3D scanner

Phase 1 - Scanning
In this phase is determined scanning strategy: choosing the correct scanning technique, preparation of the model who is scanned and the scan itself order to obtain all the information defining the object, such as passages, slots (slot, channel), pocket - links (cut, pockets) and holes.

Three-dimensional scanners are designed to scan the geometry of the object, restore an accumulation of points that define the surface geometry. In present there are two types of scanners are: scanners with contact and without contact scanners.

Scanners with contact are based on CMM technology, with a tolerance field between 0.01 and 0.02 mm. Depend on the size of the scanned object, the scanning methods with contact can be slow because each sequence is generated in the tip of head scanner. The tactile device must diverge as to record a point, here defending the need to maintain contact pressure relatively constant during the scan. This condition restricts the possibilities for scanning, for example, soft materials such as rubber, can't be scanned with a high accuracy.

A big variety of scanning technologies available on the market, get information without having physical contact with the scanned object. The non-contact scanning using lasers, lenses and charged coupled device (CCD) to capture points (Figure 3). Although these devices capture a wide range of information in a relatively short time, there are some problems related to this technology. Thus, the tolerance field is between ± 0.025 mm and 0.2 mm, reason for some non-contact systems have problems in generating data that describe the surface parallel with the laser axis. The non-contact devices using the light during the data capture process; this creates problems when the light encounters a shiny surface, where the accuracy of information (data) is secondary compare with speed capture. The research in optical technologies field carry on and device for non-contact scanners are improve continuous.

For a good capture (catch) as a desirable object to be scanned, the scanner is providing with accessories like: a pen with powder and another pent with emulsion used to cover areas that reflect light.

On the physical model is applied in advance a number of points (see Figures 3 and 4) that will be used later to "assembling" images. This will identify those points in multiple images so that scanning software will allow the reconstruction of the geometric model.

Scanning software is characterized by the pre-scanning and post-scanning elements. In the pre-scanning part, are selected scanning parameters related to the scanning object, and also the action area of the scanner. Post-scanning allows the editing possibilities of items scanned.

Phase 2 - Processing

This phase involves importing the data acquired, reducing data collection and number of points. These requirements are made using a variety of predefined filters. It is very important for users to know the filtering algorithm to know which is most suitable for each requirement. This phase allows putting multiple datasets together. This involves rotating the scanning object so that each image can be acquired. Multiple Scanning has direct influence on the processing phase of point's dispersion. After this phase we obtain an approximately geometric model of the scanned object (Figure 5).

Phase 3 - Geometric model developing

Generating CAD models from point clouds is probably the most complex activity in reverse engineering (RE), because, most CAD software’s are not designed to display and process a large amount of data in the form of clouds of points.
This phase depends very much on the real purpose of using reverse engineering. For example, to study mechanical behavior from the teeth or dental structures is intended to obtain a geometric model with a very good accuracy. The results of this phase are a geometric model with one of the established formats: IGES, VDA, STL, DXF, OBJ, VRML, ISO G Code (Figure 6).

Model thus obtained requires editing in CAD programs, thus finally we obtain a geometrical shape and dimensions very close to the real model (Figure 7). Necessary steps in this phase are erasing of surface erroneously generated and replace them with correct surfaces; the union of several surfaces in a single surface and generation of the model volume based on existing surfaces.

Advantages of 3D scanning in modelling of complex bodies consist:

• High accuracy compared with direct modelling in CAD programs;

• Export to other CAD programs, or by numerical simulation programs is quickly.

Disadvantages of 3D scanning in modelling of complex bodies consist:

• Scanning time and processing time are betimes very long;

• The impossibility of scanning inside of the body and implicitly impossibility delimitation of different tooth areas (enamel, pulp, dentine).

2.3. 3D scanning using CAD/CAM equipment

In the last time the laboratory techniques of dental technicians have been a number of new arrangements designed especially for computer-assisted reconstruction of teeth or dental structures. One of the newest ways is the use of CAD/CAM in dental technology. These equipments were intended specifically for rebuilding dental structures using new materials such as zirconia. Zirconia has become an established and indispensable material in all-ceramic fixed prosthodontics over the past few years after practical techniques had been developed that allowed yttria-stabilized zirconia to be processed in dental laboratories [4].

Ever since 2000, this innovative procedure has been investigated and followed up in clinical trials. Today it is continuously developed further by close collaboration with renowned scientists and universities. As a result, its spectrum of indications keeps increasing. After a clinical observation period of more than 7 years, zirconia has proven to be an excellent framework material for crowns and multi-unit bridges in the anterior and posterior segments.

Studies are continuously being performed both in vitro and in clinical settings to investigate potential applications and new indications (e.g. extension bridges, inlay bridges or multi-unit bridge structures). Over 1,000 restorations are currently under observation in more than 10 clinical studies.

Initially a CAM system was designed for processing zirconia. Progress in hardware and software development has been giving new impulse to zirconia technology as well. It was therefore logical to add computer-aided design (CAD) functionality to the original CAM system.
• Scanning speed (several minutes) and ease to use thought the libraries of software packages available for the equipment which is supplied;
• Easily modify the geometric model if is necessary.

Disadvantages of 3D scanning using dedicated CAD/CAM equipment consist:
• Major disadvantage of this equipment is that the scan is not a real model but the cast (dental stamp) taken from the patient by the physician (human operator) and whence can generate the errors starting with this phase; so the accuracy on the order of μm to obtain a scan is no more relevant;
• High costs of CAD/CAM equipment;
• This method also that does not allow scanning the interior of bodies;
• Some dedicated scanning software does not yet allow the export models to other CAD/CAM/CAE programs.

2.4. Reconstruction of geometric model using a 2D images obtained from imagistic investigations

This technique is currently top in the field of dental reconstruction. Technique involves taking some "sections" (longitudinal or transverse) at a distance of between 1 and 1.5 mm. from the model that is intended to be rebuilt. On them were a series of software products that allow the reconstruction of various models (Figure 9).

At each sampling point within the volume, each type of scanner will measure a value which will be converted into a pixel (grayscale) value. For the CT (or micro/nano CT) we measured the amount of X-rays absorbed by the object. On a live subject, extended exposure to X-rays (which depend on time and strength of the Xray beam) should be avoided [5].

The magnets of the MRI scanner cause a part of the hydrogen atoms (the protons, located in the nucleus) to change their orientation, and it is this “movement” or “vibration” (spin) that is measured.

![Figure 9. Geometric model of maxillo-facial bones obtained using imagistic investigations](image)

Exposure to X-rays (CT or micro/nano CT) should be avoided if high density objects and low density objects need to be scanned as high density objects will tend to obfuscate lower density objects. Use of stronger radiations can sometimes solve this artefact phenomenon. It is however not always possible (lethal radiations for a live patient). Note that these obfuscation phenomena, also called “metal artefacts” (because they often appear when scanning metallic object at the same time as organic subjects) do not distort the geometry of the parts that are visible; they merely “hide” information.

This modality is ideal when the different scanned objects can be distinguished via their absorption coefficient (amount of X-ray absorbed by the object). Very simple threshold based tools can be used. It is however not efficient at distinguishing between different soft tissues.

For the MRI scanning, in terms of image quality, metallic objects will usually not influence the generated image, but magnetic objects (such as some teeth implants) can distort the image. The magnets may damage electronic components such as pacemakers.

The MRI scanning is ideal to visually distinguish soft tissues, but objects must contain hydrogen molecules (e.g. water). It is possible to scan “dry” objects made of plastic for example; by immersing them in jelly (the negative of the object is then visible). Segmentation can be threshold based in some cases. It is quite frequent however to see different objects easily distinguished visually only by texture. In this case, manual segmentation may be required.

MRI images often suffer from signal attenuation and/or noise on the borders of the region of interest.

Advantages of reconstruction of geometric model using 2D images obtained from imagistic investigations consist:
• Very high accuracy compared with all other technique presented in this paper;
• Scanning is performed in situ are therefore eliminated any errors due to human operator;
• The model can be exported directly to the CAD or FEM software or directly to the Rapid Prototyping equipment;
• Is possible to scan the specimen inside and implicitly allow the assignation of different material properties (depending on light density).

Disadvantages of reconstruction of geometric model using 2D images obtained from imagistic investigations consist:
• The major disadvantage of this method is that involves the patient's long exposure to radiation (for CT) because the slice to increase the accuracy can be taken at very small distances;
• Very high cost of imagistic equipment necessary and software that allow reconstruction;
• Sometime is impossible to use this method because the patients have some metallic dental structures in mouth which not allows using a CT scan.

3. APLICATONS

The main applications can be developed based on models obtained from the scans are determination of the states of stress and deformation using numerical analysis by finite element method and obtain three-dimensional models of real bodies by Rapid Prototyping.

The finite element method (FEM) (Figure 10) (sometimes referred to as finite element analysis) is a numerical technique for finding approximate solutions of partial differential equations as well as of integral equations. The solution approach is based either on eliminating the differential equation completely (steady state problems), or rendering the partial differential equations into an approximating system of ordinary differential equations, which are then numerically integrated using standard techniques such as Euler's method, Runge-Kutta, etc
In mechanic field, this method allow to run some type of static analysis (when tasks are independent of time), dynamic (when certain tasks were variations over time) or own values problems (when is to determine certain values such as critical if the natural frequencies of the bodies). This applies only to simple problems were possible to integrate differential equations.

For complicated issues can be used two methods: to simplify the model and solving differential equations on this simplified model, achieving the exact solution on this model, or keeping real model and obtain approximate solutions on a real model. In 99% the approximate solution on the real model is closer to reality than the exact solution obtained from the simplified model. Therefore we need to obtain a model after scanning process, very close to reality.

**Figure 10.** Distribution of principal stress into a molar model

Using the analyzing with finite element method, we can establish:

- Stress and strains on all three directions of the Cartesian coordinates system;
- Principal stress and principal strains, and also equivalent (von Mises or Tresca) stress and strains;
- Nodal displacement on all three directions of the Cartesian coordinates system, and also total displacement at nodes;
- Safety factor.

Figure 8 shown the results of a analysis using a finite element method applied to one molar, specifically principal stress in the real case during the mastication process.

Other application of the 3D model obtained after the scanning process is Rapid Prototyping. This allows reconstruction of 3D real models, using a CAD models. Rapid Prototyping technologies follow the same basic steps:

- The CAD model which includes a complete description of it, using one of the ways described in previous paragraphs;
- Transferring CAD model to the processor section whence "cut" thin slice from the geometric model;
- The proper construction of the model, which raises a number of problems and how to resolve individually each process (type of material, the support model, how to add layers, the layers of paste, marking contours of each section etc.);
- Cleaning and finishing are operations whence that remove the stands during using the model construction, excess material or other processing operations (including mechanical) which aims to improve the dimensional accuracy and surface quality.

### 4. SUMMARY AND CONCLUSIONS

Obtaining 3D models with a higher accuracy is very important when we wish to use this model in teaching field or for other research. If these models are very close to reality can be used for numerical simulations by finite element method and also for the Rapid Prototyping (for study different types of cavity). The Rapid Prototyping is a very good method for teach the students some morphologic concepts related to the teeth, how to prepare the different type of cavity, and also how to polish the teeth for good final results.

Benefits of study using finite element methods are the ease with which students and researchers can identify potential problems since the phase of the “project”. Can eliminate such risks break bridges and dental structures from the early stages without requiring unnecessary work and costs. Turning to methods of obtaining these models will be chosen the best method based on problem analysis. Thus, direct modelling method will be chosen when what we want to model is intended only a qualitative assessment on the state of stresses and strains and not Rapid Prototyping. Methods of scanning using a laser or CAD/CAM equipment will be used in generally in dental technical laboratories for comparative studies on different materials used in dental structures, and also for reproduced using Rapid Prototyping method. Of course, the most accurate and most expensive (here enter the materials and costs related to exposure to radiation of human subjects) is the reconstruction of model using a 2D images coming from the MRI or CT. This method is recommended for maxillo-facial surgery case where the patient’s are subjected to the imagistic investigation. In this case is very good to use the Rapid Prototyping method.

As a conclusion we can say that modern methods of scanning using computers are a presents a fast-growing also in medical and dental field and tend to become tool set of investigation.

### 5. REFERENCES

CURRICULAR LINKAGE BETWEEN ENGINEERING AND BUSINESS EDUCATION. CASE STUDY – SCIENCE OF FOOD COMMODITIES

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ABSTRACT: Nowadays there are many concerns on putting into practice the knowledge, which may be reaching by higher education. In that way bridges between university education and acquirements for economy needs were built, facts that supposes a real collaboration in engineering and business education, too. The development of higher education curricula aimed at describing appropriately professional qualifications according to the requirements of the labour market in the EU, as well as in Romania. The aim of this paper is the establishment of some linkages between engineering and economic education by qualifications’ comparison in terms of syllabus for the acquirement of mutual specific competences within the higher education system. In this respect, our case study focuses on the correlations among the qualifications and curriculum of “Science of Food Commodities”. Through the content of this subject, it addresses both the Economics graduates in the business administration domain, and the graduates of Engineering Sciences in the food area. The results of the above-mentioned case study underline the necessity of specialists’ cooperation in economic and technical areas.

1. INTRODUCTION

The needs of a knowledge-based society were expanded and those have generated a new restructuring of the higher education systems so as to give national economies a leg-up in the competitive race. Of course, many issues with respect to problem-solving had arisen. An education in the knowledge-based society means a suitable access to more information resources, but knowledge helps taking decisions in it. In that aim it might improve all aspects of quality of higher education and ensuring excellence of all, without any disparities by defining the appropriate social dimension of it.

It was noticed that European ability to reach out and connect with the needs of a knowledge-based society can be done through appropriate education and training policies. Only in that way the real added value of higher education is shown, in support of growth and jobs at European level. And for that reason it is necessary to create the conditions so that graduates can deliver their full potential in society.

Consequently, since the Bologna Declaration was quoted on June 1999, based on fundamental principles laid down in the Bologna Magna Charta Universitatum of 1988, the series of reforms have started to be put in force to create a European higher education area by 2010. Through the Bologna process it aim at making a European higher education more compatible and comparable, more competitive and more attractive for students from Europe and other continents, in particular under the Lisbon recognition convention.

The three relevant objectives of the Bologna process are:

• Adoption of a system essentially based on two main cycles, undergraduate and graduate, which means the introduction of the three systems (bachelor/master/doctorate),

• Quality assurance, by European co-operation with a view to developing comparable criteria and methodologies,

• Recognition of qualifications and periods of study, by adoption of a system of easily readable and comparable degrees, through the implementation of the Diploma Supplement and the establishment of a system of credits (such as in the ECTS system).

The EU works to support a broad range of measures and programmes to modernise the content and practices of higher education in 56 European countries, as part and neighbourhood of EU. In this spirit the purpose is to find the means for the reform of higher education to reflect the diversity of modern societies, by encouraging research and development in all areas of the activity of higher education institutions.

2. RESEARCH PURPOSE

The European dimensions in higher education is promoted with regards to curricular development, inter-institutional cooperation, mobility schemes and integrated programmes of study, training and research.

To establish synergies between the Bologna process and the Copenhagen process, which concerns vocational education and training, since September 2005 there has started the setting up the National Qualifications Framework for Higher Education in line with the requirements of the Bologna Convention and with the European Qualifications Framework.

There were initiated the development of a National Qualifications Register for Higher Education in Romania, too. Certainly, this register of national qualifications will form the basis for recognition and validation of diplomas and awards issued by higher education institutions in Romania.

Nowadays the higher education is concerned with and has obvious outcomes regarding the identification and organization of professional and transversal competences, including the establishment of hierarchical levels of specific competences, taking into account the correlations among those, content areas and branches of knowledge. This way, there are rules for coherent syllabuses and the development of higher education curricula aimed at describing appropriately professional qualifications according to the requirements of the labour market in the EU.
Through co-operation between universities, governmental and non-governmental organisations there are developed different tools (standards, methodological guide, etc.) to describe the qualifications and support the registration of all qualifications in the Romanian higher education that are certified by university diplomas (levels EQF 6, 7 and 8, which correspond to ISCED 5 and 6).

The purpose to determine the qualifications structure and ensure the national recognition, as well as the international compatibility and comparability of qualifications acquired within the Romanian higher education system may be achieved by National Qualifications Framework for Higher Education.

The aim of this paper is the establishment of some linkages between engineering and economic education by qualifications' comparison in terms of curricula for the acquirement of mutual specific competences within the higher education system. In this respect, our case study focuses on the correlations among the qualifications and syllabus of “Science of Food Commodities”.

3. RESULTS AND DISCUSSIONS

As it is known, in aim to define a certain qualification for higher education at each level are used general descriptions, which are expressed in terms of knowledge, skills and competences. The learning outcomes in relationship with professional and transversal competences are based on abilities, which are developed like capacity to apply and use the knowledge for problem-solving and tasks achievement. For that reason, professional qualifications can be described appropriately by developing the higher education curricula. By qualifications’ comparison in terms of study programs, areas, curricula and syllabi for reaching the specific competences within the higher education system, hereinafter it focuses on the syllabus of “Science of Food Commodities”.

For the Romanian food industry as well as food trade, tourism or hospitality sector that is essential to be competitive in the global market, innovation and value adding to food commodities is essential. This requires strengthening of the linkages within the value chain, investment in innovation and new products development and a strong commitment to quality and food safety.

Formal education concerning science of food commodities covers a quantitative aspect, which relates to the number of programs offered at various levels (bachelor, master or doctoral studies) by the university education. Depending on underlined importance of food goods to trade or industry, there were designed different programs for individual countries. For example, science of food commodities is matter of second cycle system for graduate students in Australia and in other western European countries, while it comprises into the primary cycle – for undergraduate students in Romanian university education.

But the qualitative aspect relaying to the meanings of food goods is provided and above all to the need for establishment of relationship between food commodities on market and outputs of the science or industry.

Science of food commodities is a dynamic discipline, which it means to succeed in establishing a linkage among science, industry and trade in benefit of all actors from the food market. That read as an integrate approach of the science across different subjects or projects.

The main objective of this discipline is a comprehensive studying of food goods by a modern approach of all concepts on quality and range of goods. The food commodities may be assess on the whole food-chain from farm to fork, or starting with their origins, raw materials, processing features, food safety and traceability, food quality, range of products, packing and labelling, food storage, adulterations etc.

The content of syllabus for science of food commodities may be adapted to:

- The market needs in respect of the globalisation of markets for food goods,
- New challenges in marketing and technology,
- Innovation and products’ development,
- The structural changes at the level of food industry, and regulations and new standards put in force.

Under such circumstances, the knowledge has increased sharply in food area with economical as well as technical consequences, which are obviously reflected into management and production processes and lead to growth and diversification of the whole food sector.

Education and training on Science of food commodities would contribute to providing relevant knowledge and raising skills for employment in food sector (industry, commerce, hospitality and tourism, policy making). Through the content of this subject, it addresses both the Economics graduates in the business administration domain, and the graduates of engineering sciences in the food area. Economists that deal with food goods express their knowledge and skills in trade, marketing issue, management and entrepreneurship in food industry, tourism and hospitality sector. On the other hand, depending on their area of specialisation, food technologists may develop ways to process, preserve, package, or store food, according to industry and government specifications and regulations.

Nowadays the food industry is a technologically advanced field. In view of careers, there are many and varied employment opportunities in the food industry or in a variety of areas throughout the supply chain which comprises but is not limited to areas such as:

- Quality assurance
- Technical sales
- Production management
- Process and product development
- Research and development / Scientist
- Agro - food marketing
- Product Manager
- Food safety officer / Quality control officer / Food standards officer
- Laboratory inspector
- Food technologist
- Expertise on science of food commodities
- Teacher or trainer,
- Food consultant,
- Process control engineer.

According to the Law no. 87/2006 and next modifications (Decree No. 1175/2006, etc.) as well as the Decision no. 749/2009, at national level there are different economical or food engineering specialities, like part of economical sciences or engineering ones. From those programmes, our case study put under discussion a couple of them, as it follows in table 1.
In Romania at higher education level teaching about food goods addresses to undergraduate students. The knowledge related to science of food goods ensure guidance to those who follow a certain program of study so as to enable them to identify sense of occasion on food market and contribute to shape abilities aimed at defining their professional and transversal competences.

<table>
<thead>
<tr>
<th>Basic domain of science</th>
<th>Code</th>
<th>Area of studying</th>
<th>Code</th>
<th>Specialties/ Programs of study</th>
<th>Code</th>
<th>No. of transferable credits</th>
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<td>Business administration</td>
<td>030</td>
<td>Economics of commerce, tourism, and services</td>
<td>030</td>
<td>180</td>
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<td>Engineering sciences</td>
<td>120</td>
<td>Food products engineering</td>
<td>150</td>
<td>Control and expertise of food products</td>
<td>030</td>
<td>240</td>
</tr>
</tbody>
</table>

In the last decade the syllabi for science of food commodities, like part of curricula adequate for those specialities were named differently tided it: Science of food commodities, Food goods and technology, Food goods and consumers’ security (food safety), Science of commodities and expertise. Part one - Food goods, etc.

On basis of syllabus, Science of food commodities is appropriately described like curricula, and part of the data is collected into discipline file. The information was gathered by comparison between the both programmes of study that correspond to economical as well as engineering basic domains (see table 1, too).

Our case study focuses on two programmes of study from two different faculties, one with economical background and the other with technical ones. The faculties, which are allowed for, are located in divers places (two different towns: Ramnicu Valcea and Sibiu) and are comprised into two different universities, from which one is private and another is public. The summary information referring this discipline, which are valid for undergraduate students commencing in 2009 are shown in table 2. As we have mentioned before it, the information refer to the same discipline, even if the course title is quite another.

Although it refers to the same discipline that ensure the basic knowledge on food wares, the course description may be different because each course addressees to undergraduate students aimed at attaining different skills for economical or technical fields. Of course, there are some similarities regarding the content, namely theoretical training, but drills are conducted in different manner when the practical analyses are carried out. In that way, course description covers different aspects of food goods, but it is various manner of approaching.

The meaning of it is related to the following features, which are managed afterwards or during educational program delivery. Firstly, the necessary knowledge might be put in practice in different areas of life for problem-solving either with economical or technical background, and are aimed at developing skills for economists or engineers. In this case, the bachelors’ prospects define professional and transversal competences in various domains concerning food chain, but they have a common denominator, such as basic education on food commodities. But the basic information on science of food commodities would be used by future specialists in different ways, depending on their professional needs and challenges. A common understanding of knowledge by all actors involved within food chain generates a better information transfer, and makes efficient activities on food market through the linkage between business and engineering education. Secondly, the assumed background for students matriculated either economical or engineering sciences are quite another. For example, students for a bachelor in specialty “Control and expertise of food products” should have adequate background in food technology, food chemistry and food microbiology.

