The 6th Balkan Region Conference on Engineering and Business Education & The 5th International Conference on Engineering and Business Education & The 4th International Conference on Innovation and Entrepreneurship

October, 18th -21st, 2012, Sibiu, Romania

CONFERENCE PROCEEDINGS

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Editors:
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FOREWORD

Lucian Blaga University of Sibiu (LBUS) started to organize the Balkan Region Conference on Engineering Education (BRCEE) in 2003, benefiting of 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 further included in internationally recognized proceedings indexed by the prestigious Thomson ISI. In 2007, the year when Sibiu was a European Capital of Culture, a joint conference was organized together with another international 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 in conjunction with the International Conference on Engineering and Business Education. This was the second edition of the Conference, the first one being organized in 2008 in Wismar, Germany.

This year, we connected the 6th Balkan Region Conference on Engineering and Business Education with the 5th International Conference on Engineering and Business Education and the 4th International Conference on Innovation and Entrepreneurship into a global event called International Conference on Engineering & Business Education, Innovation and Entrepreneurship.

With a theme: Progress by Exchange. Cultural Innovation and Educational Development this scientific event brings business and academia together as well as academic researchers and scholars, from more than 25 countries in view of fostering 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:
- Entrepreneurship education and research
- Innovative new methods for engineering and business education
- Collaboration in engineering and business education
- Cooperation between academia and business
- Knowledge management in engineering and business education
- New curricula development
- Quality management in engineering and business education
- Multimedia in engineering and business education
- Social and philosophical aspects of engineering and business education
- Management of engineering and business institutions
- HCI (Human Computer Interaction) applications for educational purposes
- The heritage and the development of national culture under economic globalization
- National culture innovation and education development
- Lifelong learning

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

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TOPICS FOR RESEARCHERS
ENTREPRENEURSHIP EDUCATION AND RESEARCH
THE MODEL OF ANALYSIS AND IMPROVEMENT OF THE FIRM’S INNOVATION CAPABILITY

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ABSTRACT: The latest studies are focused on innovation. Both theory and practice are based on concepts as: innovation, innovative persons or organizations, innovation potential, innovation capability, innovation audit and innovation management. The effort of a firm to gain a certain competitive advantage implies to be capable to innovate; the organization has to offer an adequate framework for development and valorisation of the employees’ creative initiatives. The innovation capability of a firm depends on the ability of the managers to identify specific factors that work on it and finding out the way they act. Based on the results of a preliminary investigation regarding other complex tools used in the innovation management, the authors are proposing a model of analysis and improvement of the firm’s innovation capability.

Key words: innovation management, innovation capability, innovation audit.

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 [7].

The innovation capability of a firm results from the stimulation of the existing potential of innovation within the firm. Innovation management is responsible for this stimulation.

Potential of innovation is in touch with other potentials of the firms, the technological potential, the financial potential, the human potential, the managerial potential, the knowledge potential, the relationship potential etc.

2. THE IMPORTANCE OF THE ANALYSIS OF THE INNOVATION CAPABILITY IN GETTING 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. 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 getting the excellence in innovation (figure 2). 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?

**Figure 2. Stages for getting excellence in innovation (processing by [8])**

The adopted measures of correction have to be continuous analysed and improved.

### 3. DEFINITION AND IMPORTANCE OF THE INNOVATION AUDIT

Through Audit, generally, it is understanding the professional examination whereby competent and independent persons collect and assess proofs in order to have an opinion on the degree of correspondence between the one observed and certain pre-established criteria.

Through Innovation Audit, it is understanding a broad and systematic analysis of the innovation capability of a firm, with the main purpose to correct this capability.

The concept of the innovation audit is very little known in Romania. An example in this sense, it is the fact that on the Internet (accessed, July 2012), using Romanian, for this tool only nineteen results could be found, while using the terminology from English and German, over 21,830 results had been identified (table 1).

**Table 1. The concept found on the Internet**

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<tr>
<th>The concept found on the Internet</th>
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<tr>
<td>Innovation audit</td>
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<td>Innovationsaudit</td>
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The importance of the innovation audit are:

- **Correction** - Increase the competition capacity through corrections on the innovation management
- **Certification** - Drawing funds, Drawing investors, Drawing customers, Increase the notoriety
- **Project stimulation** - Funds requirement for future projects’ development

The innovation audits are different from the financial audits, which are based on the quantitative measurements of the financial result. The innovation audits follow not only the result, but also the way this result was got.

In figure 3, there are shown both stages and phases of the innovation audit.

**Figure 3. Innovation audit phases [8]**

#### 3.1. Outlooks and fields analysed through innovation audit

Generally, the auditing fields are:

1. **Objectives/Strategy** - Questions concerning the strategic orientation of a firm, the innovation objectives, the innovation strategy.
2. **Innovation culture** - Questions referring to the organizational culture, if it supports the new.
3. **Technologies/Systems/Processes** - Questions relating to the used technologies, systems and processes.
4. **Organization/Structure** - Questions with regard to the organizational framework and to the forms of internal collaboration.
5. **Resources/Tools** - Questions relating to the endowment with resources, to the existing of helping tools (tools for stimulation of creativity, for assessment etc.).
6. **Management** - Questions concerning the activities of an innovative nature carried on by the firm’s management.
7. **Employees** - Questions referring to the employees’ qualification and motivation, as well as to their attitude as against the new.
8. **Learning/Knowledge/Relationships** - In what form and by what means the employees’ knowledge and competences are activated and promoted.
9. **Innovation process** - Questions with regard to the means and systems for innovation organization and leading.
10. **Informational system/Communication** - Questions relating to getting and distribution of information within the firm.
11. **Innovation marketing** - Questions referring to the environment, competition, customers, marketing mix.
12. **Innovation results** - Questions with regard to the innovation purpose.
4. MODEL PROPOSED FOR ANALYSIS AND IDENTIFICATION OF THE IMPROVEMENT OPPORTUNITIES OF THE INNOVATION CAPABILITY

The improvement of the innovation capability looks to find out answers to the questions: Which are the determinant factors that act on the innovation capability and how do they act? And What has it to be done to innovate more quickly, better and more efficiently?

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 (figure 4).

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 5).

**Figure 4.** Methodology of analysis, improvement and assessment of the innovation capability

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**Figure 5.** Analysis and opportunities identification record for the improvement of the activities which generate innovation

All this effort implies changes at the firm’s level due to the obtained innovation degree (radical and incremental innovation). For each analysed concept, major factors of influence have to be known.

Through “NO” answers, marked on the record, about the “Maturity degree of the developed concepts”, the main directions of intervention are established for the firm’s management.

For the field of the organizational culture, the analysed concept with implications on innovation is the innovation culture (figure 6).
Innovation is an essential problem of our days. It is a multidimensional concept which goes beyond the technological approach, including, for example, the innovation of a product, or process, of an organization or of the marketing.

Firms have not only to touch the necessary degree of awareness regarding the need of innovation, but, particularly, to adopt concrete measures in order to know and develop the innovation capability – the importance of an existing innovation management within the firm. Thus, the suggested model, dedicated to the firm's management, has come in anticipation of the knowledge and valorisation of the innovation capability.

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THE IMPACT OF E-LEARNING IN THE RURAL BUSINESS ENVIRONMENT

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ABSTRACT: This paper presents the eLearning as a modern and efficient tool for teaching entrepreneurship. The outcomes of an entrepreneurship education project, developed and carried out in Romania, are shown. The eLearning projects, called “Rural Manager” and “Rural Entrepreneur”, address to the rural communities with an entrepreneurship education curriculum. The education needs were identified through a survey conducted on 954 persons random selected from 23 counties in case of the “Rural Entrepreneur” project. The eLearning platforms developed by the two projects comprise various modules for example: the firm and the economic environment, entrepreneurship and innovation, business management, business marketing, finance and business accounting, communication and negotiation, and IT for businesses. In addition, the platform facilitates the consulting and networking services, as well as an e-business platform promoting the beneficiaries’ products/services. In order to measure scientifically the needs of training and of managerial consultancy at distance, complex researches were used that implied the achievement of focus groups, brainstorming and depth interviews as well as statistical analyses. The number of the beneficiaries of the two projects was over 1000 persons and their occupational statute was variously: owners, employees from the public or private sector, freelancers, farmers, students and unemployed workers.

Key words: entrepreneurship; e-learning; projects.

1. INTRODUCTION

The EU 2020 strategy highlights the need to embed creativity, innovation and entrepreneurship into education and proposes a number of actions to unleash Europe's entrepreneurial and innovative capabilities. Entrepreneurship refers to 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. [11]

The following objectives are to be reached through entrepreneurship education:

- Improvement of the entrepreneurship mindset of young people to enable them to be more creative and self-confident in whatever they undertake and to improve their attractiveness for employers;
- Encourage innovative business start-ups;
- Improvement of their role in society and the economy.

There are a number of obstacles hindering the uptake of entrepreneurship education, such as a shortage of human resources and funding for this type of education. In addition, there has been a tendency in academic/teaching communities to perceive entrepreneurship education exclusively with learning how to start and run a business.

In the past decade the entrepreneurship education took a considerable ascendant trend since its role in the economic growth was worldwide recognized [1], [5], [7].

2. E-LEARNING AS AN ADEQUATE TEACHING TOOL

E-Learning applications and processes include computer-based, web-based, technology based learning and virtual education opportunities. Content is delivered with the help of Internet, intranet, extranet, audio or video tape, satellite TV, CD-ROM, and includes media in the form of text, image, animation, streaming video and audio. [6]

Here are some significant advantages for the learners [12]:

1. Convenience
   - Courses are matched to the learner's schedule,
   - Courses are available 24/7,
   - Online learning does not require physical attendance,
   - Study can be done at home, work, or on the road,
   - Materials can be read online or downloaded for reading them later,

2. Selection
   - A wide range of courses are accessible to meet the learner's needs,
   - Degree, vocational and certificate programs,
   - Continuing education,
   - Wide range of prices to fit the learner's budget,

3. Flexibility
   - Online learning is student-centered,
   - Instructors or courses can be chosen,
   - Focus on topics liked by the learner,
   - Using the tools best suited to the student's learning styles,

4. Collaboration
   - Technology tools make collaboration among learners much easier. Since many projects involve collaborative learning, the online environment is far easier (and often more comfortable) to work in since learners don't have to be face-to-face.

5. Global opportunities
   - The technologies used give online instructional designers the ability to build in tools that take the
learner to resources which he/she may never see them in a traditional classroom.

Different types of e-learning are presented:
- synchronous e-learning (real-time communication) such as video conferencing, teleconferencing, and online chat programs;
- asynchronous e-learning (do not require real time responses), such as web e-learning modules, knowledge databases, discussion forum, dictionary
- blended e-learning (web interaction and in-person interaction) a combination of the previous two plus live face-to-face formal and informal education.

Nowadays, blended e-learning is more adequate to the needs of learners (individuals or corporations).

The challenges experienced when implementing e-learning may arise from inadequate hardware, learner isolation, insufficient support, poor IT-skills of the learner or of the trainer or poor ability of these to judge quality. The effectiveness of e-learning is unfairly criticized when unreliable computer systems, poor quality time management or poor quality content are used.

For successful e-learning, it is necessary to [5]:
- engage technology experts in the process,
- plan the course content in detail,
- plan what devices the course need to work on,
- prepare both online and offline content,
- provide tutors and technical support for the learners,
- assure that all backup systems are functioning,
- ensure that there are proper software licenses,
- check the copyrights of the content,
- make the content interesting, which means to:
  - ensure there are enough pictures compared to the amount of the text,
  - create blogs,
  - invest in collaborative tools: chat rooms, discussion forums, social media etc.,
  - use: e-books, articles, documents, links, cases, lectures, video, audio, presentations,
- pay attention to user-friendliness:
  - search functions, save options, downloading files, clarity of presentation etc.
- create a FAQ list,
- update content regularly,
- use different elements, such as: lectures, online material, downloadable material, face-to-face meetings, teleconferences, videoconferences, tutorials, online practices, assignments, video case studies,
- collect feedback.

3. EXPERIENCE OF RURAL MANAGER AND RURAL ENTREPRENEUR

National Foundation of Young Managers (Fundatia Nationala a Tinerilor Manageri - FNTM) has organized two programs for present and future rural entrepreneurs, Rural Manager (January 2009 - April 2010) and Rural Entrepreneur (June 2010 - May 2012). Both programs were developed starting from the needs of education and information identified in this side of Romania, the rural area.

The first program, Rural Manager, which ended in 2010, was conducted in 18 counties in the North-Eastern regions, Central and South-East. About 1600 people benefited from the courses, consulting services and the promotion of the products, some of them came to obtain European funding for their initiatives.

The second program, Rural Entrepreneur, in the two years of implementation, counts over 1500 entrepreneurs in the 23 administrative units belonging to the North-Western regions, West, South West, South Wallachia, Bucharest- Ilfov. Project is aiming the achievement of 23 conference, a comprehensive platform of e-learning and access to free advice.

3.1. Research on training needs in the rural area

For scientific measurement of the entrepreneurs' training needs and of the needs of management consultancy for those who want to start a business in rural, FNTM has projected a complex research that includes several aspects:
- achieving a survey representative for the target group,
- conducting focus groups (one each for region) about career and managerial experience, entrepreneurial culture and experience,
- performing five brainstorming sessions (one per region) about the meanings associated with the main managerial concepts by the entrepreneurs,
- conducting 50 in-depth interviews (about 10 in each region) about factors that influence the success or the failure in the managerial career. [3]

Demographic characteristics of the target group are:
- 60% are men and 40% are women,
- average age is 31 years and a half,
- almost half of them have University degree or being finalized,
- their families are composed of 3 to 5 persons,
- most of them (86%) can speak a foreign language and use the computer, the internet and the email 23 days per month,
- a third of the members of the target group earn money on its own, and two thirds earn money from salaries, scholarships, or unemployment benefits,
- a third of the employers and freelancers, in rural, drive more than one business.

The results to the question (mentioned in Figure 1) reveal that general average was 7 for most of the participants.

The best notes were given by the participants at “Communication” and “Computer use” (8,61 and 8,50), as it can be seen in Figure 1. They appreciate that they are good at “Communication” and “Computer use”.

**Figure 1.** On a scale from 1 to 10, what is the note you can get for training and education in the following areas? [3]
About 55% of the participants stated that they had not attended any course, training or program of management. (Figure 2) This shows the need of managerial education among the people in the rural area.

As it can be seen in Figure 3, about 67% of the participants are willing to communicate on the Internet with trainers and colleagues.

Based on relevant issues illustrated in Figure 4, on the one hand, people in rural areas are not able to find the right information (56%), and on the other hand they do not have access to useful information (32%), Rural Entrepreneur program is forced to meet these urgent needs by providing current and well structured information.

3.2. Proposal of E-learning solutions

Within the projects Rural Manager and Rural Entrepreneur, have been provided training services, counseling and support to managers or prospective small entrepreneurs through an innovative portal - integrated tool, which included:

- e-Learning platform, consulting and networking,
- a platform for promoting e-business products and services to beneficiaries,
- a project website that has grown up in an evolving resource center available to participants and rural mayors (www.ruralmanager.ro, with over 73000 page views and www.ruralantreprenor.ro). (Figures 5, 6)
For both portals of the programs has been registered a significant interest, which means about 50000 visits and over 6500 visitors show the great interest of the public for such programs of managerial training and counseling. (Table 1)

Table 1. Comparative data about the number of visits, visitors or editions of the newsletters

<table>
<thead>
<tr>
<th></th>
<th>Rural Manager</th>
<th>Rural Entrepreneur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total visits</td>
<td>22,233</td>
<td>14,540</td>
</tr>
<tr>
<td>Number of unique visitors</td>
<td>5,433</td>
<td>1,564</td>
</tr>
<tr>
<td>Number of the editions of the newsletter</td>
<td>32</td>
<td>26</td>
</tr>
</tbody>
</table>

Over 1000 learners have benefited from the both management education programs, they have participated in training sessions as the traditional face-to-face and training on the AeL platform. (Table 2)

Table 2. Comparative data about the number of participants at the conferences, e-learning courses and consultancy

<table>
<thead>
<tr>
<th></th>
<th>Rural Manager</th>
<th>Rural Entrepreneur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of the participants at the motivation conferences</td>
<td>1,413</td>
<td>2,045</td>
</tr>
<tr>
<td>Number of the participants at the e-learning courses</td>
<td>401</td>
<td>682</td>
</tr>
<tr>
<td>Number of the beneficiaries of customized consultancy</td>
<td>396</td>
<td>500</td>
</tr>
</tbody>
</table>

The Rural Entrepreneur came up with a further offer of educational modules which increased the number of modules from 5 to 7 trying to better respond to the requests coming from the people in the rural area. Thus, starting from the five modules: Business Plan, Strategic Management, Project Management, Financial Management, IT for business, it has reached to: Firm and the economic environment, Entrepreneurship and Innovation, Business Management, Business Marketing, Business Finance and Accounting, Communication and negotiation, IT for business. (Figure 1, Table 3)

Table 3. The educational content of the e-Learning platform

<table>
<thead>
<tr>
<th></th>
<th>Rural Manager</th>
<th>Rural Entrepreneur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of modules</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Number of the packages of lessons</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Number of lessons</td>
<td>108</td>
<td>121</td>
</tr>
<tr>
<td>Number of moments</td>
<td>627</td>
<td>660</td>
</tr>
<tr>
<td>Number of frameworks</td>
<td>3068</td>
<td>1434</td>
</tr>
<tr>
<td>Number of tests</td>
<td>15</td>
<td>24</td>
</tr>
</tbody>
</table>

The number of hours spent on the platform Rural Manager was significantly lower because of a lesser number of modules, however the number of connections was double, showing rather the interest than the depth of the learners on the developed subjects (people being from North-Eastern Regions, Central and South-Eastern Regions). (Table 4)

Table 4. Number of the visits on the e-Learning platform

<table>
<thead>
<tr>
<th></th>
<th>Rural Manager</th>
<th>Rural Entrepreneur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of hours</td>
<td>5,950</td>
<td>19,938</td>
</tr>
<tr>
<td>Total number of connections</td>
<td>45,952</td>
<td>28,256</td>
</tr>
</tbody>
</table>

The large number of messages on Rural Manager platform highlights a fact already known fact that people in areas North-Eastern Regions, Central and South-Eastern Regions are more opened to communication than people in other parts of the country. (Table 5)

Table 5. Forums

<table>
<thead>
<tr>
<th></th>
<th>Rural Manager</th>
<th>Rural Entrepreneur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of forums</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Number of the topics of discussion</td>
<td>279</td>
<td>215</td>
</tr>
<tr>
<td>Number of messages</td>
<td>1,168</td>
<td>627</td>
</tr>
</tbody>
</table>

e-Commerce platform hosted by the Rural Entrepreneur portal was designed as an online store, divided into several sections: products, producers, shopping cart, new products, best sold, reviews, payment option, search engine etc.. By the end of the project, over 300 online stores were recorded, with more than 370 categories of products listed.

3.3. The impact on the beneficiaries

Lessons learned in management education courses were considered useful by most of the participants for their own businesses. (Figure 7) Only those who are still students and have not started a business were unable to appreciate the utility of the courses.
Figure 7. How much the concepts learned during the courses will be useful in your business? [4]

The trends of the personal or corporate incomes from the last year are not related to the information received in e-Learning courses by all. (Figure 8) Some have found a direct link between them, but others gave explanations related to other aspects (relations with authorities, the overall political climate, economic crisis etc.).

Figure 8. To what extent do your incomes or your company’s revenues last year were influenced by the knowledge and the relationships gained in the project "Rural Entrepreneur" [4]

In Figure 9 are presented the effects of the shared knowledge and information on the improved relationships with customers (63%) and with learner's family members (52%).

Figure 9. Information and knowledge gained in this project have brought changes in your relationship with the following persons in the last year? [4]

Here are some answers of the participants at the questions mentioned in Figure 9 and Figure 10:

"Not only the number of partners, suppliers or customers increased, but relationships with the old ones have improved. I have another approach to the problems. At that time, I felt that I had needs, but I did not know how to fill them. Now I am going to classes, I am reading a lot and I am informed so my relationships to be easier and more enjoyable." "The relationships with my competitions have not changed for the better, but with my customers have changed for the better, especially the ones of communication". "I applied marketing, I advertised. I received information at the business courses about how to make advertising without costs and all models that I have taken at my courses I have applied them. And after 2 months the results have appeared.".

Figure 10. To what extent were the courses held tailored to your managerial needs? [4]

As it can be seen in Figure 10, the participants have found out solutions to their managerial problems and have gotten a better view over the way they have to approach their businesses.

3.4. The impact on the public

Rural Entrepreneur project was presented, commented and discussed on several media channels. In the audiovisual media, information and analysis have been provided on several programs, especially at TVR, The Money Channel, Pro TV, and Reality TV. Local television stations have given wider spaces than the national television. In the virtual space, project is presented on 148 web sites and pages.

Starting at March 25, 2012 public television TVR 1 has started a series of programs "Doing business in the country," the program "Village Life". Analysis of audience data provided by Kantar Media shows that the program was monitored every week on average of 165000 people, increasing the viewer interest from a program to another. In total the eight programs were watched by 1308000 viewers. [4]

4. CONCLUSIONS

Entrepreneurship education in Romania needs more attention and development. Improved figures from GEM 2011 (The Global Entrepreneurship Monitor) as opposed to those of 2010, demonstrates that entrepreneurship programs developed started to show their fruits. [10]
By keeping an eye on the top trends in e-learning industry and implementing the appropriate e-learning tools, a solid education system can be developed.

As regard to the Rural-Manager and Rural-Entrepreneur projects, the impact of them is considerably. A total of about 3500 persons were recorded as beneficiaries of the projects so far. Other effects such as increases in turnovers of existing businesses, number of start-ups, projects that received structural funds on various sectoral operational programs (26 based on reported figures), and more to come, reveal the positive impact of entrepreneurship education.

5. REFERENCES

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ENTREPRENEURIAL ATTITUDES AMONG ROMANIAN DOCTORAL STUDENTS: AN EMPIRICAL STUDY

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ABSTRACT: The subject of entrepreneurial attitudes, orientation and potential of young students is one of great interest in approaching the way public policies can be designed in order to support and foster entrepreneurship among students. In addressing this need - with focus on doctoral students, and in the framework of other similar approaches in literature, we have conducted a survey in January 2012 and developed a sample-based study. The papers aims to present and defend the results of this study, by emphasizing Romanian doctoral students’ attitudes and facts concerning issues such as: entrepreneurial background, interest in entering entrepreneurship, on-going steps if any, factors and motivations driving the choice of an entrepreneurial career. There are also investigated some personal characteristics (age, gender, family status) in relation with entrepreneurial approaches and there are also presented concluding remarks and policy recommendations.

Key words: entrepreneurial attitudes, doctoral students, entrepreneurial careers

1. INTRODUCTION

Interest in an effective approach on integrating university education and entrepreneurship has been growing rapidly in the last decades, given that entrepreneurship acts as a main factor for national prosperity and competitiveness. In the same time, High Education Institutes (HEI) has comprehensive plans to adapt in time their educational offer to the economic challenges and to provide graduates with skills and knowledge with certain economic value.

Consequently, understanding entrepreneurial attitude of doctoral students proved to have an increasing importance in correct orientation of these efforts, to ensure maximum successful of doctoral programs. Entrepreneurship is now considered as a key competence, suitable in almost every situation. In academic environment, both for students and teachers, entrepreneurship validates the individual's ability to turn theory into action, to give practical understand to the process features and the PhD students' attitudes towards their future entrepreneurial career alternatives. Deep knowledge of the relationship between necessity and opportunity in the entrepreneurial approach could create opportunities to obtain valuable information about entrepreneurial success and could help to promote a genuine entrepreneurial spirit among the academic community, society and economy.

2. BRIEF OVERVIEW ON THE LITERATURE

Literature on entrepreneurship is consistent and diverse, examining the nature of entrepreneurship, motivation and predictors, gender differences, the influence of economic environment, education and personality, supportive measures and so on. However, understanding the link between entrepreneurship and doctoral pathway is less common in contemporary research. Thus, beyond the exceptional scientific background of PhD graduates, there are quite a few things known on the set of business skills and competencies held by them and how this set is desirable on the labor market or can be used in self-employment. Also, we found few studies on how PhD students and graduates can progress on entrepreneurial career as an alternative to academia, public institutions or large corporations.

Facing the growing challenges of the "knowledge economy", and the importance of innovation and strategic management, skills and competencies of higher education, doctoral or postdoctoral graduates become of a strategic importance in guiding the acquisition of skills by people able to combine scientific research with entrepreneurial skills. Obtaining doctoral degree remains a focal point for graduates and policy-makers, but interest begins to move to the final product "doctoral thesis itself" to the inherent value of qualified researcher, holder of a single set of high level skills.