### Table 1. List and code of domains and specialities for undergraduate level

<table>
<thead>
<tr>
<th>Data</th>
<th>Economical sciences</th>
<th>Engineering sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course title</td>
<td>Food goods and technology</td>
<td>Science of food commodities</td>
</tr>
<tr>
<td>Coordinating unit</td>
<td>Faculty of Management Marketing in Economics Affaires</td>
<td>Faculty of Agricultural Sciences, Food Industry and Environment Protection</td>
</tr>
<tr>
<td>Campus (location)</td>
<td>Ramnicu Valcea, 39th Bld. Nicolae Balcescu</td>
<td>Sibiu, 5-7th Dr. Ion Ratiu St.</td>
</tr>
<tr>
<td>Program level</td>
<td>Undergraduate</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Program duration</td>
<td>3 years full-time</td>
<td>4 years full-time</td>
</tr>
<tr>
<td>Delivery mode</td>
<td>Internal (daytime)</td>
<td>Internal (daytime)</td>
</tr>
<tr>
<td>Discipline grade</td>
<td>Base</td>
<td>Base</td>
</tr>
<tr>
<td>Option (status)</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

Mandatory, according to curricula

<table>
<thead>
<tr>
<th>Commencing semester</th>
<th>Semester 2</th>
<th>Semester 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course duration</td>
<td>1 semester (14 weeks)</td>
<td>1 semester (14 weeks)</td>
</tr>
<tr>
<td>Hours per week</td>
<td>2C, 2L/S</td>
<td>2C, 1L/S</td>
</tr>
<tr>
<td>(C- course, L/S – laboratory/ seminar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of transferable credits</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

We have noticed before that the science of food commodities comprises comprehensive knowledge on food and course description might enclose a set of information in relationship with the skills and professional competences, which may be accomplished by a certain program of study in frame of a specific area for basic domains of science. Course description is adapted to include the main knowledge, which is necessary for the higher education process aimed at achieving the proposed goals of the specialty. The course outlines one or many streams, and covers a broad range of food goods or specific features of food processing, food safety, and food quality. Generally speaking, the study will concentrate on those commodities which are spread into Romanian food chain: grains, baked products and pastry, fruits and vegetables, milk.
and dairy products and so on. On students’ request may be
taken into account other products for studying, too.

A model of syllabus content is indicated as follows here below.
It is structured in many segment descriptors:

1. Generalities on science of food commodities: specific
features of food goods and processing, connection within
other disciplines, functions of food in relation to health,
food pyramid and consumption, classification of food
products, assortments and food goods coding, food laws.

2. Food preservation – basic principles, arguments
(advantages/ disadvantages), traditional methods.

3. Raw materials from vegetal or animal origins; food
additives; specific processes in food industry; production
of food products (in brief).

4. Food commodities:
Cereals: products and quality, storage of grains, preservation
and cost. Processed-food based on cereals: bakery products,
cookies, pastries and others; range of meaty products and
properties.

Vegetables and fruits: classification, selection and variety,
properties, processing, methods to minimize the loss of
nutrients, use in a variety of preparations, some common
products, storage and outages, cost and use of processed
vegetables and fruits.

Milk and dairy products: classification, properties, quality
processing; various kinds of processed milk, butter, curds and
cheeses, ice-cream; storage, preservation, spoilage, cost.

Eggs: structure, composition, production, grade, quality,
selection, nutritive value, storage, spoilage, uses and cost.

Fish, poultry and meat: classification, selection, purchase, uses,
nutritive value, range of products, methods of processing,
qualitative characteristics, factors affecting tenderness,
spoilage and sanitary-veterinary inspection, storage and
preserving food products of animal origin, packing and
labelling.

Sugar and sweet products: different types of sugars and sweets,
properties, manufacture, storage and use.

Fats and oils: sources of fats and oils (animal and vegetables),
types, main characteristics, assortments, uses, storage cost and
nutritional aspects.

Food adjuncts: spices, condiments, herbs, extracts, concentrate,
essences and food colours, origin, classification, description,
uses, specifications, procurement, storage, effects of excess
consumption.

Catering and convenience foods: role, types, advantages, uses,
cost and contribution to diet.

5. Food quality: characteristics of food products, their
functionality; evaluation of food quality by using
subjective and objective methods, sensorial analysis and
preparation of score cards.

6. Recent concepts in food technology, packaging and
labelling of foods; brands and product-mix.

7. Food adulteration (in brief) and consumer awareness.
Principles of food safety, main requirements for a system
of food safety management based on HACCP.

This pattern of syllabus content was accomplished on basis of
both study programmes above-mentioned, and can be
considered a skeleton for correspondent curricula. Theoretical
notions may be either briefly introduced into discussion or
explained at enlarged scale for certain groups of students,
depending on their background and program of study, or the
lectures may be narrow depending on learning progress.

Practical activities refer to laboratory ones, as well as
knowledge transfer during seminars and individual training.
Experimental ones are designed to go deeper in understanding
of theory and perform abilities to put in practice information
received. A suitable example is the food quality assessment on
based of their indicators or characteristics, which may be
determine. For students from economical sciences the study
focus on sensorial analysis, while students of engineering
sciences are more interested by factors which affect the quality
during processing and find out the suitable ways to minimize
the technological loss, improve the products quality or cut the
costs. Other practical activities consist of identification of
common adulterants through demonstration. Case studies on
commercial quality of food goods, storage conditions and
labelling are performed like individual tasks. In the same time
there are some tasks on workgroups (experience in preservation
of foods, SWOT analyses, HACCP studies etc.)

Students involved into economical sciences should study the
general proprieties of food goods from technical, economical
and social point of view. Their studies also refer to general
technical characteristics, but focus mainly on sensorial
properties. The stream for this course is food quality on the
market as respects: consumers’ requirements, economical
features, food products quality, package design and labelling
information. Food technology is subject under discussion in
general terms, like main phases or technological operations, as
well as the influences of handling, storage and processing
methods on the quality and food safety. As plain as can be, in
that case the offered information by syllabus ensure a basic
training of students for understanding the other economics
aspects on commerce, marketing or management in production,
and distribution of goods.

On the other hand, students that follow engineering sciences
should go deep in technical studies, which suppose a better
understanding of biological and technological aspects of the
food products from point after harvest to the point of
consumption of food, with an enlarged assessment of technical
factors, which influence the food processing. In that case,
science of food commodities covers a broad range of scientific
disciplines, processing technologies and technical
information. An understanding of it requires a knowledge of
the biochemistry, microbiology and physics, as well as
knowledge of the transformations which take place in food
processing starting with raw materials to very large number of
processed products. Maximising the quality and nutritive value
of the food products at the point of consumption could be a
major scope of the processors, too.

The syllabus objectives are the same, namely:

1. To obtain knowledge of different ranges of food products
and their nutritive values.
2. To understand the main principles underlying food
processing and preserving.
3. To understand the basic commodities, both raw and
processed used in industry or catering and various aspects
of their production and distribution.
4. To discuss the qualities and standards of available
commodities and their suitability for different purposes.

The handbooks have to be developed in close connection to the
specific needs expressed by curricula; their role is not focused
only to a theoretical approach, but even to learn to do in aim to enhance the employability of graduates.

The used strategies from didactic point of view are: lecture, debate, discussion, case study, experimental, homework, and paper (proceeding). These strategies allow a deeper understanding of information with more achievements in learning process. On the other hand, by a transdisciplinary approach, such as problem-solving and decision making, it succeeds not only to gain knowledge or improve skills for professional competences, but contribute to performance in transversal competences, too.

Final evaluation depends on the specialty framework, but generally speaking students take a written examination. Final score depends on written paper as well as the students’ outcomes during practical works. This kind of crossing examination of the entire duration of study ensures the thoroughness of knowledge aimed at skills performance.

On basis of expressed objectives, content of syllabus, and used strategies the expected competences are related at least to the following descriptors:

- Understanding, explaining, using and transfer in an appropriate manner the technical and economical knowledge on food commodities,
- Ability to collect, analyse and do interpretations of information on goods in the entire food-chain (from both quantitative and qualitative points of view),
- Developing of a solve-problem attitude and capacity to make decisions in aim to implement suitable solutions in real time on food fields: production, trade, marketing, management or policy,
- Complex evaluation of food commodities in relation with requirements (standards, regulations, consumers’ needs, policies) for constructive reflection of them on food market,
- Creative-innovative performance of food business (production, commerce, services) regarding food safety, continuous improvement of product quality and consumers’ protection,
- Contribution to develop an organisational culture on quality,
- Manifestation of a responsible attitude towards the food quality, food safety, consumers’ education and protection.

4. CONCLUSIONS

Conclusive, students examine the fundamental principles of science of food commodities, and learn how to apply the knowledge to contemporary business environment by good practices in the whole food-chain. Their skills and professional competences are related to specific working environment and the nature of problems that might be solved. None the less that economists focus on problems’ solving in business area and their actions answer the purpose to economical environment, whiles engineers are oriented to find out solutions for scientifically or technical issues, certain linkages between both professions arose in terms of professional as well as transversal competences.

The results of the above-mentioned case study underline the necessity of specialists’ cooperation in economic and technical areas. In that way, by suitable correlations established among national university qualifications, professional competences, achieved skills, and necessary knowledge, based on coherent syllabus and curricula, the trust of all professional categories and society as a whole is promoted.

5. REFERENCES

1. Figel, J., The role of education, training and culture in the knowledge-based society, Plenary of the European Economic and Social Committee (EESC), Brussels, Belgium, July 14 (2005)
2. Korka, M., Spilling, O., Towards a comprehensive policy on entrepreneurship education in the European higher education, Theoretical and applied economics, No. 11, pp. 3-16, Bucharest, Romania (2008)
KNOWLEDGE MANAGEMENT IN ENGINEERING AND BUSINESS EDUCATION
A NEW UNIVERSITY COURSE IN ROMANIA – KNOWLEDGE BASED ORGANISATION AND MANAGEMENT

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ABSTRACT: Transition to the knowledge based economy or the new economy is the main revolutionary mutation of last decades. Unfortunately in the universities in general and - in Romanian universities in special – there is not enough preoccupation on this topic. In our paper we present the objectives, topics, methods and other major elements regarding the new university course recently implemented in Economic University of Bucharest (ASE) at MBA level. We emphasise the necessity and the multiples roles and functions of the course, in a contextual approach, taking into consideration the national and international evolutions, especially the Lisbon Strategy.

1. HISTORICAL TRANSITION TO THE NEW ECONOMY AND KNOWLEDGE BASED ORGANISATION AND MANAGEMENT

The most comprehensive and revolutionary mutation of our times, is the transition to the knowledge based economy. A few decades ago in the developed countries – USA, Japan, Canada, Germany, Great Britain, France – has started the knowledge revolution. At the beginning specialists have identified the information revolution. Later on many specialists in economy and management have realized that information revolution is just the first stage of knowledge revolution. In our days knowledge revolution is a reality, recognised by renowned specialists.

A lot of very influential literature has been focused on this subject. Lisbon Strategy has had a strategic objective to build knowledge based economy in EU and to transform it in the most competitive economy in the world.

Essentially the knowledge revolution represents the transition from the classical capitalist economy, based mainly on tangible resources, to the knowledge based economy focused mainly on intangible resources. There are three main categories of causes of the knowledge based economy (see figure 1).

![Figure 1. The main categories of causes of knowledge revolution](image)

The result of the knowledge revolution is the knowledge based economy or the new economy. Essentially, the knowledge based economy is characterized by knowledge transformation in the determinant raw material, capital, product production means, and competitive advantage of the economy, and by economical processes within the knowledge generating, selling, buying, learning, staring, developing, sharing, using, and protecting became predominantly, and decisively influence the long run profitability and sustainability of economy.

The main component of the knowledge based economy is the knowledge based organisation. This new type of organisation is radically different of traditional organisation. Knowledge based organisation is characterized by a balanced approach from an economical, ecological and social point of view, capitalising at high level knowledge and other resources at it’s disposal and the ones it attracts and thus generating for long periods of time, even decades, multi-dimensional efficiency and performances, validated by the market and acknowledged by the society.

In other words, sustainable enterprise is a knowledge based enterprise that sets long term economical, social and ecological objectives, which it is capable of accomplish by capitalizing strategic knowledge, generating multiple positive consequences for the company, stakeholders, and its environment.

The background of the knowledge based organisation is sustainability triangle (see the figure 2).

The functionality and the performance of the knowledge based organisation depend to a large extend on the new type of management – knowledge based management. The specialists have already identified a theory of knowledge based management and a practice of knowledge based management.

As a science, the knowledge-based management consists of studying the managerial process and relations based on knowledge, of discovering the laws that rule them and of conceiving new systems, methods, techniques, etc, in the view of increasing the functionality and performances of the organisation, valorising the great knowledge valences. By expressing this definition, we started from the presumption according to which setting first and foremost knowledge in the frame of firms (as resources, product, strategy, etc) determines a fundamental change within managerial processed and relationships.
Therefore, new principles, requirements, etc, appear which rule the management knowledge based process and relationships; a great part of the former concepts and methods are substantially modified, and some others are given up, as they are not useful any more. Naturally, under these conditions new approaches of the entire management system emerge new managerial methods and techniques are conceived, a great part of the previous managerial instruments is substantially modified and managerial procedures, techniques, methods approaches at present widely used shall be outdated and throw out.

Concomitantly has been developed a practice of knowledge based management. As a practice, knowledge based management consists of firms approaches, methods and techniques which are focused on producing and using knowledge, by which is ensured a much better valorisation of multiple valences of knowledge, in comparison to the preceding period. As it generally happens, in all new fields referring of the firm, theory remains behind of practice. In developed countries especially, thousands of firms are running, having developed managerial practices centred upon various form of knowledge, by which they get better functionality and higher performance. The firms acting in the IT fields – informatics, telecommunications, engineering, biotechnics etc – are most advanced.

Figure 2. Knowledge based sustainability’s triangle (O. Nicolescu)

2. THE FEATURES OF THE NEW COURSE – KNOWLEDGE BASED ORGANISATION AND MANAGEMENT.

The main conclusion of all these aspects is the following: the knowledge based economy is already present and in the next future it shall be predominantly. The economic, social and political life shall be quite different comparative with classical capitalist life. The revolutionary changes during the last years in many scientific, technologic, economic and ecological fields demonstrated the truth of these statements. The present world economic crisis, the biggest of the last 80 years, reflects our incapacity to face the challenges of the new economy, the poor state of the present strategies, institutions, laws, mechanisms etc. to tackle the new type of realities generated by the objective transition to the new economy.

One main way to overcome this situation, to prepare for understanding deciding and acting accordingly to the knowledge based economy is to teach the young generation about it and its components, mechanisms and management.

This knowledge based organisation and management curse introduced by us in the curricula of Management Faculty – Bucharest Economic University (ASE) is the first university
course of this type for MBA implemented in Romania. The main objectives of this course are the following:

a) To present the theoretical and methodological elements of knowledge based organisation and management within the framework of the new economy
b) To develop the student’s capacity to understand and to analyse the features and the mechanisms of the knowledge based organisation and management
c) To build the pragmatic decisional abilities and behaviour of the students in order to be able to generate higher functionality and performance in economy and society.

The main topics of this course are:

1. Knowledge based economy and its impact on organisation and management
2. Main features of the knowledge based organisation
3. Knowledge based management science and praxis and its features
4. Knowledge based strategies
5. Specific models, systems and methods of the knowledge based management
6. Knowledge based employees, managers and leadership
7. Knowledge based communities and mediators
8. Organisational culture and knowledge based human resource management
9. Performance of the knowledge based management
10. Transition to the knowledge based economy, organization and management in Romania.

In order to achieve the above mentioned objectives we use the following teaching methods:

- Lectures on the main topics case studies (individual, in groups and mixed) from the best knowledge based enterprises in the world (WaterpriceCoopers, IBM, British Petroleum, Samsung, Heineken, Toyota, Xerox, etc.
- Lectures-debates on the certain major feature on knowledge base management
- Specific applications on the Romanian economy and enterprises
- Papers on recent evolutions of the economy and of the best enterprises
- Final essay elaborated by students focused on the use of the major concepts and approach specific to the knowledge based management and organisation in one Romanian enterprise in a creative and personal way of each student.
- Set of tests in order to develop and/or evaluate the students specific abilities on the knowledge based organisation and management

The first teaching experiences in ASE indicate a very good perception and behaviour of students toward knowledge based organisation and management. Our conclusion is based on the following facts:

- The attendance ratio of the students in the lectures and seminars for this MBA course is more than double comparative with the average behaviour
- The majority of individual case study analysis and applications overcome quantitative and qualitative the standard requirements established by us, demonstrating a deep interest

Taking into consideration the mankind evolution to the knowledge based economy and society, the urgency for Romania to develop a high level class of specialists in knowledge economy field and to train the new generation accordingly to the new society mechanisms in which it shall live we make the following proposal:

The generalisation in all universities of a course with the basic concepts and approaches of the knowledge based economy, organisation and management. This will help to have in Romania specialists capable to understand, analyse decide and act better within new economy and society. This could be a competitive advantage for Romania, helping our country to face the difficult challenges of the new economy and using a high level the outstanding opportunities offered by knowledge revolution. This depends only on us. Let’s do it right now.

3. ACKNOWLEDGEMENTS

1 In 2006/2007 we have taught the first time a such course in the same faculty in postuniversitarian programmes and for 2007/2008 in the Ph.D. mandatory courses in ASE.

4. REFERENCES

A DIDACTICAL METHOD FOR KNOWLEDGE BASES DEVELOPMENT AT THE SMES LEVEL TO PROFESSIONAL RISK ASSESSMENT

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2 University “Politehnica” of Bucharest, PREMINV Research Center, {gdragoi, costel, mguran} @ mix.mmi.pub.ro

ABSTRACT: In the European countries more then 95% of the companies are small and medium-sized enterprises (SMEs) and majority of the European Union employees work in these companies. As a result of a new product development paradigm, there is a greater need for software tools to risk estimation. In this paper we describe the professional risk assessment (PRA) as part of risk management process (RMP) and how can be establish the risk level depending on probability and severity of consequences. In addition, the paper presents a didactical method to knowledge bases (KBs) built and used for PRA at the SMEs level.

1. INTRODUCTION

As a result of a new product development paradigm, there is a greater need for software tools to risk estimation and to effectively support the formal representation, collect and exchange of product information, during the product development stage. The risk evaluation sustains SMEs in the uncertainties elimination in the development strategy and management policies. Estimation, evaluation and control of the occupational risk represent prerequisites for grounding and for a continual support of the decision that has been previously taken on occupational safety in a working system. Risk management presumes the identification, assessment and control of risks that influence the organizations success and the efficiency of decisions making. In EU countries there is an experience and good practice both in classifying, identifying, and evaluating risks and in eliminating and reducing those. Among others we can mention that at SMEs level, a lot of attention is paid to: air quality (ventilation systems), pressure equipments, elevators, lifting equipments and accessories, noise, construction sites, shipyards, illumination, electricity, individual protection equipments, explosives, extraction of fat using flammable substances, fires, fixed refrigeration systems, heat systems, machinery, flammable liquids or liquefied gases, chemical hazard, depots, air cooling towers, etc.

The way SMEs approach the topic of risk assessment is strongly influenced by the structure and strengths of the particular SME, but there are some characteristics that are applicable to most if not all SMEs, as follows:

1.1. Informal social dialogue

In most SMEs, social dialogue is conducted in a very informal way. In most of them there are no formal consultation bodies or procedures. The social dialogue in SMEs is a continuous, informal interaction between employer and employees and also among employees. Many SMEs don’t have, and don’t need, formal consultation bodies or procedures to identify problems or pinpoint risks. The problem and the solution will be discussed on the shop floor.

1.2. Employer works with employees

An enormous advantage for most SMEs is the fact that the employer works alongside the employees. This means they can see the risks in the workplace and operations first hand and will be more likely to take measures to reduce or eliminate risk. These measures can include important innovative changes or simply small changes with great effectiveness for the safety of workers and employer. With this kind of operation, risk assessment is a continuous, informal process.

1.3. Flexibility

Flexibility is the key for SMEs. Employer and employees are often required to multi-task in a constantly changing environment. They are highly adaptable. This also means that workers have a good knowledge of how their company works, and most of the workplace risks. This flexibility among staff will affect the way the risk assessment is carried out.

1.4. Fast decision-making process

Another advantage of SMEs is the fast decision-making process. In a larger company when one wants to introduce changes, it is usually necessary to consult several hierarchies of managers. In an SME with a flat hierarchy, the employee can go directly to the right person and make a proposal. This saves both time and energy.

1.5. Familiar atmosphere

Employees are working for the company but are also ready to be mutually supportive and to help each other if necessary. The willingness to support colleagues creates a very special atmosphere in the company between workers and between employer and employees. This makes it easier for employees to correct one another and to educate one another on risk assessment.

1.6. Easy communication

The traditional informal communication and the direct and personal relationships at all levels of an SME facilitate rapid adaptation of change and a better anticipation of risks. These positive elements create a sound basis for carrying out a risk assessment that is adapted to the needs of the company.

In the European Union (Europe have 23 million SMEs and 41 000 large companies) SMEs employ more than 65% of all employees.

In the enterprise activities risk eludes probability to not perform the establish objectives such as:

- Performance – quality standards failure;
- Schedule – execution terms failure;
2. RISK MANAGEMENT PROCESS

Commonly, the risk management process includes three phases: risk identification, risk analyses and risk feedback. Risk factors are all factors that can have probability to deviate a plan. Risk management process is an important component of a successful project development process (see in figure 1 the project management process) with informational system support [7]. Risk is the net negative impact of the exercise of vulnerability, considering both the probability and the impact of occurrence.

Risk management (see figure 2) is the process of identifying risk, assessing risk, and taking steps to reduce risk to an acceptable level [8].

The RMP (see figure 3) should not be treated primarily as a technical function carried out by the IT experts who operate and manage the IT system, but as an essential management function of the organization [7].

A hazard is anything that has the potential to cause harm. Hazards can affect people, property, processes; they can cause accidents and ill-health, loss of output, damage to machinery, etc. workplace accidents and professional illnesses mustn’t be perceived only as fatality, as it is more lucrative to consider them as a malfunction of the processes taking places at the SMEs level [9]. Occupational risk refers to the likelihood and the severity of an injury or an illness occurring as a result of exposure to a hazard. The main aim of occupational risk assessment is to protect workers health and safety. Risk assessment helps to minimize the possibility of the workers or the environment being harmed due to work-related activities. It also helps to keep your business competitive and effective.

But, why is Professional safety and health an essential part of good SMEs business? Professional safety and health [10]:

- Helps demonstrate that a business is socially responsible;
- Protects and enhances brand image and brand value;
- Helps maximize the productivity of workers;
- Enhances employees’ commitment to the business;
- Builds a more competent, healthier workforce;
- Reduces business costs and disruption;
- Enables enterprises to meet customers’ OSH expectations;
- Encourages the workforce to stay longer in active life.

Under health and safety laws, all employers must carry out regular risk assessment [8]. To assess professional risk at the workplace we need to know:

- Where the workplace and/or the jobs performed are located and who works there: pay particular attention to those for whom occupational hazard may be more severe than usual, such as pregnant women, young workers or workers with disabilities; remember also about part-time workers, subcontractors and visitors, and employees who work off-site (including drivers, those visiting clients’ or customers’ homes, etc.);
- What work equipment, materials, and processes are used;
- What tasks are performed;
- What the potential consequences of existing hazards are;
- What protective measures are used;
- What accidents, occupational diseases and other occurrences of ill health have been reported;
- What legal and other requirements are related to the workplace, etc.

3. A KB MODEL TO PRA IN SMES

To identify hazards at the workplace we realized a General Checklist conform table 1 [8].
This checklist can be extended (or adapted) according to specific sectors activities such as: office work, construction, cars repair, food processing, woodworking, agriculture, etc.

Table 1. The General Hazard Checklist.

<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Uneven or slippery surfaces (which can cause slips, trips, falls, etc.)?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Moving vehicles and machines?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Moving parts of machines?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Objects and pieces with dangerous surfaces (sharp, rough, etc.)?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hot materials or surfaces?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>High workplaces or other climbing points (which can cause falls from a height)?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Electrical installations and equipments?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Noise?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hand-arm vibrations?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Whole body vibrations?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Hot or cold temperatures?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Work involving poor posture?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Lifting and carrying loads?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Chemical substances (including powders) in the air?</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Fire?</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

We analyze all factors from hazard checklist and elaborate an expert system implemented in VP-Expert (we used the expert system generator - VP-Expert version 2.1, by Brian Sawyer, Educational Version, distributed by Paperback Software International), which effectuates workplace risk assessment.

Production rules form the knowledge representation model used in this work. In the PRA.KBS knowledge base (KB) there are “if-then” structure rules (excluding the rules for inference engine operations), such as:

RULE 8 IF risk>20 AND risk<22 THEN prob=HIGHLY_IMPROBABLE conseq=MEDIUM_HARMFUL riskprof=SMALL

RULE 10-0 IF surf=YES THEN rp1=0;
RULE 10-1 IF surf=NO THEN rp1=1;
RULE 11-0 IF vehicles=YES THEN rp2=0;
RULE 11-1 IF vehicles=NO THEN rp2=1;

Direction of application of the rules is back chaining return (see figure 4). Before make the knowledge base, we establish the code variables: surf, vehicles, machine, object, hot, workplace, tools, pressure, etc.

The knowledge base rules are following: rules for awarding point’s variables, rules for calculation of the partial scores and total score and rules for assessment of probability and severity of consequences, and risk arising from hazards in accordance with the total score obtained.

For all variables, we assign a value - 0 if the hazard exist (the answer from general checklist is YES) or 1 if hazard does not exist (the answer from general checklist is NO).

Each value has an importance expressed by a factor with predetermined values (0 or 1). For all variables, the pondered factors must be introduced from keyboard during to knowledge base interrogation process (see figure 5).

After querying the knowledge base will be displayed to evaluate the outcome of risk assessment conclusion and explanations on the likelihood and severity of injury in terms of consequences (see figure 6).

Depending on the total score obtained and taking into account the probability and severity of consequences risk arising from hazards are evaluated – it may be small, medium or high.
We considered the risk level depending on probability and severity of consequences as follows: small risk, medium risk and high risk and high risk are unacceptable and small and medium risks are acceptable (see figure 7).

In general, if the risk is assessed as unacceptable (height) reduction actions must be taken immediately. If risk is assessed as acceptable (average) is recommended plan of action to reduce or necessary to ensure that it will remain at the same level (in case of risk assessed as small). Measures of prevention and protection to be implemented in the organization are to eliminate or reduce to a minimum the danger by organizational measures, or use of collective protection equipment suitable for individual protection.

We suggest a reassessment of activity sector after the implementation of these measures and to compare this result with that obtained at first evaluation in order to verify the effectiveness of measures for prevention and protection implemented.

4. CONCLUSIONS

In Romania just few SMEs develop proper risk measure and cover mechanisms. Regarding our companies the RMP in the majority of annual report of Top 15 BSE (Bucharest Stock Exchange) Romanian listed companies 60 % are in an incipient stage of implementation, only 40 % of this Top 15 companies have already defined their objectives regarding risk management or already have an integrated system of risk management [11].

In this paper we describe the PRA as part of RMP, how can be establish the risk level depending on probability and severity of consequences an present a didactical method for KBs built and used for PRA at the SMEs level.

This work realized at the UPB - PREMINV Research Centre, in University “Politehnica” of Bucharest, is focusing on a university – small and medium-sized enterprise partnership. The validation of this methodology by a case study in the PROGPROC project (CNMP 11014/2007 – between 2007-2010) is to create a support system for resources planning and programming activities according to manufacturing processes management in virtual organizations. We intend that our future work in this area includes building other knowledge bases to evaluate eventually other SMEs activities who involve risks.

5. REFERENCES

ACTUAL METHODS FOR CONSOLIDATION OF ROMANIAN NUCLEAR EDUCATION AND KNOWLEDGE MANAGEMENT

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ABSTRACT: Establishment and development of nuclear education networks at national and international level consolidate the existing expertise, enable the harmonization and mutual recognition of curricula, and provide a better use of existing expensive research infrastructure. Romanian Network of Excellence in Nuclear Physics and Engineering (REFIN) develops an efficient, flexible and modern training system in the nuclear education area, which answers the requirements of nuclear industry and redundant with the requirements of National Nuclear Strategy as well as with perspectives of the European Research Area (FP6, FP7, EURATOM). At national level, UPB coordinated the project "Romanian Network of Excellence in Nuclear Physics and Engineering-REFIN" (2005-2008) which gathered as partners University of Bucharest, University of Pitesti, Institute of Nuclear Research in Pitesti and University “Babes-Bolyai” in Cluj. REFIN developed a data base, proposed a global strategy in order to harmonize the curricula, implemented pilot modern training courses, delivered handbooks and multimedia support for these courses in order to strengthen and better use the existing research infrastructure for R&D among the network partners. It also introduced advanced learning technologies (recommendations for Systematic Approach to Training, e-learning and distance-learning platforms). All nuclear courses delivered by project partners are available on the REFIN web-site, based on a MOODLE e-learning platform. Both current and specific educational and training activities of network partners are oriented towards the nuclear knowledge management requirements.

Keywords: nuclear education, nuclear knowledge management, networking, education providers

1. INTRODUCTION

Recent official international and European documents state that many highly competent engineers and scientists who helped create the present nuclear industry and its regulatory structure are approaching retirement age.

Nuclear energy and, without a doubt, also the non-energy applications of nuclear technologies play a more and more important role in satisfying the present society’s needs and are expected to continue this role in the future, independently of the current social perceptions and political decisions. Existing plants will operate for several decades more, reprocessing will continue, the decommissioning of plants will last until the second half of the century and waste management will be around at least until towards the end of the century. All of these facilities need to be managed safely, demanding high quality and technically competent personnel with nuclear-specific skills to staff the licensees’ organizations, the support companies and the regulatory bodies. In addition, radiation protection specialists will be required.

The most developed countries have decided to construct new large nuclear power plants after an extensive evaluation of the viable alternatives and in full consensus with public opinion. Clearly, an apparent scarcity of professionals in the nuclear field would hypothecate such a decision.

Still, some of the adverse effects of market deregulation are affecting society: the pressure to reduce costs and the lack of a centralized long-term planning. It still means that educational and training structures for a few students or trainees in nuclear disciplines are hardly maintained. Although pre-retirements in the industry could be curbed, retirement and replacement rates will remain an issue, as well as the change of the required professional profiles by the industry. The lack of long-term planning and funding and of predictable regulations, as well as the political opportunism that exist in some countries will continue to paralyze or postpone decisions with respect to nuclear issues and result in fragmented ‘last-minute’, local initiatives to palliate problems ‘as they arise’, making any particular solution inefficient and, in some cases, only partially effective.

2. EDUCATIONAL SYSTEM AND EDUCATIONAL INSTITUTIONS INVOLVED IN NUCLEAR EDUCATION

The main institutions delivering nuclear higher education are presented in Table 1.
Table 1. List of universities offering courses in nuclear education.

<table>
<thead>
<tr>
<th>Number</th>
<th>Organization Name</th>
<th>Web address</th>
<th>BS</th>
<th>MSc</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University Politehnica Bucharest</td>
<td><a href="http://www.energ.pub.ro">www.energ.pub.ro</a></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>University Bucharest</td>
<td><a href="http://www.unibuc.ro">www.unibuc.ro</a></td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>University Babes-Bolyai Cluj</td>
<td><a href="http://www.ubcluj.ro">www.ubcluj.ro</a></td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>University in Pitesti</td>
<td><a href="http://www.upit.ro">www.upit.ro</a></td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>University “Ovidius” Constanta</td>
<td><a href="http://www.univ-ovidiu.ro">www.univ-ovidiu.ro</a></td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Description of the nuclear education capabilities as follows:

a) UNIVERSITY POLITEHNICA BUCHAREST

University Politehnica Bucharest (UPB) is the only higher education institution in Romania that provides education in the Nuclear Power Engineering field. The Faculty of Power Engineering of University Politehnica Bucharest has a tradition of over 50 years in power engineering education, from which more than 30 years in higher education for Nuclear Power Engineering. Every year the Power Engineering Faculty yields more than 250 graduated students from which over 40 are Nuclear Power Engineers. The last five years brought an accelerated updating of nuclear high education according to similar activities in EU countries: transferable credit system, the option of a major and a minor, curricular re-shaping according to Bologna, master studies, post-graduated studies, training for nuclear specialists and open courses. The cooperation with European countries in several TEMPUS programs helped to develop a modern Radiation Protection Laboratory and to establish master studies in Nuclear Safety and Radiation Protection. The Department has 3 full professors, 3 associate professors, 5 assistant-professors.

Due to the participation in ENEN project and related activities, first EMSNE Diploma Supplement obtained by a Romanian student in December 2005 shows the acceptance of Nuclear higher education delivered by UPB.

From 1970 to present, 1023 students graduated the Department of Nuclear Power Plants.

Since October 2005 the educational scheme in nuclear engineering was adapted following the recommendations issued from the Bologna Declaration with 3 levels of education:
- **Engineer Degree in Nuclear Engineering** with a duration of 4 years is equivalent to BS undergraduate education and is Power Engineering oriented. Curriculum is aimed to Nuclear Industry needs and provides basic nuclear engineering education.
- **Master of Science in Nuclear Engineering** has duration of 1.5 years and is equivalent to MSc graduate studies. Curriculum is focused on NRC and R&D needs, on Nuclear law and regulation, PSA and codes, advanced courses of reactor physics, nuclear materials. For Master thesis research work has an important weight.
- **Doctoral program of 3 years (PhD)**.

For the Engineer Degree the curriculum is organized in:


*Year III*-Power Engineering with course of Heat Transfer, Strengthen of Materials, Control Theory and Automation, Measurement and Instrumentation, Power Equipment etc.

*Year IV*- Nuclear Engineering with courses of Nuclear Processes, Radioprotection and Dosimetry, Reactor Theory, Nuclear Materials, Reactor Engineering, Nuclear Power Plants, Nuclear Equipment and Installations, NPP Control and Instrumentation, Nuclear Safety, Radwaste Management, Numerical Methods, Reactor Physics Experiments.

Master of Science in Nuclear Engineering has 3 semesters (total 90 ETCS/ 50 ETCS courses+40 ETCS research) and offers courses in Advanced NPPs- Gen. 3+ and 4, Nuclear Reactor Advanced Physics and Codes, Nuclear Materials for Advanced Reactors, Numerical Methods, Modeling and Simulation of Dynamics of Nuclear Installations, Nuclear Safety, Radioprotection/Codes, Nuclear Installation Impact on Environment, PSA/codes, Thermal-hydraulics/codes, Nuclear Law and Regulation, Safety Analysis, and Spent Fuel Storage and Repository.

The educational capacity per each level (except PhD) in Nuclear Engineering is 40-60 students/year and depends mainly on the market demand and on the number of enrolled students. At present the enrollment is cca. 34 students/year.

b) UNIVERSITY OF BUCHAREST (UB)

University of Bucharest has a long tradition in delivering courses for Physicist Engineers, but this specialization was formally abolished during transition period in higher education in the 90’s. Nowadays the Faculty of Physics is delivering some nuclear engineering courses.

**Faculty of Physics**

Established under the auspices of Faculty of Mathematics and Physics at the beginning, Faculty of Physics has a long and prestigious reputation in assuring the education of students in physics.

The institution benefits of a strategic location inside the IFA (Institute of Atomic Physics) Platform. The university provides:

**CYCLE I (Undergraduate Studies).** The duration of studies is 3 – 4 years and there are two domains of License Studies:

- Domain PHYSICS (Academic Undergraduate Studies) with 3 year duration, containing the Specializations: Physics, Biophysics, Medical Physics and Informatics Physics
- Domain APPLIED ENGINEERING SCIENCES,

The studies are 4 years duration, containing the Specialization Technological Physics.

Undergraduate studies are concluded by a graduation examination (License), consisting of 3 exams. The graduates obtain the Diploma in Physics, Biophysics, Medical Physics,
Informatics Physics, for the ones that graduated the 3 years domain and the Diploma of physicist - engineer for the ones that graduated the 4 years domain. The Technological Physics specialization offers, beginning the third year, the direction of study: Physics and protection of the environment.

The Faculty of Physics offers, in addition to the Curricula in Romanian language, the possibility to study in English (Physics) for the compulsory courses.

**CYCLE II (Academic Master Studies).** Graduate students can continue their training in the second cycle, following M.Sc. programs e.g. Atomic and Nuclear Interactions.

The degree “B.Sc. in Physics” obtained at any Romanian university is a prerequisite. The Curriculum of M.Sc. program, for every specialization, includes: 3 special course units /semester in the first 2 semesters and 1 course unit in the third semester. Students in Master programs are required to participate in one of the research projects offered by the department and to write a final dissertation.

**Cycle III (Academic Doctoral Studies)** Ph.D. programs are organized inside of Physics Doctoral School, of University of Bucharest, in various fields of physics: Biophysics and Medical Physics; Condensed Matter Physics, Atomic and Nuclear Physics; , Theoretical Physics; Optics, Spectroscopy, Plasma and Lasers; Physics of the Earth and Meteorology; Educational Physics.

**Department of Atomic and Nuclear Physics** has 21 staff members that provide the following courses: Atomic Physics, Molecular Physics, Nuclear Physics, Elementary Particle Physics, Interaction of Radiation with the Substance, Reactors Physics, Radioprotection and Dosimetry.

Educational capacity is at least of 20 students/year, but at present it is difficult to enroll students due to low demand from the labor market and (as a subjective factor) location of the university campus outside Bucharest.

c) **UNIVERSITY BABES-BOLYAI in CLUJ (UBB)**

The Babes–Bolyai University in Cluj-Napoca is the oldest institution of higher education and the largest university in Transylvania. Today it claims a multicultural profile rooted on a multilingual basis.

The history of the Cluj-Napoca university can be traced back to 1581. The official teaching languages are Romanian, Hungarian, German and English.

The UBB in Cluj-Napoca has a Physics Department and a didactic Nuclear Physics laboratory, equipped with some alpha, beta, gamma emitting sources and two neutron sources (one Am-Be and one Pu-Be); detection is made with old fashioned but working equipment.

The taught courses cover basic nuclear physics, radiation detection, radiation protection, nuclear reactors and nuclear materials. Additional optional courses as ‘Nuclear Interactions’, ‘Nuclear Magnetic Resonance’ and ‘Elementary Particles’ are available.

d) **UNIVERSITY OF PITEȘTI (UPIT)**

The University of Pitesti is a young, dynamic, modern and flexible institution of high education which offers large educational possibilities to high school people mostly at a regional basis.

Close links and location to the Institute for Nuclear Research (INC) in Mioveni-Pitesti and to the National R&D Institute of Cryogenics and Isotopic Technology in Rm. Valcea (ICSI) raised the interest for nuclear education. Consequently at the Faculty of Sciences were introduced courses with nuclear topics for physicist engineers (in the third and fourth years) as: Nuclear Materials, Reactor Physics and Nuclear Materials, Nuclear Physics, Nuclear Technologies, Nuclear Safety, Radwaste Treatment and Management, Quality Assurance in Nuclear Engineering etc.

From 1999 until now, 18 students graduated in the Nuclear Engineering field. At the present, 100 students are studying Nuclear Engineering.

University has a didactic Laboratory of Atomic and Nuclear Physics as well as a modern Laboratory for Advanced (nuclear) Materials research.

e) **UNIVERSITY “OVIDIUS” IN CONSTANTA (UOC)**

Starting 2003 University “Ovidius” in Constanta offered at the Faculty of Physics, Chemistry, Electronics and Oil Technology a 5-year program in Technological Physics with two specializations: Physics of Materials and Physics of Nuclear Reactors.

At Master level, starting 2002 was proposed a Master of Science in Physics, Technology and Safety of Nuclear Reactors.

Transition to Bologna system ended these programs and starting 2005 were introduced:

- a 3-year program in Physics with a specialization in Nuclear Physics offering courses in Radioprotection and Dosimetry, Nuclear Processes, Nuclear Safety and Environmental Protection and Introduction in Command of Nuclear Processes, and
- a 4-year program in Technology Physics with a specialization in Nuclear Reactor Physics offering in addition courses in Nuclear Materials, Physics of Power Nuclear Reactors, Design and Safety of Nuclear Reactors.

University “Ovidius” also delivered courses for Cernavoda NPP personnel at the Training Center in Cernavoda.

The main difficulty University “Ovidius” is facing is lack of students as for the time being no student graduated these courses.

f) **NATIONAL INSTITUTE FOR R&D IN PHYSICS AND NUCLEAR ENGINEERING (IFIN-HH) - Vocational Training Center for Nuclear Activities (CPSCDN)**

CPSCDN represents one of the departments of IFIN-HH, which is in charge with education and training of all personnel working in nuclear, excepting Nuclear Power personnel. It represents the basic training center for regulatory body (CNCAN), but also is providing courses required by different governmental institutions on Radioprotection, Decommissioning etc.

The center doesn’t provide academic education, but more likely training courses for regulatory body and industry.

The training center has an experience of more than 40 years in providing training courses in the following fields of activity:

- Application of radioisotopes and nuclear radiation sources
- Radioprotection and radiological safety
- Non-destructive defectoscopy
- Radioprotection and Nuclear Safety for uses of the fixed X-rays installations

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• Dosimetry and radioprotection
• Transport of radioactive materials
• Radioactive waste treatment
• Mining radioprotection
• Medical uses of open sources.

As a conclusion, industrial demands for nuclear expertise compared to what the educational system is able to provide shows that exists the educational capacity and the needed academic expertise. The actual problem is the number of enrolled students, still low because of unattractiveness of location and especially of scarce salary policy of nuclear industry.

3. NATIONAL AND INTERNATIONAL COOPERATION AND EDUCATIONAL NETWORKS

National and international cooperation aims academic and scientific research activities.

At national level cooperation between universities is formalized by the Council of Rectors of Romanian Universities, but one has to take into consideration the autonomy of academic institutions which virtually gives to the Academic Senate the freedom to establish the educational strategy and the means to achieve it.

To strengthen the cooperation in the field of Nuclear Physics and Engineering in 2005-2008 was carried out the project of “Romanian Network of Excellence in Nuclear Physics and Engineering- REFIN”[1]. The project gathered UPB, UB, UBB, UPIT and ICN and aimed to create an educational network similar at national level to the European Nuclear Education Network. The project partners developed a data-base [2] [3] with information about all nuclear courses delivered in Romania and in EU countries, introduced new national and international pilot courses on Radwaste Management and on Numerical and Experimental Methods in Nuclear Reactors, introduced e-learning and facilitated students’ access to nuclear courses, established criteria of mutual recognition based on SAT and self-evaluation reports (www.refin.pub.ro).

Cooperation at national level consists also in consortium agreements for scientific research contracts signed with the National Authority for the Management of Research Programs.

At international level the efforts are oriented towards:

• Exchange of students and teachers through Erasmus/Socrates program,
• Organization of joint training courses,
• Participation in EU funded research programs,
• Active involvement in European Nuclear Education Network Association.

University Politehnica of Bucharest (UPB) was among the founding members of this association. Its members, universities and research centers implemented the Nuclear Engineering Platform for Training and University Organizations (NEPTUNO) project with a few training organizations and industrial partners under the 6th Framework Programme and continue to work with them in the Consolidation of Nuclear Education, Training and Knowledge Management (ENEN II) project. The objectives of the ENEN II project were to consolidate the results and achievements obtained by the ENEN Association and its partners during the ENEN and NEPTUNO projects and to extend and expand the activities of the ENEN Association. The other objectives of the project are also to enlarge the effective membership of the ENEN Association by expanding into new fields and nuclear disciplines (e.g., radiation protection, nuclear waste management), attracting universities and faculties active in those fields, and increase the number of associated members by strengthening cooperation with regulatory bodies, nuclear industries and waste management organizations.

4. NUCLEAR KNOWLEDGE MANAGEMENT

Nuclear knowledge is characterized by high-complexity topics and a long duration of individual competence build-up. At the organizational level, these characteristics determine that the power of an organization or institution is related with the accumulated existing knowledge capital. Furthermore, the capacity of an organization to regenerate knowledge according to its specific processes and the existing market demand decides its position/ranking in the economy of the nuclear field.

Knowledge management emphasizes the reutilization of existing practices and experience and the upgrade, enrichment and revaluation of accumulated knowledge. It identifies and classifies the nuclear knowledge steps - tacit knowledge, explicit knowledge, conserving, transfer, knowledge capture, etc.

On this basis [4] were identified the actual existing problems of nuclear knowledge management in Romania: difficulties in preserving the existing expertise, little or lack of interest in nuclear education and a low level of organization of existing knowledge (reduced number of databases, insufficient integration of the existing knowledge in IT systems, lack of ontology and taxonomy, average structuralism). Therefore, REFIN aims to play a leading role in promoting the activities related to knowledge management in complete accordance with the International Atomic Energy Agency's (IAEA) requirements. The REFIN partners are aware that nuclear knowledge in Romania is facing a major challenge generated by the future development of nuclear facilities and is related to the rising demand of expertise and experts. This challenge is better solved by a partnership between the end users and R&D together with university organizations, which could also provide the generation, transfer and preservation of nuclear knowledge.

Thus, the network could provide an excellent structure for better interaction and cooperation of all interested entities.

5. CONCLUSIONS

From the technical point of view, networking (REFIN) improves the quality of training in the nuclear field, the competence of trainers and students and the efficient use of facilities and research infrastructures.