According to Smith et al., Higher Education Institutions (HEI) have to be "more pro-active in providing postgraduates with the opportunity to develop the core competencies they need to succeed in a competitive job market" [2]. From this point of view, it is essential that teachers, all people involved in career guidance and entrepreneurship education to be well trained, to have practical and theoretical skills to effectively manage processes of permanent training of graduates [3]. In many studies, the importance of entrepreneurship in the university environment is analysed in relation with identity, „that relate to their sense of personal and occupational identity” [4], both on doctoral students and also to their teachers. As a general assertion, the accumulation of knowledge and the pursuit of scientific research in a favourable academic environment are considered as the main drivers determining doctoral students and academic staff to get involved in entrepreneurial activity, ”although some were categorised as reluctant entrepreneurs ‘forced’ into an entrepreneurial pathway as the only way to continue their scientific work” [5]. Other researchers consider that the implicit purpose for
valorising research results and the academic standards are not neither fundamentally opposed, nor congruent, and the concept of academic capitalism is associated with a change of academic identity [6]. For others, this may be equivalent to a limitation of latitude in scientific research and even of academic freedom itself [7], [8].

The traditional view emphasizes the potential of doctoral studies to develop human capital to high standards in individual terms. On the other hand, we have to admit that the process of innovation and commercialization of research results is a process involving a range of stakeholders, and, in most cases, it is not expected that a researcher, a doctoral student or a recent PhD manage to set up a business, to launch a product or a marketing strategy, to negotiate, in the same way (and efficiency) as he or she carried out the research itself. A real help in aligning the highly qualified researchers with innovative potential and business requirements is increasing the number of spin-out companies. “These spin-outs, as demonstrated […], frequently provide a vehicle for those with doctoral qualifications to pursue an entrepreneurial career path” [9].

The intentions of graduates and postgraduates entering the labour market are diverse, from academic and research careers, to public or private sector, and finally, establishing and developing own business. The literature contains substantial discussion on the added value of individual skills and employability of PhD holders (see, for example Hooley et al. [9] or Thrift [10]), and on the relative importance given by employers to such degree diploma [11]. According to recent researches, about 10% of doctoral graduates in Europe choose to develop their own business [12], and this proportion appears to be higher than the proportion of the first degree graduates acting as self-employed [13], [10]. In 2010, according to the Global Entrepreneurship Monitor data for Romania, about 4.80% of Romanian entrepreneurs has postgraduate studies [14] and official data show that interest in doctoral studies in Romania is relatively high: the last five years recorded about 17,000 graduates, and figures presented by the Ministry of Education in Romania estimated around 3,500 places for doctoral studies, per year [15]. By comparison, in the European Union in 2010 there were granted around 100,000 titles of doctor in 2010. More than 70% of total titles were awarded in four countries: Germany (26,000), United Kingdom (19,000), France and Italy (12-13000 each) [16]. Obviously, an important share of PhD graduates in these countries are originated from developing countries, attracted by high-performance systems for education and future employment opportunities in these countries.

Empirical research has revealed a variety of situations and attitudes on entrepreneurship in doctoral community in HEI. Thus, in a survey on economist students in five European countries (Germany, Romania, Latvia, Italy and Austria) [17], researchers have found remarkable differences, both in the attitude toward entrepreneurship, and in the image of the entrepreneur. While students from Latvia were less tempted to consider themselves as potential entrepreneurs (and the image of entrepreneurship does not seem to have much importance for their future decisions), Romanian students tended to attribute high ethical standards to entrepreneurs and had the most positive image of entrepreneurs (compared with other countries). At the same time, Romanian students were also the most tempted to consider themselves as (potential) entrepreneurs, considering that the entrepreneur’s social position in the economy and society will increase in the future. However, the results of this study have some limits, the authors pointing that ”Exploring this […] could also involve looking at whether there are differences in students' image of the entrepreneur depending on whether or not they have been educated in entrepreneurial thinking and conduct” [17]. From another perspective, using "identity as a lens through which to examine both employability and entrepreneurship as they are perceived by PhD researchers" [5], a research made on groups of PhD students and their teachers from China and United Kingdom has shown a wide range of acceptance of the relationship between entrepreneurship and the purpose of doctoral studies, both within and between groups, an awareness of the importance of entrepreneurial activity, confirming previous research that students (including PhD students) from Asia, Central and Eastern Europe give a more valuable place for the entrepreneur in society, and also as a career option. In the same time, this research shows serious concerns about the conflict between the two social roles, researcher and entrepreneur [5]. Finally, according to a research on entrepreneurial attitude among doctoral students from the University of Osnabrueck (Germany), Marion Titgemeyer, and Gerold Holtkamp have found that a large majority of doctoral students are interested in starting their own business, and even they have already founded a business, in a larger proportion than bachelor/master students. In terms of gender, "female doctoral students have approximately the same interest to start business than male doctoral students, but, the share of male doctoral students having a business is higher than for female doctoral students". While for launching a business "females expect an advisor, males expect role models" [18].

3. AIM, METHODOLOGY AND SAMPLE

As a part of a wider project investigating some relevant issues on the subject of entrepreneurial attitudes, orientation and potential of doctoral students, in order to support and foster entrepreneurship among students, we have conducted a survey in January 2012 and developed a sample-based study by emphasizing Romanian doctoral students’ attitudes and facts concerning issues such as: entrepreneurial background, interest in entering entrepreneurship, factors and motivations driving the choice of an entrepreneurial career, gender.

Online questionnaire was applied during 9 to 18 January 2012 to all 110 doctoral students (in their first, second and third years of study.) and recently graduated doctors who have been financially supported by POSDRU projects (EU funded project on Human Resources Development), coordinated by the University of Oradea. The number of PhD students answering to the questionnaire was 88, with the following distribution by study area: Engineering Sciences 25, Philology 20, Geography 17, Economics 8, Biology 6, Medicine 5, History 5, Sociology 1. By the university where attending studies, the distribution is as follows: University of Oradea - 77 PhD students (88%), Aurel Vlaicu University in Arad - 6 PhD students (7%), Petru Maior University of Targu Mures - 5 PhD students (6%). Occupational status at that time was: doctoral students only (as grants beneficiary, so called “bursier”) - 23 persons (26%); employed in education and research sector - 42 persons (48%); employed in public sector - 8 persons (9%); employed in private sector - 5 (6 %); entrepreneurs - 3 (3%); other 7 (8%). By gender, 51% of the respondents were female and 49% male.
In this paper, we analyse the following issues:

- Future career intentions;
- Contribution of doctoral stage in improving employability and future earnings;
- Entrepreneurial and business start-ups intentions and previous experiences (if any);
- Types of entrepreneurial and business activities intended;
- Relation between the field of doctoral stage and the field of business start up;
- Perception of doctoral students concerning the importance and role of doctoral stage for a future entrepreneurial career.

4. RESULTS AND DISCUSSION

As already mentioned, most of the respondents, i.e. 74%, are, as occupational status, either doctoral students only (as grants beneficiary, so called “bursieri”) or already employed in education and research sector. Given that, there is not surprisingly the fact that, concerning the future career intentions of doctoral students, most of them desire to continue this career (those already involved in education or academic sector) or they are tempted to assume an academic career in the future. At the completion of their doctoral studies, 78% of them declare their desire to work in education and research, 8% in the public sector, 6% in the private sector and only 5% intend to set up their business. Compared to their current occupational status, we note that potentially there are only two possible shifts, i.e. towards the research and education sector and toward entrepreneurial activities; in the case of entrepreneurship, both the variation and the final weight appear to be insignificant.

Before acting as an option in entrepreneurship, holding a doctoral diploma is a necessity and an opportunity for employees in public sector, or private companies, but especially in education and research sector. Thus, an important issue of the analysis concerns the relationship between the doctoral stage and diploma and the employment opportunities and employability. For PhD students, targeting a doctoral title is related (in variable degree, depending on the economic sector indicated) to increased employment opportunities and wages. Respondents were asked to rank (on a scale from 1 – strongly disagree, to 4 – strongly agrees) their agreement with the statement: “doctoral stage improve my employability and wages in the field of …”. Results calculated as weighted average of the responses indicate that the highest score (strongest agreement) was registered, as expected, for the field of education and research sector (3.41 score), followed by public sector (3.02), entrepreneurship (2.55), and employment in private companies (2.52). What it is surprising is not the spread between the place held by education and research sector compared with the next option (public sector), but rather the relatively low agreement in the case of education and research sector (compared with normal expectations), given that, in terms of employment, promotion opportunities and salary, working as academic or researcher is definitely conditioned by holding a doctoral title. Entrepreneurship registers relatively high score, slightly above the private sector, meaning that PhD students are concerned on their future career and consider entrepreneurship as effective option for further career.

Almost two thirds of respondents (55 people, or 63%) affirm that they are interested in starting their own business, and 33 of them (37%) admit they are not interested. Moreover, the relatively high interest shown in starting their own business is confirmed by the actual situation, i.e. about one third of all respondents declare they have already started a business of their own, and a considerable number of these businesses (18 out of 27) still work.

![Interest for entrepreneurship](image)

**Figure 1 Interest for entrepreneurship**

Source: own calculations, based on the dataset

Most of the interviewed PhD students are interested, at least at declarative level, to start a business, but the form this business will run appears to raise greater problems than a simple affirmative option. Going deeper, we questioned the respondents to detail and explain their entrepreneurial options (agreement/disagreement), by offering them five pre-defined options: developing of existing business in the family; taking over an existing business; entering into a franchise; investing in an established business; and finally - the most riskiest option - to start their own business. For each of these options, doctoral students were asked to express agreement / disagreement on a scale with four levels, from 1 – strongly disagree, to 4 – strongly agree (besides these, respondents could choose not to answer the question). The results were quite surprising. Thus, for all five entrepreneurial choices we have recorded a large number of non-responses (between 28% and 40%). Considering only those respondents effectively answering to the question (i.e. excluding non-responses), we notice that most of them pointed out their partial or total disagreement. Thus, taking over an existing business or entering into a franchise are simply not considered as a business alternative (although they are often recommended for your and inexperienced entrepreneurs). The lack of interest for the first three choices (i.e. developing of existing business in the family; taking over an existing business; entering into a franchise) could be countervailed by the propension for classical entrepreneurship, but neither this choice have not reported significant agreement, i.e. only 25 “strongly agreement” responses (40%). As a partial conclusion, we can state that, either PhD students remain “captives” in theoretical sphere and do not really understand actual forms of entrepreneurship, either their agreement is formal and declarative - facing a tougher choice, they prefer not to answer and dismiss the proposed alternative.
A significant part of PhD students (59%) state that they are tempted to start an entrepreneurial career, and even have already undertaken some steps in this direction, and this business is to be outlined in their doctoral studies and concern (58%). Deeper analysis shows, however, that the quasi-similarity of the two figures (59% vs. 58%) do not necessarily describe the desire for an entrepreneurial career based on doctoral skills and knowledge. Thus, only 37 answers (from 52, i.e. 65%) admit that this intended business would be linked to their PhD, and the rest, over one third, considering this business will be in other areas, not directly related with their doctoral studies.

In terms of gender, the extent to which female and male are tempted to start (and even have already started) shaping an entrepreneurial career, are very similar (49% females and 51% males). The largest gender differences occur when respondents indicate whether their business (even in early stages) have, or will have, a direct relation with the field of their doctoral studies. Compared with the general percentage of PhD students with business in areas related to their doctoral studies of 65% (mentioned above), the figures for women drop to 50%, i.e. only half of the female PhD students’ entrepreneurial intentions have something to do with the advanced skills and competences they acquire during the doctoral stage. On the other hand, the men’s percentage is much higher; about 87% of male doctoral students tempted to launch an entrepreneurial activity state that this is related to doctoral studies they are following.

Beyond simple gender differences, these responses raise two issues:

- The extent to which entrepreneurial option is logically and honestly correlated with the doctoral stage, i.e. whether promoting entrepreneurship choices for future career is only a trendy way of thinking, remaining on a declarative stage in doctoral student’ speeches and formal declarations; in fact, they prove to be much more interested in academic career or enjoying the benefits offered by a doctoral diploma for people employed in the public sector;
- If the entrepreneurial intentions turn real and became effective entrepreneurial careers, the fact that most of the entrepreneurs holding a doctoral diploma will not effectively use the high scientific knowledge and skills acquired during their doctoral stage reflects, somehow, a waste of resources, both on personal and societal level.
Propensity for business start-ups differs, as expected, according to PhD domain. Most interested to start a business in the field of their doctoral studies are, by far, doctoral students in engineering sciences (92%) followed by geographers (71%) and economists. Doctoral students in medical sciences, philology and history appear to be less interested in starting a business.

The same trends are found when asking doctoral students to evaluate whether the doctoral stage helps them in choosing an entrepreneurial career: future doctors in engineering (96% of them), geography (71% of them) or economics (75% of them) consider that skills and competences acquired during the doctoral stage would support and help them in entering the entrepreneurship and developing their business. The explanation of these optimistic responses for engineers and economists relies with the nature itself of their field and economic sector working into, and much larger opportunities for economic and entrepreneurial involvement in the so called “real economy”, i.e. in the production of tangible goods and industrial services. In the case of geographers, the high rates reported could be related to their interest and initiative in interdisciplinary areas such as tourism. The tourism sector is considered having an important development potential for small businesses and many Romanian HEI successfully developed bachelors and doctoral programs in the field of tourism and hospitality.

5. CONCLUSION

Achieving and transferring knowledge and skills with economic value should be a constant concern both for HEI and policy makers, for public institution and private employers. Undergraduate, postgraduate and especially doctoral stages should not be limited to acquiring high scientific knowledge, but also should consider how ideas, innovations, research can be honestly and motivating marketed, as to give real value to human capital investment. Creating “doctoral entrepreneurs”, based on strategic policies and not as result of individual initiatives of doctoral graduates, could be integrated in such efforts. The high skills held by this select group of people, their training in research and innovation, the high qualifications and opportunities to insert in high efficiency and innovative driven economic sectors should help to motivate and focus the interest of economic decision makers, policy and academics. Our research showed a significant interest of young doctoral students to acquire skills, to use them in their future career, whether they will follow an academic career, would be employed in private or public sector or will start and run their own business.

The aim of studying doctoral stages with reference to doctoral students’ future business options is clearly focused on understanding the attitudes and behaviour towards entrepreneurship, as to avoid redundant, common or formal information, and, finally, to provide arguments for policies promoting a genuine and effective entrepreneurial spirit among academics, as part of the society. Our research also revealed the existence of a formal and declarative interest of some doctoral students for the business sector, and superficial knowledge of the realities and requirements for an entrepreneurial career. The fact that most of the doctoral students consider the doctoral stage and diploma as a condition or an asset in their career promotion and higher wages is, in reasonably limits, normal. What should worry is the great proportion of doctoral students not interested in entrepreneurship in a practical manner, although they have previously proclaimed it as a possible option for the future. Another concern regards the fact that significant entrepreneurial intentions of doctoral students are not directly related to the doctoral field and would not use the knowledge acquired as doctoral student.

Of course, it is important to recognize the fact that the relationship between doctoral degree and entrepreneurship goes beyond empirical approaches developed in some universities (such this research) or within business environment. Revealing some features of this relationship, emphasizing stronger the role of doctoral entrepreneurship on the academic concern map, could be a good step forward and a challenge for future research and economic policy measures.

The limited sample and objectives of our research did not allowed us to capture the extent to which entrepreneurial approach is likely to materialize within the HEI, but we strongly consider that these opportunities exist and wait to be supported by internal reforms, integrating entrepreneurial courses in academic university curricula etc. Thus, in our opinion, a fair and realistic attitude of doctoral students toward entrepreneurship could significantly improve, generating positive impact on the development of Romanian society and economy.

6. ACKNOWLEDGEMENTS

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EVALUATING THE EFFECTIVENESS OF AN ADULT ENTREPRENEURSHIP TRAINING PROGRAMME

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ABSTRACT: The purpose of this research was to determine the effectiveness of an adult entrepreneurship training programme in a developing country such as Namibia. A cross-sectional research approach was followed with surveys distributed to a convenience sample of entrepreneurs (N=102) who participated in the training programme. The results overall showed that the respondents benefitted to a large extent from the training programme. The training programme contributes amongst others to improved business performance and increased clients base for the respondents. The training methods used as part of the training programme are adequate and improved the respondents work attitude and overall entrepreneurial skills.

Key words: entrepreneurship training, business performance, entrepreneurial skills, work attitude

1. INTRODUCTION

The art and science of being an entrepreneur is receiving increased attention globally. Triggering this phenomenon is the emerging economic environmental changes, uncertainty in the corporate world, new technology and new emerging world markets. According to Henry, Fill and Leith [1] changes at the organisational level such as decentralisation, downsizing, re-engineering, strategic alliances, mergers, and the growing demand for flexibility in the workplace, all contribute to an uncertain climate. Clearly then, as the work environment changes and careers become increasingly fragmented in contemporary society, people of all levels in society will need entrepreneurial skills and abilities to prepare them for the current challenges and an uncertain future [2; 3].

The significance of entrepreneurship and small business management education is evident in statistics on the prominent role Namibian entrepreneurial enterprises and small businesses play in the promotion of local, regional, and national economic growth. According to the Bank of Namibia Symposium [3] SMEs account for 20% of employment in Namibia, and contribute 12% to GDP. The Namibian Government has recognized and acknowledged the importance of the SME sector within the economy [3]. As one of the ways towards achieving the goals Vision 2030, Namibia aspires to have a flourishing SME sector by the year 2030. The importance placed on this sector therefore, is evidenced by the special attention and efforts directed to this sector.

Various initiatives have been started by the Government of Namibia, particularly the Ministry of Trade and Industry, in trying to develop this sector. These include amongst others, the existence of a dedicated department which deals with SME issues in the Ministry of Trade and Industry, the establishment of physical infrastructure to provide an enabling environment for production and trading by the SMEs, as well as Government efforts to provide financing to this sector. Initiatives by the private sector as well as non-governmental organisations (NGOs) aimed at assisting SMEs are also acknowledged.

Despite all these efforts, there is still room to further develop the SME sector to contribute meaningfully to the Namibian economy. However, there are several challenges, which are currently hampering this sector to flourish. Shejjavali [4] identified five key areas of challenges facing the Namibian SME environment which include market access, information technology, funding access, management, and human resources. This author argues that part of the human resources challenges are the lack of high education and skills, as well as the tradition orientation of the family members. In addition Ipinge [5] indicated that a lack of managerial training, lack of market information, low level of education and inability to retain staff with relevant skills also hampers the effectiveness of SMEs in the Namibian context. In a similar vein the report of the Bank of Namibia [3] also emphasised that there is still a shortage of skills and capacity in the SME sector. As a result the Government was called upon to ensure the provision of skills and capacity.

It is against this background that this research aimed to determine the effectiveness on an adult entrepreneurship training programme as offered by the Centre for Enterprise Development (CED) of the Polytechnic of Namibia. The Centre for Enterprise Development was established in 2000 and delivers training programmes to address the needs of Entrepreneurs in business management. Through tailor-made training courses, base line research and strategies to alleviate poverty, CED diversifies the markets and develops the Namibian labor force. The SME Development Unit focuses on imparting relevant business management knowledge and skills to entrepreneurs.

Entrepreneurial learning forms one of the grounds for analysing the effectiveness of the CED entrepreneurship training programme in this study. It is important to investigate how the training content and methods succeed in contributing to management skill building in the entrepreneurs since it has never been evaluated. The study evaluated to what extent the outcomes of the programme are attained when entrepreneurs are confronted with the realities of problems on a daily basis, by collecting data from trainees who completed the programme.
since 2008 until 2011. No research has been conducted that assess the effectiveness of a training programme for local Entrepreneurs nor is there any consensus as to the components that should be included in such initiatives.

1.1 Entrepreneurship Training

The extent, to which entrepreneurship skills can be transferred or are even worth teaching, is a matter of debate among scholars [6]. Henry et al. [6] states that certain elements of entrepreneurship, can be taught as entrepreneurs are not just born but can also be made. Teaching entrepreneurship involves both “arts” i.e. creative and innovative thinking and “sciences” i.e. business and functional management competencies [7].

“Entrepreneurship-science” can therefore be taught using conventional methods such as classroom training to provide the entrepreneur with technical skills i.e. financial management and marketing [6]. An added component to the classroom training is the core practical and informal support like mentoring, counselling and informal networking events.

On the other hand, the “art” of entrepreneurship which is the hub of creation and innovation, does not appear to be as transferrable in the same way according to Henry et al [1]. It is highly subjective and is a skill that cannot be directly taught due to its fundamentally experiential nature [7]. In order to make sense of the “art” of entrepreneurship there is a need for a greater understanding of how people learn entrepreneurial behaviour and how entrepreneurial capabilities are developed [8].

Pretorius, Nieman and Van Vuuren [9] pointed out the key issues that seems to differentiate a more successful learning programme for opportunity identification and business start-ups from an average programme is whether there is attitudinal and behavioural modification by the participant after having attended the programme. The modified attitude will lead to activities associated with business start-up. If the facilitator, on top, can impact on the participant in such a way that the attitude and behaviour are modified, the programme will most probably lead to a more venture start up.

The task facing CED is to find creative solutions in training adult entrepreneurs. It was thus important for the researcher to understand the level of contribution that the current Entrepreneurship training programme of CED makes to the Namibian market while keeping the Namibian market conditions and Entrepreneurs’ challenges in mind. The role that “general accepted” value systems plays in the day to day activates and their perceptions of how it is in the broader community can add to the richness of the training programme.

It is believed that finding solutions to these challenges will not only broaden the economic activity base, but also address the issues of poverty, unemployment and income inequality. Mwasalwiba [2] for example states that the major rationale for entrepreneurship education is more economical than social. Following a belief that Entrepreneurship is a solution to some economical problems, especially unemployment, entrepreneurship education should influence attitudes, values and general community cultures. The aim is the driving force behind all other objectives, namely, start-ups, self-employment, job creation, knowledge advancement and skill development.

In this research paper we will address the following research questions:

- To what extent did the respondents attend the modules presented as part of the training programme?
- To what extent did the content of the courses offered as part of the training programme contribute to the respondents’ entrepreneurial skills?
- To what extent were a variety of training methods used as part of the training?
- To what extent did the training modules contributed to the general business skills of the entrepreneurs?
- To what extent did the training methods used as part of the training programme contributed to the transfer of learning?
- To what extent did the training modules contributed to the entrepreneurs’ business?
- To what extent did the training assist in increasing the client base of the respondents?
- To what extent did the respondent’s work attitude change as a result of the training course?

2. RESEARCH DESIGN

The research approach of the present study is quantitative in nature as the aim of the research was to determine the effectiveness of an adult entrepreneurship training programme in the Namibian context. A non-experimental cross-sectional survey research strategy of inquiry is utilized in this study based on the need for exploratory research on entrepreneurship training.

2.1 Respondents

The target population for this research was all adult entrepreneurs who completed or attended the CED Entrepreneurship programme between the years 2008 and 2011. A total of 102 questionnaires were distributed to Entrepreneurs that enrolled for the beginners level training of which all were returned. Most of the respondents in this research were female (63.7), aged between 30-39 (49%) years, speaking indigenous languages (74%), and in possession of Grade 12 certificate and higher qualifications (60%). The perceived monetary value of the training attended by the Entrepreneurs was estimated to be between N$1000 and N$4999 (41%). 24% of the Entrepreneurs who participated are involved in the services industry – which include professions in events management, day care for kids, maintenance of buildings and upholstery. Next on the list was catering services, with 15%. Most of the Entrepreneurs who participated could be classified as Informal Entrepreneurs (59%). Informal entrepreneurs can be classified as survivalist.

2.2 Measurements

A questionnaire was developed to measure the effectiveness of the adult entrepreneurship training programme. The questionnaire measured the courses attended as part of the entrepreneurship training programme, adequate coverage of content/topics, change in attitude because of training, training methods used during training sessions, contribution of teaching methods to entrepreneurial skills, increase in profit as a result of training, increase in client base as a result of training and results achieved by skills acquired. A variety of Lickert scales were used to measure the above. The questionnaire was piloted prior to administration.
2.3 Data Analyses

Statistical analysis was carried out using the SPSS Program (SPSS Inc., 2012). For purposes of this paper the results will be reported in descriptive format.

3 RESULTS

In the section that follows we will present the results of this research. The results are presented per research questions.

3.1 Attendance of Modules

Graph 1 below shows that the respondents attended most of the modules that constitute the programme offered by the CED. it is evident that in general the above modules are attended by most of the respondents. It is important to note that the module in Tendering Processes and Procedures as well as Production was only introduced later in the programme therefore the low response rate to this particular module. The training modules mostly attended include Bookkeeping and Budgeting, Marketing and Sales and Communication Skills and Customer Care.