It introduces advanced course packages, the use of modern training and knowledge management methods and helps harmonization with similar education systems in view of the integration of Romania, with the direct effect of increasing economical competitiveness while fulfilling the sustainable development criteria. The implementation of the proposed measures may help develop the technological and R&D capacity of all partners and increase the mobility of students and teachers at the national and international level.

Also, networking gives opportunities related to technological transfer from international and European partners and participating in ENEN, NEPTUNO and ENEN II programs, as well as from the ENEN Association.
From the social point of view, this project offers better opportunities for larger student categories in education and training, direct and affordable access to network database and e-courses.

Eventually networking could provide an excellent structure for better interaction and cooperation in the generation, transfer and preservation of nuclear knowledge.

6. REFERENCES


2. Victor CIUPINA, Florin MOSCALU, Mihai GARTU- Curricula in Nuclear Reactor Physics and Technology at University “Ovidius” in Constanta, Nuc Info Day 2009, Pitesti, June 11-12, ISSN 2066-6128

3. Alexandru CHIROSCA- Radiological Protection Research Center- Achievements and Perspectives, Nuc Info Day 2009, Pitesti, June 11-12, ISSN 2066-6128

4. Petre GHITESCU- Nuclear Education and International Opportunities for Professional Up-grading, Nuc Info Day 2009, June 11-12, Pitesti, Romania, ISSN 2066-6128
USING THE COST-EFFECTIVENESS ANALYSIS IN THE OPTIMAL SELECTION OF PRODUCTS

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ABSTRACT: This type of analysis is performed when the most convenient offer has to be selected out of a wide range of products having the same utility. The model offered by decision trees is a useful tool for the accomplishment of the cost-effectiveness analysis. The most important stage of this approach is the one establishing criteria, sub-criteria and their weights in order to identify, analyze and describe the qualities this type of product has to present. Once this stage has been accomplished, we have to consider the cost of the products analysed. An important stage that can radically change the result of our analysis is the one establishing product costs out of a wide variety of offers by considering only the acquisition cost or the lifecycle cost for the type of product analysed. This study does not only present a software which makes it possible to perform such analyses and to automatically hierarchize offers by modifying the weights given to cost and benefit respectively, but also offers the possibility to perform a sensitivity analysis.

1. INTRODUCTION

The modern battlefield has recently become digital and automated, the military structures have gained greater autonomy in action through fast, decisive and dynamic manoeuvres, the armaments as well as the logistic bases have been modernized, and the military have been trained to the highest standards so as to be capable of using the available equipment and to successfully accomplish missions.

In all the fields of activity, including the military one, the equipment has turned more and more sophisticated (more complex, wider spectrum of operations), the costs having also grown accordingly. Thus, such expensive equipment should not be purchased without a careful analysis so as to choose the best option in terms of cost-effectiveness.

These analyses should be performed by teams of experts who should identify the criteria (requirements) to be taken into consideration when analysing the offers, establish their weights [1], and determine equipment’s costs in general and the lifecycle costs in particular.

The Romanian army has lately acquired complex combat systems (planes, frigates, etc.) so as to become operational (replace the old and obsolete equipment), to use technology compatible with that of NATO member states and to achieve interoperability with NATO member states armies, given the need to develop joint common missions in different theatres of operation all over the world.

The objective of this study is to perform a cost-effectiveness analysis on a complex armament system, in order to emphasize the stages of such a study, and the way sensitivity analysis is performed depending on the allocated funds and on the characteristics specific to the equipment of the Romanian Army.

Such analyses should usually be backed up by other models [2] and [3], in this particular case the alternative being the decision-making-under-certainty-conditions model, so as to double-check the optimal solutions obtained in order to see if the two models are identical or at least similar.

This study will consider the acquisition of a tank, the stages to be followed in this respect being as follows:

- establish the criteria, sub-criteria and all other further details, if necessary;
- establish the weights of the identified criteria and sub-criteria;
- establish the acquisition costs of all the tanks considered for analysis;
- establish the lifecycle costs of each tank considered for analysis (maintenance, spare parts, operationalization costs, etc.);
- obtain the optimal alternative;
- perform sensitivity analysis (to modify both the cost-efficiency ratio, and the variance of criteria and sub-criteria weights).

2. MATHEMATICAL MODELLING

The new missions and challenges of modern armies, the uncertain and rapidly changing operational environment re-emphasizes the importance of a technological advantage over the adversary. The new technology entailed on the one hand more dynamic combats, complex and unpredictable actions, and on the other hand higher acquisition and operationalization costs. The decision making process is more complex and requires superiority in the informational domain, a fact that stands true in all the fields of action and even more so in the military one [4].

Given the costs of this state-of-the-art equipment, aspects such as the following are more and more often referred to:

- using modelling and simulation in order to establish the optimal combat waging strategies;
- making an optimal use of combat means and ammunition;
- designing and using specialized software that supports the decision-making process.

By using adequate analysis models for the study of phenomena and processes, we can improve them and make them better contribute to the decision making process [5], [6] and [7]. Moreover, by using specialized software we can determine the optimal solution, minimize decision time, perform sensitivity
analyses and rapidly determine the optimal solution, depending on the system’s state parameters [8] and [9].

One of the models used in the decision making process is the decisional tree model. DECIMAK, a specialized software that allows a comparative analysis of equipment, has been developed based on the above mentioned model. It allows us to:

- assess the efficiency of the equipment considered for analysis;
- classify the equipment based on acquisition and lifecycle costs;
- perform sensitivity analysis:
  - when the weight of criteria and sub-criteria are modified;
  - when the efficiency-cost ratio is modified.

This program is particularly useful for such analyses and, as we have already mentioned, it allows us to obtain the optimal solution and to perform sensitivity analyses which would otherwise be extremely time-consuming.

Adaptability is this program’s most important characteristic and it means that this program can be used for other types of analyses as well. For instance, if we want to determine an optimal route, all we need to do is introduce the criteria and sub-criteria and replace “cost” with “route difficulty”.

3. ASSESSMENT OF TANK MODELS

As we have already mentioned, the Romanian Army has currently taken up an acquisition programme meant to make the equipment compatible and interoperable with NATO member states armies, within the programmes established by the Ministry of National Defence.

Even if the Romanian Army does not dispose of more tank models, the national TR 85M1 tank being the only one available, we can still draw a comparison between the latter and other tank models from different countries.

The technical-tactical characteristics to be taken into account when establishing the efficiency of the tank models considered for analysis are as follows:

- crew;
- dimensions and weight (weight, length, gun forward, hull length, width, height);
- armament (main gun, ATGW, machine guns, elevation range, traverse range);
- ammunition load (main gun, machine guns);
- mobility (engine, engine power, maximum road speed, range);
- manoeuvrability (gradient, side slope, vertical step, trench, fording, fording (with preparation)).

The tank models considered for analysis are as follows:

- Type 99;
- Leclerc;
- Leopard 2A6;
- T-80U-M1 Bars;
- Challenger 2;
- M1A2 Abrams.

Most of the technical-tactical characteristics have been retrieved from the site http://www.military-today.com-[10]. If the information we needed were not available on that site, we searched for each particular item on other sites.

The data will be introduced into the program only after the decision matrix has been normalized, depending on the type of criteria:

- if the criterion is of minimum, then the normalized value is calculated according to the following formula:
  \[
  r_{ij} = \frac{a_{ij} - a_{j \text{min}}}{a_{j \text{max}} - a_{j \text{min}}} \]

- if the criterion is of maximum, then the normalized value is calculated according to the following formula:
  \[
  r_{ij} = \frac{a_{j \text{max}} - a_{ij}}{a_{j \text{max}} - a_{j \text{min}}} \]

where:

- \(a_{ij}\) – is the element of the decision matrix specific to the mission \(i\) and to the criterion \(j\);
- \(a_{j \text{max}}\) – is the highest value of the decision matrix specific to the \(j\) criterion;
- \(a_{j \text{min}}\) – is the lowest value of the decision matrix specific to the \(j\) criterion.

The normalization stage is a method used for standardizing the values corresponding to the different measurement units of the criteria the analysis is based on.

The normalized values are included in table 3, depending on the criteria (minimum or maximum).
Table 1. Analysed tanks’ technical-tactical characteristics and estimate costs

<table>
<thead>
<tr>
<th>MODEL</th>
<th>Type 99</th>
<th>Leclerc</th>
<th>Leopard 2A6</th>
<th>T-80U-M1 Bars</th>
<th>Challenger 2</th>
<th>M1A2 Abrams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew</td>
<td>3 men</td>
<td>3 men</td>
<td>4 men</td>
<td>3 men</td>
<td>4 men</td>
<td>4 men</td>
</tr>
</tbody>
</table>

Dimensions and weight

| Weight | 54 t | 54.6 t | 62 t | 46 t | 62.5 t | 62.5 t |
| Length (gun forward) | 11 m | 9.87 m | 9.97 m | 9.651 m | 11.55 m | 9.826 m |
| Hull length | 6.86 m | 6.88 m | 7.7 m | 6.982 m | 8.33 m | 7.918 m |
| Width | 3.4 m | 3.71 m | 3.7 m | 3.582 m | 3.52 m | 3.479 m |
| Height | 2.2 m | 2.92 m | 3 m | 2.202 m | 2.49 m | 2.438 m |

Armament

| Main gun | 125-mm smoothbore | 120-mm smoothbore | 120-mm smoothbore | 125-mm smoothbore | 120-mm rifled | 120-mm smoothbore |
| ATGW | 9K119 Refleks (AT-11 Sniper) | - | - | 9K119M (AT-11 Sniper-B) | - | - |
| Machine guns | 1 x 7.62-mm, 1 x 12.7-mm | 1 x 7.62-mm, 1 x 12.7-mm | 2 x 7.62-mm | 1 x 7.62-mm, 1 x 12.7-mm | 2 x 7.62-mm | 2 x 7.62-mm, 1 x 12.7-mm |
| Elevation range | -10 to +45 degrees | -8 to +15 degrees | -10 to +12 degrees | -5 to +14 degrees | -10 to +20 degrees | -9 to +20 degrees |
| Traverse range | 360 degrees | 300 degrees | 360 degrees | 360 degrees | 360 degrees | 360 degrees |

Ammunition load

| Main gun | 41 rounds | 40 rounds | 42 rounds | 45 rounds | 50 rounds | 40 rounds |
| Machine guns | 2 000 x 7.62, 300 x 12.7 | 3 000 x 7.62, 1 100 x 12.7 | 4 750 x 7.62-mm | 1 250 x 7.62, 450 x 12.7 | 4 000 x 7.62-mm | 12 400 x 7.62, 1 000 x 12.7 |

Mobility

| Engine | Diesel engine | Diesel engine | Diesel engine | Gas turbine engine | Diesel engine | Gas turbine engine |
| Engine power | 1 500 hp | 1 500 hp | 1 500 hp | 1250 hp | 1 200 hp | 1500 hp |
| Maximum road speed | 80 km/h | 71 km/h | 68 km/h | 70 km/h | 56 km/h | 67 km/h |
| Rang | 400 km | 550 km | 500 km | 400 km | 500 km | 425 km |

Manoeuvrability

| Gradient | 60% | 60% | 60% | 60% | 60% | 60% |
| Side slope | 40% | 30% | 30% | 40% | 30% | 40% |
| Vertical step | ~0.8 m | 1.25 m | 1.15 m | 1 m | 0.9 m | 1 m |
| Trench | ~3 m | 3 m | 3 m | 2.85 m | 2.34 m | 2.7 m |
| Fording | ~1.2 m | 1 m | 1 m | 1.8 m | 1.07 m | 1.2 m |
| Fording (with preparation) | 5 m | 4 m | 4 m | 5 m | 3-4 m | 2 m |
| COST | 2.5 mil $ | 6.09 mil $ | 5.7 mil $ (T-80B) | 5 mil $ | 7.6 mil $ | 4.3 mil $ |
### Table 2. Data considered for analysis.

<table>
<thead>
<tr>
<th>Model</th>
<th>Crew (min)</th>
<th>Weight</th>
<th>Length (gun forward)</th>
<th>Hull length</th>
<th>Width</th>
<th>Height</th>
<th>Main gun</th>
<th>ATGW</th>
<th>Machine Guns 7.62</th>
<th>Machine Guns 12.7</th>
<th>Elevation range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 99</td>
<td>3</td>
<td>54</td>
<td>11</td>
<td>6.86</td>
<td>3.4</td>
<td>2.2</td>
<td>125</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>55</td>
</tr>
<tr>
<td>Leclerc</td>
<td>3</td>
<td>54.6</td>
<td>9.87</td>
<td>6.88</td>
<td>3.71</td>
<td>2.92</td>
<td>120</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Leopard 2A6</td>
<td>4</td>
<td>62</td>
<td>9.97</td>
<td>7.7</td>
<td>3.7</td>
<td>3</td>
<td>120</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>T-80U-M1</td>
<td>3</td>
<td>46</td>
<td>9.65</td>
<td>6.98</td>
<td>3.58</td>
<td>2.2</td>
<td>125</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Challenger 2</td>
<td>4</td>
<td>62.5</td>
<td>11.55</td>
<td>8.33</td>
<td>3.52</td>
<td>2.49</td>
<td>120</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>M1A2 Abrams</td>
<td>4</td>
<td>62.5</td>
<td>9.83</td>
<td>7.92</td>
<td>3.48</td>
<td>2.44</td>
<td>120</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>29</td>
</tr>
</tbody>
</table>

### Table 3. Normalization of data introduced in table 2, depending on the type of criteria and subcriteria.

<table>
<thead>
<tr>
<th>Model</th>
<th>Crew (min)</th>
<th>Weight</th>
<th>Length (gun forward)</th>
<th>Hull length</th>
<th>Width</th>
<th>Height</th>
<th>Main gun</th>
<th>ATGW</th>
<th>Machine Guns 7.62</th>
<th>Machine Guns 12.7</th>
<th>Elevation range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 99</td>
<td>1</td>
<td>0,52</td>
<td>0,29</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Leclerc</td>
<td>1</td>
<td>0,48</td>
<td>0,88</td>
<td>0,99</td>
<td>0</td>
<td>0,1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0,11</td>
</tr>
<tr>
<td>Leopard 2A6</td>
<td>0</td>
<td>0,03</td>
<td>0,83</td>
<td>0,43</td>
<td>0,03</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0,083</td>
</tr>
<tr>
<td>T-80U-M1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0,92</td>
<td>0,42</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Challenger 2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0,61</td>
<td>0,64</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0,31</td>
</tr>
<tr>
<td>M1A2 Abrams</td>
<td>0</td>
<td>0</td>
<td>0,91</td>
<td>0,28</td>
<td>0,74</td>
<td>0,7</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0,28</td>
</tr>
</tbody>
</table>
4. DETERMINING THE OPTIMAL SOLUTION

All the data in table 3, criteria, sub-criteria, weights, technical-tactical characteristics and the costs associated with them are introduced into the computer program, as it can be seen in figure 1.

By using the “M” command we get a graphical representation of tank models’ effectiveness, the total effectiveness as well as the effectiveness of each criterion and sub-criterion being displayed (figure 2).

As it can be seen the most efficient model is the French LECLERC model which has an effectiveness coefficient of 0.375.

By using the “C” command we get a graphical representation which compares all tank models by taking into consideration both cost and effectiveness, the ratio between them being equal (figure 3).

It follows that the best tank model in this case is the Chinese one, given both its low fabrication costs, as compared to other models (we have considered the entire lifecycle costs as an analysis based only on the acquisition costs would result in a different hierarchy which would not accurately reflect the actual costs of the equipment considered for analysis), and its effectiveness. The cost-effectiveness ratio can automatically be changed by dragging the cursor over the “cost-effectiveness” button.

As it can be seen in figure 4, in the case of a 12.5/87.5 ratio, the Leclerc French model becomes as efficient as the Chinese one and can thus be the optimal solution as well. An in-depth analysis should also refer to the optimal solution when the criteria and sub-criteria weights are only slightly modified.

5. CONCLUSIONS

The programs we have presented are user-friendly and help us to obtain efficient results for military missions and not only. With the help of these mathematical models the best action
options can be determined, the decision maker having the possibility to choose the most favourable option for mission accomplishment.

Our analysis reveals the importance of using an adequate model when thoroughly studying processes and phenomena. Such a model should however be backed up by a specialized software that automatically processes data and obtains real-time solutions. It is also important to use more models (if possible) in order to validate the optimal solution. Last but not least, the software we have presented can be adapted to be used for other types of analyses as well.

6. REFERENCES

1. www.rta.nato.int.
11. http://www.military-today.com
17. http://www.globalsecurity.org/military/facility/lima.htm#prof
CHALLENGES AND SUCCESS FACTORS IN DEVELOPMENT, IMPLEMENTATION AND ADMINISTRATION OF AN E-LEARNING COURSE FOR LARGE NUMBER OF PARTICIPANTS

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ABSTRACT: The interactive e-learning course “Essentials of Personnel Management” was realized for managers and teachers of secondary and primary schools. This course was developed by teachers of the Slovak University of Technology in cooperation with their colleagues of the Constantine the Philosopher University in Nitra in the learning environment Moodle and supported by the European Social Fund. This e-learning course is a part of National Project of Further Education of Pedagogical Employees in the field of communication skills, school management and marketing. Nearly 2,000 participants took part in ten course runs starting in October 2007 and ending in September 2008. The authors summarized and analyzed experiences gained by the course developers, providers and participants in the form of challenges in the development and implementation phases of this course and factors contributing to their successful completion.

1. INTRODUCTION
The interactive e-learning course „Essentials of Personal Management” was custom developed to the requirements of Centre of Pedagogical Methodology (further MPC) in Bratislava for secondary and primary school management and teachers, university graduates with Pedagogy majors. Its purpose was to improve their qualification and adaptability as employees, stimulate and enhance education quality in order to meet the requirements of their employer in terms of communication skills, school marketing and management beyond the scope of obligatory study of school managers. The course was co-financed by the European Social Fund.

2. KEY FACTS ON THE COURSE
The course „Essentials of Personal Management” was developed as a distance learning course in the environment of CMS Moodle. It resided at the server of Centre of Distance Education at the Faculty of Electrical Engineering and Information Technology (further FEI) of the Slovak University of Technology (further STU) on the link http://elearn.elf.stuba.sk/moodle/. One course run took four calendar weeks with 80 hours of total study load. It can be categorized as an asynchronous e-learning course without tutor’s presence and with e-communication.

2.1. The aim of the course
The aim of the course was to provide an overview of personnel management concepts and activities as carried out at primary or secondary school, or in a company to its participants, giving them impulses to compare it with the current school practice and suggestions for improvements in personnel evaluation, development, motivation and stabilization. Systematic and regular employee evaluation is considered to be a fundamental activity for efficient execution of further personnel activities, such as employee selection for vacancies, remuneration, personnel and career planning. The course should close the existing gap in this field at primary and secondary schools and motivate the teachers to use and possibly also develop e-learning courses in their work.

2.2. The course target group
The course target group were primary and secondary school managers and teachers with basic PC and Internet usage skills able to connect to the server of Centre of Distance Education at the FEI STU. The course aim, type, duration and requirements were agreed in the contract between the FEI STU and MPC in Bratislava. However, the exact total number of course participants was not contracted. It depended on the interest of the participants and might vary from 1,000 up to 10,000 potential participants. The real number of active users who took the final test was 1,820 of 1,932 assigned users as it will be shown further.

2.3. Course authors, tutors and co-workers
The course content was developed first as a printed monograph [1] by 5 teachers of Department of Economics and Management from the FEI STU in cooperation with 3 teachers of the Institute of Education Technology from the Constantine the Philosopher University in Nitra and with an external personnel management and training specialist. The author team was managed by Mr M. Zajko who worked as a course tutor, coordinator of tutors and coordinator of the whole project as well. Subsequently the monograph text was converted into e-learning course in the CMS Moodle by 5 members of the eLearn Central team [2] set up in the Dept. of Microelectronics and managed by Mrs L. Stuchlíková. The operation of the server was supported by 1 teacher of the Institute of Control and Industrial Informatics and another teacher from this institute was in charge of the administration of the course study groups supported on the ad hoc basis by 2 persons of technical support. The logistical side of the course took another 2 persons supported by 5 more persons in ad hoc situations.

The course tutoring was carried out by teachers of the Dept. of Economics and Management in the FEI STU and teachers of the Institute of Education Technology in the Constantine the Philosopher University in Nitra. The number of active tutors varied depending on the number of active study groups (numbering 10 to 25 participants) from 5 to 13 tutors over the total learning period.
2.4. Course content
The course consisted of 11 lessons, 42 self tests, 2 partial tests and 1 final test, 1 opinion pool and number of hypertext references. The course lessons were created by conversion of the text of monograph „Essentials of Personnel Management“ and enriched with further graphical elements in line with the requirements of Internet studies. The course was divided into eleven modules covering the following topics:

1. Introduction into distance electronic learning
2. School management
3. Personnel management within school management
4. Leadership as core of personnel management
5. Job analysis
6. Personnel planning
7. Personnel acquisition and selection
8. Personnel evaluation
9. Personnel development and education
10. Personnel stabilization
11. Termination of labour contract.

3. CHALLENGES AND SUCCESS FACTORS IN THE COURSE DEVELOPMENT

3.1. Challenges in the course development
The main challenges in the course development were the following:

a) In the development of printed text:
   a.1) content and structure of the printed text should facilitate conversion in the online text as much as possible.

b) In the development of e-learning text:
   b.1) definition of appropriate lesson format
   b.2) definition of standard navigation elements in lesson texts,
   b.3) development of course testing modules (quizzes),
   b.4) development of course discussion forums.

3.2. Success factors in the course development
3.2.1. Printed text
In the development of printed text we put focus on the following success factors:

- Selection of relevant and appealing content in the field of personal management of primary and secondary schools for the course participants.
- Definition of the style and format rules for authors writing the text modules of the monograph which should comply with rules for distance online learning, such as: conciseness of body text, transparent text structures, concise multilevel headings, text highlighting, clear and transparent figures and tables increasing the ease of reading, minimum of relevant references.
- Definition of standard module structure: introduction, learning objectives, structured body text, module summary, references, self test questions (with a key to them).

3.2.2. E-learning text
The course lessons were converted into the SCORM packages. SCORM (Shareable Content Object Reference Model) is a widely approved e-learning standard describing a specific way of delivering e-learning contents. A user’s view in the SCORM package in Moodle is presented in Figure 2.

In the development of e-learning text we put focus on the following success factors:

- Each lesson is to be introduced with clear definition of study objectives (Figure 3),
- Lesson wording is to be divided into short well-defined units enriched by content-related illustrations and images drawing student attention to the issue under study and promoting the ease of orientation in the text (Figure 4),
- Use of standard navigation elements in the course is strongly recommended (Figure 5).

Figure 1. User’s view of the course main user menu.
A user’s view of the course main user menu is presented in figure 1.

Figure 2. SCORM package in Moodle.
We used the following elements:
- Active navigation menu bar on the left side of the screen providing full course content overview; student just selected the topic and the selected study section immediately appeared on the screen,
• Arrows in the page heading and footing; if the text exceeded the page scope, the active continuation link enabling to progress to the next page was added (Figure 5),
• hyperlinks for direct referencing/quoting the information sources (legal acts); these links would turn inactive if any change of the pages of the source quoted occurred,
• educational texts were amended by topic-related questions, thought-provoking questions and tasks.

Individual lessons were included in the course first as independent units in the section where the courses were located, and second in the section with full set of course lessons.

This implementation approach made it easier for student to get a comprehensive picture of the topics under study. At the same time it enabled student to concentrate upon the lesson the knowledge of which was to be tested.

Course testing modules (Quizzes) were created in Moodle XML format. We kept to the following rules for quizzes:

• In the end of each lesson there are to be at least 4 various quizzes with 5 multiple-choice questions supporting single or multiple answers available in both types of quizzes. They are designed for fast revision of student’s knowledge.
• Students should see not only the success rate of their answering the test questions in %, but also their expected correct answers after the test completion (Figure 6),
• The best results are to be stored in user accounts. The user might be informed about these results if he/she repeated the test.

Two partial tests and one final test were embedded in the course to serve the following purpose:

• The partial tests are to be used not only for student self-evaluation but they will enable the students with limited PC and Internet experience to gain sufficient experience and self-assurance in the test handling and course navigation,
• The final test is to be used as the official comprehensive check of participant command of study texts,
• If the success rate of participant’s answers in the final test meets the pass criteria he or she will be entitled for a course pass certificate.

3.2.3. Discussion forums

Course discussion forums within study groups and among them are considered to be extremely important learning tool for course participants in three aspects

• Key communication tool between course coordinator, tutors and students,
• Tool for students learning from one another during the course study,
• Social networking tool for territorially dispersed participants.
We introduced the following discussion forums:

- General discussion forum was set up as the main communication channel between course coordinator and its participants; tutor consulting hours were announced in the general forum immediately after forming the discussion groups of each tutor (Figure 7),
- 13 tutor discussions forums served for communication between tutor and members of his/her group as well as among members within each study group,
- Opinion pool for participant evaluation feedback is to be set up at the start of the first course run.

**Figure 7.** View of discussion forum.

### 4. CHALLENGES AND SUCCESS FACTORS IN THE COURSE IMPLEMENTATION

The main challenges in the course implementation were the following:

a) challenges in the course start up and operation,

b) challenges in the course administration.

#### 4.1. Challenges in the course start up and operation

1. The ordering party was able to provide neither any electronic participant database with postal addresses not any participant e-mail addresses but hard copy participant lists of the preceding module. Therefore it was vital for the course start up to set up an address database of 10,000 prospective participants for printing of mail labels for further mailing of instructions and printed study materials to prospective course participants as well as for mass e-mails to them. This laborious activity took about four man-months of full-time work.

2. The ordering party required full freedom of participant registration to a specific course run date. Thus the course provider was not given any definite target group of course participants to a specific date by the ordering party. This requirement increased the workload of course administration considerably.

3. The course marketing to the potential participants was the responsibility of course provider. Under such unusual conditions the course providers had to pay special attention to the relevance of the course content as well as to its graphical attraction for anticipated course participants already during the course development stage. Moreover, the providers also launched course promotion activities via direct mailings to prospective participants and via the websites of the MPC and FEI STU and relied on the advertising by the word of mouth. More efficient networking communication methods could have been used.

4. Demanding requirements upon management of study groups and organization of individual course runs. In order to cope with the unknown total number of course participants’ sufficient number of qualified tutors had to be recruited and trained well in time. Potential number of study group members might be 20 to 50 participants per tutor within the individual course runs. Therefore 10 course runs had to be planned from October 2007 to September 2008 to accommodate up to 1,000 participants each. The first course run served as a pilot run. Evaluation of its results helped develop efficient administration procedures for participant registration in subsequent runs.

5. Neither meetings of tutors and participants, nor tests or exams supervised by tutors were envisaged during the course runs. All contacts between course tutors and course participants were to be exclusively via e-mails and course discussion forums. Phone, fax or correspondence contacts were reduced to a minimum.

#### 4.2. Success factors in the course start up and operation

In the course start up and implementation we put focus on the following success factors:

1. The initial course advertising campaign over internet sites and direct mailings aimed at attracting the potential course participants for the specific course runs which commenced one month prior to the course opening and continued over the next six months.

2. The adequate level of professional knowledge and communication abilities of tutors.

3. The behavioural pattern of proactive and caring tutor had to be established and reinforced over the course period. The lack of personal contact between tutor and participant was partially substituted by the use of teacher and participant photos. The tutor was expected to regularly monitor the frequency of student access to the e-course offering assistance and advice to student with a longer absence. He/she was to respond to student questions in the e-mails and discussion forums and evaluate the student results in the partial and final tests in a timely manner.

4. The responsive and reliable course coordination, administration, and logistics to the students’ issues and questions acting under the time constraint and stress.

5. Attractive and easy-to-use user interface of the e-learning course enhanced by the responsive user support.

6. Promotion of tutor-participant communication based on the tutor initiative proved to be very useful. The content of this communication reflected heterogeneous level of PC skills among the course participants and problems in their internet access.

7. Keeping a high and steady level of participant satisfaction with course communication channels and content. The early tutor - participant communication was devoted predominantly to technical and organizational issues and less to the course content. With the increasing participant learning curve and self-confidence in the course environment the tutor-participant communication grew more professional (questions on personnel management issues, comments and suggestions on the study text and tests) and useful participant feed back and suggestions on course management and operation were raised.
5. CHALLENGES AND SUCCESS FACTORS IN THE COURSE ADMINISTRATION

5.1. Challenges in the course administration
1. Distribution of several tons of course monographs from the printing office to the central distribution site at the FEI STU, from the central distribution site at the FEI STU to the course participants and finally mailing them to participants, since the ordering party required that all 10,000 participants of the preceding training module will receive the course monograph.
2. The agenda of participant registration to the course, dispatching the access keys to the individual participants of the course runs,
3. Preparation of the data from the participant database for printing of course certificates, and handling the participant questions put the study group administrator under severe time pressure. Therefore the project coordinator took over the assignment of new course participants in the study groups and discussion forums of the individual course tutors.
4. Numerous requests for assistance in solving the hardware and software issues on the part of the participants with various PC and Internet skill levels put the technical course support under pressure especially in the starting period of each new course run.
5. The technical course support was very busy with handling issues related to the course server in the start up phase and then after the CMS Moodle upgrade in the middle of course period in order to maintain a reliable e-learning platform.

5.2. Success factors in the course administration
1. It is recommended to minimize the transportation routes from the printing office to the central distribution site of course publications and then to the mailing site. Optimal solution might require use/purchase of a packing machine/line located in the printing office for mailing the study documentation to the course participants in order to save loading/unloading and packing/mailing operations.
2. Skilled study group administrator with experience of running several small to medium e-learning courses should be able to cope with the inflow of course registrations and changes from course participants on one hand and with outgoing communication to the participants including the mailing lists for postal services. However, the workload peaks, especially in the first six course runs required hiring another two assistants to support her in these activities.
3. Skilled technical support person with experience of handling issues related to the connection to the course server, potential issues related to the participant PCs as well as impacts of the CMS Moodle upgrade during the relevant course period. It is indispensable in order to maintain a reliable operation of the e-learning platform.

6. CONCLUSIONS
1932 participants took part in ten course “Essentials of Personal Management” runs starting in October 2007 and ending in September 2008. 1820 (94%) participants were successful. Several views on the final evaluation of participation and success rates in the e-learning course are presented in Figure 8. The project coordinator and tutors were the first line of response to potential criticism and suggestions raised by the course participants. All such comments were registered by project coordinator on an ongoing basis and adequate actions were taken with minimum delay. The overwhelming majority of course participants enjoyed and appreciated the electronic communication with their tutors.

The participants appreciated especially the possibilities of going through the tests after each lesson at their own pace at their free time. That enabled them better individual self-study organization given their comparatively high work load at school not considering their personal work load in their families (women) after returning from school. They also appreciated unlimited and non-graded practicing two partial tests at the end of the 2nd and the 3rd course week. It did enhance their self-confidence in working in the course environment before approaching to the graded final test with a threshold on minimum correct test answers. 101 participants did not take the final test of the course. The final tests showed very good results of the course participants, the average score per participant being 37.2 points out of 40 points. Several of them were given a second chance of running this test after consideration of their technical issues occurring on the final test day or their test failures.
undoubtedly will gain on significance in current teaching and learning methods.

Collaboration of tutors from the FEI STU in Bratislava and from the UKF in Nitra proved to be very inspiring especially in the preparation of course study text. Both tutor groups appreciated very much their collaboration with the eLearn Central [3] team members during the conversion of their study texts into the e-form. It helped them realize the shortcomings of traditional approach to writing study texts in comparison to e-learning texts. Moreover, all tutors gained invaluable experience in working in the CMS Moodle environment. They all wished they had gone through comprehensive training in the Moodle environment before their tutoring. It would have improved the communication among teachers during the pilot run and later also their communication with course participants.

7. REFERENCES
DETERMINANTS OF KNOWLEDGE AND TECHNOLOGY TRANSFER
ACTIVITIES BETWEEN FIRMS AND UNIVERSITIES

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ABSTRACT: The purpose of this paper is to investigate mechanisms of knowledge transfer between firms and universities that involve knowledge spillovers, the extent of use of these mechanisms, and the determinants of their use. Universities have become increasingly involved in technology transfer by establishing offices of technology transfer, business incubators, and technology parks. Results point to differences between technology transfer and knowledge transfer. Our findings suggest that either investment in university research do not generate acceptable returns, or indicators used to measure returns on investments such as patents, licenses, and spin-offs do not capture a large part of the returns generated by investments in university research. The future research will be focused on the organizational dimensions of university research.

1. INTRODUCTION

In the new knowledge economy, the knowledge can be seen as the most important resource. The traditional products factors – land, work and capital – not disappear but become secondary. The knowledge becomes the only really relevant intangible asset. The innovations’ diffusion and the high technologies’ convergence will play a key role in the knowledge importance acceleration in the globalization context.

The most developed countries from the world invest an important part of their GDP into research. For example, the United States invests 2.5% in research, and Japan more than 3%. The EU wants to invest 3% of GDP in research. For example, the 7th Research Framework Programme 2007-2013 developed by the EU has the biggest budget an amount of 67.8 billion EUR and four specific programmes: Cooperation, Ideas, People and Capacities.

In the United States, overall, the government, universities, and non-profit institutions fund roughly $95 billion of research and industry funds approximately $181 billion. This is 34% public and 66% business.

Through technology transfer the universities provide commercial sector companies with access to new discoveries and innovation resulting from research. Industrial partners develop these inventions and manufacture products. Research universities seek to facilitate the transfer of technological innovations to private companies in order to create jobs and contribute to local economic development, and earn additional funding for university research. Therefore, the relationship between teaching and research is positively correlated. Research helps teachers lead the way in their fields, and an active interest in research contributes to teaching effectiveness. Education and training are considered to be some of the main factors to foster entrepreneurship. Businesses that take into account knowledge, offer better products and services made with more intelligent processes [1].

Spin-offs refer to new firm entrants founded by employees of firms in the same industry or university researchers. We describe spin-off firms as firms founded by experienced employees of incumbent firms in the same industry. The previous experiences of founders of spin-offs influence not only the formation and product development of new firms, but also the firms’ ability to establish a position of competitive advantage and achieve organizational longevity. Universities encourage the development of faculty spin-off companies or have taken an aggressive position in encouraging technology entrepreneurship through creation of technology incubators and technology parks.

The development and evolution of new technologies will impact the business of technology transfer. The main purpose of this research is to analyze the relation between entrepreneurship university support and the level of entrepreneurial activity. The specific objectives are the following: (1) to analyze relationship between university support and entrepreneurial activity and (2) to analyze the relationship between entrepreneurial intentions and university support to entrepreneurship.

The Romania business sector develop not enough the research and diffuse not enough the knowledge throw other organizations. In these conditions the knowledge can be imported from other organizations, especially from universities research centres.

In this paper, we investigate the determinants of knowledge and technology transfer activities between firms and universities. We find that education and training and R&D – transfer are, among others, some of the main factors of the business creation process. Universities are being required to operate in a more entrepreneurial way, commercialising the results of their research and spinning out knowledge-based enterprises.

In the subsequent sections, we first review the existing literature relevant to create competitive advantage through technological transfer. Using this literature we develop a conceptual model. Finally, the theoretical and managerial implications are discussed.

2. LITERATURE REVIEW

Technology transfer is the process of sharing of skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among companies to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit
the technology into new products, processes, applications, materials and services.

In the literature to date, there is little existing evidence of technological transfer between universities and firms. Technology transfer is a service industry and that the primary business activities can be placed into two broad categories of services: (1) facilitating the commercialization of new technologies and (2) providing technical advice to solve unmet needs. The Technology Transfer Centre offers technical advice to small businesses seeking technology or technical know-how.

Universities research results are extensively, freely, and publicly disseminated through publications, conferences, consulting contracts, joint ventures, and patents. Access to such extensive sources of advanced information is vital for industry research. The process of introducing a technology into the marketplace is called technology commercialization.

Knowledge transfer is the practical problem of transferring knowledge from universities to firms. It seeks to organize, create, capture or distribute knowledge and ensure its availability for future users [1].

Despite obstacles in producing and marketing a promising technology, start-ups succeed and survive if their entry into the market could potentially force existing companies with inferior technologies out of the market. However, this would be a solution only if the technology belongs to a dispersed industry with little concentration and no clear leader. In heavily concentrated sectors, developing production and sales distribution channels may be cost prohibitive [6].

The premise behind our study is that the proactive role of the financial institutions, universities and firms may influence business performance. The knowledge investments by both universities and research units generate new entrepreneurial opportunities. As a consequence new firms are created in order to exploit knowledge [2].

The capability of firms to significantly develop or improve their products and manufacturing processes depends primarily upon the capacity of identification, acquisition, integration and application of knowledge by individuals in the firm. Intellectual property protection is most successful with knowledge that can be easily described and codified. In sectors where initial research investment is necessarily high and the cost of imitation is low, the mechanism of technology transfer may fail, and intellectual property protection becomes essential.

Technology refers to tools for changing the environment, while knowledge embodies theories and principles helping us to understand the relationships between causes and effects. Technology transfer is a construct referring to the instrumentality of knowledge, to sets of tangible tools stored in blueprints, data bases, manuals, and other forms of documents such as patents. This attributes transform technology into products that are easily amenable to commercial transactions.

The universities tended to focus on adapting their traditional roles in teaching and research to support business needs, rather than through knowledge capitalization. However, there was a weakness in the university’s ability to capture the commercial benefits of the knowledge bases that it had created, or co-created. The tensions under which researchers operate; on the one hand, the traditional vision of universities, which encourage researchers to publish, compete with the entrepreneurial vision of universities, which encourage researchers to consider their publications as knowledge assets that can be transferred outside the scholarly community. In Romania, a few universities had adopted an entrepreneurial orientation.

Since the beginning of the 1990s, the Romanian university system has been changing significantly through the several reforms. These reforms gave new opportunities to universities in defining and pursuing their strategies. Nevertheless, the research and the education are treated, yet, like being services that funds consume and not like being the main ways for the added value realization. In Romania there is a weak involvement of the universities in the activity of research, only 20 research institutions (9 universities) produce over 70% of the scientific results recognized internationally. In practice, we can note a diminishing of relative income and of the social prestige of scientific, academic and engineering staff.

In many Central and Eastern European countries, the scientific infrastructure - including equipment - is in a poor state. Technological innovation is directed mostly to the existing traditional technologies and not to new, prospective areas. Investments are small and the role of foreign investors is limited.

The universities as facilitators of knowledge transfer are fundamental catalysts for regional economic and social development. Consequently, the role of universities as organisms delivering potential entrepreneurs to society is actually becoming very relevant. Technology transfer is a valuable mechanism by which industry can accelerate its innovation activities and gain competitive advantage through cooperation. Now approximately 20% of the relevant age population is enrolled in higher education worldwide.

The means of technology transfer are not simple. There are various channels of technology transfer including trade of goods and services, licensing contracts, and movements of engineers as well as the supply of technology from a parent company, university, or other research units and firms. In the first stage, technology flows from the university to firms, and in the second stage, the technology held by the firm, is diffused to the other companies. However, the second stage of technological diffusion occurs through various routes and is extremely difficult to be specified by statistical data.

Companies look to transfer technologies to other organizations as a potential source of revenue, to create a new industry standard, or to partner with a firm that has the resources or complementary assets needed to commercialize the technology. The license is favoured when the licensee brings special knowledge of the local environment, or when the technologies are changing in such a way that new licensors or licensees with new core expertise are needed from time to time [6].

In general, whether an inventor benefits from an invention depends on whether it is easily marketable. If there is already a strong demand, for the technology, as in case of Nobel’s dynamite, the inventor will immediately see the economic value and try to capture it. On the other hand, if there is no apparent market value, as in the cases of the personal computer and the Internet, the inventor may miss the chance to reap the economic benefit. In such situations, it usually talks one or more entrepreneurs to bring the technology to the market, and it is the entrepreneurs rather than the inventor who are financially rewarded. For example, personal computers found few buyers when the technology first becomes available. IBM, Hewlett-Packard, and DEC all missed the chance to be the first to mass-market personal computers, although these were in a better position than anyone else. It was Steve Jobs, not the
inventor of the technology, which founded Apple Computer and established the enormous PC market.

In the last time, the attention has been focused on the precise channels of technology transfer between university and industry. The most effective mechanisms for technology transfer to industry, as well as the values of contracts, consulting, patenting and licensing, as well as the incubation of new firms, offices of technology transfer, and the returns of public funds and venture capital invested in academic spin-offs. When, the innovation includes high levels of tacit knowledge, the inventor (university researcher) will most probably find a start-up firm to get higher possible rents from his invention. Conversely, if the invention involves moderate levels of tacit knowledge, the best option will be licensing it to an existing firm. However, if universities require a royalty from academic entrepreneurs, total output may be reduced, as inventors will transfer the invention to the university instead of marketing it by themselves.

Although the knowledge of individual founders and characteristics and resources of their parent firm are likely to be positively related, we believe that the precise mechanisms by which industry knowledge enhances the survival of new firms work through the influence of individual firm founders, rather than through the characteristics of their parent companies. Therefore, firms whose founders have more extensive experience from a parent firm in the financial or the technological industries will have a higher chance of survival.

Spin-offs, if not the most widely used mechanism of technology transfer from university to industry, are the most visible, as new companies emerge that may become engines of regional economic development. In nanotechnology area, university spin-offs play important but not dominant roles in the development of this new technology, but that they compete with large companies as well as corporate spin-outs and new technology based firms [7].

University incubators should clarify their missions, their structure, their processes, and the resources that spin-off companies need to receive in order to become successful. Also, different types of corporate incubators may add some specific lessons from university ones: for instance, university incubators should clearly make the distinction between leveraging core university technologies requiring long-term support (i.e. biotechnology) and fast-profit spin-offs putting forward some specific short life cycle ones (i.e. software) in order to provide different services to different technologies.

The firms’ competitive advantage and economic growth in general are more and more determined by knowledge creation and technical progress. Knowledge is a good that cannot be appropriated. Thus, it may spill over, primarily from universities, and it is freely available to firms. Interrelation among firms, universities and research units are now considered vital for the generation, dissemination and absorption of new knowledge [5].

Spillovers are created by a combination of the new knowledge resulting from an R&D effort, and the commercialization of the new technology in terms of a product or process that is successfully implemented in the market place. R&D spillovers are thus an example of a positive externality.

Network spillovers result when the commercial or economic value of a new technology is strongly dependent on the development of a set of related technologies. For example, a network spillovers exists among all of the different developers of application software for use with a new operating system platform. If one firm/university develops a particular application, people will buy it only if many other firms develop other sufficient applications so that the platform itself is attractive and widely used.

Labour mobility is obviously one mechanism of knowledge spillovers and a growing literature documents the importance of social interaction, local networks, and personal communication in knowledge transmission. Given the tacit nature of knowledge it could be expected that one of the main transmission mechanisms of new knowledge developed by the scientific system, would be the researchers and scientists who participated in the scientific creation, moving to other areas.

Indeed, mobility of human capital is another mechanism for transferring knowledge. The availability of a higher number of skilled and highly educated resources stemming from universities has a positive effect on knowledge transfer [2]. Thus, we expect a positive relationship would exist with the rate of growth of firms.

**H1:** A growing number of skilled and highly educated resources, the higher rate of growth of firms

New entrepreneurial opportunities are generated by new knowledge. As a consequence, new firms are created in a process involving the spillover of knowledge. In addition, the access to knowledge gives a competitive advantage to the company. In this case, the access to knowledge generated by universities may affect the potential to create new economic opportunities, introduce new ideas in the market and, in turn, grow at a fast rate [5]. This leads to the following hypothesis:

**H2:** Knowledge generated by universities has a positive impact on the growth rate of firms located in the same area where the university has accomplished the research

Sponsored research may take the form of grants or contracts. Grants are more open ended in terms of outcomes, while contracts typically enumerate a set specific deliverable products and explicit end results. Contractual mechanisms used to transfer knowledge such as licensing agreements are structured as market transactions. But in contrast to the typical goods involved in market transactions, the value of knowledge is uncertain, with uncertainty being highest for the most basic research activities. Formal technology-transfer agreements are negotiated prior to the research being complete and at a time when the commercial value of the end results is not known. Thus, negotiations are based on estimates of the subjective expected value of that position of the knowledge. This imperfect estimate of the value of knowledge to the contracting firm may entail a market failure.

Overall technological development in learning systems, which can only be achieved by the successful absorption of knowledge, is determined by the absorptive capacity by training its personnel, by carrying out R&D and by using advanced manufacturing equipment. Universities can both help to train personnel and stimulate learning by exposing companies to new ideas in cooperation projects. But as universities themselves are often not used to carrying out research and to monitoring the latest technological developments in their fields, they themselves need incentives to upgrade their R&D capabilities and to bring their knowledge to bear in university-industry cooperation. Thus, learning and promoting capability has to involve both industry and academia.
H3: A greater emphasis on learning and promoting capability increases the successful absorption of knowledge

University spin-offs are studied primarily by researchers who seek to understand the phenomenon of technology transfer from university to industry. A great deal of knowledge created at universities is tacit and not codify and that the dissemination of such knowledge relies on direct interpersonal contact. Professional mobility, therefore, is considered a critical element in transmitting knowledge, and the movement of university employees from academia to industry constitutes an important channel for technology transfer.