3.2 Adequate coverage of training modules

The purpose of this section is to determine whether the content covered in the different training modules enabled the entrepreneur to apply the skills in his/ her business. Graph 2 below shows that it is evident that on average Entrepreneurs benefitted the most from the Bookkeeping and Production module. The content covered in the Personal Development and Marketing and Sales training modules also enabled the entrepreneurs to apply these skills in their respective businesses. The results also showed that the training modules of Communication skills and General Business Management needs slight improvement while Leadership & Ethics as well as Tendering Processes needs more improvement.

3.3 Training Methods used

This part deals with the training methods used as part of the training of the various modules as well as the effectiveness of the training methods and the need for additional training methods. Graph 3 below indicates that training methods such as lecturing, team activities, small discussion groups and case studies were mostly used. Role play and DVD’s were used less often while mentorships were used the least.

3.4 Effectiveness of Training Methods used in the transfer of learning

This section indicates the training methods most effectively in the transfer of learning for the entrepreneurs. Graph 4 below shows that it is evident that the entrepreneurs benefitted the most form the training methods of Lecturing, Practical Exercises and Small Discussions in the transfer of Learning. Case studies and DVD are less popular while role play and mentorship made the least contribution.
3.5 Additional Training Methods required

Graph 5 indicates that there is strong need for Twinning with a Successful Business Person and on the Job Training. Business Simulation Games and Time for Self Reflection also received a strong response. There was also an open ended question where more proposals could be listed to enhance the learning experience. Some of the responses were: More advanced training, include IT skills training. Localize case studies, training should be over longer period, more emphasis on maintaining and growing a business, appoint and train more capable mentors, include human resource training, visit the workplaces and give on the job training as well as offering of the option in e-learning mode.

3.6 Results of the Training

This section reports on the results that the entrepreneurs achieved because of the training received through CED. This section will first report on the general results achieved, followed by increase in turnover and client based and the finally change in work attitudes.

3.6.1 Results achieved of learned skills applied in the Business

This section deals with the results that the entrepreneurs achieved in their businesses with the application of the skills learned as part of the training modules. Thus include business related results, changes in work attitude, increase in turnover and increased in customer growth. From Graph 6 below it is evident that the training mostly led to an increase in customers, improved financial systems and well as better buying procedures. Although the means are still high the least effect was on formalising marketing structures, expansion of the business and increase in turnover.

3.6.2 Increase in Turnover

Graph 7 below shows that most of the Entrepreneur’s business profit increased by up to 25%. Some experienced between 25 – 75% while a few reported an increase of 75% or more. There were participants that did not want to, or was unable, to share this information with the researcher.

3.6.3 Increase in Client Base

Graph 8 below shows that 40% of the Entrepreneur clients’ database was up by 25%. Others reported an increase of more than 25%, to more than 100%. There were participants that did not want to, or was unable, to share this information with the researcher.
Graph 8: Increase in Client Base

3.6.4 Changes in Work Attitude
The results of the respondents’ perceptions of their change of work attitude as a result of the training programme are presented in Graph 9 below. Graph 9 shows that the CED modules have resulted in the participants positively attitude in their working environment, as well as being perceived as a better colleague/ supervisor by their fellow workers. Most of the participants also agree that the CED courses resulted in their businesses having more clients, and that they are able to manage their businesses better than before. The entrepreneurs were more positively inclined to regarding that CED courses contributed to skills that enabled them to yield larger profits in their businesses than before.

Graph 9 Changes in Work Attitudes

4. RESULT DISCUSSION
The main objective of this research was to determine the effectiveness of an adult entrepreneurship training programme. Respondents indicated that the content/topics were covered adequately during the formal session. Personal Development is an essential part of the make-up of an entrepreneur and was presented as part of the topic “General Business Management”. However, the entrepreneurs did not explicitly experience it as such which indicates that more emphasis should be placed on the topic. Production management was covered as part of round two of the training and at the time of the research was only presented to a selected group of entrepreneurs surveyed. The indications by all entrepreneurs were that the topics were covered on a satisfactory level and that they applied the newly found skills as part of their daily programs.

The program significantly contributed to the attitude change of entrepreneurs either in their own work space or as an employee in the service of an entrepreneur. Understanding the world and challenges of Entrepreneurs and including it into the training programme, contributed to the success rate of behavioural change.

The program contributed to the increase in profits of almost all entrepreneurs. The greatest increase ranged between 25 – 75 percent. This demonstrates beyond any doubt, that the knowledge-by-experiences contributes to the success of an entrepreneur. It was also found that the average increase in clients was 25% for a significant portion of the entrepreneurs while some reported an increase of up to 100%. This shows that appropriate emphasis was placed on the basic business fundamentals and marketing. No evidence exists of how many customers were retained and this could be a topic for further research. The training program resulted in improved financial systems, more formal marketing structures and procedures, better understanding of buying procedures, increase in turnover, as well as expansion of business.

A great variety of training methods can be used [10] Eight methods were used by CED. Mentorship has played the most prominent role as the methods that contributed the most. Role play case studies, video’s and DVD’s, follow close behind. However Namibian case studies were not used efficiently. (Researcher opinion) and more should be included. Small group discussion and team activities were effective effectiveness of the group dynamics are not maximized due to non-equal participation of group members. No group work assignment was given during mentorship period, but individual assignments were due. Lecturing contributed the least of the methods used, although still significant. Methods that should be added are twinning, on the job training, simulation and more time for self reflection.

This research made contributions on a theoretical, methodological and practical level. From a theoretical point of view this research contributed to new knowledge regarding the effectiveness and importance of entrepreneurial training programmes in a developing context. This research made a methodological contribution in the sense that a questionnaire was developed that could measure the effectiveness of a training programme. This questionnaire can be expanded and customised for use in other training contexts as well. From a practical point of view the results of the research showed that the training programme can make an important contribution towards improved business performance, both financially and increase in client base. This programme also contributes to important work attitudes that are important for successful entrepreneurial businesses.

This research had some limitations. First the sample size was relatively small and limited the type of statistical analyses that could be used to differentiate more between the different demographic groups. Secondly, the research only focused on an entrepreneurship training programme which means that the results of this research cannot be generalised to other types of training programmes. This research made use of self-report measures. Other types of data gathering methods can be used in future such as interviews, focus groups discussions and observation. Finally this research was cross-sectional in nature.
which has implication for cause and effect inferences. Longitudinal studies can be used to address the above.

From a research point of view it is recommended that this study be expanded to measure the effectiveness of other training programmes. In addition it is also recommended to include other key role players such as the government in the sample to gain a broader perspective on entrepreneurship training in Namibia. In addition it is also recommended to use mixed method studies to gain more insight into the quantitative data obtained in a study such as the present one. Finally it is also recommended to measure the impact on a training programme such as the present one to other work-related outcome variables such as job satisfaction, commitment, retention etc.

5. CONCLUSION
The overall objectives of the beginners level of the training program was reached but more attention should be given to the training methods, continuous building on values, ethics and attitude. More Namibian case studies should be discussed and an added practical angle should be considered. Mentoring and evaluation measurement and future performance measure should be encouraged.

6. REFERENCES
INVESTIGATION OF THE IMPACT OF NETWORKING AMONG TENANTS IN THE SEDA LIMPOPO JEWELLERY INCUBATOR IN SOUTH AFRICA

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ABSTRACT: This study investigates the extent to which tenants in a jewellery incubator in the Limpopo Province of South Africa network. Since 1994 SEDA has set up more than 31 incubation centres in furniture making, construction, chemicals, jewellery, ICT, metal fabrication, agriculture and small scale mining. This study was done through a survey conducted on tenants in the SEDA Limpopo Jewellery Incubator (SLJI). Information was obtained through a structured questionnaire. The study revealed how tenants benefit from networking around exhibitions and collective purchasing of raw material. Through the Incubator institutional mechanisms, the study explains how tenants share expertise, experiences, technology and resources. Unfortunately the tenants do not initiate the own networking programmes. They lose out on benefits associated with collective effort in other areas such as advertisements, lobbying the government for industrial stands, organising an newsletter, hiring of consultants, and organising joint training programmes. Lastly the study identified opportunities that the tenants could collectively exploit in order strengthen and sustain their businesses.

Key words: networking, incubator tenants, survey, structured questionnaire, benefits.

1. INTRODUCTION

In South Africa (SA) an enterprise category is defined by the number of full time employees, the total annual turnover and the total gross asset value [1]. Table 1 depicts the size standards for the quantitative definition of SMMEs in South Africa.

<table>
<thead>
<tr>
<th>Size or Class</th>
<th>Total Full -time equivalent of paid employees</th>
<th>Total Annual turnover (Million Rand)</th>
<th>Total gross asset value (Million Rand)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>200</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>Small</td>
<td>50</td>
<td>25</td>
<td>4.5</td>
</tr>
<tr>
<td>Very Small</td>
<td>20</td>
<td>10</td>
<td>1.6</td>
</tr>
<tr>
<td>Micro</td>
<td>5</td>
<td>5</td>
<td>0.1</td>
</tr>
</tbody>
</table>

The south African Government realised the importance of the SMME sector and its contribution to the country’s economy in the late 1970s [2]. Data on small and medium enterprises in South Africa suggest that SMMEs contribute about half of total employment and more than 30% of the total gross domestic product [3]. Brijlal suggests that one out of five units exported from South Africa is produced in the small and medium sector [3]. The sector has the potential to address socio-economic challenges such as unemployment, economic growth and poverty alleviation [4]. The South African government has set as a priority the development of Small, Medium and Micro-Enterprise sector [4]. Since 1994, a number of mechanisms have been implemented to support and develop SMMEs in the country [2] and according to Mbedzi [5] the South African government has at national level introduced the following institutions:

- Khula Enterprise Finance Limited – formed in 1996 to initiate programs that foster business start-ups and build the capacity of existing ones. It works through partnerships with commercial banks, retail finance institutions and specialist funds.
- South African Micro-Finance Apex Fund (SAMAF) – was established in April 2006. It is a wholesale funding institution that works through financial intermediaries in providing financial and non-financial services to micro and survivalist businesses.
- National Youth Development Agency (NYDA) – was launched in June 2009 through the merger of the Umsobomvu Youth Fund and the National Youth Commission. It enhances the participation of youth in the economy through targeted and integrated programmes.
- National Empowerment Fund
- Land Bank – provides short term and medium term loans to both commercial and small development oriented farmers.
- Mafisa

According to Nieman [6] the government has also introduced the following pieces of legislation that favour the development of SMMEs:

- the National Small Business act of 1996 that opened the way for Department of Trade and Industry to address SMME development in South Africa;
- the Skills Development Act (SDA) of 1998 that provided a framework for training to take place at the workplace;
- the Skills Development Levy Act (SDLA) of 1999 that provided funding for training at workplace; and
- the National Qualifications Framework Act (NQF) of 2008 that provided a national framework for education and training in South Africa.
An integrated Small Business Strategy was introduced in 2005 to promote entrepreneurship, create an enabling environment and enhance the competitiveness and capabilities of existing enterprises [2]. The strategy also allowed the SMMEs to make meaningful contribution to the national economy.

In addition to the interventions at national level there are numerous programmes that were introduced through provincial governments, Non-Governmental Organisations and the private sector. The support mechanisms addressed barriers to the SMME survival and growth in four functional areas of business operation, i.e. management, marketing, operations and finance [7].

Between 1994 and 2012 the government set up 31 incubators in furniture making, construction, biotechnology, mining, equipment and tooling, agriculture, motor industry, metal fabrication, ICT, and jewellery. The thrust of the incubator programme was to develop new organisational model that is suited to creating value and wealth in the SMME sector.

One of the fourteen factors suggested by Lee and Osteryoung as important for effective operation of the incubator system is networking of tenants [8]. Hansen et al [9] argue that the new economy is a network economy. Incubators exploit networking by providing fledgling companies with preferential access to potential partners and advisers. The objective of this study was to investigate the extent to which tenants in the SEDA Limpopo Jewellery Incubator (SLJI) compliment government effort in overcoming internal and external challenges through networking. The incubator was officially opened in July 2009 in Polokwane by SEDA [10]. Tenants design, manufacture and sell precious metal and stone jewellery [11]. The incubator is jointly funded by SEDA Technology Programmes (Stp) and the European Union (EU). The incubator creates an enabling environment for jewellers by providing access to gold, platinum, diamond and other raw materials. SMMEs are assisted in accessing markets through participation in local and international exhibitions. In addition SMMEs are assisted with equipment and production facilities including quality control. Figure 1 gives the major support components.

SLJI also offers the basic benefits of internet facilities, office space, company registration, writing business plans and common services, thereby allowing the jewellers’ businesses to grow very quickly [11]. The tenants produce and sell their products under the SA FairMadeTM brand, a jewellery brand established by Vukani-Ubuntu.

2. METHODOLOGY

This study was accomplished through a survey. According to Kelly et al [12], surveys are suited to descriptive studies, but can also be used to explore aspects of a situation, or to seek explanation and provide data for testing hypotheses. This study is a descriptive research that gathers information on different forms of networks at a single point in time. The rationale of the study was to identify benefits enjoyed across tenants through networking around advertisements, exhibitions, lobbying the central and local governments for industrial stands, dissemination of information to members, purchasing or raw material, hiring of consultants, and organising joint training programmes. Moreover the study collected information on how tenants shared experiences, technology and resources.

The questionnaire used in the survey was piloted using five tenants. Difficulties identified during the pilot resulted in the realignment of the questionnaire for the main survey.

2.1. Study Population

At the time of the study, the SEDA Limpopo Jewellery Incubator hosted 13 tenants. It was practical and economical to collect data from all the tenants in the population. The researchers delivered the questionnaire to the work places of the respondents, explained the study, and then picked the questionnaires up at a later date.

2.2. Data Collection

The researchers collected primary data on networking in the SLJI using a self administered questionnaire. Floyd and Fowler [13] argue that sensitive information is more frequently and almost certainly more accurately reported in self-administered modes than when interviewers ask the questions. This enabled the researchers to access the respondents’ true feelings, attitude and understanding of the subject.

To reduce non-response, tenants that failed to return the questionnaire in time were contacted by the researchers in person.

3. FINDINGS

According to Mbewana networking partners share experiences of both successes and failures such that incubators can learn [14]. Mbewana also suggest that networking is important in opening up and widening market opportunities for incubatees and graduates [14]. This study had the following findings:

1. In SLJI, the management sponsors local and international exhibitions. When participating in the exhibitions, the tenants naturally learn from each other’s success and failures.
2. The tenants’ work places are located within the same building. This setup allows the tenants to share tools and equipment, knowledge and expertise on improving product quality. They do not charge each other on the service rendered. This relationship is informal and is based on mutual understanding.
3. By working in the same locality, the tenants enjoy the benefits of informal discussions without a need to make appointments.
4. Helping incubates access the markets is one of South African incubators’ biggest challenges [15]. SLJI is not an exception. To overcome this challenge, SLJI assists tenants participate in local and international exhibitions. Moreover their products sell under one brand name, FairMadeTM. This arrangement compels the tenants to
help each other produce quality products. Poor supply from one member damages the reputation of the whole incubator.

5. The incubator does bulk purchasing of gold, diamond, platinum and other raw materials used in making jewellery. This arrangement enables the tenants to benefit from cost reductions and discounts associated with bulk purchasing.

6. There is over reliance on government in solving the tenants’ operational problems. They do not initiate programmes on their own.

4. CONCLUSIONS

The enterprises in the Seda Limpopo Jewellery Incubator’s portfolio are related to one another by size, needs, industry and by technology. The portfolio does not have any stars, i.e. top companies in the market. They are all start-ups that are still going through the incubation programme. The tenants have survived largely through the incubator’s support in business management, financial management, marketing management, jewellery technical skills training. The incubator avails furnaces, soldering equipment, casting facilities, cutting and polishing equipment to help with production. Communication is enabled through the provision of telephone and internet facilities. Moreover the incubator has organised mechanisms to facilitate cooperation among the tenants. On their own, the tenants have done very little to improve their competitive advantage.

5. RECOMMENDATIONS

To compliment the efforts of Seda Limpopo Jewellery Incubator, the study recommends that the tenants do the following:

1. To improve on the visibility of their products, the tenants should collectively organise a newsletter, a website and showrooms or trade outlets in strategic cities in the country.

2. The incubation period is currently three years. The tenants could collectively lobby the local, provincial and central government for business premises after the incubation period. An industrial park would be a better arrangement. There is great potential of building their reputation if they work in the same locality.

3. There is over reliance on government, NGOs and the private sector assistance. If the tenants are turn their business into meaningful enterprises they should eventually stop looking beyond themselves for survival and growth.

4. They should recognise that networking enables the tenants to jointly call a meeting and receive full attention from busy people.

5. As noticed by Mathibe and Van Zyl [2], most of the business support programmes rendered to the SLJI tenants is supply-driven. Strong collaboration within the tenant network would better inform the service providers on pressing needs.

6. As pointed out by Ceglie and Dini [16], through networking the SMMEs can influence policy making at national level. This is one opportunity that the tenants at Seda Limpopo Jewellery Incubator are missing.

7. There is also an opportunity for the tenants to collectively establish vertical networks with large scale manufacturers.

6. LIMITATIONS OF THE STUDY AND AREAS FOR FUTURE RESEARCH

The study focused on one of the thirty one incubators supported by SEDA. It looked broadly at the support that they get from government, NGOs, and other stake holders. It also looked at the institutional mechanisms that Seda Limpopo Jewellery Incubator put in place in order to foster networking among the tenants.

Moreover, the government is spending on average between R4 million and R6 million to set up a Seda incubator and R3.5 million a year to run one [17]. The expenditure will be even more if the government attains its target of 250 incubators by the year 2015 [15]. Despite this support the challenge still remains. Tenants do not want to fully embrace the concept of networking. There is need to conduct a full study on factors stopping the tenants from embracing the concept. There is potential to reduce over reliance on government support if the tenants take ownership of their internal problems and challenges.

7. REFERENCES


ON THE ART OF MAKING BUSINESS PLAN - A SUCCESSFUL CASE

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ABSTRACT: “Challenge Cup” business plan competition of Chinese college students is held jointly by Central Committee of Chinese Communist Youth League, China Association for Science and Technology, Ministry of Education and All-China Students Federation. It is held every two years and is universally acknowledged as the “Scientific and Technological Olympics” of Chinese college students. It is important to make a business plan after the student chooses a subject of business plan, builds a business creation team, and does a wide & deep marketing investigation. However, tens of year’s practices of business plan competition have seen that business plan’s theory is not closely related to the practice, its practicality is not strong and the attractiveness & persuasiveness need to improve. Thus, it’s necessary to do a summarization through analyzing cases.

Key words: business plan, marketing investigation, language ability

1. INTRODUCTION

When it comes to improve student’s innovative capacity, cultural innovation is the basis, the first and second classes are the platform, method innovation is the key and system innovation is the guarantee. Among all experiment teachings, there should be experiment teachings that focus on one individual factor, certain curriculum, major, cross-major, cross-principle and simulated market experiment teaching and innovation and entrepreneurship practice.

“Challenge Cup” business plan competition of Chinese college students is held jointly by Central Committee of Chinese Communist Youth League, China Association for Science and Technology, Ministry of Education and All-China Students Federation. It is held every two years and is universally acknowledged as the “Scientific and Technological Olympics” of Chinese college students. The purpose of “Challenge cup” is to stimulate students’ learning enthusiasm, strengthen students’ information consciousness, to cultivate students’ scientific research and practice ability, train students entrepreneurship spirit. Shijiazhuang University of Economics participate in all previous contest.

Business planning competition is the most important content of the second class and experiment teaching in Shijiazhuang University of Economics. The author uses a work he once instructed for a business plan contest for college students, that is “Business Plan for Highly Effective Nitrogen Fertilizer” (Tuopu Technology Co. Ltd.) as a case, discussing the art of writing a business plan. The case participated in “Challenge Cup”, a business planning competition for Chinese college students, and won a second prize.

A successful business planning competition should include three elements: competition teams with complementary advantages, products or services that have a market prospect and a complete, detailed and in-depth business plan.

In order to win in the business plan competition, the following requirements should be met: being able to arouse the judges’ interest and make them think from another perspective; the plan should be appealing(A business plan’s projects, title, expected profit, market situation, investment structure, organization structure and form should all be attractive to judges and be convincing); a broad and deep analysis of the market(The business plan should include an in-depth analysis of markets home and abroad, its competitors and the supply of resources, and highlight the project’s possibility of production and its competitive advantages); an innovative organization structure to suit the project; the company has a clear business aim, grand and feasible strategic aim(Capital needed by the project shall have a huge investment potential and a profitable return.); a scientific and feasible financial analysis; the balance sheet, profit and loss statement and cash flow statement are feasible and clear; the business plan is highly practical.

When students have decided their project name, built their team and finished their broad and deep market research, analysis and demonstration, turning their ideas into paperwork becomes the key issue. However, during our over 10 years’ instruction in the business plan competition, we find that theories for business plan have a weak connection with practice and are hard to put into practice, that works are not attractive and convincing enough, especially that the art of writing a “business plan” is yet to be improved. Therefore, it is necessary to summarize and outline in the form of case analysis.

2. LANGUAGE CAPABILITY

Language is the jacket and tool for abstract thoughts. Abstract thoughts cannot exist without language. Reaching a complete scientific conclusion and writing a business largely depend on the writer’s language capacity. There are many authors whose language capacity is so poor that the business plan they drafted are full of mistakes, such as confused ideas, loose structure, fuzzy logic, obscure concept and words lack of fluency. Therefore, language capacity is the basis for writing a business plan and one of the most important skills for intellectual innovation.

The language used in writing a business plan should be both scientific and simple that grandma can understand, rather than using policy language, news language or oral language, let alone network language.
Generally speaking, a business plan is composed of executive summary, industry background, company overview, market research and analysis, company strategy, overall schedule, major risks, assumptions, team, capital of the company, financial assumption, and profitability.

2.1. Executive summary

Execution summary, also called execution review, is the outline for the whole business plan. It mainly includes a brief introduction to this business, its chances, an account of its market goals, predictions, competitive advantages, capital profile, a prediction of its profitability, a brief introduction to the team and profits it offers.

The major function of an execution summary is to win favor from investors and attentions from readers. Only when the writing is successful can the content be convincing and can judges and investors continue to read for more information.

2.2. Industry background and company overview

Industry background and Company Overview mainly include an introduction of industry background, company overview, and a detailed description of its product or service, how does it meet the demand of customers, and its strategies for market entry strategy and market expansion.

Company overview should be written in simple and concise language, for instance, Tuopu Technology Co. Ltd., founded on December 29th 1959, is manufacturer of highly-effective nitrogen fertilizer. It is lawful established as a limited liability company, and its capital equity structure is XX.

A good business philosophy is of vital importance to a company’s success. There must be your own business philosophy so that investors may believe that your company has considered deeply about its development and management. The business philosophy must adopt the company’s slogan, which should be repeatedly used in order to consolidate its impression on investors and readers, for instance, “Innovate fertilizer technology; Benefit manufacturers and farmers” is the business philosophy of Tuopu Technology Co. Ltd.

As for company business, there should be a clear statement of what products or services XX company provides, what phase is its management in, when is the first product invented, when do they hired the first employee, and when do they sign the first order.

What is XX Company’s sales income during a certain period of time and the balance of profit and loss? How much capital is raised? What is our expected sales income? How much pre-tax income to be reached by which year? How to distribute the capital raised?

Descriptions of the products and services should be clear so that others can understand what are your products and services exactly. It should clearly say that XX company produces the following products (or provide the following services). Currently, our products and services are in what stage. We plan to expand our production line to improve what product or services. What key features are there in the process of production and service? Why are our products or service unique? We have an advantageous market position is due to a particular patent, sales pace and brand name.

2.3. Market research and analysis

Market research and analysis deal with customers, market capacity and trend, competition and its competitive advantages, estimated market share and sales volume, the trend of market development.

As for consumer, market capacity and relative trend, there should be a clear and detailed description of the consumer, market and driving force of the market, for instance, what is our market? By what time and according to prediction report by what agency, its market value can reach how much million? Who is our client? Where are they? How could we reach them? How to attract and persuade consumers to buy from your company? Why would consumers care about your products?

As for competition and your own competitive advantages, you should get to know your major competitors and make it clear who is your major competitor in terms of products, management, price, plant location, promotion strategy, and financial plan. It should be clearly written that AA company is a direct rival for XX Company, or that XX Company has no direct rival, but there are other alternatives or relative products in the market. What is the unique feature of our products? What are our competitive advantages?

2.4. Corporate strategy

Corporate strategy illustrate how company compete with competitors, it include marketing plan (pricing and distribution, advertising and promotion); planning and development plan (develop aim, difficulties and risks); manufacture and operating plan (operation period, equipment and improvement).