Commercializing a technology may encompass many different types of transactions between a university and the company and different types of transactions may occur sequentially to reinforce commercialization. Therefore, for a long time after a technology is developed, only the chief scientist (very likely a university researcher) and others involved in making the technological breakthrough are in the position to commercialize it.

Finally, no firm can afford to pay the costs of performing research if the benefits of the research accrue as much to its competitors as to itself and if it does not achieve an economic return for its products that covers research costs as well as production costs. In economic terms, this requires a return beyond marginal cost. Because of this phenomenon, much research is supported publicly by university institutions, or though subsidies to private sector institutions.

3. CONCEPTUAL MODEL

Figure 1 provides the conceptual framework that guides our analysis of determinants of knowledge and technology transfer activities between universities and firms. Universities’ relationships with companies are formed through a series of sequential transactions such as sponsored research, licenses, spin-off firms and labour mobility.

Universities are involved in a two-phase process that involves first the production of knowledge and then its application and diffusion. Linkages between academic and industrial research appear to be powerfully influenced by the degree of centralization of the funding system. There is a belief that competition for funding, diversity of funding sources, and, in general, a decentralized funding system would be more conducive to university-industry relationships. In addition, decentralized systems tend to be responsive to local industries. Knowledge production increasingly is trans-disciplinary and depends on the ability of researchers to work with other across a broad spectrum of disciplines. A system that adheres to rigid disciplinary boundaries in funding research projects will inhibit these interactions and thus may limit technology-transfer opportunities [5].

For high technology firms skilled labour services and proximity to sources of knowledge and expertise are much more important than cost reductions. Indeed, innovative start-ups frequently create new markets where no competition exists and demand is not sensitive to product costs. The small firms’ competitive advantage lies in being first to market or offering a higher quality product. Small firms, lacking the resources of their larger counterparts, are more dependent on resources in their local environments. Indeed, many times small firms become the mechanism by which academic knowledge is commercialized. A convergence of knowledge management and collaboration technologies could increase an organizations ability to create value with knowledge [3].

Figure 1. The conceptual model

As illustrated in Figure 1, a conceptual model is in line with the importance of knowledge as a major source of innovation. This model offers a clearly defined process for identifying the determinants of knowledge and technology transfer activities between firms and universities that leads to competitive advantage for companies and additional funds for universities.

Many researchers see tacit knowledge as a main source of ambiguity and therefore count it among the barriers to knowledge transfer along with complexity and specificity. Tacit knowledge is defined in terms of how difficult it is to articulate and codify a given domain of knowledge. A higher degree of tacit knowledge decreases the speed of transfer since tacit knowledge is hard to articulate with formal language or express directly. That is, the degree of tacit knowledge influences knowledge transfer outcomes through its impact on
knowledge ambiguity. Technologies for collaboration enable
the sharing and use of distributed knowledge by researchers.

Knowledge and technology transfer activities must take into
account the characteristics of knowledge, absorptive capacity,
disseminative capacity, and characteristics of the relationships
between knowledge senders and receivers. The amount of
knowledge a firm is able to use economically is described by
the absorptive capacity. The absorptive capacity of knowledge
receivers is a major determinant of the knowledge transfer
process; the greater the absorptive capacity, the greater the
degree of knowledge transfer [6].

The actual process of knowledge sharing is highly dependent
on the ability to capture and understand the complex
knowledge being developed by other research units.
Communication is important as it is the process through which
information flows, and evidently lays the foundation of
knowledge sharing, while successful interaction among
concerned units/researchers increases the understanding of
each others’ capabilities, providing a stronger base for efficient
knowledge processes.

Asymmetry of information between the researchers and
research users arises when the users cannot precisely evaluate
the applicability of the transferred knowledge until they attempt
to translate it into new or improved products or services. In this
case, the transfer of knowledge is unlikely if researchers and
research users do not have frequent interactions. Therefore, the
knowledge transfer depends on the opportunities created by the
linkages between researchers and research users. That is, one
of the major determinants of knowledge transfer is the linkages
between researchers and research users.

The dimensions of research infrastructure, large research
infrastructures, provide more resources that facilitate the
undertaking of knowledge transfer activities. Faculty quality is
important and statistically significant, suggesting that higher
faculty quality tend to produce inventions with greater
commercial viability. Each firm holds a technological profile,
which represents the capabilities for innovations. For example,
Swedish telecommunications group Ericsson wants to develop
its operations in Romania. Ericsson is looking for a research
centre that will employ at least 200 staff. In this case, a
university research centre can be a good solution.

The primary objective of research oriented universities should
be a contribution to knowledge, not pecuniary profit. They are
committed to research activities regardless of the immediate
future economic outcomes. The more innovative research gets,
the less its foreseeable economic outcome becomes [4].

The fact that the software industry has the most university spin-
offs is not surprising. It is well known that investors tend to
invest in high-technology start-ups with great potential for
rapid growth, which fit the characteristics of both industries.
Some universities created research parks and incubators to
facilitate academic entrepreneurship in biotechnology and
software development.

There are the opportunities created by developing linkages and
interactions between researchers and research users. This
means that must be enough communication between the
universities and firms by which the university researchers can
understand local industry’s need and that industry can know
what technologies are being developed that might be useful. It
is important to have strong linkages between academia and the
real world, as through programs by which those in practice in
industry can study in the university, students can work as
externs in industry, faculty can consult, and industry can
sponsor research projects.

Networks may be seen as a specific external source of
resources. The capabilities are those through which a company
can enter into alliances and access partner’s resources and,
accordingly, can overcome resource deficiencies. Particularly,
small high-technology companies may gain cost-advantages
from flexible types of knowledge networking or from contract-
based research partnerships such as universities.

Knowledge Transfer Networks are designed to stimulate
innovation in the Romania economy through higher levels of
research and development. These entities offer invaluable
opportunities to make contacts and exchange information with
other business, academic or research organizations working in
similar fields or sectors through networking.

University Research Park is a good solution to transfer of
academic research. A university research park is a cluster of
technology-based organizations that locate on or near a
university campus in order to benefit from the university’s
knowledge base and ongoing research. The university not only
transfers knowledge but expects to develop knowledge more
effectively.

The long-term networks may be a means for achieving the
diffusion of technology. Through networks, an entrepreneur
can obtain technology from other entrepreneurs in the same
sector or from universities and researcher institutions. Through
cooperation in a cluster, firms may take advantage of external
economies and it becomes easier for universities to provide
supporting services.

In Slovenia, University of Maribor has already established
Technology Transfer Office. In Bulgaria, The Technical
University of Sofia has effectively established a big techno-
park of SMEs that use the development infrastructure for
applied research. Another development in the applied research
is the establishment of co-operative links of university
researchers with big international companies.

Universities are motivated to develop a research park on their
own or in partnership by the possibility of financial gain
associated with technology transfer, the opportunity to have
faculty and students interact at the applied level with
technology-based organizations. In addition, research
organizations are motivated to locate in a research park to gain
access to faculty, students, and research equipment.

A science park is essentially a cluster of knowledge-based
businesses, where support and advice are supplied to assist in
the growth of the companies. In most instances, science parks
are associated with a centre of technology such as a university
or research institute. This entity encourages and supports the
start up, incubation and future growth of innovative businesses
with good growth potential.

Informal interactions and networking between university
scientists and engineers and private companies constitute a
significant and frequent component of the process of
university-industry technology and knowledge transfer. In
practice, there is little analysis explaining whether or in what
ways these interactions are important, such as collaborative
research. Unlike formal university-industry interactions, the
less formal channels of technology transfer are difficult to
gauge [3].

We noted that informal interactions are an antecedent to more
formal interactions such as collaborative research. The support
to facilitate interaction between university and industry at the individual level may also lead to tangible results while having the advantage of being simpler, cheaper, and easier to institute than formal dedicated institutions.

Long term sustained enhancement of entrepreneurial activity requires a substantial commitment to and investment in educational and vocational training programs. So, if in Romania it is desired to get the same level of university influence in entrepreneurship as in other developed countries, there is no doubt about the necessity to integrate the skills development and the capabilities required to start a business into specific educational and vocational training programs at all educational levels. Irrespective of the educational level, emphasis should be placed on developing the individuals’ capacity to recognize and purpose new opportunities.

4. DISCUSSION AND CONCLUSIONS

This study has sought to fill a gap in understanding of factors that contribute to the technology transfer between firms and universities. By adopting an entrepreneurial perspective, it has attempted to identify the relevant determinants of knowledge and technology transfer. By this paper, authors attempt to show that academic education has to be related with entrepreneurial activities. That is, the higher education is related with the socialization of attitudes towards entrepreneurship.

The literature to date suggests that universities, as the centre for knowledge creation and dissemination and a major force of technological innovation, contribute increasingly to economic growth through direct and indirect channels, one of which is the entrepreneurial activities of academic scientists. In practice, the university spin-offs tend to survive longer. A reason may be that the higher opportunity cost of academic entrepreneurs motivates them to engage in more self-screening before they create a company. In addition, it’s possible that university spin-offs are built around a truly advanced technology that enhances the company’s chance of survival.

For the firms, past research in the field has mainly focused on the transfer of technology-driven concepts into the new product development processes. The greatest opportunities for improving the overall innovation process lie in the very early phase of new product development. High-technology firms do not search for local knowledge (local universities), but search for the best available knowledge in the frame of their competitive edge.

The extra investments and incremental additions to the product’s performance do not come for free. The rising costs lead to rising prices. The high price, in turn, limits the product’s performance do not come for free. The rising costs lead to rising prices. The high price, in turn, limits the attraction of the product to a small segment made up of technology enthusiasts and early adopters.

Radical innovations are disruptive to consumers because they introduce products that disturb prevailing consumer habits and behaviours in a major way. The end result of this is that the early pioneers that create these new-to-the-world markets are very rarely the ones that scale them up from little niches to big, mass markets. The companies that eventually scale up new markets jump into the market right before the dominant design emerges. But jumping in at the right time is not enough to conquer the market. The eventual winners not only time their entry into the market to perfection, but they also undertake a series of actions that rows the market from a niche into a mass market. Typically, this involve making heavy investment in exploiting scale economies, travelling down learning curves, developing strong brands, and controlling the channels of distribution to the mass market.

Early pioneers emphasize the technical attributes of the product, but latecomers shift the basis of competition away from technical performance to other product attributes such as quality and price by cutting the price of the product to a mass-market level while simultaneously improving the quality of the product to make it acceptable to the average consumer.

Despite limited financial resources, most R&D activities of universities comprise applied research, making it more likely to meet private sector’s demands. For example, in Romania the technological capabilities of most local companies and manufacturing subsidiaries of multinationals remain low. The share of spin-offs is yet negligible. If universities collaborate with bigger companies, they are more likely to benefit from joint projects academically.

Research could be a strategy to develop a unique academic profile and to improve academic quality and funding at the same time. Since it has to be based on a long-term vision and excellent researchers, very few Romanian universities will be able to succeed.

In Romania, despite the expectations of many professors and university administrator to obtain large income from commercialization, projects with firms in general are still quite small in financial terms and contribute to the funding of respective departments only to a limited degree. Since academic capabilities are still to be developed, the government has to play an active role in financing higher education.

This study is clearly an early, exploratory research using various sources of information. The outcomes call for a further elaboration and rigorous testing.

Despite the interesting results, this study has certain limitations which represent future paths to follow. Future research should cover also the knowledge transfer processes from firms to universities as a feedback and a source of combined explicit knowledge.

5. REFERENCES

CONFLICT MANAGEMENT IN MODERN ORGANIZATIONS. DIFFICULTIES AND PRECAUTIONS IN DESIGNING AND CARRYING OUT RESEARCH INITIATIVES

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ABSTRACT: The difficulties underlying any experimental approach to conflicts can hardly be denied. Whatever precautions researchers may take, there is always a risk of failure involved. One can compensate for this risk by performing rigorous research, based on thorough documentation, and starting from a realistic view of research. The methods used in the research of conflicts within organizations must be designed with due precaution. Given that the topic of research includes social actors placed in tense, stressful situations, they are bound to become increasingly susceptible. Therefore, any unsuitable word or expression, any unprofessional conduct on the part of the researcher will trigger attitudes of reluctance and hostility. This may lead to the occurrence of undesirable phenomena, such as distorting with the data collected, inauthentic involvement of social actors in experimental tasks and a potential shifting of the latter’s hostility towards the researchers.

Keywords: differences of opinion, conflicts, experiment, conflict management.

1. INTRODUCTION

For a long period of time, conflicts were seen as a taboo in society. Their existence was either strongly denied, ignored (with a view to making them pass unnoticed), or condemned/incriminated as stemming from individual drives or uncontrollable social abnormalities. This topic of tensions, differences of opinion, and conflicts among various social actors (individuals, groups, organizations, etc) is therefore extremely exciting and appealing to both theoreticians and to those who have to deal with such situations on a daily basis, that is to managers, irrespective of their hierarchical level in the structure of an organization.

Unfortunately, due to a faulty social perspective and to negative, outdated stereotypes, conflicts between groups and organizations are a true nightmare for most managers. It is true that the phenomenon in itself has strong negative connotations and it is the role of modern management to change this perspective.

As a matter of fact, conflicts cannot be seen as either good or bad a priori. It is their management, effective or less so, that produces positive, beneficial, synergetic effects, or, on the contrary, negative, destructive effects at the level of the entire organization, and sometimes even beyond its boundaries, at the level of society as a whole.

Within such complex socio-human structures as present-day organizations, conflicts and their related aspects assume specific, extremely varied forms, involving significant numbers of social actors. Each social actor has a unique cognitive, emotional, behavioural style, as well as specific problem solving strategies. Actually, this is the main reason why we have preferred the plural form of the noun conflict rather than the singular.

We have chosen to talk about conflicts within groups and organizations, rather than conflict in the singular (the singular form would suggest a certain unity, homogeneity and convergence of the phenomena under discussion). These phenomena and their related aspects are so varied and complex that it is almost impossible to find common traits. Hence our choice of the plural form of the noun conflict (conflicts within groups and organizations rather than conflict).

2. METHODOLOGY OF CONFLICT EXPERIMENTAL APPROACH: OPPORTUNITIES AND LIMITATIONS

The experimental study of conflicts within groups and organizations is a long and expensive process that implies a number of methodological difficulties, such as:

1. The difficulty to draw clear boundaries between the interpersonal, intergroup and organizational level. There is a multitude of psychosocial phenomena (such as social category, preconceptions, social discrimination, etc.) specific for the group level or the organizational level because they stem from processes and interactions within the same group or between different groups, but these phenomena also reverberate at the level of the individual, at interpersonal level, producing in individual social actors certain tendencies in attitude, motivation, scale of values, and behaviour. Such phenomena are mostly (yet not exclusively) typical for groups and organizations, and they can be seen as individual or interpersonal only by extension, that is only by their interiorization as a result of pressure from the group through normative aspects.

2. The experimental study of differences of opinion, tensions and conflicts within groups and organizations is a delicate mission for the following reasons:

• The phenomena mentioned above are not regarded favourably in society; they are considered undesirable and are consequently penalized through a variety of mechanisms. Due to this reputation, the idea of explicitly informing the social actors about the actual purpose of such research is likely to trigger false reactions and an inauthentic involvement in the study, with a view to conforming their conduct to the socially acceptable rules of the particular group, organization, or society. Consequently, a wide variety of pro-social, cooperative attitudes and lines of conduct become manifest, while competitive, conflicting attitudes are avoided; social actors tend to control their hostility and aggressive/obstructive behaviour. The above-mentioned drawbacks can only be compensated for if the experimental tasks have a very high stake. This raises two additional problems: on the one hand, if the objective is
3. Thorough and realistic documentation of the subjects’ history is absolutely necessary, especially during the stage of conception and preparation of experiments. More precisely, it is advisable to be aware of the actual objectives of the research, but of different objectives (more or less connected to the actual ones), in order to avoid triggering the defense mechanisms mentioned above.

- Given the risks that such research brings along, no social structure (be it a group or a socio-professional organization) is willing to provide subjects for experiments. In an attempt to maintain a positive, cooperative, socio-affective workplace climate (or at least one that is not hostile and aggressive), leaders tend to avoid the dangers that tension and conflicts usually bring about, but, in the process, they tend to overlook the potential for social and economic development.

- The study of tensions, conflicts and differences of opinion is a complex endeavour that involves numerous notions and concepts. In order to eliminate the margin of error and randomness in the completion of the tasks, the influence of several different factors and experimental variables should be taken into account. Ignoring them may result in severe misrepresentations and distortions of the experiments likely to be proposed in the course of this type of research. At the same time, awareness of these factors may help anticipate subsequent developments of the social interaction/exchange. Given the difficulties mentioned above (2.a and 2.b) we cannot afford to take the risk of being faced with unforeseeable problems and aspects, which will render any subsequent experimental attempt quite impossible.

The preexisting relationship between the social actors involved (individuals, work groups, or departments), essentially determined by the nature of previous interactions. This specific type of relationship is reflected in a bipolar manner in a series of perceptive-evaluative concepts such as: good-bad, trust-mistrust, winner-loser, co-operative-hostile, etc. The relationship is based on a series of expectations, attitudes and beliefs developed between social actors over the time, in a succession of interactions socially reinforced at some point in their life (through various types of rewards and punitive measures). All these enable researchers to make assumptions about potential subsequent interactions and behaviour. In other words, certain tendencies of action become obvious that provide the social, psychological and emotional setting that makes the respective social actor prone to a particular type of subsequent participation in social interactions.

- The psychosocial characteristics of the social actors involved in experiments. Included here are the subjects’ peculiarities of attitude, motivation, scale of values…… their actual ability (depending on the specificity of each experimental task) to participate in the task and to carry out the objectives, their knowledge and intellectual capacity, as well as their potential to deal with tensed situations.

The existence of major differences or discrepancies at the level of the aspects mentioned above (especially if the differences are irreconcilable and mutually exclusive), should be seen as indicative of preexisting conflicts between the respective social actors, as early as the designing/planning stage of the research. This means that, under the circumstances, the study of the emergence, development and solution of conflicts is no longer possible, since conflicts have already emerged in another social context (practically impossible for the researcher to get familiar with in a straightforward manner), they have a certain evolution in time, a certain historical “itinerary”, and therefore one can say they “have been healed” in a sense. Given the circumstances, the only experiments that can be conducted at this point concern the solution of conflicts but exclusively on condition that the emergence and development in time of the respective interactions be very thoroughly documented, which is very difficult, if not downright impossible.

Similarly, the attempt to study the phenomena of interest to us by selecting social actors who had previously employed strategies that were incompatible with or irrelevant for the purpose of research (especially evasive strategies, lack of involvement or inauthentic involvement in interactions), may also result in failure of the research. Tensions and conflicts are by definition mutual bilateral relationships that require a high degree of involvement on the part of all social actors. The phenomena under discussion require a type of negative interdependence between participants, which is impossible to achieve if one of them bluntly refuses, directly or indirectly, to be part of the interaction mentioned above.

Ignoring these aspects may result in manipulation of the experiment to the point that its results will be predictable, erroneous and impossible to generalize at the level of other social structures than the ones studied:

- Importance assigned to the goals/objectives pursued by social actors. One social actor (individual, group, department, organization) may assign greater importance to the objective of research, whereas his partner in the interaction may consider it insignificant or irrelevant, which will result in the latter resorting to various evasive strategies and lines of conduct or to inauthentic involvement in the interaction. It is recommendable that, prior to embarking on an experiment, researchers make sure that the social actors involved share the same definition of and attach the same significance to the pursued objectives.

- Position and role of social actors within a given social structure. Conflict between socially equal social actors is completely different from conflict between subjects that belong to different social categories, in the same way that conflict between the component parts of a system is completely different from conflict between part and whole, or between global social entities (whole-whole or system-system).

- Acknowledged characteristics of the conflict. They include aspects related to the causes of conflicts and their significance, the clarity or ambiguity of the social/organizational definition of phenomena under discussion, a periodical recurrence of tensed episodes in the past, the existence of a series of rules (either formal or informal) regulating the unfolding of tensed interactions.
• Anticipated characteristics of conflict solution. Each social actor (individual, group, department, organization) involved in an interaction will put forward various hypotheses and assumptions regarding potential conflict solutions. If both social actors involved in a conflict embrace the same solution(s), the result is a compromise. On the other hand, if one social actor imposes solutions on the other, which implies either the latter’s acceptance of obedience or his/her rebellion and disobedience, the conflict will follow an ascending curve and it is most likely that it will recur with added intensity.

Therefore, depending on these assumptions about potential solutions, each interaction will unfold according to a different scenario, and each social actor will make use of a variety of different strategies. Within each social group or organization, certain solutions are preferred over others, which are either rejected or avoided. Therefore, it is very likely that social actors will constantly resort to the same solutions that have proven efficient before, while solutions that have turned out to be inefficient or inconvenient will be systematically avoided in subsequent interactions. Awareness of such aspects will facilitate a more effective and realistic planning of experimental endeavours.

• Social environment of the interaction. It includes available facilities, as well as possibilities of reward and punishment that the behavioural strategies employed by social actors at various stages of the conflict are formally invested with (according to the rules generally accepted within the respective group or organization). Groups and organizations can institutionalize various types of conduct typical for tensed situations, while other strategies are considered unacceptable, highly objectionable, and therefore firmly reproved. In other words, if the social actors belong to distinct groups or environments, it is recommendable to ascertain whether there are major differences between them in as far as the social/organizational rules that regulate the tackling and solution of tensions and conflicts are concerned.

• Presence of a third party, be it one that is passive, bystanding and uninvolved in the interaction, or one that has some interest (either real, apparent, ascribed, or imaginary) in the unfolding of the interaction, playing either a role of trigger or one of facilitator/catalyst of a particular type of social interaction.

It is often the case that differences of opinion, tensions and conflicts are brought about by the very presence of a third party. Moreover, the social actors’ motivation, attitudes, scale of values, and especially their behaviour tend to undergo significant changes when a third party is involved in the social interaction (whether the third party’s involvement is real or not). The mere possibility of establishing a tacit connection with the audience (the third party involved), of gaining their approval and support, as well as the anticipation of establishing similar relations to the audience in the future may interfere with the unfolding of a given interaction.

Therefore, the presence of the researcher in an experimental situation has to be thoroughly prepared, so that both social actors involved will accept it to the same degree and in the same manner. Moreover, the researcher’s conduct must be carefully devised so as to avoid bringing about (unilaterally or bilaterally, directly or indirectly) the phenomena mentioned above, that is to avoid manipulating the experimental situation one way or the other.

4. The consequences of tensions and conflicts for the social actors involved, for a third party (if involved in the interaction in one of the manners mentioned above), as well as for other social actors (though not directly involved). Tensed situations and conflicts tend to bring about significant short term and long term changes both in the social actors directly involved and in more distant ones.