2.5. Schedules

Corporate schedule include making plans in the most important areas such as: revenue, equilibrium and positive cash flow, market share, product development and introduction, main partners, and financing.

2.6. Key risks, difficulties and hypothesis

This part explains how to deal with risks and difficulties (contingency plan). Define what is the most risky, such as market risk, pricing risk, product risk, management risk. Describe when should provide financing existing plan and the exiting mechanism.

2.7. Management team

Make introduction of the management team, especially the team members’ education and working background related to the company. Make introduction of the management level, entrepreneurship consultant, main investors and holding shares.

2.8. Company’s financial condition

Make introduction of the company’s financial plan, and discuss the critical driving factors of the financial performance. The following leverage ratio should be included: gross profit, net profits, profitability and persistency, fixed, variable and semi-variable cost; the months that needed to achieve equilibrium.

2.9. Financial forecast

Financial forecast is the basis to evaluate investment opportunity; it should reflect the best estimated financial needs. Financial forecast include income statement, balance sheet, cash flow statement in the same period and cost control system.

2.10. Assumed benefit that company can provide

This is the “selling point” of business plan, it include the total financial needs; how to use the fund; what investors can gain; the possible existing strategy.
As to financial needs, it should tell the purpose of increasing investment and the expected rate of return, why this business opportunity could inspire people. For example, it should tell the amount and the nature of the investment of Tuopu Technology Co. Limited, what the money for, how the amount would be used. How many years investors can get dividend by using residual profits or refinancing.

3. EXPRESSION FORM

The characteristic of expression form of business plan is the combination of text description and chart, referred to as article elements. Text description takes the forms of exposition, description, narration and argumentation.

The combination of the many kinds of chart, table, and photo in the business plan called diagrammatic element. Diagrammatic element is one of the most important parts of business plan that used to illustrate the most efficient method to express the result of investigation, research and experiment.

4. WRITING SKILLS

4.1. Rich in logicality

Write a business plan must be rich in logicality, that means writing business plan by using different form of thinking (concept, judgment, reasoning, argument) and law of thinking (analysis and syntheses, conclude and deduce, abstract to concrete), that could be logical and easy understand.

4.2. Illustrate the work truthfully

The core is “how to illustrate truthfully”. It could be achieved by studying the excellent business plan and learn from past experiences.

4.3. Normalized writing

Business plan must be normalized in writing so that it would better for collection, store, process, search, and communication.

4.3.1. Text format specification

Different business plan has different text format, however the main content are similar, take Tuopu Technology Co. Limited as example:

The text structure composition is according to the following order: title; author/name of author’s working place; content; executive summary; text; reference/ contact.

Author name is generally written in business plan under the headline. According to China’s new rules, the surname and given must be consistent in English and in Chinese.

Content include titles and page numbers of each part in business plan.

Executive summary is the miniaturized version of the business plan, it must be short, concise, complete and should be within one to two pages.

Text also called demonstration chapter, it is the main part of business plan, it generally include the following nine parts: industrial background, company profile, market research and analysis, corporate strategy, schedule, key risks and assumed team and company financial condition, financial forecast, benefits that company can provide.

Attentions are needed when writing the main part: 1. clear position of the research object and situation. 2. Go in-depth and more detailed based on the hypothesis. 3. Less theoretical knowledge.

Pay attention to the copy right when writing references, layout according to international and domestic standard.

4.3.2. Structure specification

A business plan generally has no more than 5 levels and should have a certain provision system and unified format. The structure of the levels is as follow: Chapter one, chapter title; Section one, section title (selective); Title; Subtitle; Serial Title; Article; Paragraph (selective); Sub paragraph (selective).

The title is divided into the headlines and sub-headlines, it should be concise and clear, generally no more than 15 words. There are no punctuations at the end of title.

Title should be accurately generalized the text content.

Title should be a noun or noun phrase, try to avoid using non-noun structure words

Avoid using function words.

The structure and style of all subtitles should be as consistent as possible.

Try to not use punctuation when title is not easy to generate ambiguity.

Title should avoid using brackets with synonyms, foreign abbreviations. If necessary, take the lines in the bracket to the text.

English and digital fonts in the title should be consistent with the Chinese fonts.

No punctuation at the end of the title.

4.3.3. Layout specification

Editing and printing should be in accordance with the formal publication requirement, such as the font and font size settings, paragraph spacing setting, page setup, etc.

4.3.4. Expression specification

4.3.4.1. Terminology

The using terminology in a business plan must be validated by National Terminology Committee and accepted by public with no standard or requirement. Author self-created terminology should be stated when first appears in the business plan.

4.3.4.2 Numbers

The use of numbers must be in accordance with the national standard GB/T15835-1995-- General Rulers for Writing Numerals in publications

Except for those idiomatic expressions, all numbers should be Arabic numerals. Pay special attention to the following usages:

1) Arabic numeral should be applied to anywhere needed and appropriate, such as 1980s, 1 billion dollars, and less than 5 years, etc.

2) All counting and calculation (including positive and negative integers, fraction, decimal fraction, percentage and divisor, etc ) should use Arabic numerals, such as $\frac{3}{4}$, $4.5\%$, 10 years, more than 500 kinds, etc.

3) All percentage or frequency should be written in the form of “%” and “X/X”, instead of “fifty percent”, “one quarter”. Besides, $x\% + x\%$ cannot be written as $x + x\%$.

4) The first two numbers of a year cannot be omitted, for
instance, year 99 should be written as year 1999.

5) Chinese characters should be applied to proper nouns and oral expression, for instance “the 11th five-year plan/ and “two provinces and one city.

6) When two numbers put together to indicate a round number, they should be Chinese numbers without punctuation.

7) Chinese numbers should be used to express seven days of a week.

8) A number with more than 5 figures and most of them are zeros can be rewritten with the unit of million or billion, for example, 235 million cannot be written as 235000 thousand. A long number cannot switch lines.

9) Numbers with 4 or more than 4 digits shall be divided by a small space after every three digits, for example, 84 175.

4.3.4.3 Quantities and units

Quantities and units involved in a business plan should all be the same with the national standard GB3100-3102-93-- Quantities and Units, such as km, kg and so on. Avoid using Mu to measure land area, instead it should be converted into hectare, the symbol of hectare is Hm², and the international symbol is ha.

4.3.4.4 Chart and diagram

All charts and diagrams shall follow related rules for the formulation of a statistical diagram, statistical chart, and the process of screenshot and illustrations.

4.3.4.5 Mathematic formula

Mathematic formula in a business plan should be placed in the middle and can directly number them with Arabic numerals in round brackets, and leave no space at the end of the line. There should be no dotted line in between. For example, (1) (2) means the first formula and the second formula respectively. When there is continuation line, it should be marked at the last middle. A long formula should start with a new line and be placed in the middle. When the formula need to start new lines, only when there is+, −, ×, ÷, <, > can we switch to a new line. Try to align the upper and lower formulas around the “=”.

A formula in the middle of a new line doesn’t need to be numbered. There should be a precise and clear explanation for each parameter in the formula (except symbols that have been used and explained above).

4.3.4.6 Foreign letters

When writing a business plan, foreign letters should be properly italicized and capitalized and keep in uniform with letters in pictures.

4.3.4.7 Punctuation marks

The use of punctuation marks should base on the new national standard GB/T 15834-1995--Use of Punctuation Marks.

Pay special attention to the distinction and correct use of“" , ‘’ ’” ”. Generally speaking, there should be a ““for a quotation, and “” instead of “《》 ”for the title of a task. Try your best to avoid long sentences with dozens of words or even more than a hundred words. Punctuation marks should be used to properly divide the sentence.

4.4. CONSTANT MODIFICATION

An important business plan is worth reading a dozen times and then be revised carefully before finalizing it. When it comes to revision method, it is suggested that read it again and again, examining it from a height, and then deliberate over it paragraph by paragraph, going deeper from the surface.

Firstly, after finish writing a business plan, read it again and again for many times to find major problems, to see whether the structure is reasonable, whether the arguing point is sharp enough, whether supporting materials are adequate, whether the argument is well-conceived, whether the content is in consistence with its title and whether the comments are appropriate, etc. This is to examine the whole of the business plan. Secondly, try to find mistakes paragraph by paragraph and then revise them. Sentence by sentence modification shall take into consideration both the content and the form of expression. How to write a sentence? How to choose the right word? How to draw a diagram? How to design a chart? All these need careful consideration.

Why the papers first emphasize looking down from the high? That is because only when reached the advanced level in the world can you correctly evaluate the business plan and find its shortcomings. Why should deliberate the business plan deep down from the surface? That is to deal with the more obvious problems first and then put all the efforts into digging deeper and find out those important but less noticeable problems. Thus the business plan can have a better content and quality.

5. CONCLUSION

Business planning competition is the most important content of the second class and experiment teaching in Shijiazhuang University of economics. A Complete, detailed and in-depth business plan are the three majors factors of a successful business planning competition. The art of making business plan includes language ability, way of expression and writing skill. The key to business plan’s persuasiveness lies in the reliability of data, the rigor of demonstration, the normalization of text and the feasibility of operation. It is the key to arouse the judges’ interest and attract venture capital.

Business plan should be demonstrated with the language that “grandma can understand the meaning”. Executive summary is the most important part in a business plan. When writing a business plan, great attention needs to be paid on narration and argumentation among those four ways of expression. The key to increase reliability and persuasiveness is to correctly use the form of thinking and law of thinking to write business plan.

6. REFERENCES

**CULTURAL ENTREPRENEURSHIP – A CHANCE FOR THE CREATIVE STUDENT**

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**ABSTRACT:** Culture is part and parcel of life and civilization. It not only enriches us aesthetically, it is also an essential economic and strategic factor. In Germany in 2008, the turnover of this so-called economy of culture and creativity was EUR132b and included 210,000 companies with over one million employees. At around 25%, the proportion of self-employed individuals is extremely high. It is a business world in its own right. A trailblazer in a knowledge-oriented society. But arts, culture and creativity alone are no longer enough. For this reason, defining the requirements and competencies of those who intend to get involved in this difficult sector is crucial. With good training and well-defined curricula they will have the chance to operate more effectively and successfully in the creative/cultural value chain. Cultural and creative entrepreneurship means linking entrepreneurial policy and thinking to cultural and creative objectives. Driving forces include: personal initiative, creativity, innovation, and professional competence, to name just a few. Although these competencies are taught, the didactic approach must also take into account the economic process and structures and an evaluation of success or failure. It is these qualifications that contribute to one being a good cultural/creative entrepreneur and a spearhead in regional development. Don’t complain about not earning (enough) money. Think of ways to earn it.

**Key words:** cultural entrepreneurship, creative entrepreneurship, knowledge-oriented society

1. **CULTURAL ENTREPRENEURSHIP**

Nowadays, art, culture and creativity are defined in a sense that they contribute to the generation and production of knowledge. They are products that are created, need a market, and thrive on clients. In addition, culture and creativity have an aesthetic, social, political, economic and idealistic value. Yet culture, art and creativity waste away if they do not have a market, if they are not received. Yet to make that reception possible it needs cultural entrepreneurship or an effective cultural and creative business.

In 2008, this so-called economy of culture and creativity turned over EUR132b in Germany. It included 210,000 companies and over one million employees. At around 25%, the proportion of self-employed individuals is extremely high. The economy of culture and creativity is a business world in its own right, and a trailblazer in a knowledge-oriented society.

Yet many who produce culture and are creative do not find their way into self-employment. When they do, it is generally not voluntarily and rather due to the existential necessity of keeping one’s head above water. For many cultural creatives the formal prerequisites and conditions for taking the step into self-employment are a black spot. Terms such as profit and loss accounts, market analysis, networking, market positioning and profit maximisation often send them running for cover. They fear the infringement on their independent labour and in doing so forget that it is actually they themselves who are contributing to this situation. Generating knowledge, producing it. If they do finally, or eventually take the leap into independence it is to realise their own perspective of art and culture and the associated visions. Yet, and this is often forgotten in this context and discussion, profit-oriented creativity should and can generate innovation and lead to freedom. Nevertheless, the preconditions and comprehension of the entrepreneurial process are often lacking.

Entrepreneurial thought and behaviour is driven by:

- A focus on the problem
- Innovation
- Creativity
- Quality
- Personal initiative
- Effective communications
- Efficiency
- Social, professional and methodological competence

These thoughts and behaviour are in turn expressed in areas of action:

![Figure 1. Entrepreneurial areas of action](image-url)
If we take a look at those studying, it is fair to say with a few exceptions that they are minimally informed about the scope of their possible functioning and barely have the skills required to gain a foothold in the market. Moreover, it is suggested to them that the State should/must pay for art and the creative if things are not faring well with his or her job. This is too simple a solution. A better way to solve this would be to install a different focus in the study programmes that is based on the framework of cultural entrepreneurism:

2. **INDIVIDUAL PROCESS AND STRUCTURES RESULT**

![Framework of cultural entrepreneurship](image)

- Quality of the relationship portfolio
- Success of the cultural company
- Entrepreneurial organisational culture
- Entrepreneurial motivation
- Business Know-how
- Cultural knowledge (professional and sector)
- Social competency

3. **THIS FRAMEWORK NEEDS TO BE FILLED INTRINSICALLY.**

The social competencies include:

**Empathy:**
- Enjoying interaction with people / networking
- Coordination skills
- Team and personal focus
- Intercultural action and behaviour
- Ecology and ethics

Cultural knowhow includes:
- General artistic and cultural knowledge
- Structural knowledge (politics, media, etc.)
- Specific experience (sectors, branches, etc.)

Corporate business know-how includes operative managerial, organisational and functional experience:
- Management competency
- Sales experience
- Company management experience
- Marketing and communications knowhow

The core of the area of action ‘Person’ is the entrepreneurial individual demonstrated intrinsically through

- The will to perform
- Decision-making capacities
- Identifying and capitalising on opportunities
- Conceptional thinking and behaviour in alternatives
- Innovation and creativity
- Improving one’s own situation
- The desire for self-fulfilment
- The desire for autonomy
- A focus on challenges and willingness to take risks.

In a further step it is about the scope of the influences and their actual elements in the model field Process and Structures. At the centre are the entrepreneurial performance contributions as they are decisive for the success of the cultural company. This is where the actual decision-making occurs for anticipating market developments, address risks and transforming ideas into action: [1]
- Looking after personal relationships
- Generating a personal network
- Operational management assignments
- Artistic/strategic contribution
- Entrepreneurial operational contribution (entrepreneurship posture) [2]

Another important contribution stems from the quality of the relationship portfolio. It is not about simply knowing someone but rather about knowing the decision-makers and opinion leaders:

- Representatives from cultural representation
- Media representatives
- Business representatives
- Cultural representatives
- Politicians

In 1995 Quinn distinguished between four cultural types. For SMEs this distinction seems useful as it is based on theory and used in empirical studies:

- Adhocracy culture
- Market culture
- Clan culture
- Hierarchical culture

These types of culture are characterised based on four criteria:

- Dominant characteristics
- Roles of leaders
- People who keep the organisation together
- Strategic priorities. [3]

Tabulated this gives [4]: Cultural Types

<table>
<thead>
<tr>
<th>Features</th>
<th>Dominant characteristics</th>
<th>Dynamics</th>
<th>Performance focus</th>
<th>Feeling of belonging</th>
<th>Standardisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Entrepreneur Willingness to take risks</td>
<td>Competition</td>
<td>Familiar atmosphere</td>
<td>Formalisation</td>
</tr>
<tr>
<td>Roles of leaders</td>
<td>Entrepreneur Risk-happy doer</td>
<td>Decision-maker</td>
<td>Mentor Father or mother figure</td>
<td>Coordinator Representative</td>
<td></td>
</tr>
<tr>
<td>People who keep the organisation together</td>
<td>Appreciation of innovation and further development</td>
<td>Stress on tasks and achieving goals</td>
<td>Loyalty Tradition</td>
<td>Rules Behaviour</td>
<td></td>
</tr>
<tr>
<td>Strategic priorities</td>
<td>Growth Acquisition Resources</td>
<td>Competitive advantages Market success</td>
<td>Development HR Staff commitment</td>
<td>Constancy Stability Processes</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Cultural types

For innovative cultural companies in the sense of entrepreneurship the adhocracy and market culture are important. With an eye to the entrepreneurial organisational culture, this means:

Figure 3. Entrepreneurial organizational culture
Whether the cultural product is actually received or accepted by the market has to be shown in the evaluation. This includes:

- Assessing the growth
- Estimating the development potential
- Assessing the success situation
- Assessing the establishment situation.

The cultural sector is tough. But with good training and well-defined curricula, students will have an opportunity to operate more effectively on the market of creativity and culture. In addition, they can also participate more actively and successfully in the creative/cultural value chain. Cultural and creative entrepreneurship means linking entrepreneurial policy and thinking with cultural and creative objectives. With those qualifications, the student has the chance to be a good culturepreneur and a spearhead in the development of regions.

[5] Education, that has the average Yore as its objective, is standardised and doesn’t promote the ability to innovate.

“Come, Learn, Create, Go” [6]

4. REFERENCES
THE CRITICAL FACTORS OF ENTREPRENEURIAL UNIVERSITY IN ENGINEERING EDUCATION: A CONCEPTUAL AND EMPIRICAL ANALYSIS

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ABSTRACT: The transformation of a traditional research university into an entrepreneurial university is increasing due to the reduction or limitation in the university funding from public sources and the emergence of a competitive market for education and research. Entrepreneurial universities play an important role as both knowledge-producer and as disseminating institutions. The aim of this paper is represented by contribution to a better understanding of the most critical factors that conditioned the development of entrepreneurial universities, as hubs of creativity, with the teaching, research and entrepreneurial missions. This paper provides evidence based on survey data for a sample of Romanian investigators in engineering sciences. A multivariate regression analyses were used to test our hypotheses by research field. We obtain statistical evidence indicating that our hypotheses have supported. The results of this research show that the most critical factors identified were attitudes towards entrepreneurship from academics and students. In addition, our findings suggest that some universities seek to improve the university-industry cooperation as a means to obtain additional income and learning from industry.

Key words: traditional university, entrepreneurial university, engineering education, university-industry collaboration

1. INTRODUCTION

The transition of state ownership to market economies in the former Eastern Bloc has oriented all universities towards teaching with marginal emphasis on research and weak interaction with industry. Today, many Romanian universities need to identify new ways to attract funds and to act proactively in the business environment. Unfortunately, the entrepreneurial orientation in academic institutions does not receive a special attention from their management and government.

The transformation of a traditional university into an entrepreneurial university will play a critical role in the community as a knowledge creator and will speed up research into applications with high commercial potential. The transformation of a traditional research university into an entrepreneurial university is increasing due to the reductions or limitations in the university funding from public sources and the emergence of a competitive market for education and research.

The aim of this paper is represented by the contribution to a better understanding of the most critical factors that conditioned the development of entrepreneurial universities, as hubs of creativity, with teaching, research and entrepreneurial missions. Entrepreneurial universities play an important role as both knowledge-producer and as disseminating institutions [1].

Few studies treat the entrepreneurial university concept by examining the critical factors that determine the development of entrepreneurial universities. Therefore, this paper aims to fill this gap and examines the existence of these factors.

In Romania, a large number of students are enrolled in the social, humanities or economics fields where there are fewer jobs opportunities, whereas there are fewer graduates in the engineering sector for which there will be a greater need in the future. In addition, the traditional visions and practices are still held and have a relatively reduced capacity to create and maintain relationships with the companies.

The next parts of the paper are organized as follows. In the following section, we describe the theoretical background and hypotheses. Section three presents the research. Specifically, we test several hypotheses related to the critical factors that conditioned the development of entrepreneurial universities. Section four contains preliminary empirical findings. The final section presents preliminary conclusions.

2. THEORETICAL BACKGROUND AND HYPOTHESES

The teaching university is based on education and seeks to increase the rate of enrolment. The research university alongside with teaching activities is engaged in knowledge creation by basic research projects. The entrepreneurial university has three directions to action: teaching, research and business services. Practically, only the entrepreneurial university have the absorptive capacity and innovation potential to support the sustainable economic development.

Universities are now “drivers of change” that stimulate sustainable development and innovation. Drivers of a university’s intent to become more than a “latent asset” are affected by the response to external and internal pressures to improve their economic and reputation. Some universities are engaging in building clusters by “connected university” and bringing together thinking, finance and knowledge transfer [1].

The entrepreneurial university focuses on research and academic entrepreneurship [10]. They have policies to encourage the collaboration with industry. Some researchers engage into seeking to gain reputation among the academic staff and industry sector.
An entrepreneurial university tries to be more creative and efficient in establishing links between education and research [6]. Entrepreneurial universities are involved in partnerships, networks and other relationships to generate and exploit knowledge and technology [5].

Engineering education is a multi-disciplinary science that includes mathematics, natural sciences, engineering and technological, innovation, economic and organizational knowledge [7]. In entrepreneurial universities teaching is characterized by courses which are adapted to the needs of the industry and encourage students to initiate start-ups and offer them the consultancy and support to do it. Research has to enhance the technology transfer from university to industry through research projects.

Romanian companies are very weak in absorptive capacity and innovation ability. Based on this premise, Romanian universities need to play an increasingly important role to improve the innovation potential of companies. Thus, the entrepreneurial university is the solution. Only an entrepreneurial university can conduct both basic research and direct technological innovation [14].

The creation of new businesses is very important to influence the economic growth. Entrepreneurship is the foundation for job creation, new value innovation and market competitiveness [8].

We hypothesize a theoretical framework for identify the key factors to identify the most critical factors that conditioned the development of entrepreneurial universities, as hubs of creativity, with the teaching, research and entrepreneurial missions.

Both creativity and innovation are major contributions to transform traditional universities. Teresa and Nijkamp (2009) consider that creativity can occur within a network of universities and companies linked by common goals such as share values, beliefs and knowledge [11].

Innovation orientation refers to a university’s openness to new ideas and ready to change through knowledge creation, adopting new technology, skills, management practices or resources [13]. It measures the degree of willingness of members in a university to adapt to new situations. Hence, we propose that a university’s ability to adapt to changing depends on the university’s innovation orientation. Therefore, we hypothesize the following.

**H1. Innovation orientation has a positive impact on transformation of traditional university into an entrepreneurial entity**

Gertler and Vinodrai (2005) characterize universities as “anchors of creativity” that attract highly skilled and talent researchers [4]. Skilled and flexible academic staffs are one of the key drivers of high education services. A skilled and flexible labour force can play important roles in knowledge transfer. The academic members contribute to stock of tacit knowledge. Human capital is a source of higher performance for universities and a critical factor for getting competitive advantage. This leads us to the following hypothesis.

**H2: The skilled and specialized talent academic members have a positive impact on transformation of traditional university into an entrepreneurial entity**

Knowledge has become the critical factor of production and economic growth. Universities produce knowledge and industry used it. Schulte (2004) believes that research and its results should be used as a source of innovation in the economy and society [12]. Technology diffusion is based on collaboration between university and industry. Therefore, we hypothesize:

**H3: Adoption and diffusion of new knowledge especially tacit knowledge has a positive impact on transformation of traditional university into an entrepreneurial entity**

Universities are entrepreneurial if they are innovative, risk taking and proactive. Today, the business environment is complex, dynamic and ever more competitive. Risk tacking involves a willingness to pursue opportunities that have a reasonable likelihood of producing losses. Academic staff is willingness to commitment large resource to exploit the opportunities. Risk taking involves a willingness to pursue opportunities that have a reasonable likelihood of producing losses. That is, the risks those are moderate and calculated. Hence, we hypothesize:

**H4: Risk taking will increase the likelihood of the transformation of traditional university into an entrepreneurial entity**

It is an empirical fact that the proximity between the university and companies indicates their collaboration potential. The university proximity is a critical factor for support the collaboration processes. This means that there exists an “optimal distance” between university and companies from its neighbourhood. Therefore, we hypothesize the following.

**H5: The proximity between university and companies increases the probability to transform the traditional university into an entrepreneurial entity**

Transformational leadership stimulates innovation and knowledge and influences the fundamental attitudes and creates a common mentality to obtain the university’s goals. Research reputation may have an indirect influence on levels of academic entrepreneurship because the academic staff can obtain access to external financing and recruit high-quality personnel [2].

The managers of entrepreneurial university need to be charismatic leaders they are emotionally stable and positively engaged to build networks and alliances. Transformational leaders need to have special ability such as vision, shared values and ideas [3]. They are hardworking, tolerant and fair minded. Thus:

**H6: Transformational leadership has a positive impact on transformation of traditional university into an entrepreneurial entity**

Figure 1 provides a full overview of our hypotheses as presented above.
In an entrepreneurial entity. Internal factors have a critical role to transform the university. The questionnaire provides the perception about external and internal factors regarding the various aspects of entrepreneurial universities.