There are significant changes at the following levels:

• The level of motives: a number of motives, goals and objectives are lost and others, which were initially assigned less importance or were simply inexisttent, take precedence and are pursued preferentially. One social actor’s former objectives start being pursued by other social actors;

• The level of emotions: conflict tends to reorganize the system of feelings, emotions, affective preferences according to different patterns, thus influencing the social actor’s behaviour. By definition, differences of opinion, tensions and conflicts have a strong emotional component;

• The social level: it is at this level that the majority of changes and the most significant ones occur, as follows:
  • Redistributing the balance of power. Social actors that were previously in the forefront fade into the background; subjects that previously formed the majority are now a minority, and the other way around. The most noteworthy effect of such interactions is that the balance of power is continuously reconsidered and undergoes constant alterations;
  • Reorganizing the system of ranks and roles. Shifts in rank within the hierarchical structure of organizations and groups occur as a consequence of conflicts, in that some social actors are bound to move up to a higher hierarchical level, while others go through a lowering of rank and lose their initial prerogatives. Group leaders change and so does the structure of groups and organizations;
  • Reorganizing the system of attitudes. Former opponents become partners (the initial hostility makes room for a positive, cooperative attitude) or the other way around, while some of the social actors simply move to parallel social structures (they are no longer involved in any social interaction, either positive or negative, and therefore become invisible and socially uninteresting);
  • The various types of relationships with other social actors undergo significant changes. Preferential relationships are established with social actors who were previously ignored or seen as socially and affectively remote. Other relationships, that were initially sought for and considered extremely valuable tend to fade away, as the social actors involved have nothing left to offer in order to arouse social interest;
  • Significant changes at the level of the value structures. Many interchanges or permutations in the lists or inventories of values specific to
various social actors, take place as a result of conflictual relationships;

- The re-calibration of formal, normative aspects (entire sets of rules and norms disappear, making room for new ones, adapted to the present moment), and of informal ones (mentalties, beliefs, ideologies, representations);
- The change of communication structures, networks and channels, deriving necessarily from the changes already mentioned. This involves both quantitative aspects (more or fewer social actors involved in the new communication, more or fewer messages exchanged), and especially qualitative aspects, referring to message content, transformations from one type of network to another (star, cross, chain, etc.), disappearance of some communication relays and the appearance of others;
- The natural and most important consequence of conflicts is the profound restructuring of the psychism of the social actors involved, which can have positive, healthy valences, or, on the contrary, destructive and alienating ones;

5. Acceptance of an existing social situation. We cannot include in a research like this social actors who fully accept a certain social/organizational situation, and are satisfied, at least for the moment, with their social position and all the consequences deriving from it.

Reference is made to the power balance that is blatantly unbalanced. For example, we can talk about some social actors who form a minority or are seriously underprivileged because of the power balance (they lack resources completely). Due to the fact that they are unwilling to try to change anything at all in these respects, because they believe they have no chance whatsoever, the social actors in question (individuals, groups, departments, organization) are the most unsuitable for research purposes.

Paradoxically, the same holds true for social actors who hold privileged positions (absolutely, irrevocably and incontestably), by virtue of which they already benefit from a series of advantages, and who have no reason at all to bring the existing social situation into question again, as long as this is considered to be fully satisfactory.

Of course it is very unlikely that these two categories be involved in a new interaction, but not completely impossible, in which case it is common for an exacerbation of the emotional components of the conflict to occur. In such cases, the conflict becomes a goal in itself rather than a means of fulfilling well-defined objectives and goals.

At the antipode there are those social actors who are highly motivated to bring the existing situation into question again, in order either to restore its balance (i.e. social actors who are moderately underprivileged in the power balance), or to gain extra social advantages (those who are moderately privileged in the power balance). These social actors are the most suitable for the stated aims of the study of conflict, both categories being interested in solving the situation in their favor, or to put it differently, in increasing (decreasing respectively) the inequality of the existing power balance.

3. ETHICAL ASPECTS INVOLVED IN THE RESEARCH OF CONFLICTS. IS OUR INTERVENTION RECOMMENDABLE?

Familiarity with the following aspects: history of the social actors involved in similar interactions, characteristics of conflicts, the way they unfold, tactics and strategies employed, as well as changes undergone as a result of previous tensions and conflicts, enables researchers to launch predictions concerning the evolution of such relationships in the future, the changes that these phenomena are likely to induce in the actors and the social/organizational environment. Acknowledging all these characteristics as early as the conceptual stage of the research is significant for the experimental approach of such delicate social processes as competition and conflict.

Needless to say, that ethical considerations should primarily govern the mapping of the research, in order to avoid that they cause significant reorganization at the level of the structures involved, disappearance of some of the social actors involved, a radical distribution of power prerogatives, serious damage to the existent relationships, or exacerbation of hostility and aggressiveness.

Beneficial to any environment are only those reorganizations, changes, social recalibrations that derive necessarily from real, authentic interactions, due to their high degree of acceptance by social actors. Conversely, inauthentic changes brought about by interventions on the part of the researchers (real or perceived as such) prove to be quite dangerous, as they generate reactions of denial or, at least, of reluctance on the part of the ones involved, which may eventually eliminate the positive, constructive valences of tensions and conflicts. Such interventions are allowed to a certain degree, but only after taking extreme precautions, within well-thought, complex, managerial plans. It is only in such conditions well-defined conditions that the intended objectives can be achieved.

4. REFERENCES


ABSTRACT: Basic courses of geotechnical and foundation engineering are intended to provide the principles of soil mechanics. The graduate of the 1st cycle should be competent in constructing a geotechnical model appropriate for a well defined situation. The master program in geotechnical engineering intends to continue the education on advanced subjects of soil mechanics, to enhance the training in appropriate use of standards and norms, and also to develop research applied competence in laboratory and field testing. Geo-engineering sciences have a low visibility during education but a significant social impact due to losses induced by failures of construction projects. Risk management can be approached as one course intended to provide investigation of failure modes and corresponding effect analyses, risk assessment and solutions for reducing risks of ground-related uncertainty. It can also be included as one chapter in each course of the master program in Geotechnical Engineering. The paper intends to present these two approaches in risk management and to comment on the acquired competences of the graduate.

1. EXPECTATIONS FROM THE 2ND CYCLE

In countries were integrated Master Programs were designed more like Postgraduated Courses, while the previous 5 university years where accepted implicitly as graduating at master level, the Bologna process, although not very popular, implements the three education cycles – 1st cycle as the bachelor program, the 2nd cycle as the master program, and the 3rd cycle as the doctoral program.

Since this year the Romanian labour market meets the graduates of the 1st Bologna cycle in engineering, the 2nd cycle is already tailored to continue the higher education with various offers and expectations from the corresponding target groups. When designing the curricula for the master programs several interests were considered relevant: the present economic conditions, the bachelor programs existing in the field of interest and the evolution of all technologies.

The EUCEET thematic network - European Civil Engineering Education and Training has been initiated by the Civil Engineering Technical University from Bucharest since 1998 and continued for the next 10 years in three stages, I, II and III, developing a unitary point of view over competences, curricula, labour market expectations, research and innovation across European universities, professional associations and industry related to the field of civil engineering.

Over the years, the Bologna process developed in Romania from the civil engineering perspective beginning with the bachelor programs, based on the confidence of the on-going increase of construction investments. The master programs have been designed to accommodate the same construction booming activity while nowadays, the economic perspective is changing, decreasing dramatically the investments on the real estate market and at a lower extent, in transportation infrastructures.

Based on questionnaires addressed to stakeholders and academics, there are significant differences on the perspective of civil engineering education, competences and skills of the graduates from a master program, reflecting the followings:

the labour market in Romanian companies demands at present more training than education while multinational companies acting on the local market demand less training and more education;
the students are oriented more towards multidisciplinary programs, with immediate employability, demanding more management than design issues;
the academics display a heterogeneous perspective of a master course content, still theoretically developed, with conservative teaching approach and sometimes with unclear evaluation system.

Since Romania has been a fresh and open market for new business to implement and make immediate substantial profit, the construction of the necessary infrastructure has been accepted with high geotechnical risks, with considerable extra-costs, the only requirement being the deadline of becoming operational.

During the last 5 years, major investments in constructions have been developed by multinational companies, where risk management is an important part of the project management work and reflected in a better cost management related to the infrastructure works.

In civil engineering, it is always a question related to the value of the investment and according to that, risk management is considered relevant only to large sum of money involved. In this respect, risk management is saving money when compared to the costs induced by last minute solutions to solve a crisis situation.

Moreover, geotechnical risk management is strongly dependent on the investigation program quality of the ground condition, significant costs being involved when identified risks are overlooked during both design and construction of the infrastructure. Figure 1 presents different perspectives of the costs for detailed ground investigations related to the construction class of importance. In this respect, the difference relates to the load intensity, the settlement restrictions, the induced active zone, the structural restrictions and the cost to correct a temporary failure.
Since Bachelor Programs in Civil Engineering are focused on 4 main domains: Civil, Industrial and Agricultural Constructions; Roads, Railways and Bridges; Hydrotechnical Engineering; Urban Engineering, a Master Program in Geotechnical Engineering is designed to accommodate the need of training students from all previously intertwined Bachelor Programs, focusing on ground related issues in Civil Engineering at large.

2. DESIGNING THE GEOTECHNICAL MASTER PROGRAM

In 2005, higher education in Civil Engineering at Romanian universities shifted from the 5 years program as undergraduate studies and 1 year of post-graduate studies to 4 years Bachelor program (240K) and 1.5 years Master program (90K).

In the 1st cycle / Bachelor programs in Civil Engineering, Geosciences participate with 15 ETCs as presented in Table 1:

Table 1. Geo-courses as minors in Civil Engineering BSc

<table>
<thead>
<tr>
<th>Year-semester</th>
<th>Course</th>
<th>ETCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd year – 1st sem.</td>
<td>Engineering Geology 1C+1LW</td>
<td>3K</td>
</tr>
<tr>
<td>3rd year – 1st sem.</td>
<td>Geotechnical Engineering 3C+1LW</td>
<td>5K</td>
</tr>
<tr>
<td>3rd year – 2nd sem.</td>
<td>Foundation Engineering 3C+2PW</td>
<td>4K</td>
</tr>
<tr>
<td>4th year – 2nd sem.</td>
<td>Special Foundations 1C+1PW</td>
<td>3K</td>
</tr>
</tbody>
</table>

Geologists as graduates from a 3 years Bachelor program in Geology can enter the Master program in Geotechnical Engineering under the obligation of completing the minor courses in geo-sciences from the Civil Engineering Bachelor program during the 1st year of the Master Program together with fundamentals in Reinforced Concrete, Steel and Masonry Structures.

2.1. Structure of the Master program in Geotechnical Engineering

The learning outcomes and student competencies from the Geotechnical Engineering Master Program are focused on soil-structure interaction correlated with the Romanian challenges such as earthquake pro-active design, difficult soil occurrence, landslide mitigation, and high rate urban development.

In this respect, the first semester is mainly focused on advanced studies on structural engineering and then, the next two semesters are dedicated to specialized subjects – Table 2.

Table 2. Structure of the MSc in Geotechnical Engineering

<table>
<thead>
<tr>
<th>Type of subjects</th>
<th>ETCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core subjects</td>
<td>20K</td>
</tr>
<tr>
<td>Specialized subjects</td>
<td>35K</td>
</tr>
<tr>
<td>Elective subjects</td>
<td>15K</td>
</tr>
<tr>
<td>MSC thesis</td>
<td>20K</td>
</tr>
<tr>
<td>Total</td>
<td>90K</td>
</tr>
</tbody>
</table>

The university-industry link played a key-role in the design of this master program, that although focused on ground related issues, advanced studies in structural engineering were considered core subjects in the training of the master student, as soil-structure interaction is the first priority in engineering design and construction. The list of courses is presented in Table 3, to explain the perspective over geotechnical risk approach later in the paper.

Table 3. MSc courses in Geotechnical Engineering Program

<table>
<thead>
<tr>
<th>Type of subjects</th>
<th>ETCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st semester</td>
<td></td>
</tr>
<tr>
<td>Special problems in soil mechanics</td>
<td>2C+1LW</td>
</tr>
<tr>
<td>Physics of porous medium</td>
<td>1C+1LW</td>
</tr>
<tr>
<td>Retaining structures in geotechnical engineering</td>
<td>2C+1PW</td>
</tr>
<tr>
<td>Supplementary topics in engineering geology</td>
<td>1C+1LW</td>
</tr>
<tr>
<td>Geo-Environment engineering</td>
<td>1C+1LW</td>
</tr>
<tr>
<td>Drainage and dewatering systems</td>
<td>1C+1PW</td>
</tr>
<tr>
<td>Soil behaviour under dynamic conditions</td>
<td>2C+1PW</td>
</tr>
<tr>
<td>English Language</td>
<td>2S</td>
</tr>
<tr>
<td>Modern methodologies for designing and drawing up scientific papers</td>
<td>2C+2PW</td>
</tr>
<tr>
<td>2nd semester</td>
<td></td>
</tr>
<tr>
<td>Special site conditions and infrastructure solutions</td>
<td>2C+1PW</td>
</tr>
<tr>
<td>Special topics in soil-structure interaction</td>
<td>1C+1PW</td>
</tr>
<tr>
<td>Slope stability</td>
<td>2C+1PW</td>
</tr>
<tr>
<td>Foundations for special constructions</td>
<td>1C+1PW</td>
</tr>
<tr>
<td>Difficult foundation soils</td>
<td>2C+1LW</td>
</tr>
<tr>
<td>Rehabilitation and assessment of infrastructures</td>
<td>1C+1LW</td>
</tr>
<tr>
<td>Modern problems of computer assisted design and research</td>
<td>1C+2PW</td>
</tr>
<tr>
<td>Geotechnical modelling</td>
<td>1C+2PW</td>
</tr>
</tbody>
</table>

2.2. The need for geotechnical risk management

Sustainable development involves large scale investment projects with a multidisciplinary use of knowledge in structural, earthquake, geotechnical, and environmental engineering.

The main types of projects developed lately in Romania are focused on:
residential quarter as individual villas developed at the outskirts of dense urban zones, mostly on landslide prone regions;
residential quarters with high-rise buildings, peripherally located from large cities, on soft soil conditions, recent alluviums, recent fill deposits or even waste disposals;
residential quarters as high-rise buildings within the most populated area of large cities, having multi-storey basements, and historical monuments in the immediate vicinity;
rehabilitation of massive historical buildings in very dense populated city quarters in difficult ground conditions;
rehabilitation of transportation infrastructure with associated bridge and tunnel strengthening works;
highway construction works with new retaining structures, bridges, viaducts, and tunnels to accommodate the present design road path requirements.

The construction process of such projects encountered temporary failures of the on-going infrastructure works or/and of the existing above or under-ground constructions that finally induced significant delays in finalizing the projects and additional costs to correct the failure. These unfortunate geotechnical induced events were lessons about the necessity of a new approach in project management during the construction process and they can be translated in ignored ground-related risks of the projects.

The risk analysis and lately the risk management are mostly associated nowadays in Romania to an induced hazard correlated to a vulnerability of the construction zone and consequently the following situations are considered important:
activated ground movement in a landslide prone area, earthquake activity,
floods of socially underdeveloped regions and terrestrial transportation sectors.

Geotechnical risks are closely related to activating landslides and consequently attention of professionals was focused on landslide risk management and developing urban policies to reduce risk to landslide when granting the construction permit for new investment projects.

3. INTRODUCING THE RISK MANAGEMENT APPROACH IN THE GEOTECHNICAL ENGINEERING MASTER PROGRAM

Late in the 90’s, Eurocodes have been disseminated in Romania in the framework of the Tempus Phare Complementary Measures Project 01198. Eurocode 7 – Worked Examples [1] was the first technical strategy presented in dealing with ground uncertainties. The good part although difficult to accomplish was to change the attitude towards the ground conditions of a construction project, to develop an insight of the dynamics in soil conditions, to introduce the monitoring of the on-going infrastructure works, to acknowledge the benefits of in situ tests and the implementation of the observational method.

Many renewals of the norms and standards related to soil investigation, soil improvement, geotechnical design and special foundation works have been developed as a consequence of this Eurocode 7 and there are still many in press. Professionals from industry crossed paths with academics and many projects have been developed with increasing expertise due to this new created links. New experience on site academics accumulated via consultancy works is slowly introduced in classrooms at both undergraduate and post-graduate level.

Incoming investments were the trigger of many grants and applied research projects, mostly related to landslide management and special foundation works in difficult ground conditions. Thus, the new approach of geotechnical risk management is coming on a sound background related to technical solutions for ground related issues. One of the most important tasks to be developed is the one called the human factor in geotechnical risk management [2]. Many relevant lessons are related to human failures in approaching a geotechnical risk. Some is associated with miscommunication and some with underdeveloped skills during the education in university.

3.1. Educational issues in geotechnical engineering

Atkinson [3] is clearly making the difference between education and training in geotechnical engineering and what a graduate should be competent at when graduating a university program. Some of the pressure over the training necessity during a university program is created by the industry, that partly cannot afford specialized training of young graduates once they become employees and partly consider the short term benefit of training on design codes instead of the long term benefit of a basic education in the field of interest.

Consequently, the Master program in Geotechnical Engineering is trying to accommodate both training and education in geotechnical engineering and will be revised in due time to harmonize objective with similar programs in more experienced universities in the field. A geotechnical risk management can be generally characterized in the flowchart proposed in Figure 2, were activities are harmonized with the regulations and urban policies in risk management at large.

![Figure 2. General framework of geotechnical risk management during construction works](image-url)
Although there is not a specific course of Geotechnical risk management introduced in the curricula of the Geotechnical Engineering Master program, there are courses that include risk management principles applied in geotechnical engineering and these are:

- Retaining structures in geotechnical engineering
- Geo-Environment engineering
- Special site conditions and infrastructure solutions
- Slope stability
- Foundations for special constructions
- Rehabilitation and assessment of infrastructures

3.2. Allocation of risk on ground related issues

Romanian norms evaluated qualitatively the risk by summing up contributions from both the construction to be built and the site conditions as points that are given within a range of values, depending on the estimation of the geotechnical engineer performing the geotechnical investigation and report.

The risk is established as high, average or low and a geotechnical category of the site is given as 3, 2 or 1 respectively. The risk evaluation is made before the geotechnical investigation and the geotechnical category is established, which reflects the amount and extent of the investigation that follows. During the investigation, when unforeseen situations develop a different estimation of the risk, the amount of the geotechnical investigation can increase in order to meet the new evaluation.

In general terms, risk is the expression of the probability of occurrence of failure and the consequences of this failure. When a hazard such as a landslide, earthquake or flood is the subject of interest, the risk is only one, with various intensities over a specific area. In risk management dedicated to that risk alone, mitigation measures are focused on reducing the risk [4].

During the construction process of a new investment or rehabilitation works of an existing construction, there are several potential failures, that once identified they generate, each, a geotechnical risk. In this respect, attention goes to evaluation of failure probability and vulnerability of the site to each failure. There is a ranking of these resulted risks and a management plan that has to control all of them, and finally to avoid any geotechnical failure.

Some failures can be identified from the beginning, some are unforeseen and difficult to predict. Most of the courses are focusing on potential failures, identification and scaling the importance and mitigation measures as a unitary package for the entire project. The observational method, based mostly on monitoring of specific ground objectives and construction elements already in place is gaining more efficiency and thus, experience in the field accumulates with designers, contractors and consultants.

The future of geotechnical risk management in the master program is building up through personal experience, by attending scientific events organized on this topic by the national and international society for geotechnical engineering and with guest lectures delivered by major contractors applying successfully this risk management on a daily basis [5].

4. CONCLUSIONS

Many geotechnical failures during construction works of major investments reflected in significant time delays and extra costs have raised the interest of all factors involved in project management to develop a risk management approach on ground related issues.

By education in Geotechnical Master Program, students are given the correct attitude, knowledge and skills in managing several potential failures on the same project, potential that will never be eradicated since ground will always hold a measure of uncertainty in its behaviour and the human factor is important as designer, contractor or consultant.

5. REFERENCES

ASPECTS CONCERNING ORGANIZATIONAL CLIMATE AND CULTURE AND THEIR IMPACT ON EDUCATION

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ABSTRACT: The aim of the paper is to discuss aspects concerning the organizational climate at the level of the working staff and at the level of the management of an organization, with special emphasis on educational organisations. The discussion will be based on learning style, task-oriented attitude and personal management style. The assessment of the organizational climate is made usually with the help of a set of three standardized questionnaires conceived by Adizes. The first questionnaire that will be described is called the learning style, with its four types described by Adizes, the second questionnaire will make reference to the task requirements, which aims at the managerial development styles and the third questionnaire, Adizes’ personal test”, aiming at the assessment of the respondents’ profile regarding the managerial development. Other questionnaires developed to assess learning styles will be presented, due to the importance for an academic institution. The assessment of the organizational climate at the level of the top management is based, besides the above-mentioned questionnaires, on McGregor’s XY-theory and on the LEADSELF questionnaire. Such a complex analysis of the organizational climate is important for an educational organization as it helps to design the best ways to deliver knowledge to the students, taking into account their learning styles and behavioural profiles. A study of the correlation of different assessments of learning styles and the consequences for educational management is also presented.

1. INTRODUCTION

More than twenty years ago, Rousseau [1] noted "recognition is growing that both individual differences and characteristics of organizational settings are germane to all phases of organizational research.” Organizational context is important in the determination of attitudes and behaviours. Based on their findings, Podsakoff, Niehoff, MacKenzie and Williams [2] suggested that organizational context should be considered in future organizational commitment research. Rousseau defined context as “the set of circumstances or facts surrounding an event. Context can refer to characteristics of the organizational setting, of the individual, of his or her role in the organization, and of any other environmental factor that may shape responses. Researchers have used many different contextual variables including tasks characteristics such as task identity, task significance, autonomy, dealing with others, variety, feedback, and learning, structure and technology, organizational age, slack resources, structure, motivating potential of jobs, geographic scope, product scope etc.

The aim of the paper is to present some instruments for assessing the organizational climate in an organization based on the following parameters: learning style, task-oriented attitude and personal management style. The assessment of the organizational climate may be done with the help of standardized and reliable questionnaires, previously validated. The results of a study that uses some of the questionnaires in an educational environment are also presented and discussed.

2. ORGANIZATIONAL CLIMATE ASSESSING TOOLS

A part of the questionnaires described in this study are conceived by Ichack Adizes, a management theoretician, who was himself a manager and who thinks that management is a set of roles and tasks and that it is not necessary for one single person to do them all. On the contrary, it is important to evaluate the capacity of each member of an organization and, according to his/her identified weaknesses, to raise the level of cooperation and to induce change.

2.1. Learning Styles

Adizes proposed a set of three standardized questionnaires for the assessment of the working staff. These questionnaires, with minor changes, can be used also to assess students in a university.