The questionnaire contained questions in the form of a 7-point Likert-type scale (1=strongly agree, 7=strongly disagree) regarding the various aspects of entrepreneurial universities. The questionnaire provides the perception about external and internal factors have a critical role to transform the university in an entrepreneurial entity.

The study’s dependent variable is the entrepreneurial intensity of university. We measured the entrepreneurial intensity as a multidimensional construct (2 items). Respondents were asked: our courses are adapted to needs of business environment; our university enhance the technology transfer and support the research activity. The innovation orientation was measured by using a scale consists of three items: we enjoy working on new projects and want to generate the innovative ideas; we enjoy working to develop new products or services; we enjoy working to develop new processes, methods or procedures.

We operationalized human capital as the extent to which a university is attracting and hiring academic staff with valuable human capital to increase talent retention. We measured this dimension by using a scale consists of two items: our university attracts and hiring employees with valuable human capital: our employees try to constantly update their skills and abilities. The critical knowledge represents a strategic source for universities. We operationalized knowledge transfer by using a scale consists of two items: our university enhance the transfer of knowledge and expertise between academic staff and employees from companies; the critical knowledge is successfully integrated in university’s processes and operations.

For measuring the risk taking we adopt two items. This scale was operationalized by using the construct proposed by Lee et al. (2011): we prefer to live a challenging life rather than a comfortable one; we think that by solution of new research project or challenge represent the only way to succeed in life.

The university location was operationalized by using a scale consists of three items: our university is located in an area where there are many opportunities to collaborate with many companies; our university is located in an area with high density of population and close to the potential students; our university is located in an area which is located by a very good public transportation system.

Transformational leadership was measured by using a scale designed by Podsakoff, Mecchenzie and Bommer (1996). We selected four items to construct a scale (4 items): the university’s management is always on the lookout for new opportunities; the university’s management has a clear common view of its final aims; the university’s management always acts as the organization’s leading force; and the university’s management succeeds in motivating the academic staff [9].

We used some control variables reflecting the characteristics of academic staff. We aimed to control for researcher experience measured by number of research projects with business environmental and academic status (professor, reader or lecturer). Previous studies have indicated that these factors may affect the transformation the classic university in an entrepreneurial entity

**Figure 1. Overview of conceptual research model**

### 3. RESEARCH METHODOLOGY

The main purpose of this study is to explore the critical factors that conditioned the development of entrepreneurial universities. For this purpose, we collected data from a survey of academic staff. The data were collected during the 2011-2012 academic year. The survey was administrated on sample consist of academic staff enrolled at “Politehnica” University of Bucharest and generated 48 valid questionnaires, a response rate of 70%. Our tests for response bias indicated that there are relatively minor and unlikely to affect the results.

The questionnaire contained questions in the form of a 7-point Likert-type scale (1=strongly agree, 7=strongly disagree) regarding the various aspects of entrepreneurial universities. The questionnaire provides the perception about external and internal factors have a critical role to transform the university in an entrepreneurial entity.

The study’s dependent variable is the entrepreneurial intensity of university. We measured the entrepreneurial intensity as a multidimensional construct (2 items). Respondents were asked:

- our courses are adapted to needs of business environment;
- our university enhance the technology transfer and support the research activity.

The innovation orientation was measured by using a scale consists of three items:

- we enjoy working on new projects and want to generate the innovative ideas;
- we enjoy working to develop new products or services;
- we enjoy working to develop new processes, methods or procedures.

We operationalized human capital as the extent to which a university is attracting and hiring academic staff with valuable human capital to increase talent retention. We measured this dimension by using a scale consists of two items:

- our university attracts and hiring employees with valuable human capital: our employees try to constantly update their skills and abilities.
- The critical knowledge represents a strategic source for universities.

We operationalized knowledge transfer by using a scale consists of two items:

- our university enhance the transfer of knowledge and expertise between academic staff and employees from companies;
- the critical knowledge is successfully integrated in university’s processes and operations.

For measuring the risk taking we adopt two items. This scale was operationalized by using the construct proposed by Lee et al. (2011): we prefer to live a challenging life rather than a comfortable one; we think that by solution of new research project or challenge represent the only way to succeed in life.

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Transformational leadership was measured by using a scale designed by Podsakoff, Mecchenzie and Bommer (1996). We selected four items to construct a scale (4 items):

- the university’s management is always on the lookout for new opportunities;
- the university’s management has a clear common view of its final aims;
- the university’s management always acts as the organization’s leading force;
- and the university’s management succeeds in motivating the academic staff [9].

We used some control variables reflecting the characteristics of academic staff. We aimed to control for researcher experience measured by number of research projects with business environmental and academic status (professor, reader or lecturer). Previous studies have indicated that these factors may affect the transformation the classic university in an entrepreneurial entity.

### 4. ANALYSIS AND RESULTS

All measurements of the construct are based upon the respondent’s opinions. SPSS 20 for Windows was employed for determining relationships among the constructs. In addition, we examined the unidimensionality and convergent validity of the constructs with confirmatory factor analysis (CFA) using LISREL. We used hierarchical moderated regression analysis to test our hypotheses. Because the research experience is positively skewed, we transformed it by taking its logarithm.

Descriptive statistics show the good face validity of the data. The correlations and descriptive statistics for the non-categorical variables are presented in Table 1. Correlations greater than or equal to 0.369 are significant at p<0.05. Correlations greater than or equal to 0.485 are significant at p<0.01. Examining the pairwise correlation, we note that innovation orientation has a significant positive correlation with entrepreneurial intensity, which is not surprising as challenging life and human capital do not have significant impact on entrepreneurial level. Also, university location and transformational leadership are positively correlated significant way. Lastly, there is a significant negative correlation between clear vision and this enhances the transfer of knowledge. To text our hypotheses, we adopted the multiple regression by using ANOVA as a solution to examine how the variables support or not the entrepreneurial intensity. Linear regression is used to specify the nature of the relation between variables. The first regression model is displayed in Table 2. Standardized regression coefficients are also displayed in the table. We applied the hierarchical regression with entrepreneurial intensity as a dependent variable and independent variables without the control variables. In model 1 we entered only dependent variables. We entered all of the variables in model 2, including the control variables (research experience and academic status). Our first hypothesis states that the relationship between innovation orientation and transformation of traditional university into an entrepreneurial entity is positive and significant, providing preliminary support for Hypothesis 1. Inspection of the individual regression weights showed that the skilled and specialized talent of the
academic members has a positive impact on the transformation of traditional university into an entrepreneurial entity. It was positive but it was not significant \( b_1 = 0.024 \) and \( b_2 = 0.095, p>0.3 \) and this result doesn’t support Hypothesis 2. Attract and hiring talented people is a serious problem for Romanian universities for various reasons: academic staff is not motivated, education has been underfunded for many years and this situation led to lower quality of human capital and service provided. For example, universities managed only with great difficulty to attract talented graduates and hire them. Inspection of the adoption and diffusion of knowledge showed that new knowledge especially tacit knowledge has a positive impact on the transformation of the traditional university into an entrepreneurial entity. These coefficients were positive and significant \( b_1 = 0.401 \) and \( b_2 = 0.321, p<0.05 \), and provide preliminary support for Hypothesis 3.

<table>
<thead>
<tr>
<th>Table 1. Means, standard deviations and correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses are adapted to needs (1)</td>
</tr>
<tr>
<td>Enhance the technology transfer (2)</td>
</tr>
<tr>
<td>Enjoy to work new projects (3)</td>
</tr>
<tr>
<td>Enjoy to develop new products (3)</td>
</tr>
<tr>
<td>Enjoy to develop new processes (4)</td>
</tr>
<tr>
<td>Attract an hiring talent people (5)</td>
</tr>
<tr>
<td>Update skills and abilities (6)</td>
</tr>
<tr>
<td>Enhance the transfer of knowledge (7)</td>
</tr>
<tr>
<td>Integration of critical knowledge (8)</td>
</tr>
<tr>
<td>Challenging life (9)</td>
</tr>
<tr>
<td>New search is a success in life (10)</td>
</tr>
<tr>
<td>Opportunities to collaboration (11)</td>
</tr>
<tr>
<td>High density of population (12)</td>
</tr>
<tr>
<td>Good public transportation system (13)</td>
</tr>
<tr>
<td>Look for new opportunities (14)</td>
</tr>
<tr>
<td>Clear vision (15)</td>
</tr>
<tr>
<td>Management is a leading force (16)</td>
</tr>
<tr>
<td>Human resource is motivated (17)</td>
</tr>
<tr>
<td>Research experience (18)</td>
</tr>
<tr>
<td>Academic status (19)</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>6.77</td>
</tr>
<tr>
<td>6.7</td>
</tr>
<tr>
<td>5.67</td>
</tr>
<tr>
<td>6.20</td>
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<tr>
<td>6.00</td>
</tr>
<tr>
<td>4.37</td>
</tr>
<tr>
<td>4.00</td>
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<tr>
<td>6.23</td>
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<tr>
<td>5.13</td>
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<tr>
<td>4.63</td>
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<tr>
<td>5.83</td>
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<td>6.10</td>
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<tr>
<td>6.87</td>
</tr>
<tr>
<td>6.97</td>
</tr>
<tr>
<td>6.70</td>
</tr>
<tr>
<td>5.73</td>
</tr>
<tr>
<td>5.43</td>
</tr>
<tr>
<td>6.33</td>
</tr>
<tr>
<td>2.92</td>
</tr>
<tr>
<td>2.43</td>
</tr>
</tbody>
</table>

The entrepreneurial university has a high potential to create new knowledge and identify and adopt tacit knowledge by using its integration mechanisms. The academic staff plays a critical role into the integration of new knowledge in processes, rules and policies. The inspection of risk taking showed that it will increase the likelihood of the transformation of the traditional university into an entrepreneurial entity and had a positive impact on the transformation of the traditional university into an entrepreneurial entity. It was positive but it was not significant \( b_1 = 0.002 \) and \( b_2 = 0.051, p>0.124 \) and this result doesn’t support Hypothesis 4. A possible explanation for this result consists in the lack of the academic staff’s motivation and aging of the researchers from universities. In these conditions, risk assuming is done by academic staff with many restraints. There is a certain state of passivity to why most academic staff prefers teaching because there are not enough opportunities to engage in research activities. Nevertheless the separation of technology, research and business operations becomes less sustainable. Inspection of the proximity university showed that the proximity between university and companies increases the probability to transform the traditional university into an entrepreneurial entity was positive but it was not significant \( b_1 = 0.512 \) and \( b_2 = 0.221, p<0.05 \) and this result supports Hypothesis 5. This result is not surprising because a university set up in the proximity of an industrial area or a community with a high population density will increase the likelihood that the university attract a greater number of students. Meanwhile, universities are likely to contribute to the formation of clusters and research consortia to meet the regional development needs. Entrepreneurship is viewed as an action with a good chance of success and can lead to the transformation of the university into an entrepreneurial entity, even if many academics view the entrepreneurial orientation as a threat to the traditional integrity of the university. The inspection of the transformational leadership showed that it has a positive impact on transformation of the traditional university into an entrepreneurial entity. The relationship between looking for new opportunities and the
as an entrepreneur, the university is positive and significant (b=0.239, p<0.05). The relationship between clear vision and entrepreneurial university was positive and significant (b=0.202, p<0.042). The relationship between human resources is the leading force and the entrepreneurial university was positive and significant (b=0.3, p<0.037). Finally, the relationship between human resources is motivated and the entrepreneurial university is positive and significant and Hypothesis 6 is supported. As you can see in Table2, R square is the amount of variation to the response that is explained by the model 1. R square for model 1 is 94.4 % of the variation in entrepreneurial intensity and it is explained by the regression model with all cases, and the adjusted R square is 0.875 and F=13.735 (df=29).

Table 2. The regression analysis applied to Model 1

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Standardized coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>(constant)</td>
<td>-</td>
<td>3.48</td>
<td>0.004</td>
</tr>
<tr>
<td>Enjoy to work new projects</td>
<td>0.554</td>
<td>4.261</td>
<td>0.001</td>
</tr>
<tr>
<td>Enjoy to develop new products</td>
<td>0.666</td>
<td>4.416</td>
<td>0.001</td>
</tr>
<tr>
<td>Enjoy to develop new processes</td>
<td>0.458</td>
<td>4.248</td>
<td>0.001</td>
</tr>
<tr>
<td>Attract an hiring talent people</td>
<td>0.024</td>
<td>0.269</td>
<td>0.792</td>
</tr>
<tr>
<td>Update skills and abilities</td>
<td>0.095</td>
<td>0.964</td>
<td>0.353</td>
</tr>
<tr>
<td>Enhance the transfer of knowledge</td>
<td>0.401</td>
<td>2.021</td>
<td>0.015</td>
</tr>
<tr>
<td>Integration of critical knowledge</td>
<td>0.321</td>
<td>2.681</td>
<td>0.019</td>
</tr>
<tr>
<td>Challenging life</td>
<td>0.002</td>
<td>0.008</td>
<td>0.966</td>
</tr>
<tr>
<td>New search is a success in life</td>
<td>-0.051</td>
<td>-3.85</td>
<td>0.124</td>
</tr>
<tr>
<td>Opportunities to collaboration</td>
<td>0.512</td>
<td>4.7</td>
<td>0.001</td>
</tr>
<tr>
<td>High density of population</td>
<td>0.221</td>
<td>2.435</td>
<td>0.003</td>
</tr>
<tr>
<td>Good public transportation system</td>
<td>0.318</td>
<td>3.128</td>
<td>0.001</td>
</tr>
<tr>
<td>Look for new opportunities</td>
<td>0.239</td>
<td>1.91</td>
<td>0.042</td>
</tr>
<tr>
<td>Clear vision</td>
<td>0.202</td>
<td>2.04</td>
<td>0.042</td>
</tr>
<tr>
<td>Management is a leading force</td>
<td>0.3</td>
<td>0.343</td>
<td>0.037</td>
</tr>
<tr>
<td>Human resource is motivated</td>
<td>0.281</td>
<td>2.77</td>
<td>0.016</td>
</tr>
</tbody>
</table>

As you can see in Table 3, R =0.974, the R-square 0.948, adjusted R square is 0.874 and F=11.225 (the degrees of freedom, df=29). The change in R square is a way to evaluate how much predictive power was added to the model by the addition of another variable in step 2. In this case, the 97.4 % of variability accounted for went up from 87.5% to 97.4%.

Table 3. The regression analysis applied to Model 2

<table>
<thead>
<tr>
<th>Model 2</th>
<th>Standardized coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>(constant)</td>
<td>-</td>
<td>2.403</td>
<td>0.035</td>
</tr>
<tr>
<td>Enjoy to work new projects</td>
<td>0.527</td>
<td>3.756</td>
<td>0.003</td>
</tr>
<tr>
<td>Enjoy to develop new products</td>
<td>0.751</td>
<td>4.012</td>
<td>0.002</td>
</tr>
<tr>
<td>Enjoy to develop new processes</td>
<td>0.5</td>
<td>3.579</td>
<td>0.004</td>
</tr>
<tr>
<td>Attract an hiring talent people</td>
<td>0.044</td>
<td>0.423</td>
<td>0.681</td>
</tr>
<tr>
<td>Update skills and abilities</td>
<td>0.098</td>
<td>0.684</td>
<td>0.508</td>
</tr>
<tr>
<td>Enhance the transfer of knowledge</td>
<td>0.018</td>
<td>1.260</td>
<td>0.235</td>
</tr>
<tr>
<td>Integration of critical knowledge</td>
<td>0.359</td>
<td>1.894</td>
<td>0.085</td>
</tr>
<tr>
<td>Challenging life</td>
<td>-0.025</td>
<td>-0.15</td>
<td>0.88</td>
</tr>
<tr>
<td>New search is a success in life</td>
<td>-0.521</td>
<td>-3.52</td>
<td>0.005</td>
</tr>
<tr>
<td>Opportunities to collaboration</td>
<td>-0.505</td>
<td>-3.43</td>
<td>0.006</td>
</tr>
<tr>
<td>High density of population</td>
<td>-0.193</td>
<td>-1.52</td>
<td>0.157</td>
</tr>
<tr>
<td>Good public transportation system</td>
<td>-0.188</td>
<td>-1.46</td>
<td>0.171</td>
</tr>
<tr>
<td>Look for new opportunities</td>
<td>0.264</td>
<td>1.2</td>
<td>0.254</td>
</tr>
<tr>
<td>Clear vision</td>
<td>0.239</td>
<td>2.00</td>
<td>0.07</td>
</tr>
<tr>
<td>Management is a leading force</td>
<td>0.39</td>
<td>0.35</td>
<td>0.033</td>
</tr>
<tr>
<td>Human resource is motivated</td>
<td>0.45</td>
<td>2.13</td>
<td>0.046</td>
</tr>
<tr>
<td>Research experience</td>
<td>-0.189</td>
<td>-0.66</td>
<td>0.522</td>
</tr>
<tr>
<td>Academic status</td>
<td>-0.014</td>
<td>-0.04</td>
<td>0.97</td>
</tr>
</tbody>
</table>
5. CONCLUSION
The aim of this paper is to make a contribution through extending our understanding of the traditional universities to entrepreneurial entities. In doing so, we introduce and examine the transformation of the traditional university into an entrepreneurial entity, we have examined some factors with significant impact on the process of traditional university transformation. We contribute to explain how a university is transformed into an entrepreneurial entity. This transformation is possible by the creation of alliances with the industry. Knowledge is transferred to the firms through students, by publications in scientific journals or research projects. Employers need to attract graduates with a range ofenterprising skills. Graduates need to be equipped with capacity for innovation, creativity, networking capability, risk taking and personal entrepreneurial capacities. They promote the spill-over of knowledge through an entrepreneurial university. Academic technology transfer supplies the industry with new technologies and solutions for the industry problems. Thus, the economic development can generate funds to support the development of public and private universities. Therefore, there are common objectives of universities and companies to support their transformation into entrepreneurial entities. Public funding for university research in Romania has to be dependent on the perception of whether it will contribute to the economy growth. The goal of the research projects needs to start from the consumers needs and not from desires or revelations of the researchers who are often interested in developing solutions with high complexity or novelty and fail or ignore to evaluate their commercial potential. In a more general prospective, this study highlights issues that need to be tackled when one deals with sustainable development. It is important to go beyond the teaching and examine the possibilities to improve the research and business operations initiated by the universities. This change from the traditional university to the entrepreneurial entity needs transformational leadership. Creation of an entrepreneurial culture in a university environment is a long-term process and requires considerable effort. This aim can be achieved by intensifying research activities and exploitation of research results through technology transfer or by setting up science parks or establishing start-ups (i.e., spin-offs). Attracting talented people with high skills in the academic environment is a key objective. Transformational leadership is a key catalyst for creating an entrepreneurial culture and support for transforming universities into entrepreneurial entities. The reduction of research funding has forced public universities to undertake operations to attract industry funding or generate income. Unfortunately, in the Romanian industry there is a diffuse and limited demand for research services addressed to the universities. There is no public policy to support innovative companies, establishing of spin-offs or the formation of clusters for the common exploitation of business opportunities (i.e., university-industry collaboration). In Romania, many companies are focused on the commercial activities of selling products or services which were produced by foreign companies. For this reason, R&D activities are located in the countries of origin of the goods sold in Romania. The interest of foreign companies to relocate their research operations in Romania is low although globalization will determine this change. For example, the French company Renault has a research centre in Titu, Romania. This centre has initiated a series of collaboration projects with UPB but these initiatives are quite few in Romania. This research has several limitations but these however create future research directions. We propose an extended investigation of all Romanian universities. Also, it’s possible to conduct a longitudinal comparison in time of the entrepreneurial evolution of our university. Furthermore, we can identify other factors that need to be considered in the conceptual model constructed. In addition, there is a need for future research on the international factors linked with the dynamics of entrepreneurship.
6. REFERENCES
AN ENTERPRISE DEVELOPMENT INITIATIVE: INCUBATION IN THE SOUTH AFRICAN MOTOR BODY REPAIR SECTOR

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ABSTRACT: The paper investigates motivations, challenges and success factors experienced by an incubator company and panel shop owners during transformation from a non-registered to a registered panel shop. Since 2006 the company has assisted six black owned panel shops in upgrading their businesses through an annual grant of R1.5 million per business. The objective is to develop and empower disadvantaged black owned motor body repairers. The study was conducted through multiple case studies and in-depth interviews with owners and staff of these panel shops including incubator company personnel. The study revealed that noticeable improvements were in better infrastructure, improved management skills, registration with the repair authority, access to work from the insurance industry and better turnover. Challenges faced were in building of trust among panel shop owners and support agencies seconded to their businesses by the incubator company during the incubation process.

Key words: Entrepreneurship, transformation, incubation, empowerment, multiple case studies.

1. INTRODUCTION

Entrepreneurship is multi-dimensional, it includes owning a small business, being innovative, acting as a leader or starting up a new company, [1]. Entrepreneurship education inspires students towards starting up, developing and growing new successful business, [2], and promoting innovation or introducing new products or services or markets in existing firms, through realising and exploiting opportunities, [3]. Important skills developed through entrepreneurship education include increased problem-solving and decision making abilities, improved interpersonal relationships, teamwork, money management and innovation, [4]. Entrepreneurial education provides an efficient and cost-effective method of increasing the number and quality of entrepreneurs in the economy., [5].

Small Medium and Micro Enterprises (SMMEs) as business outfits contribute significantly to the economy and have a strong potential for economic growth. In addition they tend to be innovative, productive and generate of employment, [6], Japan, Korea and Taiwan are countries that have shown high economic growth rates, high employment rates and equitable income distribution as a result of the well-structured SMMEs, [7]. There are about 2 million SMMEs in South Africa, representing 98 % of total number of businesses, employing approximately 55 % of the country’s workforce and contributing about 42 % to the country’s wage bill, [8]. 87 % of these SMMEs are survivalist, mostly owned by balcks, hence the need for incubation and enterprise development to enhance small enterprise growth sustainability. Common internal and external barriers faced by SMMEs, lack of resources, under capitalisation, poor infrastructure, lack of skill and poor perception from the public, [5], [6], [7] and [8].

Business incubation has been defined as an environment that links talent, technology, capital and know how in providing leverage for entrepreneurial talent, [11], accelerates the development of new companies, [12], training and networking, [13]. The incubation process brings in a network of individuals and organisations that include the incubatee companies and employees, local universities, industry contacts, and professional service providers such as lawyers, accountants, consultants and marketing specialists, [11]. Business incubators minimise problems faced by SMMEs by providing comprehensive assistance and conducive environment, [12]. The aim of a business incubator is to increase rate of new business formation, [13], increase rate of survival and success of new enterprises, [14]. This is achieved through entrepreneurial development, training in various skills, [14], shared use of equipment and facilities, technology transfer, research and development, lower operational costs, networking and business linkages, [15]. This is the focus of the incubator company.

The South African government has set up several initiatives that support small businesses like the Local Economic Development programmes, establishment of small business incubators, [9], and the National Strategy Framework for the development of small businesses, [10]. The work being done by the incubator company complements the government’s initiatives.

1.1. Research Problem

The South African motor body repair (MBR) sector is characterised by SMMEs. These SMMEs’ have raised business concerns, which include the need to be registered by the South African Motor Body Repair Association, (SAMBRA), South African Insurance Industry, (SAIA), and certification by Original Equipment Manufacturers (OEMs), called the panel system, as a condition of getting work from the insurers, [16], [17]. The insurance industry dictates parts margins and labour rates hence the low margins experienced in this sector.
1.2. The Incubator Company’s Initiative

The incubator company adopts and gives a panel shop a grant of R 1.5 million every year since 2006. The incubator company is committed towards the growth and development of operational and financial capacity of black-owned auto body repairers. The grant is used to upgrade infrastructure, procure better equipment and technology and to carry out training in technical, managerial and business skills. These efforts prepare the SMMEs to be competitive and to get registered on the panel system. This paper will detail how these entrepreneurs are identified, selected, trained and monitored. The study will highlight the motivations, challenges and success factors experienced by both the company and the panel shops.

2. RESEARCH OBJECTIVES

The paper has the following objectives:

1. To investigate motivations and success factors experienced by the incubator company and the panel shops.
2. To investigate challenges experienced by the incubator company in the incubation / mentorship process.
3. To analyse business performance before and after the incubation process.

3. LITERATURE REVIEW

3.1. Entrepreneurship

“Entrepreneurship studies the practices of entrepreneurs, it examines their activities, characteristics, economic and social effects and the support methods used to facilitate the expression of entrepreneurial activity”, [18]. Research has presented two main entrepreneurship theories; disequilibrating force that causes economic development through “creative destruction”, [19] and an equilibrating force that restores markets to equilibrium through the process of price adjustments [20]. The later one supports the work of SMMEs in the motor body repair sector. From literature the main streams of entrepreneurship research are, psychological-traits and behavioural; sociological-social and cultural; economics and management, [21], and these entrepreneurship streams will guide this study.

3.2. Business Incubation

Business incubation is a well-documented tool for economic development, [22], through enterprise development and job creation. Incubation is a valuable mechanism for technology transfer through interaction with mentors and advisors, [22]. Incubates are educated through the process of action learning. Several authors have indicated the main purposes of incubators in addressing the needs of SMEs and these were summarised by [23], [14], as follows:

- Develop managerial skills of the entrepreneurs through strategic guidance.
- Improve business infrastructure by facilitating the acquisition and transfer of technology.
- Promote quality standards.
- Increasing the competitiveness of the incubator firms.
- Promote entrepreneurial activities of Business incubators,
- Reduce the relatively high failure rate of start-up and emerging enterprises.

Incubators provide the necessary business infrastructure and strategic guidance, as well as an environment in which information, experiences and ideas can be freely exchanged, [14], [26]. The process of incubation prepares the entrepreneurs’ skill and knowledge base in preparing them for increased business growth and profitability.

3.3. Small Medium and Micro Enterprises (SMMEs)

SMMEs play an important role in the socio-economic stability of a country through significant contribution to the economy and their strong growth potential, [24]. The global importance of small businesses in any country were summarised by [25] as “Small businesses are multitudinous, suppliers of employment and creators of work opportunities, innovators and initiators, sub-contractors for large organisations, responsible for the manifestation of the free market system and an entry point into the business world”. SMMEs promote a flexible, innovative and competitive economic structure, [26]; better customer service, lower cost and filling of isolated niches. In developed countries, more than 90 % of all firms fall under the umbrella of SMEs and above 90 % of these SMEs are microenterprises, [26].

4. METHODOLOGY

The research methodology of this study includes relevant literature review, and detailed multiple case studies on six medium sized auto-body repairer enterprises. Case studies, [27] can be used to explore, describe, explain and compare while [28] stated that case studies focus on one instance’s relationships and processes in a natural setting with the possibility of using multiple sources and methods for both data gathering and analysis. The triangulation method was used for data gathering as suggested by [29]. The method included extensive literature review, interviews with well prepared structured questionnaire observations and analysis of records. Most of the data was however provided by the company that is implementing the enterprise development process.

5. ADOPT A PANEL SHOP INITIATIVE

5.1. The Incubator Company’s Motivations

The incubator company’s motivation is to empower SMMEs in assisting them to acquire sound managerial, technical and financial capabilities. These attributes would enhance business growth and sustainability and they form the conceptual framework of this study as shown figure 1 below.

5.2. Selection criteria done by the Incubator Company.

The qualifying enterprise must be owned by black South African as defined by the Department of Trade and Industry Codes of Good Practice on Broad-Based Black Economic Empowerment. The enterprise must be owner managed, be registered as a legal entity, with a VAT (tax) number. The
owner must be qualified panel-beater or spray-painted certified by Manufacturing Engineering and Related Services Training Authority (MERSETA). Educational and prior industry experience is considered to be critical for the success of the enterprise in terms of its growth and its performance, [30]. The enterprise must be operating in an area designated for industrial type of work and not a backyard workshop, equipped with suitable equipment and tools. The enterprise must demonstrate an ability to produce decent quality work. The owner must be willing to raise 5% of the capital investment required to develop the enterprise and must have been in operation for at least two years with stable client base. The owner’s growth orientation, [30], guides in the selection process.

5.3. Entrepreneurship Mentorship
Entrepreneurship mentorship is promoted by means of providing necessary training, infrastructure for entrepreneurs to further their business aspirations. During the incubation process business professional; consultants, lawyers and accountants are seconded to work with the SMMEs. The first step focusses on infrastructure upgrade, both buildings and equipment including internet networking. The second step emphasises skills development which include training opportunities aimed at technical and business skills. Incubation programme follows ensuring that there is on-going coaching and mentorship for the beneficiaries to improve their operational capabilities. The fourth step focusses on business growth and sustainability of beneficiaries. Efforts are directed towards the expansion of operations, which would result in job creation, competitiveness, access to more markets and opportunities which would enable the business to be sustainable.

5.4. Repair Areas Focussed on
Two repair areas have been focussed on namely Non-Structural Repair (NSR) and Major Structural Repair (MSR). Non-Structural Repair (NSR) shops mainly focusses on repairs that have not affected the structural integrity of the vehicle. These repairs form an estimated 70% of all repairs. Scope of work undertaken include minor dents, hail damages, dent removal, scratches, bumper repair, colour coding and panel replacement. Estimated set up costs of these repairs are R 1,000,000.00 for a non-franchise and R 1,600,000.00 for a franchised shop. Major Structural Repair (MSR) involves all damages from minor to major repairs. This repair aims at restoring the car to its originality. Estimated set-up costs are between R 3,000,000.00 and R 5,000,000.00. Highly qualified spraypainters and panelbeaters are required for this repair. Panel shops offering NSR and MSR repairs are expected to be accredited or approved by SAMBRA and motor manufacturers (OEM).

6. FINDINGS
6.1. Success Areas
The incubator company has provided hands-on management assistance, access to finance and have exposed these SMMEs to business and technical support, [31]. The incubation process is away from site development and subsidized rents, [31]. Noticeable positive results include formalised recruitment that goes beyond immediate family members, there is delegation of responsibilities, and all SMMEs now have a business strategy, this agrees with the work of [32], on growth paths of small enterprises. Four critical elements of incubation process as suggested by, [33] have been met namely, analysis of business needs; monitored application of business services; provision of financing and access to the incubator networks. Success of an enterprise is usually measured by business performance metrics which are cost management, profit, sales and turnover, [34], growth in employment rates, [30]. Data for sales turnover and employment is usually used because it is easily available, [35]. Figures 2, 3, and 4, shows the trend of turnover, employment rates and types of repairs done by three SMMEs, hereby named A, B, and C. These SMMEs were incubated from 2006, 2007 and 2008 respectively.

![Figure 2. Graph of turnover over six years](image1)

![Figure 3. Graph of employment rates.](image2)

![Figure 4. Types of repairs done by SMMEs.](image3)

The employment rates are not as high, indicating a similar trend which was studied in the manufacturing sector as was reported by [36], that most entrepreneurs do not always choose to increase employment.

![Types of repairs done by SMMEs.](image4)
6.2. Networks

Through the incubator company these SMMEs now enjoy benefits of business networks accessing and utilizing external resources in the network, outperforming other small businesses, by increasing their competitive advantages and efficiency, [37]. Networks sustain long-term business objectives and contribute to an enterprise’s survival. The business networks become a community of practice, [13]. These SMMEs now enjoy trust and long term relationships with other stakeholders, [38] have been built, through among panel shops that deal with the incubator company. Participation in these networks have generated new market information, new customers, [39] and SMME owners can now negotiate with partners and suppliers. Through industry peers, these SMMEs can now access industry related information and it has opened up opportunities for collective lobbying, [40]. The network provided by the incubator company has strong ties in the industry, [38] since it offers risk insurance services that include motor vehicles.

6.3. Entrepreneur’s Knowledge

The research established that prior knowledge and experience of the owner had an impact on the SMME’s success, [41]. Good managers exhibited better formal education, had better work experience, were self confident and understood functional skills, [42], [43]. During the intervention it was noticed that there were inadequate control systems to monitor utilisation, efficiency, quality and wastage. All SMMEs owners acknowledged that they now have a better business strategy in place, [39]. Through the enterprise development of the incubator company these SMMEs’ ability to survive and grow in their business has been enhanced, (firm life endurance), [39].

6.4. Challenges Faced

6.4.1. Trust

Challenges faced were in building of trust among panel shop owners and support agencies seconded to their businesses during the incubation process. Three owners wished to avoid the inconvinences and headaches associated with continued expansion, [44]. The study revealed that noticeable improvements were in better infrastructure, improved management skills, owners are now able to delegate, [45] can now employ managers, shedding off some of the day to day responsibilities to their subordinates, [39]. All the SMMEs are now registered with the repair authority, SAMBRA; enhancing their chances of accessing work from the insurance industry.

6.4.2. Training

Training of technical staff was a challenge. Most workers are now trained on the job by senior artisans. There is no formal college (FETs) that is offering courses in motor body repair. Barriers to job-related training that were discovered were that workers were too busy at work, courses offered were too expensive, lack of employer support and that some courses were offered at an inconvenient time and location, [46]. The incubator company has however managed to send workers from the said SMMEs to their supplier partners for in-house training. Both intangible and tangible benefits such as employee motivation and self esteem; and improved quality were quite evident in all SMMEs, [47]. These SMEs now have the ability to respond to market changes through flexibility brought about by new equipment and improved skills of their employees, [30], [48].

6.4.3. Financial Accountability

The incubating company discovered that with some SMMEs there were inadequate record, bookkeeping systems, invoicing and debtor control systems. Cash flow, costs and profit were not well monitored. These inadequacies were corrected by financial consultants that were seconded to each SMME. With improved financial records and collateral base these SMMEs can now afford to seek for loans for the expansion of their enterprises, [39]. Improving access to finance was reported by [48], as a strategic theme that helps small businesses. Staff retention and morale has also improved. There was a noticeable improvement in the way these businesses price their services as well as manage their cash flows, [30], [39].

6.4.4. Incubation Problems

Out of 22 Incubators under Small Enterprise Development Agency (SEDA) and funded by the Department of Trade and Industry (DTI), only two of them focus on the motor industry, [23] and of the two none focusses on the motor body repair sector. Through the Automotive Industrial Development Corporation, (AIDC), the South African government established an Automotive Technology Centre as an Incubator which mainly services component manufacturers and OEMs. Two universities involved with this incubator are University of Pretoria and Tshwane University of Technology, [23]. Their main focus is in the improvement of automotive manufacture’s competitiveness. The automotive aftermarket sector, where the motor body repair belongs, is not catered for.

7. LIMITATIONS

The nature of SMME business activities made it difficult to make use of Performance Measurement Systems (PMS), as a unit of analysis. However internal and external aspects of PMS were looked into. On internal PMS the study looked into business operations and capabilities which covered training and equipment. The other limitation was that few panel shops were studied and information on their working capital, income statements, working capital and cash flow could not be verified. Data on turnover were estimates given during interviews. Panel shop owners were reluctant to share this information. Few panel shops were studied hence these results can not be generalised.

8. RECOMMENDATIONS

The research recommends that an incubator specifically focussing on the motor body repair sector must be established. The incubator will focus on motor body repair courses such as panel beating, stripping, car preparation, assembly and polishing. South African universities as custodians of new information and creators of knowledge are expected to spearhead establishment of an auto-body repair incubator. Major cities in South Africa will be ideal centres for this incubator namely Johannesburg, Cape Town and Durban. These are centres with high volume of cars, [Motoring SA, 2004], Other companies are also encouraged to follow the route taken by Alexander Forbes of developing small enterprises that are in their sector. This will assist government efforts in developing sustainable SMMEs that have both growth and sustainability potential.
CONCLUSION

The enterprise development work done by the incubator company ensures that these SMMEs are well resourced, especially on the acquisition of equipment and improved infrastructure. Managerial and financial skills are improved through secondment to consultants such as accounting and law firms. Post incubation support is given through channelling of work to beneficiaries of their programme. The incubator company monitors progress of these SMMEs, thereby keeping them in their business networks and linkages. These efforts enable business growth and sustainability.

REFERENCES


LEADERSHIP STYLE TOWARD COMPETITIVE ADVANTAGE OF BUSINESS EDUCATION

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ABSTRACT: Leadership style used in a higher education institution affects the competence-based performance of the lecturers and the administrative staff. In turn, their performance will affect the institution performance. So, leadership style influences the institution toward strengthening its strategy to sustain. This study examined the transactional and transformational leadership styles toward the lecturers and the administrative staff of STIE Perbanas Surabaya. Transformational leadership was measured using ideal, inspirational, and intellectual stimuli; while transactional leadership was measured using exceptional management and contingency reward. The indicators used to measure the lecturers’ performance were on teaching, module, research, civil services, IT, English; while for administrative staff were integrity, service, professionalism, learning, adaptation, documenting, English. The survey involved 32 lecturers and 31 administrative staff. The data was collected using questionnaire and was statistically analyzed using multiple regressions. The result was that transformational leadership significantly influenced both the lecturers and the administrative staff. In turn, their performance will affect the institution performance. So, leadership style influences the institution toward strengthening its strategy to sustain.

Key words: Transactional Leadership, Transformational Leadership, Contingent compensation, management exception compensation

1. INTRODUCTION

The competition among higher education has been in the form of getting public attention in forward and backward level. Forward level means the attention from the target market of the university meaning the point of the university’s new students. Backward level means that the universities are also in a competition to get good attention from the industries that will hire the universities’ graduates.

The agent in the university that strongly takes important roles is the lecturers then the administrative staff. Anyhow, the way they perform are strongly affected by the way the leadership cope their effort of works. Lecturers focus on their contribution within the three aspects of teaching and learning, conducting research and conducting social services. While the performance of administrative staff are also important since their service to the internal customers and other stakeholders are very strongly support the success of the university operation. Competitiveness of a university can be affected by the accumulative efforts of those the lecturers and the administrative staff.

The performance of the lecturers and the administrative staff are the efforts that increase quantitatively as well as qualitatively. This cab because of the way the top management as the leader in the university govern the organization especially in handling the people in this case is the lecturers and the administrative staff. Human resource becomes a very important agent for the competitive advantage of a university. The support of lecturers and administrative staff strongly contribute to the university even much better than other assets.

In order to have supporting lecturers and administrative staff, leaders must be able to fit the way they lead with the condition of the lecturers and administrative staff. This refers to the kind of leaderships that are transactional leadership and transformational leadership. Top management of a university must understand that the success of the university depends on the quality of the human resource. So, they must be able to manage the human resource. When the human resource tends to need and consider rewards every time they complete work and show performance, then the leadership should be transactional leadership (Pawar and Eastman, 1977). This is appropriate at the early leadership level but this should be encourage to be in the transformational leadership when the condition of human resource has been improved by the leaders so they are ready for the transformational leadership. Transformational leadership will give a lot empower and self belonging of the staff since their expectation is getting self esteem and self actualization (Bass, 1985).

Based on the improvement of the human resource management in university that has been influenced by the quality assurance challenge and information technology challenge, there should be a shift in the kind of leadership existing implied in universities that affect the performance of the staff. This study is about examining the university’s kind of leadership that affects the performance of the lecturers and administrative staff, what kind of leadership affecting their performance.

2. LITERARY REVIEW AND HYPOTHESE FORMULATION

Transactional leadership is a leadership that operates the existing system that tries to satisfy the needs of the organization members and focuses on the rewards giving at the positive change of the staff attitude and takes a corrective action when problems and mistakes happen (Pawar and Eastman, 1977).
Transformational leadership is a leadership in which the leader’s influence is dominating the employees. The staff or employees feel the leader’s trust on them, proudness about the leaders, loyalty, and respectfulness to the leaders. Employees are motivated for a better performance and target. This leadership motives staff to be better (Bass, 1985).

2.1. The relation between Transactional Leadership with the performance

Nat sir (2005) explain that in transactional leadership, leaders give rewards to the employees based on the performance gained and hoped by the employees. This kind of leadership can improve the attitude of the staffs and vice versa whenever the leaders do not give rewards to the staff. The leaders give rewards that can directly affect to the increase of the staff’s positive attitude. This is not this way when the leaders do not give the rewards. Bass (1990) and Yulk (1998) stated that the relationship between the leaders and the staff can be in the following points:

1. Leaders know what the need of the staff is and explain to them what they will get when they meet the performance.
2. All efforts of the staff will be compensated with rewards.
3. If personal need in line with the value of the works or performance, the leaders will response for the rewards.

Bass in Howell and Avolio (1993) stated that the characteristic of transactional leadership falls to two kinds namely contingent reward and management exception reward. Contingent reward refers to reward that is given with a certain requirement set by top management. The requirement is that if the employees well perform they will be rewarded, and vice versa. Management exception reward refers to similar idea as contingent reward namely it requires certain condition of the employees to get reward.

2.2. The relation between Transformational Leadership with the performance

The relationship between leaders and the staff will be good if the staff appreciate and support the leaders. This situation will be a very good point for the leaders to encourage better contribution of the organization members to the organization. Further, the leaders can make control in a better way since the situation happening is conducive for a better moves forward to the staff area of work.

Podsakoff, et al (1996) stated that transformation leadership is very important to influence the attitude, perception, motivation that can increase the trust of the staff to their leaders. Cox (2001) stated the existence of the transactional and transformational leaderships. Burn (1978) stated that transformational leadership is a leadership that can give inspirational stimulus and intellectual stimulus. Thus, transformational leadership can also affect the attitude and performance of the staff.

Referring to the above theories, the hypotheses were:

- H1a: Transactional leadership positively and significantly affects the performance of lecturers.
- H1b: Transformational leadership positively and significantly affects the performance of lecturers.
- H2a: Transactional leadership positively and significantly affects the performance of administrative staff.
- H2b: Transformational leadership positively and significantly affects the performance of administrative staff.

The model was explained in the following equations:

Y1 = α + 0.098 X1 + 0.042 X2 + e...
Y2 = α + 0.228 X1 + 0.040 X2 + e...

Note:
X1 Transactional Leadership
X2 Transformational Leadership
Y1 Lecturer Performance
Y2 Administrative Staff Performance

3. RESEARCH DESIGN

The variables of this research were Transactional Leadership and Transformational Leadership as independent variables and Lecturer and Administrative Staff Performance as dependent variable. Transformational leadership was measured using ideal, inspirational, and intellectual stimuli; while transactional leadership was measured using exceptional management and contingency reward. The measurement elements for lecturers included teaching, module, research, civil services, IT, English; while for administrative staff were integrity, service, professionalism, learning, adaptation, documenting, English.

The population was all lecturers and administrative staff of STIE Perbanas Surabaya (the college). By taking all respondents from the population, this means that this study used complete enumeration. The data was analyzed using multiple regression.

4. ANALYSIS AND DISCUSSION

The result was that transactional leadership did not significantly affect the performance of both the lecturers and the administrative staff, while transformational leadership significantly affected the performance of both the lecturers and the administrative staff.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted R square</th>
<th>R square</th>
<th>Prob.</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transactional leadership (X1) → lecturers performance (Y1)</td>
<td>.089</td>
<td>.148</td>
<td>.098</td>
<td>Not significant</td>
</tr>
<tr>
<td>Transformational leadership (X2) → lecturers performance (Y1)</td>
<td>.082</td>
<td>.111</td>
<td>.042</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Further analysis on the research was viewed from the point of view of the research object namely the lecturers and the administrative staff. Table 1 shows the influence of transactional leadership (X1) and transformational leadership (X2) toward the lectures’ performance (Y1). The probability score of the influence of X1 toward Y was 0.098 that was higher than 0.05 as the maximum score of acceptance. In other word the hypotheses was accepted if the probability score was
below 0.05. This means that the transactional leadership did not significantly affect the lecturers’ performance. While the probability scores of the influence of X1 toward Y1 was 0.042 that was lower than 0.05 meaning that transformational leadership significantly affected the performance of the lecturers.

It is mentioned by Natsir (2005) that if transactional leadership sets compensation in line with the staff’s performance and expectation, it can improve the staff’s attitude, and vice versa. In this situation, a leader must set rewards that can increase the staff’s performance. The staff thinking they have accepted rewards in line with their performance will compensate it with better work attitude. This study showed that transactional leadership did not significantly affect the lecturers’ performance while transformational leadership did. Based on this research, transactional leadership is not appropriate to be applied in a university or college where the members are lecturers. Lecturers are intellectual individuals that need inspirational leadership. They need management that accommodate them to extensively develop by themselves. Their satisfaction is when they well perform and show their actualization.

The research result showing the influence of transactional leadership (X1) and transformational leadership (X2) on the performance of the administrative staff is shown in table 2.

Table 2. The Statistical Result on Administrative Staff

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted R square</th>
<th>R square</th>
<th>Prob</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>transactional leadership (X2) → performance administrative staff (Y1)</td>
<td>0.036</td>
<td>0.100</td>
<td>0.228</td>
<td>Not significant</td>
</tr>
<tr>
<td>transformational leadership (X2) → performance administrative staff (Y1)</td>
<td>0.085</td>
<td>0.196</td>
<td>0.040</td>
<td>Significant</td>
</tr>
</tbody>
</table>

The probability score of the influence of X1 toward Y2 was 0.228 that was higher than 0.05 as the maximum score of acceptance. This means that the transformational leadership did not significantly affect the administrative staff’s performance. While the probability scores of the influence of X1 toward Y2 was 0.040 that was lower than 0.05 meaning that transformational leadership significantly affected the performance of the administrative staff.

Podsakoff, et al (1996) and Cox (2001) stated that transformational leadership was the drive to influence attitude, perception, and motivation. Burn (1978) stated that transformational leadership was a leadership in which the leader was able to give ideal stimulus, inspirational stimulus, and intellectual stimulus. Burn’s research showed that transactional and transformational leadership affect the staff’s performance meaning that the higher the level of the transactional and transformational leadership are, the better the performance of the staff, and vice versa.

The result of this research supported the previous study mentioning that transformational leadership affects the performance of lecturers and administrative staff. This means that leaders at higher education institution should be more transformational. Transformational leadership fits to strengthening strategy of higher education institution sustainability. This is because transformational leadership can improve organization and empower the organization member. Referring to the hierarchical need of Maslow, the lecturers and the administrative staff have already been at the need of self esteem. At this level, it hoped that the performance of the lecturers and the administrative staff will be of better since they are motivated by the moves of the leaders that always show ideal spirit. This inspirational stimulus given by the leaders orally, by showing positive attitude and behaviours can help the staff take them into their positive consideration that for the long run this will build positive culture for the whole organization. Transformational leadership is also in line with intellectual stimulus refers to the way the leaders able to show how they should think and find problem using better perspective. This stimulus are hoped to be showed by the leaders in education organization, since this refers to the core of the organization. If all members or the organization are positively affected by the transformational leadership, then they will have open mind to accept changes and improvement; that they will help a lot to the growth and sustainability of the organization.

5. CONCLUSION

The result of the study was that transactional leadership did not affect the performance of the lecturers and the administrative staff, while transformational leadership did.

At higher education institution level, leaders should imply transformational leadership since this is in line with the substance of the business that in turn can strengthen the organization sustainability.

6. REFERENCES


ABSTRACT: It has become a necessary requirement of the time for colleges to carry out enterprise education to produce high-quality personnel with entrepreneur spirit and ability. It is discussed at the beginning of this article that the purpose and status quo of the enterprise education for college students in China and then the reasons for the poor condition in enterprise education are explored. It is found out that colleges do not provide an effective systematic platform for enterprise education; necessary personnel are not provided for such purpose in the teaching staff in Chinese colleges; in actual operation practical effect is not achieved in the moral training in colleges. Therefore, new concept in moral training must be introduced and first-rate teaching staff must be provided for the effective enterprise education. Special courses must also be systematically compiled for the purpose.

Key words: entrepreneurial education, moral training, college, China

1. INTRODUCTION

The aim of moral education of Chinese universities is to improve one’s ideology and morality and to respect one’s subjectivity. Creativity is the best form for colleague students to subjectively develop, and the inner quality of entrepreneurial leadership. Developing colleague students’ subjective creativity and entrepreneurial leadership are the new goals, priority and effective carrier of Chinese universities’ moral education work.

2. THE SIGNIFICANCE OF ENTERPRISE EDUCATION IN COLLEGES AND UNIVERSITIES OF CHINA

2.1. Enterprise education suits the urgent demand for Chinese economy and social development

College students are groups of people with the most potential for starting up businesses and if they are well educated to improve their ability to start enterprises the problem of high unemployment caused by expansion of higher education can be solved and a sustainable development and a harmony within the higher educational system can be achieved. In addition, if college students start businesses on their own they will provide more working opportunities for other numbers of the society and thus our national economy will be promoted and the social harmony will be secured.

2.2. Enterprise education is good for college students’ all-round development

Through enterprise education college students will have more consciousness of starting businesses and enterprise spirit and their ability to establish businesses will also be improved. As the enterprises consciousness will guide the attitudes and behavior of the business founders the initiative of college students will be greatly tapped their business consciousness. With their initiative the college students will make fully use of their creative potentials.