The Learning Styles questionnaire contains 60 statements and it is used to assess the learning style of each member of an organization. The variables assessed with the help of this questionnaire are the following learning styles: enthusiastic, imaginative, logic and practical. The scores obtained for each variable will be summed up in descending order, and will help the interviewer to find out the dominant style and the profile of the learning style of each respondent.

Adizes describes four learning styles with the following characteristics: Enthusiast – where the subjects manifest their interest for everything that is new. They are spontaneous, dynamic, quick, detached and they never have time for details. Logic – where the subjects are meticulous, detail-oriented, ask themselves a lot of questions and they like to draw conclusions. They are very good critics, trust their own forces and are perfectionists. Practical – the subjects belonging to this style category like to turn everything into actions, they are tidy, concise persons, know exactly what they have to do and work constantly. Imaginative – is the last learning style, with inventive subjects, who always find original solutions to all the problems. Generally, these persons need time when they think, they are inconstant in their work, often, even absent-minded.

Taking into account these four learning styles, the manager will be able to identify the “learning organization”. The learning organization is an organization that makes progresses in a continuous manner, rapidly creating and developing the skills necessary for its future success.
When the learning organization is a university, organizational climate aspects have to be centred on the student. In this sense Adizes learning styles questionnaire can be correlated with other learning styles in order to obtain a more complete picture of the student component of the learning organization [9].

Learning styles as a description of the behaviours and attitudes, determine the preferred way to the students to learn.

For example, in the 70s, David Kolb [7] was studying the Aristotelian learning by doing paradigm and developed a learning schema - Learning Cycle – consisting of four mandatory stages: real experience (concrete experience - CE), learning from experience by reflecting and observing (reflective observation - RO), abstract conceptualisation - AC - (identifying patterns, using theories and models, understanding what happened) and active experimentation - AE, trying out and planning for the next experience. Kolb defined four-type learning styles, each representing the combination of two preferred styles: Diverging (CE/RO), Assimilating (AC/AE), Converging (AC/AE), and Accommodating (CE/AE). Starting from Kolb’s learning cycle, Peter Honey and Alan Mumford have shown ten years later that there are different learning styles and that, in general, a person is favouring only one way of learning [6]. They have design a questionnaire (in fact there are two versions of the Learning Styles Questionnaire, the 80-item and the 40-item) to determine the preferred learning style. The Honey and Mumford four learning styles are:

- **Activists (Do)** - involving themselves fully in new experiences, open minded, enthusiastic, flexible, enjoying the here and now and being happy to be dominated by immediate experiences; acting first and considering consequences later; seeking activities to be centred around themselves.

- **Reflectors (Review)** - standing back and observing; reviewing the experience; collecting and analysing data about experience and events, slow to reach conclusions; maintaining a global view using information from past, present and immediate observation.

- **Theorists (Conclude)** - disciplined, aiming to fit things into rational order, adapting and integrating observations into coherent theories; thinking problems through in a vertical, step-by-step logical manner; attracted by systemic thinking, models, principles and theories.

- **Pragmatists (Plan)** - searching and new ideas and planning the next experiments; keen to put ideas, theories and techniques into practice; impatient with endless discussions.

The styles are not exclusive. A student can show different learning styles, but one is usually predominant.

Other learning styles have been defined for students in engineering and science starting from the observation that these students have an inductive way of learning (progressing from particulars - observations, measurements, and data- to generalities - governing rules, laws, and theories) in contrast with the teaching style that is deductive.

Analysing teaching practices and students’ needs, Felder and Silverman [8] of North Carolina State University have built a model of learning styles for use by college instructors and students in engineering and sciences, a model that has subsequently been applied in a broad range of disciplines. They have designed an Index of Learning Styles - ILS to assess preferences on four scales: sensing (concrete, practical, oriented toward facts and procedures) or intuitive (discovering possibilities and relationships, disliking routine), visual (prefer visual representations of presented material, such as pictures, diagrams and flow charts) or verbal (prefer written and spoken explanations), active (learn by trying things out, enjoy working in groups) or reflective (thinking things through, prefer working alone or with one or two familiar partners), and sequential (linear thinking process, learn in incremental steps) or global (holistic thinking process, learn in large leaps). Each scale has 11 items.

“The learning organization” should be able to adapt the context and to develop people profiles corresponding to this context, through the development of the learning-related skills at individual level, as well as the skills relative to the group learning at team level. The learning organization supposes a common vision, that allows the organization to identify the future opportunities and to take advantages of them, a structure that should facilitate learning, a supportive culture that encourages the challenges regarding the “status quo” and the establishment of the action methods, a management commitment – generally, the managers think that, by committing the employees in the decision taking process and team work, will lead to the increase of performance, motivated employees, who always want to work and a sustainable learning.

The success of the “learning organization” is provided by the following characteristics: a leader with a well defined vision, a rapid circuit of the information, innovation, a detailed action plan and the ability to implement this plan.

2.2. Task Requirements

Adizes’ questionnaire – task requirements – is made up of 22 items and assesses the management development style, based on the respondents’ perceptions regarding the tasks imposed by their workplace. Adizes describes four management styles [3]. The Producer (P) is the first managerial style, characterized by individuals that have the drive and the discipline necessary to see real results produced. Impatient, active, and always busy, the Producer has little time for idle chit-chat. Direct and to the point, typical Producers are behind-the scenes movers and shakers. Many Producers are attracted to high-intensity departments such as Sales. They are too busy to "waste time" with meetings. They prefer to cut the small talk and get out there to get the job done. The Administrator (A) ensures that rules are in place and followed, that plans are made and adhered to. Precise and accurate, the Administrator creates methods and procedures to make sure things are done "right". Analytical and logical, Administrators clean up other people's carelessness. They like to keep the organization humming at a steady pace, and are willing to do things more slowly and carefully. Administrators are drawn to tasks that require systemic thinking and precision, such as Accounting. The Entrepreneur (E) is an ideas person, always asking "why?" or "why not?" A visionary with dreams, plans and schemes, the Entrepreneur leads others to ideas that they would not pursue on their own. Success for an Entrepreneur requires both creativity and risk. They sometimes get bored with short-term tasks, and prefer developing the long-term vision. Entrepreneurs are charismatic, and generate ideas for new projects, new approaches to problems, or even new businesses. The last managerial style is the Integrator (I). The integrator is people-oriented. True Integrators value social harmony, and thrive on peacemaking and teamwork. The Integrator's pleasantness is unmistakable. Amiable and empathetic, the Integrator is the first to cooperate in helping with tasks or problems. They prefer to work by consensus, instead of taking a strong position against others. Integrators are attracted to people-oriented occupations like Human Resources. The
investigator must assess these four variables in order to identify the respondent’s profile.

2.3. Adizes’ Personality Test

It is the last type of questionnaire used for the assessment of the organizational climate at working staff level. The variables assessed with the help of this questionnaire are the same as in the questionnaire number 2 (producer, administrator, entrepreneur, and integrator) [4]. It is made up of 27 pairs of statements and is used in order to establish the respondents’ profile regarding the management development style based on their perceptions on their own working behaviour.

This questionnaire requires the respondents to think about themselves, about the actions that bring them beneficial effects. The respondents should not indicate what would be the best actions to take or do, but honestly, indicate the way in which they really act.

3. LEADSELF QUESTIONNAIRE

The people involved in top management should be addressed, besides the same set of questionnaires used for the assessment of the working staff, another two extra measuring instruments: the leadself questionnaire and McGregor’s X and Y theory. This questionnaire is used for the self-assessment of the management behaviour used by a leader in his/her attempt of influencing the actions and attitudes of those around him/her. It consists of 12 situations, each having four alternatives. The manager is asked to choose only one alternative for each situation, the alternative he/she thinks it would apply and not the one he/she wish to apply or which seems to be more appropriate. The data collected allows the appreciation of the management styles and the extent in which these superpose over the needs of the subordinated persons. The respondents are asked not to omit any of the situations and to stick to their first choice, due to the fact that tendency shows that the first choice is the right one. The advantage of this questionnaire is that it allows the assessment of the respondent’s management style profile and the adaptability of the respondent’s management style.

3.1. Theory X and Theory Y of McGregor

Theory X and Theory Y are theories of human motivation created and developed by Douglas McGregor in his work “The Human side of Enterprise”.

**Theory X** is based on the hypothesis that the employees are inherently lazy and will avoid work if they can. Because of this, workers need to be closely supervised and comprehensive systems of controls developed. According to this theory, employees will show little ambition without an enticing, incentive program and will avoid responsibility whenever they can. A Theory X manager believes that his or her employees do not really want to work, that they would rather avoid responsibility and that it is the manager's job to structure the work and energize the employee. The result of this line of thought is that Theory X managers naturally adopt a more authoritarian style based on the threat of punishment.

**Theory Y** assumes employees may be ambitious, self-motivated, and anxious to accept greater responsibility, and exercise self-control, self-direction, autonomy and empowerment. It is also believed that if given the chance, employees have the desire to be creative in the workplace. McGregor’s Theory Y forms the basis for the concept of the management by objectives [5] and assumes that individuals within an organization will exercise self-direction and self-control in the process of attaining the objectives and goals to which they are committed. There is a chance for greater productivity by giving employees the freedom to perform at the best of their abilities without being haggled down by rules. A Theory Y manager believes that, given the right conditions, most people will want to do well at work and that there is a pool of unused creativity in the workforce. They believe that the satisfaction of doing a good job is a strong motivation in and of itself. A Theory Y manager will try to remove the barriers that prevent workers from fully actualizing themselves. Many people interpret Theory Y as a positive set of assumptions about workers. A close reading of The Human Side of Enterprise reveals that McGregor simply argues for managers to be open to a more positive view of workers and the possibilities that this creates.

Today, Theory X and Theory Y are still important terms in the field of management and motivation. Recent studies have questioned the rigidity of the model, but McGregor's X-Y Theory remains a guiding principle of positive approaches to management, to organizational development and to improving organizational culture.

4. LEARNING STYLES ASSESSMENT CASE STUDY

In order to determine if the Azis’ learning styles questionnaire is valid also for students, we have applied Azis questionnaire and an adapted Honey and Mumford questionnaire to a group of 64 students. A NLP (Neuro-Linguistic Programming) assessment of their intelligence (intercommunication abilities and behaviour) has also been made.

The structure of the sample was as follows:

- 64 subjects, aged 18 to 21
- 26% girls; 74% boys
- 6% left-handed
- 80% enrolled at the speciality of Computer Science and Information Technology; 20% - at Multimedia systems engineering.

According to the NLP theory, and not only, we have different types of intelligence: verbal/linguistic, logical/mathematical, musical/rhythmic, visual/spatial, bodily/kinaesthetic, interpersonal and intrapersonal, naturalistic.

![NLP Intelligences](image)

One person, depending on her background, age, genetic inheritance, has one or more intelligences more developed than others (fig.1).

After assessing the NLP intelligence types, we have kept for each subject the predominant one. In the study group most students had visual intelligence, 23.43 showed verbal intelligence, and contrary of our expectations, only 15.6% logical/mathematical intelligence. 21.87% had kinaesthetic intelligence as a predominant characteristic (fig.2).
The results of the Honey&Mumford questionnaire are presented in figure 3. Most students declare to have a pragmatic learning style; 22% were identified as activists, 18% theorists.

The results obtained after applying the Azis’ learning styles questionnaire are presented in figure 4. One subject was eliminated as he did not answer to all questions, and 9 other questionnaires were cancelled being randomly filled in.

So in the reduced sample of 54 subjects, we found out 37% practical, 26% enthusiasts, 22% imaginative and only 14.81% logic.

Analysing the results of the two learning styles assessments we have observed that students that were identified as pragmatists by the Honey&Mumford adapted questionnaire were also identified as practical, with one exception. Other correspondences were noticed:

- Reflector → Imaginative
- Theorist → Logic
- Activist → Enthusiast

Most students with verbal intelligence as predominant were identified as activists (Honey&Mumford) and enthusiast (Azis). Those with visual and musical/rhythmic intelligence were partly pragmatists (Honey&Mumford) and practical (Azis).

5. DISCUSSION

Management invariably involves people working together to accomplish goals.

Many of the challenges of working together arise from the fact that people are different in fundamental ways. They want different things; they have different values, needs and drives. They perceive differently and think differently. We fundamentally undermine the ability to work together when we see these differences as flaws or shortcomings. When we do not see and acknowledge these differences we undermine our ability to communicate with them, to predict what they will do and to reward them.

By understanding these differences people can often better accept differences between their co-workers. Awareness of your preferred managerial style and those of others will give you more ability NOT to be swept up in a style conflict. Understanding and appreciating these differences in temperament form the foundation of successful interactions in executive groups or project teams.

The assessment of learning styles in the students’ population has showed a picture different as the one expected. There is a greater diversity of intelligences and learning styles and that means that the learning programs must be adapted to face that diversity. That means that tutors must monitor the students’ learning styles, and try to harmonize them with the practical works assigned to students. It is important that both tutors and students became aware of the situation and act in consequence, to the benefit of the student’s performance. This implies a great effort from the teacher that has to prepare a large set of proposed projects and practical works, fashioned on different learning styles.

Every culture seems to have invented a system of describing human style differences. Most style assessments focus on psychological dimensions. This assessment focuses on five key managerial dimensions. Thus, it becomes very useful in applying it to many work challenges such as matching the individual to the job, analyzing an organization’s structure or understanding its culture as a whole.

6. FUTURE WORKS

Recent Information Technology (IT) progresses are offering the possibility to develop friendly user tools to assist the manger in the measuring and evaluation of the organizational climate. As future developments we have started a project that aims to develop a Web based tool for the assessment of the organizational climate in a university. The web tool will be tested and validated through a pilot study with students and teachers from the Faculty of Engineering. In a first phase, the tool will focus on the assessment of learning styles of the students involved in the pilot study. Results from several learning styles questionnaires will be correlated, analysed by a virtual tutor [9] and communicated to the professor that plays the role of tutor in real life. The questionnaires will be available online. Besides this questionnaire the application will have also a “life style” questionnaire. The virtual tutor will check the compatibility of the life style with the identified learning styles. A follow up tool is also designed. This is necessary because our experience has shown that some students are changing their way of learning when passing from one academic year to another.
7. REFERENCES


ABSTRACT: Starting from the educational goals of the Lisbon set to be completed by 2010, priority axes detached from the Sectoral Operational Program for Increase of Economic Competitiveness and the National Plan for Research and Development II 2007-2013 targets results that the mission of the Counselling and Career Guidance Center be reconsidered. In the current socio-economic, particularly complex, a new approach concerning human resources management, in connection with the management of technological change is necessary. The paper makes reference to concrete data on engineering education in North University of Baia Mare, analysis, comparison and proposals for improving the quality of human resource growth in technical and technological culture of it.

1. ANALYSIS OF THE CURRENT SITUATION. INITIAL PREMISES

We initiated this study with the intention of discovering the conditioning and perspectives that the graduates of the technical faculties within the North University of Baia Mare have on the national and European labour market, after joining the EU and close to the reunion of the ministers of education which will be organized in Benelux in 2009.

Generally speaking, the perspectives of hiring graduates on the labour market are grim due to the fact that during 2007, with an unemployment rate of young people (aged bellow 25) of 25,9%, Romania ranked last among the European states in terms of including young people into the labour market. In western countries such as the Netherlands, where programmes for including young people into the labour market have been implemented, the unemployment rate reached 5,1%, while in Denmark it reached 8,3% during 2007 [1].

The optimism of young graduates, which often replaces their lack of experience when they are first employed, is supported by psychological openness, as well as the information and advice regarding the development of their career that they receive at the guidance and counselling office within the university. The data regarding the failure of the graduates of technical faculties on the labour market, and its causes have to be added to the existent data regarding the number of enrolled students. This is the task of the guidance and counselling centers.

In Romania only part of the state and private universities has guidance and counselling centers within their organizational structure. These centers, together with the international relations offices, offer information about Community Framework for Transparency of Qualifications and Competences, offer assessment of the students’ professional skills, prepare students and graduates in order to obtain a job in terms of writing letters of intent or curriculum vitae, and familiarize them with the job interviewing techniques. Most of these guidance and counselling centers within the universities have a database with the students and graduates who benefited from their services. These centers also offer information about grants and scholarships, foreign language tests and job opportunities by means of job fairs for students and graduates. The websites of these guidance and counselling centers contain links towards relevant recruiting agencies, as well as Romanian and sometimes even foreign agencies (such as EURES) in charge with offering job opportunities to the labour force.

The international mobility programmes and the inauguration of the Lifelong Learning Programme 2007-2013 for universities were designed aiming towards the increase of the young people’s chances of inclusion into careers corresponding to their training, both in their home country and in other countries belonging to the European Union which offer them employment opportunities.

Between 2007 and 2013 Romania will receive great amounts of money for the development of human resources. Besides the Lifelong Learning Programme 2007-2013 Programme to which all international relations offices in Romanian universities are connected, the European funds meant for training and professional reconversion will be administered through Operational Sector Programmes for Human Resources Development [5].

Thus it becomes imperative to involve the guidance and counselling centers within universities in projects organized by POS DRU with the aim of increasing the chances of graduates from technical departments to find employment on the Romanian as well as other European countries’ labour market. A first step towards this was taken with the analysis of the statistical data regarding the evolution of graduates from the engineering departments of the North University of Baia Mare, as well as with comparative studies and identifying the causes of both success stories and failures. One has made suggestions for increasing the professional training of students, graduates, human resources in the technical field, their technological culture, and towards raising awareness as to the necessity of high quality professional training.
2. CASE STUDY REGARDING THE GRADUATES OF THE FACULTY OF ENGINEERING/ NORTH UNIVERSITY OF BAIA MARE

The role of the guidance and counselling centers is very important at the career planning stage, which is the first step in career development, as well as its assessment in the coming years. Career planning is tightly related to labour market planning. According to the changes on the labour market, changes in career planning also occur. Similarly, changes in the size of graduate groups occur in relation to the changes which appear when planning the number of students.

The evolution of enrolment figures does not reflect to a large extent the demographic evolution of the generations born after 1989, due to the fact that the enrolment quota in higher education has been rising constantly.

The relationship with the labour market aimed at guaranteeing employment of all graduates is not supported currently by any mechanism for planning at national level the need of specialists for specific domains or areas of the economy. Although these mechanisms are functional in other European states, through mechanisms for planning over set periods of time, based on agreements between different ministries, they keep stating that in Romania planning the labour market is impossible even for short time spans such as 4-5 years. Thus, the responsibility of choosing a career falls entirely into the hands of graduates and their families.

Figure 2 Evolution of the total enrolled students / total graduates, on the academic years, TCM specialization

Study of the ration evolutions graduates/enrolled students are based on the results of the survey regarding the statistical situation of the last three years graduates in the Faculty of Engineering. Theses results are presented in figure 1, 2, 3, 4, 5, 6.

One can notice a decrease in the ration graduates/enrolled students, as well as a decrease in number of graduates from the technical domain, which is a general phenomenon in Romania.

The causes that lead to this situation are the following:

a) the training of students in technical departments requires intensity, continuous learning and a longer cycle of training;

b) the education of students in technical departments must be creative and avant-garde;

c) early school because:
   - financial support from the poor family;
   - difficulty and complexity of technical studies.

d) the lack of technological culture at basic undergraduate level and within the family;
   - the decrease in the number of hours allotted to Physics, Mathematics, Informatics at undergraduate levels;
   - little equipment within the laboratories meant for these subjects;
   - guidance from the family towards jobs that are easier to study/practice, better paid (lawyers, economists, financial advisors, journalists) with shorter training cycles;
   - the salaries are not motivating, as compared to the salaries of salesmen, tradesmen, insurance agents, employees in the field of services, and generally easier jobs which do not require much responsibility;
   - the recovery of an engineer’s job takes longer than that of a salesman, or whom the cash flow is faster and more profitable, which is an inequity as compared to the work invested; and this was noticed by the population.

e) delays in equipping or updating the materials in universities.

All these barriers have led to the deepening of the phenomenon of diminishing the fundamental, as well as technological education for future engineers.

Their technological education, defined as “The Study of Technology, which provides those studying an opportunity to learn about processes, and knowledge related to technology, which is necessary for problem solving and expanding human skills” [3], becomes the target for the Guidance and Counselling Center of North University of Baia Mare.

We must raise awareness in the students regarding the importance of the development of technology because it “is the most wonderful, fascinating and invincible resource, which...
We must raise awareness in the students regarding the importance of the development of technology because it “is the most wonderful, fascinating and invincible resource, which springs from man’s mind and which can be exploited unlimitedly, without destroying the environment, with sustainable effects along centuries”[3].

On the other hand, technological development based on invention and innovation generates economic growth, whereas technological change appears when technological knowledge intensifies.

This is the reason why countries of the EU and the Romanian Government, trough the National Plan of Research and Development II 2007-2013, are currently focused upon technological development and especially upon technological transfer regarded as a process through which industries keep up with the continuous development of technology.

The EU by means of the European Institute for Technology stresses upon the fact that in order to have technological development it is necessary to have technological human resource.

“Technological management assumes that every managerial function will use technology on the one hand, and on the other hand should consider technology as a doorway or a resource”. In this context the human component, no matter their role, producer, client or user, has to be aware of the importance of their expertise, their involvement in the company’s technological development, as well as the economy’s development in general. This is achieved through a management of advanced knowledge, which intends to [3]:

- implement specific recruitment methods;
- implement means for individual career development;
- motivating research-development teams and engineers;
- the role of training in knowledge evolution in the highly technological environments;
- introducing new skills required by the new technologies;
- developing creativity and increasing the skills of the human resource;
- communication systems and an organizational culture to support innovation.
The Management of technological change in this field aims at training the human resource in specialized universities and technological companies [2], [4].

Thus the following result:

- the necessity of creating technological culture and education structures;
- the social and human importance of technological development;
- the importance of professional education and technological career.

All these work together towards the suggestion of reconsidering the importance and activities of the Technological Guidance and Counselling Centers [6].

3. CONCLUSIONS AND RECOMMENDATIONS

- According to the meeting of the ministers of education in London in 2007, the data regarding enrolment into higher education must be supplemented with data regarding the success and failure of graduates of technological higher education on the labour market.
- After founding the guidance centers at university level, the necessity to create similar departments at the level of each faculty becomes ever more obvious, because every department has a different professional profile.
- As regards the technical faculties, the analysis undertaken in this paper motivates the suggestion of reconsidering the activity of Career Guidance and Counselling Centers (identifying problems and providing solutions) and transforming them into Technological Guidance and Counselling Centers.
- The Guidance and Counselling Center within the North University of Baia Mare, through its activities, has to intensify its influence upon undergraduate education aiming at raising awareness in the young generation towards the importance of quality technological culture and the necessity of technological development in Romania.

4. REFERENCES