2.3. Enterprise education will push forward the innovation of moral education at colleges

With the information economy and economic globalization the restraint of geopolitical concept has been broken and the economic structure of the world has been greatly adjusted and changed thus new types of work and profession have spung up. And in the same way complexes and profound changes have also taken place in the environment of college moral education. On the one hand now our country faces great pressure in employment and reemployment and man power demand for traditional jobs is sufficient thus sharp employment contradiction occurs; on the other hand great differences exist between new jobs of modern time and the qualified workers that meet the high international competitive demands. In order to take an active part in international competition we need to produce more highly qualified, creative and business-oriented people. Furthermore, the reform of higher education in China is deepening and the mode of higher education is becoming diverse, so moral education in colleges both in content and method faces unparalleled challenges and opportunities. Therefore the inovation of the moral education in content and the expansion of the moral education have become an necessity of the time.

3. THE PRESENT SITUATION OF ENTERPRISE EDUCATION IN COLLEGES OF CHINA

As a member country of enterprise education organized by UNESCO, as early as 1991 China started research in enterprise education for basic education period. For some reason enterprise education was not popularized and it did not last long. The systematic enterprise education really started in 1990s.

At present three main models exist in enterprise education for colleges in China:

In the first model represented by the People’s University of China, it was stressed that enterprise education “focuses on the cultivation of the students’ enterprise consciousness, the
construction of knowledge needed and the improvement of students’ all-round quality”. Students were encouraged to creatively plunge into social activities and through activities such as discussion meetings, contests and so on groups of enterprise education were formed based on specialties and organizations.

The second model is represented by Beijing University of Aeronautics and Astronautics and it is stressed in this model that students should improve themselves in enterprise knowledge and skills. This model has the characteristic of commercialization and students’ garden of enterprise is established and students are taught how to start businesses of their own and capital help and consultation are provided for students. [2]

The third is represented by Shanghai Communications University featuring a comprehensive enterprise education. In this model innovation education is the basis for enterprise education and in equipping students with technical knowledge their basic quality is also cultivated; on the other hand capital and consultation are provided for students. [3]

In China, although enterprise education at colleges is given a high priority by all walks of life and the national government takes it as an important measure to develop economy and promote employment, the colleges as the main institution of enterprise education is not clear about the nature of enterprise education and some work is done only on the surface and enterprise education lags behind at colleges and this can seen in the following aspects:

Firstly, enterprise contests take the place of enterprise education and the nature of enterprise education is not fully understand. It is true that enterprise contests have an positive effect on enterprise education and students’ innovative consciousness and enterprise skills will be strengthened and they are new carriers of quality education and forms of scientific activities. Enterprise contests can arouse students’ enterprise consciousness to some extent and they play a very important part in popularizing enterprise education. Nonetheless we must clearly realize that contests are after all contests and only part of students are involved; the knowledge around the theme of enterprise and the skills learned are partial and unsystematic or empirical; Even if prizes are awarded in the contests it does not mean enterprise education is well done at colleges. Therefore enterprise contests must not take the place of enterprise education which includes enterprise theory and practice. Neglecting the basic knowledge and restricting the enterprise education only to operative level and technical skills hinder us from truly understanding the deep implication of enterprise education. We must correctly understand and handle the relationship between contests and education and enterprise contests are only an extrinsic and introductory form of enterprise education.

Secondly, the enterprise report takes the place of enterprise education which has only one form. Enterprise report plays an important role in arousing students’ enterprise consciousness and the enterprise report can motivate the students’ enthusiasm for enterprise. College students are eager for knowledge and they are idealistic and impulsive. On the one hand they are interested in enterprise experience which may include knowledge of success and attitude. On the other hand they tend to be emotionally moved by the experience of the enterprise starters therefore holding enterprise report often has the better result on the spot. But we should not substitute enterprise education with enterpriser report which is limited in education, superficial and less enduring. Students may be very enthusiastic on the spot but discouraged afterwards because they are lack of systematic information for enterprise.

**4. REASONS FOR BACKWARDNESS IN ENTERPRISE EDUCATION IN COLLEGE FOR MORAL EDUCATION**

**4.1. In the working mechanism moral education in colleges fails to provide an effective platform for enterprise education**

A flexible and effective administrative body is a guarantee enterpriser education. For the moment the moral education in colleges of China is done through the unified arrangement of the Party committee and students are educated by political cadres from pioneer committee and students’ affair office and the department committee. This working system plays an important role in enterprise education but it is also limited in its function.

Firstly, the moral education at colleges is under the leadership of two systems: the Party committee is responsible for the moral education while the administrative departments are responsible for the teaching of specialities. As the two systems are not well coordinated the enterprise education is influenced in effectiveness.

Secondly, the courses of moral education need improving. The reform of moral courses used to limit to one certain course or a teaching office and it is rare to construct it as a whole. As a result, different courses are not consistent and repetitive. Moreover this kind of reform is not comprehensive because it focuses mostly on teaching method and means and rarely on teachers’ qualities, teaching time and content, examination mode etc.. Many new problems need exploring in teachers’ main role in teaching and students’ subjective function, in fostering high moral quality and enterprise spirit and ability.

**4.2. Colleges are not well equiped with necessary teaching staff for enterprise education in moral education**

Firstly, on the whole the teaching staff at the college level is not well qualified. Some responsible for moral education adhere to old habits and rigidly copy the classic works of Marxism and ignore the creativeness in the content of moral education. As a result they can not adapt themselves to the modern time and market economy in creative ideas and ways. Therefore enterprise education as a new subject in the content of moral education is not studies and the students’ enterprise spirit and ability are not consciously cultivated.

Secondly, the role of profesional teachers in producing enterprising graduates is ignored in traditional moral education and the moral education and the teaching of profesional knowledge are separated. Teachers are the direct performers of teaching and scientific research and their leading position is decided by their work. Besides imparting their research and ideas of learning to studets and converting their personal knowledge to social wealth, teachers, especially professionals, are also mentors and guides in helping students acquire knowledge and ability and in fostering students’ moral fibre. It must be made clear that in the new concept of moral education all teachers are teachers of moral education and all courses and activities of school should be regarded as moral education. The enterprise education in moral education at colleges should not
be performed in an isolated way, broken apart from education of knowledge and profession. It needs to be pushed forward in an all-round and systematic way in colleges of China.

4.3. In operation, colleges of China fail to provide an ideal practical mode in their enterprise education

In the recent years, colleges of China keep pushing the reform forward in moral education and great achievements have been made. Nevertheless, the real situation in moral education remains poor, which is not hopeful in producing enterprise-oriented people.

Firstly, the objectives of moral education are separated from the real moral practice of students. Instead of teaching the students on their reality (their moral ideological structure and their life) and help students accept the objectives of moral education, educators of moral education inculcate an absolutely lofty ideas extracted from the whole society. As a result, the objectives of moral education in certain moral text (theoretical systems, textbooks and plans for moral education etc.) get into the students’ world of knowledge students find it hard to satisfy their inner need in the moral objectivity, thus the objectives fail to become inner beliefs and outer actions. It is obvious that this kind of separation is not helpful in shaping enterprise characters in moral education. [4]

Secondly, the moral education is separated from the students’ real life. There exists a trend that the college moral education separates the social life and reality on the pure campus situation. Under such moral circumstances, enterprise consciousness, competitive consciousness and pioneering spirits can not be cultivated.

Thirdly, moral education workers are separated from college students. Moral education is an organized practical activity based on plans. Any social practice includes not only the interaction between people and things but also between people and the social practice is unfolded this way. But for a long time, in the practice of moral education, students are regarded as objects and the relation between moral education workers and students is that of subject and object. The initiative and creativeness of students are ignored and the interactive relationship between them is not set up. As a result, moral education is performed in such a way that educators talk in higher position and students listen and do things in their usual way without any change. Such moral education is not helpful in cultivating students’ subjective consciousness and enterprise spirits.

5. ENTERPRISE EDUCATION AT COLLEGES IN THE BACKGROUND OF MORAL EDUCATION

5.1. Freshening the ideas of moral education

To carry out enterprise education old educational ideas should be discarded in colleges of China. The educational objective in cultivating pioneering people must be set up. In the educational system students should not only be taught intellectually and technically the confidence and will power students need in their pioneering activities must be reshaped. To carry out enterprise education and renew ideas of moral education the work should be started in three aspects:

Firstly moral education workers should have an all-round development education objective and change their view of education. Students should have an all-round development in morality, intellectuality, physical education, arts and physical work; students are the subjects of education therefore they should be respected. Students’ individual potential should be brought into full swing and it must be firmly believed that every student is creative and students must be encouraged to think independently and do things in a new way and challenge authorities. Students’ creativity must be aroused and their creative character must be cultivated. For example, they must have a high sense of independence, a strong thirst for knowledge and curiosity, a rich imagination and an ability to think critically.

Secondly, college students should keep up with the time and change their view of learning. They should change their view of learning for exams and higher level of schools to learning for creativity and enterprise and their action should center around such purposes. They should have a solid foundation for basic theories and special knowledge and they should master both basic and special skills and skills of enterprise to satisfy the need for social development.

Thirdly, the conception of enterprise education as the core of education must be accepted and a good and enterprise education environment must be created. Moral education sectors must take the main responsibility to organise all kinds of cultural activities on campus and spread the idea of enterprise and individuality thus form an atmosphere of campus culture to develop students’ creativity.

5.2. Forming a first-class team of enterprise education

Teachers are the subjects of teaching and practitioners of advanced teaching ideas. These ideas mean nothing without a change old teaching ideas and activities. To have a qualified teaching team at colleges professional enterprise education training is necessary especially at colleges so that teachers become broad in knowledge, solid in theory and profound in academy. Students will be well-instructed in enterprise education. If teachers are well-equipped with enterprise spirit and ability they will become good teachers and friends of their students. If they are good at handling information they will be able to deal with difficult technical problems in tutoring the students. Secondly some measures must be taken to build up a dynamic part-time team of teachers. According to the success of enterprise education both at home and abroad and our practice in this field teachers for enterprise education should come from colleges, departments of economic management, technical engineering, government sectors, investment companies and so on. They are in a system of dynamic development as theorists in economic management, specialists in technology, government officials, successful entrepreneurs, risk capitalists and experts on law. They will inspire and guide students in relative enterprise aspects.

5.3. Establishing a special system of enterprise education syllabus

The cultivation of people of enterprise is a process of upgrading cognition

Firstly, the idea of ability as the core of education must be carried out in planning teaching objective and norm of talented people and the basic goal of education should be enterprise skills and spirits. Enterprise education should be in every teaching process throughout students’ stay at college.
Secondly, enterprise education should be taken as a course. To encourage students to start their business means providing practical and valuable enterprise courses for students to ensure the encouragement and support at college or after graduation and students’ ideas for enterprise can be converted into enterprise actions. As the enterprise course does not belong to any speciality it can be offered to all students as a selective course.

Thirdly, the teaching content and method should also change accordingly. Markets need and social trend must be studied at colleges so that the selection of courses, syllabus and content of teaching will meet the need of future development. Enterprise course may include the following fields: the first category includes knowledge of law, finance relevant to enterprises or companies e.g. certain parts of constitution, contracts, corporate laws, intellectual property rights, patent technology and taxation etc. The second includes knowledge and skills relevant to the inner management of the company such as enterprise planning, capital management, capital raising, assets management, cost control, market analysis, product development, marketing and product services; the third includes basic management such as decision making, organising, leading and controlling and quality management etc. In moral education teachers should include enterprise education in varied ways. For example classroom teaching can take the form of discussion and so on to combine the moral education with students’ real life so that their interest will be aroused. The method of motivation can also be used to encourage students to imagine so as to cultivate students’ ability to think creatively.

6. CONCLUSION

Entrepreneurial education aims at cultivating entrepreneurial talents, and consists of the contents as cultivating entrepreneurial moral, consolidating entrepreneurial sense, modeling entrepreneurial spirit, elevating entrepreneurial capability, pointing entrepreneurial way. Its main channel lies in in-class study, out-of-class activity, social practice; students are the main body and teachers are the main guidance. Meanwhile, it’s an educational system with closely cooperation between schools, societies and families. Entrepreneurial education is the extension of quality education, the break through of employment, the innovation of education and the new evolution of vitalizing the national economy.

With the fast development of science and technology and the continuous deepening of education reforming, the Entrepreneurial education become more and more important to be the future focus of the talents cultivation. To meet the demand of the modern education, the demand of scientific outlook on development, the demand of calling for talents’ grow, moral education should be at the very important place in course of cultivation innovative talents. The Entrepreneurial education should be combined with moral education, research on the method of implementing Entrepreneurial education in colleges, elevate Entrepreneurial education and moral education on facets of scientificness, pertinence and statute of limitation.

7. REFERENCES

A RESEARCH ON THE INNOVATION AND ENTREPRENEURSHIP MODE AND IMPLEMENTATION WAYS FOR UNIVERSITY STUDENTS – TAKING SHIJIAZHUANG UNIVERSITY OF ECONOMICS (SJZUE) AS AN EXAMPLE

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ABSTRACT: The purpose of this paper is to analyse and define the main problems and key elements that affect the practical effect of university students' innovation and entrepreneurship education, and to plan the idea and mode for conducting university students' innovation and entrepreneurship education more scientifically through a comprehensive summary on the basic mode and implementation ways of Chinese university students' innovation and entrepreneurship education. Based on the comprehensive analysis of the mode, operation process, achievement and the existing problem of innovation and entrepreneurship education in SJZUE and other universities in China, this paper constructs a new mode and implementation way of innovation and entrepreneurship education for Chinese university students, which includes three coupling and interactive modules of logic content module, procedure guidance module and system support module. Some solutions and suggestions are put forward for enhancing the work of innovation and entrepreneurship guidance centre, completing the construction of Production, Education &Research practice base, promoting the teaching revolution, and enhancing the construction of internal and external environment.

Key words: innovation and entrepreneurship; mode and implement ways; innovation experiment; achievement transformation

1. THE BASIC METHOD AND PATH OF UNIVERSITY STUDENTS’ INNOVATION AND ENTREPRENEURSHIP ACTIVITIES IN THE UNIVERSITY

The development of innovation and entrepreneurship activities in SJZUE originated from the selection and application of innovation design and extracurricular scientific design in China. Through many years’ accumulation and correction, we have formed a continuous operating system of innovation and entrepreneurship activities for college students, which includes the education of innovation and entrepreneurship activities, the practice of innovation and entrepreneurship activities and the achievement of innovation and entrepreneurship activities, and they cooperate each other and proceed harmoniously (figure 1). In the education of innovation and entrepreneurship activities, through conducting the courses of “creation science”, “innovative thought and entrepreneurship”, “entrepreneurship science” and several other subjects, the students’ innovative interests, mind and idea are cultivated. In the practice of innovation and entrepreneurship activities, we encourage students to develop scientific projects, scientific design, social investigation and other activities in order to prove, study and examine their entrepreneurship ideas and capability. In the achievement of innovation and entrepreneurship activities, the result of innovation and entrepreneurship from students will be displayed or demonstrated, such as taking part in the competition of entrepreneurship plan and scientific design, publishing academic papers, the application and the promotion of the achievements (table 1).

![Figure 1. The basic method and path of university student’s innovation and entrepreneurship activities](image)

<table>
<thead>
<tr>
<th>Scientific activities towards students (number)</th>
<th>Different classes of awards (number)</th>
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<tr>
<td>Scientific projects</td>
<td>National prize</td>
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<td>Research reports</td>
<td>Provincial special prize</td>
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<td>Published papers</td>
<td>Provincial 1st prize</td>
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<td>Forum of science for college students</td>
<td>Provincial 2nd prize</td>
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<tr>
<td>Acceptance by different departments</td>
<td>Provincial 3rd prize</td>
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<td>Uni. Presidents prize and excellent prize</td>
<td>Total</td>
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Table 1. The statistics of the achievements of students’ innovation and entrepreneurship activities

Foundation item: Hebei Province Department of Education Humanities and Social Sciences Fund Project (SZ2011807), Hebei Province Social Sciences Fund project in 2012 (201203207)
2. EXISTED PROBLEMS AND DIFFICULTIES IN THE INNOVATION AND ENTREPRENEURSHIP ACTIVITIES

Although the innovation and entrepreneurship activities in SIZUE get many kinks of enforcement, enrichment and perfection from the university, and much progress has been made, the innovation and entrepreneurship activities in the university still remain many problems[2], and it reflects as follows:

2.1. Simple representation and application patterns in the innovation and entrepreneurship activities

Most of the achievements are displayed by awarding, the approaches of the application and transform of the innovative achievements are still deficient, so the economic benefits brought by the achievements are not obvious.

2.2. Inefficient practice and guidance for the innovation and entrepreneurship activities

Recently, innovation and entrepreneurship education activities are stable, but the guidance, cooperation and support from the departments and the teachers are still deficient in academic skills, the scientific research processes, the development of innovative project, the real practice for innovation, and the application and promotion of the achievements made by university students.

2.3. Lack of effective industrialization ways for the innovation achievements

The major phenomenon is that there is no effective approach for the industrialization and application of students' innovation achievement. Students have not established allied organization with social agents. Therefore, the transform and the application of achievements are difficult.

2.4. Imperfect support and environmental conditions for innovation and entrepreneurship activities

There exist some deficiencies in teaching system, servicing system, campus culture and social culture for meeting the need of different level of students to conduct innovation and entrepreneurship activities. To develop innovation and entrepreneurship activities, transform the scientific achievement into products, and put them into application practice all need the support of policy environment both inside and outside the campus.

3. THE CONSTRUCTION FOR THE PATH OF INNOVATION AND ENTREPRENEURSHIP ACTIVITIES

Through summarizing the pattern and idea of developing innovation and entrepreneurship activities in universities in China, we build a activity mode or frame which contains three parts (figure 2):

- **Teaching System of Innovation and Entrepreneurship**
  - Education of Innovation and Entrepreneurship Activities: Establishing ideas, consciousness and intellectual property of innovation and entrepreneurship
  - Practice of Innovation and Entrepreneurship Activities: Research, experiment and development of innovation and entrepreneurship projects
  - Result of Innovation and Entrepreneurship Activities: Application, transform and spread of innovation and entrepreneurship results

- **Servicing System of Innovation and Entrepreneurship**
  - The transform and the application of the results
  - The guidance and the support of policy environment

- **Political Environment of Innovation and Entrepreneurship**
  - Establishing of legal framework
  - The guidance of policy environment

- **Cultural Environment of Innovation and Entrepreneurship**
  - The promotion of cultural environment
  - The establishment of social organization

*Figure 2. The pattern and path of Innovation and Entrepreneurship for college students*
3.1. Logic content module of innovation and entrepreneurship activities

This module includes teaching, practice and application of innovation and entrepreneurship activities. The education of innovation and entrepreneurship activities will help the students to establish the notion or idea of entrepreneurship through related subjects, practice, reasoning and the selection. Through the study and practice, combining with related to academic knowledge and skill, students can determine, demonstrate and select the innovation or entrepreneurship projects based on the extended social investigation. The practice takes of innovation and entrepreneurship imburs students to determine project and make scientific research through establishing student-faced projects. Through conducting different competition of the different academic skills and innovative practical project, the study, experiment and development works of the project can be accomplished. The application, promotion and transformation of scientific achievements from innovation and entrepreneurship activities can be realized through patent application, industrialization, adoption in different government constitutions, taking part in national or regional entrepreneurship project or works competition, and publishing research papers in different magazines or periodicals[3].

3.2. The process guidance module of innovation and entrepreneurship activities

To support the three takes mentioned above, it is needed to establish relevant platform and guidance centre for innovation and entrepreneurship and establish the base of Production, Education & Research. The education platform of Innovation and entrepreneurship is responsible for planning the education of students’ innovation and entrepreneurship, conducting the classroom teaching of innovation and entrepreneurship, and cultivating students’ quality and capability of innovation and entrepreneurship, as well as guiding the projects selection, reasoning and demonstration. The guidance center of innovation and entrepreneurship is in charge of the tutorial of students’ research work, the organization of contests on professional expertise and skills and the guidance of the experiment and trial production and development. The base of Production, Education & Research helps students with the application of the patent, the recommendation, implementation and transformation of the outcome of the innovation and entrepreneurship contest, representative works selection for participating entrepreneurship contest. Through the effective communication, coupling and interaction among the three takes of education module, we can consistently adjust and optimize the content, form and tutorial method or approach of innovation and entrepreneurship [4].

3.3. The support system module of innovation and entrepreneurship activities

Based on the requirements of each section of innovation and entrepreneurship activities, it is necessary to establish and perfect the innovation and entrepreneurship education system, innovation and entrepreneurship service system, policy environment and culture environment for innovation. In this way, we can provide sound mechanism of teaching and service, internal and external policies and cultural environment for students.

4. SUGGESTIONS FOR PROMOTING THE WORK OF STUDENTS’ INNOVATION AND ENTREPRENEURSHIP ACTIVITIES

On the basis of the construction of students’ innovation and entrepreneurship mode and implementation ways, combing with the existing problems and difficulties in the activities of innovation and entrepreneurship in China universities, the authors put forward some suggestions as follows:

4.1. To maximize the function of college students’ tutorial centre of innovation and entrepreneurship

Students’ tutorial centre undertakes the bridge and link function among education, project demonstration and achievement transformation for the innovation and entrepreneurship of college students. It is an important take for realizing the studying, experiment and development of innovation and entrepreneurship projects. And therefore, universities should establish and perfect tutorial centre of the innovation and entrepreneurship in which includes teachers specialized in class teaching, experimentation and researches, relative professional personnel from enterprises and other institutions specialized in transformation and application of innovation achievements. We should make their function into full play in their professional guidance for the practice and research of innovation and entrepreneurship programs and then we can match the achievements of research & development with the demand of companies, institutions and market.

4.2. To construct the base of production, study and research for college students’ innovation and entrepreneurship programs

The base is a key sector for successful converting and applying the innovation achievements into social practices. According to the present situation both in home and abroad, the construction of the base take two modes. One is to build it based on development garden of science and technology within university, the other is to construct the alliance of innovation and entrepreneurship for students relaying on national or regional development zone of science and technology. Based on their respective situations, different universities or colleges can establish students’ bases in various forms to promote the brewing and industrialization of innovation and entrepreneurship programs.

4.3. Take the innovation and entrepreneurship activities as the breakthrough to push the reform of education

On the basis of strengthening of study of basic knowledge, universities should reform their teaching contents, approaches and methods based on the professional expertise requirement in the process of research, experiment, development and application of innovation and entrepreneurship activities. Teachers should be mainly taken as a role of guiding; in that case, we enable students to convert their courses learning from passive into positive learning on the knowledge demand in the innovation and entrepreneurship activities. Then the pertinence, initiativeness and practicability of knowledge study for students can be promoted [5].
4.4. To construct and perfect the support system for the innovation and entrepreneurship activities

Along with the ongoing of the innovation and entrepreneurship activities of students, it is needed to construct and perfect the teaching and service system, including innovation and entrepreneurship class teaching, experimentation and professional guidance, querying in books, information and literature data. Moreover, we also should create favourable campus culture and internal and external policy system that includes stimulation, investment and finance. Through the construction of internal and external assistant condition and circumstance, the innovation and entrepreneurship activities of college students can be promoted.


DEVELOPMENT OF A METHODOLOGY FOR IMPROVING PRODUCT QUALITY IN ORDER TO MAINTAIN MARKET COMPETITIVENESS

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ABSTRACT: This article summarizes a research study conducted at SC Scandia SRL Sibiu with double purpose: first to propose a methodology designed to help maintain the competitiveness of the market; on the other hand to provide a complex tool use in training of future graduates of academic skills. The methodology developed is multidisciplinary combining established marketing methods and quality management. The team followed the methodology to be effective, easy to apply and involve minimal costs.

Key words: QFD, continuous improvement, customer requirements, technical requirements

1. INTRODUCTION

To cope with fierce competition, organizations constantly seek to improve products and to streamline processes.

Management instruments used in marketing, quality management, production, research and development, can help companies to perform business environment, to prevent and to satisfy consumers.

In particular, produced food is perceived and consumed by each of us, premise on which researchers started the study in this direction.

Consumers of food have multiple expectations from consumed products, with profound implications, both for rational and emotional order.

Tools applied in the development of this methodology are established tools in marketing, R&D and calitologie, as follows:

1. Market research method - qualitative research. In qualitative research approach two instruments were used:
   a) focus group discussions - to investigate in depth consumer habits packaged canned meat products;
   b) duo type interviews - to identify barriers to consumer packaged canned meat products.

2. Methods for determining the technical parameters. To determine the physical and chemical parameters standardized and validated methods were used: ISO 1442:2010 humidity, ISO 1444-2008 Fat, Protein ISO 937/200, ISO 1841-2:2000 salt. For organoleptic characteristics were used:
   a) sensory examination analytical methods, namely methods for assessing the quality - small number of points scored method, scoring commented;

Quality Function Deployment (QFD) is a planning tool that aims to design a product or service quality based on customer needs. It is an approach involving cross-functional teams seeking full product development cycle.

2. CASE STUDY

The proposed product quality improvement methodology involves the following steps:

- Stage 1. Setting goals;
- Stage 2. Identifying customer requirements;
- Stage 3. Identifying technical requirements;
- Stage 4. Correlations;
- Stage 5. Data analysis;
- Stage 6. Identification and evaluation of improvement alternatives;
- Stage 7. Planning improvements.
- Stage 8. Control.

2.1. Stage 1. Setting goals:

The research aimed to achieve the following objectives:

- Identifying consumer perceptions and habits;
- Investigation of existing brands into categories in terms of benefits;
- Generating optimal product.

2.2. Stage 2. Identifying customer requirements

Consumer panel was selected based on the typology mainstream consumer product [1].

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<td>DUO 5</td>
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Criteria that underpinned the process of identifying customer requirements were:

- Familiarity;
- Safety;
- Comfort / convenience and relaxation;
After market research the following customer expectations resulted:

- **Familiarity** = prepared "like at home" (recipe type, ingredients, texture and overall presentation gives a sense of familiarity, closeness, care of others);
- **Safety** = safe product for consumers not inducing disease risks;
- **Comfort / Convenience and Relaxation** = often get out of the impasse - makes life easier in the kitchen, relieving housewife for some or even all of the steps in preparing a snack for herself and family;
- **Beautiful** = packaging especially important the first purchase of a variety or brand, may inspire the play as suggestive content, and with a clearer presentation of the ingredients. A sign of product quality it contains:
  - Bright colours draw the eye and give the impression of a good product is flavour full;
  - Wiped / dull colours product conveys as doze, made for people without expectations, trivial;
- **Health** = contains additives and ingredients detrimental to health;
- **Fast** = is the way to have a quick snack effortlessly when you have cravings, satisfy the need for relaxation, leisure and comfort at any time of day, especially at work or when travelling. An affordable and convenient solution, especially in terms of time spent in the kitchen;
- **Accessible** = price gives clues on product quality and manufacturer concern. A higher price indicates a high quality, yet the Romanians will always choose the middle path - the average price for a satisfactory quality;
- **Consistent**:
  - Start time of day associated with the idea of energy and freshness, but also with the idea of consistency and endurance. For this they choose sandwiches and produced in small quantities, but with higher caloric intake, providing the energy they need;
  - Provides a feeling of fullness soon;
- **Colour** = specific to meat (pink-brown-yellow);
- **Odour** = odour of spices and meat;
- **Tasty** = specific taste, pleasant, liver and spices;
- **Spreadable** = specific texture, easy to spread on bread, without removal of gel or grease;
- **Quantity** = small portions enough for a meal of this type;
- **Notoriety** = the trademark / brand:
  - Origin / area of origin of the manufacturer so subtle details about the quality of ingredients used, the accuracy of which is prepared products and so on;
  - Brand image matters less, as a category that is less emotional involvement;
  - Growing importance to provide information about product quality. Usually experience with brands in other categories close help decision.

2.3. Stage 3. Identifying technical requirements

As a reference in the definition of technical parameters technical documentation and product specific legislation in force were used. Thus the following technical requirements were identified:

- Microbiological criteria (absent);
- Cover EO / optimized fixed
- Humidity (max75%);
- Fat (max30%);
- Protein (min 9%);
- Salt (max 2%);
- Pork Liver (min 20%);
- The energy (185kal/100k);
- Additives content (no);
- Design.

2.4. Stage 4. Establishing the correlations

To establish correlations the research team turned to the house of quality [2] (Figure 1).

![Figure 1. Block diagram of QFD matrices](image-url)

This part forms the main body of the house of quality and requires extensive effort to be complete. Its purpose is to transform customer requirements as they were formulated in technical characteristics of the product.

Its structure is that of standard two-dimensional arrays, with individual cells that binds combinations of customer and technical requirements.

The level of interaction is weighted in the manner usual awarded on a scale with four levels: high (9), medium (3), down (1) and irrelevant (0) and a symbol representing the level of interaction is introduced into the cell.

QFD team's task was to identify where these interacting matter. Each combination of customer demand - Technical requirements are analyzed one by one by the QFD technical team.
2.5. Stage 5. Data analysis

Applying the QFD methodology the team identified the need to adjust technical characteristics. Thus the impact of each characteristic on customer expectations was analyzed and four main improvement on content have been highlighted:

- Fat;
- Proteins;
- Salt;
- Additives.

Directions for improvement were identified and were translated into measurable objectives presented in Table 3.

2.6. Stage 6. Identification and evaluation of improvement alternatives

In this stage, the research team used an instrument called a matrix for selecting the alternatives [3] (table 2) and gave the following scores:

- 3 - very positive impact;
- 2 - environment impact;
- 1 - slightly positive impact.

Also have used the following selection criteria:

a) total cost;
b) the impact on the problem;

c) the cost / benefits;

d) resistance to change;

e) implementation time;
f) uncertainty about the effectiveness.

Table 3. Selecting the improvement alternatives regarding to clients requirements

<table>
<thead>
<tr>
<th>Objective</th>
<th>Improvement alternative</th>
<th>Selection criteria's</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreasing the number of additives from 11 to 8</td>
<td>Use of natural functional alternatives</td>
<td>1 1 3 2 2 3 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changing the proportion of used ingredients</td>
<td>1 1 2 1 3 1 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changing recipe ingredients</td>
<td>1 1 1 2 2 2 9</td>
<td></td>
</tr>
<tr>
<td>Increasing the percentage of protein from 9 to 10%</td>
<td>Use of protein concentrate</td>
<td>3 3 3 2 2 2 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increase in liver volume</td>
<td>2 3 1 3 2 2 13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use of meat</td>
<td>1 2 3 3 2 1 12</td>
<td></td>
</tr>
<tr>
<td>Decreasing the percentage of NaCl from 1.4 to 1.3%</td>
<td>Use of natural flavors</td>
<td>1 3 2 3 2 3 14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use of other food salts</td>
<td>1 2 2 1 3 1 10</td>
<td></td>
</tr>
<tr>
<td>Decreasing the fat percentage from 17 to 15%</td>
<td>Increasing amount of pork skin</td>
<td>3 3 2 2 3 1 16</td>
<td></td>
</tr>
</tbody>
</table>
2.7. Stage 7. Planning improvements.

After evaluating the alternatives for improvement, the team established corrective action, resources and responsibilities and developed an action plan.

Table 4. Planning improvements

<table>
<thead>
<tr>
<th>No.</th>
<th>Objective</th>
<th>Improvement alternative</th>
<th>Resources needed</th>
<th>Responsible</th>
<th>Deadline</th>
</tr>
</thead>
</table>
| 1   | Decreasing the number of additives from 11 to 8 | Use of natural functional alternatives | M: natural ingredients  
H: R & D and acquisition specialists  
F: according to acquisitions budget  
I: literature, product specs, legislation | R&D Manager | 6 mounts |
| 2   | Increasing the percentage of protein from 9 to 10% | Use of protein concentrate | M: protein concentrate  
H: R & D and acquisition specialists  
F: according to acquisitions budget  
I: literature, product specs, legislation | R&D Manager | 3 mounts |
| 3   | Decreasing the percentage of NaCl from 1.4 to 1.3% | Use of natural flavors | M: aromatic plants  
H: R & D and acquisition specialists  
F: acquisitions budget  
I: product specs | R&D Manager | 6 mounts |
| 4   | Decreasing the fat percentage from 17 to 15% | Increasing amount of pork skin | M: aromatic plants  
H: R & D specialists, production engineers  
I: Product technical specifications, physicochemical analysis | R&D Manager | 2 mounts |

Table 5. Control chart

<table>
<thead>
<tr>
<th>Measure</th>
<th>Wow is measured?</th>
<th>Were?</th>
<th>Who is measuring?</th>
<th>What does?</th>
<th>Reference</th>
<th>Who verifies?</th>
<th>Where registers?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease E's No.</td>
<td>Organoleptic evaluation. Product tests</td>
<td>Physico-chemical laboratory</td>
<td>Internal evaluation team</td>
<td>Accept or reject the test</td>
<td>Standard product/ Technical</td>
<td>Marketing Manager</td>
<td>Organoleptic evaluation sheets</td>
</tr>
<tr>
<td>Protein increase (%)</td>
<td>Organoleptic evaluation and physicochemical properties. Tests/product</td>
<td>Laboratory fizico-chimic</td>
<td>Internal evaluation team; Analyst</td>
<td>Report the obtained parameters to the reference value.</td>
<td>Standard product/technical specification of the product; Legislation</td>
<td>Marketing Manager; Quality Control Manager</td>
<td>Organoleptic evaluation sheets; Bulletin of physico-chemical analysis</td>
</tr>
<tr>
<td>Decrease (%) Sodium chloride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat decrease (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.8. Stage 8. Control

At this stage the project team designed and implemented controls to ensure that corrective actions will be used and maintained. These activities are shown in the control chart. From the process of data gathering, resulted an important direction, common to all technical requirements: improving product recipe as modifying the physico-chemical properties: NaCl reduction, reduced fat content, protein content increased, reducing additives content.

3. CONCLUSIONS

Tools used in developing the method are classic tools, quality tools, marketing, management, team performance management, project management, leading to develop a methodology to improve products, easily applied, low-cost motivational effects on team members project, designed to ensure effective and efficient business.

Method development is the result of interference technical and academic expertise of the multidisciplinary team, which highlights the synergy process knowledge, innovation and research.

The challenge organizations to be competitive in the current macroeconomic context requires addressing methods developed in partnership with academia, to build complex results of the research, while offering practical support in completion of works.

4. REFERENCES

INNOVATIVE NEW METHODS FOR ENGINEERING AND BUSINESS EDUCATION
ABSTRACT: The paper presents a pull production mechanism that based on Kanban cards and a Heijunka panel. Based on this model, a game was developed that enables students to get a better understanding of pull production in manufacturing streams. The game is played in several rounds. Emphasis is laid upon the importance of work balance in manufacturing cells, as well as on the necessity to reduce the time required to switch production. The game also underlines the dependency between the number of cards in the process and the level of interopertational stocks. Last but not least, students are confronted with aspects of teamwork. Based on suggestions from the students and from the acquired experience, some ideas were formulated for the improvement of this educational activity.

Key words: lean manufacturing, Kanban, Heijunka, game

1. INTRODUCTION

Research performed by psychologists and teachers in education has shown the existence of a number of so-called laws of learning.

Some of these have been discovered by Thorndike [2], while the others by Hilgard and Bower [1], as well as Seligman [8]. These laws are: readiness (the individuals learn if they are physically, mentally and emotionally ready to learn); exercise (whatever is being repeated is easier to remember); effect (learning is easier when it is accompanied by a feeling of pleasure or satisfaction); primacy (the first student experience is the foundation on which all that follows is built, and it is therefore important that this experience is a positive one); recency (recently learned items are easier to refresh); intensity (a learning experience that is vivid, clear and dramatic enriches the pupil far better than a boring routine) and freedom (items that are learned freely and in an unconstrained way are better remembered and fixated).

The understanding of the principles of learning explains the success that learning games have in the educational process. The game enables the students in a mental state of maximum mental focus and enjoyment towards getting involved or following a process. Basically all the principles of learning are obeyed whenever the game is a success. This is the reason why games are increasingly used within educational processes.

The purpose of this paper is to present a game that can aid the understanding of the organisation of the pull production mechanism via the Kanban cards and the use of the Kanban Heijunka panel, which is a fundamental methodology of organising modern companies.

2. LEAN MANUFACTURING

Lean manufacturing is a production management concept, devised by the company Toyota, whose main purpose is removing any form of waste. To apply this methodology one has to implement a series of step-by-step methodologies inside continuous improvement projects (kaizen). Additionally, an honest organisational culture, teamwork, awareness of employee needs, as well as individual and group improvement is equally important.

Generally, all companies, irrespective of whether they desire or not to implement the principles of agile manufacturing in the long term, start off by improving the layout of space. This is accomplished through the 5S and visual management methodologies, without the necessity to implement any other specifically lean methods. It is not uncommon that with a rather small financial effort a significant diminishing of losses be attained.

Many companies, and especially those which manufacture a wide array of products, keep the push production system. They use management systems such as MRP (Manufacturing Resources Planning) or, more recently, ERP (Enterprise Resources Planning). Even these companies use the Kanban supply system, as it enables them to work with small intermediary product stocks.

In companies producing a narrower array of products, having stable clients and suppliers and trying to maximise production efficiency without the high costs associated to ERP systems, the pull manufacturing stream and the Kanban production system are implemented. This system is somewhat harder to understand as it requires a detailed understanding of the daily planning mechanism, as well as of the pull production system. This is the system we will focus on further on.

Figure 1. Steps of the implementation of the lean methodology
There are also other production optimisation instruments, such as SMED (single minute exchange of die) or quality enforcement instruments. However, all of them are mere parts of larger production management systems, which can be of either push or pull type.

It is to be noted that the instruments of agile manufacturing are applied successively and repeatedly. After applying 5S and Visual Management, it is frequent that the Kanban supply management system be implemented, followed by the Kanban production system, and of course alongside improvements to the previously implemented systems. Continuous improvement is an important axis in the life of an organisation. (fig. 1)

2.1. Lean Manufacturing Games

Lean implementation processes largely depend on the way in which they are understood by all the participants to the process. In order for this understanding to be as clear as possible, a number of educational games were devised until now. They are useful to both students delving into the subject matter and to employees working in companies that apply the Lean Manufacturing methodology.

In order to grasp the effectiveness of the 5S method, games were devised on the principle of having to quickly recognize shapes. The number of firms who use such games is relatively large.

Other games underline the power and benefits of creating flow in the working processes. The games are played in rounds each of them demonstrating traditional layout, cell layout, single-unit flow with pull, [3]. NCube, L. proposes “The Lean Lemonade Tycoon”, a game in which groups of students produce and sell lemonade. The continuous improvements of businesses are performed by applying the main Lean instruments [7]. Shannon et al. propose a simulation exercise that provides students a hands-on experience in developing and evaluating alternative lean implementation strategies [9]. Yazici developed a game that allows students to better understand layout modelling and evaluate various manufacturing and labour-allocation strategies [10]. “Goldratt’s Game” is an Excel simulation with the purpose of helping the participants understand the impact and interaction of statistical fluctuations and dependent events on the process flow [4].

In order to achieve understanding of certain aspects of the Kanban concept, Excel simulations were created, which explain how the number of products to be manufactured each day has to be computed, according to the number of products ordered by the client. There are also simple games that portray the functioning of the withdrawal kanban system.

Functional models of Kanban production systems that use Kanban board and production pull systems are less present in literature. Kumar presents a synthesis of the types of Kanban methods that appear in literature [5]. Matzka models a more detailed Kanban system with production levelling, but does not show all the functions that a Kanban Heijunka board possesses [6].

2.2. Kanban-Heijunka principle

In this paper the functioning of the pull production system is described, in which production is triggered by a Kanban Heijunka board.
In this system the Kanban Heijunka board has both a role in triggering the production and in triggering the supply operation (fig. 3). For this purpose, the cards are used on both sides. One side has a colour that is specific to a product, while the other one is white. The name of the product is written on both sides. For example, let us consider that on the assembly line four products are being built. We shall label them M, N, O, and P. When the card is placed on the board with the white side facing out, it means that supplies need to be brought in the interational supermarket-type stock number 1 (fig. 2). This rule must be checked for at regular intervals, and, whenever necessary the stocks have to be updated accordingly. In this moment, all the respective cards are turned with the other side facing out, i.e. the coloured one instead of the white. The number of coloured cards thus always indicates the number of pieces waiting in the supermarket stock number 1 to enter the production of the respective product.

On the Kanban board, next to each product stack two arrows are drawn. Whenever the coloured cards reach up to the bottom arrow, production can commence. Whenever the number of coloured cards reaches or surpasses the top arrow, production on the respective assembly line must commence.

For a product the number of cards and the position of the arrows is directly proportional with the number of products ordered by the beneficiary.

After the product starts being produced, the cards will be taken off the board and will accompany the product up to its final destination (supermarket number n). All along this path of operations the FIFO principle must be obeyed (first in first out). From the supermarket number n the free cards return to the board and the products are carried to the finite product warehouse, from where they will be transported to the beneficiary. On the board the cards will be again displayed with the white side visible, which means a new supply of work pieces for the respective product.

At any time the product with the highest level of supplies will enter production.

It is to be noted that the Kanban Heijunka board is genuinely a pace maker of the production system. The adjustment of the production commands (based on the quantities ordered by the beneficiary), as well as further adjustments of production planning are all performed by adding or removing cards from the circuit. For any product, the number of cards is directly proportional to the request of the beneficiary and should also be proportional to the time required to change the production. The longer it takes to switch the production, the larger the number of cards should be for a certain product.

3. **KANBAN HEIJUNKA GAME**

One objective was to elaborate a game whose main objective was to make students understand the complex mechanism underpinning the pull production system using cards and Kanban Heijunka boards.

3.1. **Setup of the game**

The story line of the game is that a group of 8 to 12 students start a company that produces four paper toys: M – a small paper boat made out of A5 paper, N – a boat made out of an A4 paper sheet, O – a paper airplane and P – a paper helm. The students take on the following roles: production manager, logistics manager, 3 to 4 workers, transporter (of both work pieces and finite products) and production engineers, who organise and optimise the activity. Out of the total product request from the beneficiary, the proportions required from each product are as follows: M – 40%; N – 20%; O – 20%; P – 20%. There is a production triggering board constituted similarly to the one in figure 3. Each card will accompany a batch of 2 products of the same type, which corresponds to a container. The students are given the task to organise themselves in the group and then to organise and control the production.

3.2. **Playing the game**

Several rounds are played and each time the number of pieces produced in a unit of time (7 minutes) is followed, as well as their percentage. Additionally, the duration on each job and the lead time are timed. The production engineers optimise the process after each round. The first round starts off with a number of 8 cards for product M and 4 cards for each of the products N, O, and P. After more rounds they managed to reduce the time required to switch the production and finally, at the last round they brought down the number of cards to 2 cards for product M and 1 card for each of the other three. Every time stock levels are also being measured.

3.3. **Learning from the game**

At the end of the semester the students filled out a questionnaire in which they were asked what they learned from the game. The understanding of the way the Kanban production principle works was still vivid enough so as of 85% of them were able to coherently explain the mechanism behind the Kanban board and pull production. The main conclusions drawn about the functioning of a manufacturing stream (a manufacturing cell) were as follows: at the beginning, the poorly optimised process had bottlenecks, the level of inoperable stocks was large, and the system suffered from long waiting times in changing the production. The result were long lead times and a small number of products. After the work load was balanced, the production got more fluid, the same work could be performed by fewer workers and the stock levels decreased dramatically. The shortening of the production change times allowed the reduction of cards per process and, therefore, also of stocks. Thus, the students grasped the overall functioning of pull production, the connection between the number of cards and the level of stocks, the importance of work load balance in the manufacturing cell, as well as the importance of reducing the time assigned to changing the production.

3.4. **Game improvement**

Asked at the end of the semester about what improvements they consider that should be brought to the game, they emphasised the need of a previous presentation in which the concepts behind agile manufacturing appearing in the game to be clarified.

At the first games the instructions were oral, after which the group had the freedom to lead the game by themselves. The results were such that the groups that had a charismatic leader had the best results, whereas the other groups were less effective. Therefore, at subsequent games the actions were led by the teacher to a greater extent, with the aid of PowerPoint explanation of the characteristics of the round. The teacher then set out to supervise the structure of the groups in such a way as to achieve the best results, but at the same time avoiding to place too many constraints on the groups. If a group chooses its leader within the first 5 minutes, the game is left to develop more freely. Otherwise it has to be done rigidly through strict
requirements on the organisation of each round, as formulated by the teacher.

It is useful to have a period in which students have a chance to learn how to build the paper toys, before the game itself starts.

The students were also stimulated to analyse the results and to draw conclusions after each round. An important phase in learning was the summary of the game, the recapitulation on how production pull is performed with Kanban cards, and the analysis of the causes and effects of the observed phenomena. It was very interesting to also analyse the behavioural models played by each of the students, as well as suggesting the behaviour that would lead to the unity and progress of the group. The optimum group size was found to be 6 to 8 people.

4. CONCLUSIONS

Lean games are excellent methods that enable students to understand the Lean Philosophy concepts. A game was described that leads to an understanding of the functioning of the pull production lines using Kanban cards and the Kanban-Heijunka board. The paper has also presented our experiences from playing those games with students. Based on the way the games evolved and on the suggestions from the students who were involved, a series of useful recommendations for the future were formulated. Of major importance were the analyses performed after each round and after the end of the game. It is also very useful to document these observations for future reference. Last but not least, an important analysis to be performed during the game is that of the observed effects and their causes.

5. REFERENCES

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STATISTICALY ANALYSIS FOR IN-DEPTH UNDERSTANDING OF THE VEHICLE LIFETIME LOAD CYCLE

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ABSTRACT: The automotive industry faces future important changes through adoption of several new complex technologies like "X-by-wire" systems for vehicle dynamic control and high focus on green technology, fuel efficiency hybrids and electric vehicles. The implications of these technologies require in-depth understanding of the vehicle behavior during lifetime cycle, in order to reach a maximum optimized design. Therefore this paper introduces an analysis of a long-term capture data collection from a fleet of serial production vehicles in normal everyday use, as a solution to the lack of information available to describe the vehicle dynamics and load over the systems in a sufficient way. The analysis brings knowledge-based information, where before was difficult to answer and where statements were mainly based on subjective explanation. Results reveals important information describing load cycles during vehicle lifetime for different control events with focus on the braking events.

Key words: automotive, vehicle lifetime cycle, complex technologies, vehicle dynamics

1. INTRODUCTION

In the past recent years the automotive industry faces an increasing number of features installed in vehicles and as well their technical complexity, resulting in an increased likelihood of faults to occur during the lifetime operation. The OEMs (Original Equipment Manufacturers) targets for quality and safety standards are set to a very high level. To achieve auto maker’s standards, research and development process has been pushed to introduce more complex and innovative technologic development methods for testing and analyzing a product during design and development phase in such a way that that the best performance and design reliability throughout the life cycle of the product is achieved.

In this matter this paper proposes an original approach of analyzing statistically an existing collection of data recorded from a fleet of several serial vehicles under normal everyday use. The purpose of this study is to cover the lack of information available to describe vehicles dynamics and load over the systems and subsystems in a sufficient way. The collected data analysis is done with a focus on the vehicle brake system and results of observations are presented by creating data histograms which highlights useful information of vehicle load cycles.

For automotive related products, especially for complex, innovative technologic developments such as X-by-wire, the additional information’s described in this paper are similar and applicable to other automotive technologic developments, such as non-conventional power trains, hybrid power train, automotive batteries and brake energy recuperation, among many others. By using this analysis results, extra information regarding vehicle dynamics in real life use is helpful in prototype design phase, by avoiding oversize of components and by redefining tests which can be in some cases exaggerated introducing unnecessary additional time consuming and financial spending.

This paper begins by describing in detail the electronic equipment used and the data collection in Section 2. Thereafter, Section 3 includes a general relevant statistical analysis of the data collection, followed by an analysis focused to the braking system in Section 4. Conclusions and future work in section 5.

2. INSTALLATION OF TECHNICAL EQUIPMENT AND DATA ACQUISITION

2.1. Equipment and installation

Modern vehicles include up to 70 electronic control units (ECU the electronic control units) installed in the vehicle for various subsystems that have many functions such as engine management module (ECM engine control module), transmission, airbags, function anti-lock wheels while braking (braking/ABS), cruise control function, electric power steering, stereo, windows, doors, mirror adjustment, etc.. All these subsystems are connected and include various functions through a communication network called CAN-Bus (Controller Area Network) and allowing data transmission easily with the use of microcontrollers. The Figure 1. schematic represents subsystems connected together by CAN-Bus network communication.

Figure 1. CAN-Bus (Controller Area Network).

The data acquisition is facilitated due to the reason that vehicles in serial production are designed with direct access to the CAN-Bus communication network via USB outlet. Data real time recording is done using dedicated electronic
equipment (Data-Loggers) installed in the vehicles whose properties make it possible to record data over long periods of time without great effort and without additional technical changes to the vehicles. Data recorder CAN case XL type is equipped with SD-card slot and can be operated without a computer. It is configured with its own software, and has storage capacity of up to 1GB. The transfer of recorded data to a PC is done using removable SD memory card. In Fig. 2 is showed the electronic data acquisition equipment and how these recording devices are connected to the CAN-BUS communication network in the vehicle.

2.2. Data collection using recorders

For this study a fleet of five different vehicles have been chosen. The vehicles are typical passenger cars of different engine capacity driven in the area of Frankfurt, Germany. Table 1. shows a short overview over the real-time collected data and highlights important information like the number of observation days, kilometres travelled by the vehicles and characteristics regarding vehicle engine type and power.

Table 1. Data acquisition information

<table>
<thead>
<tr>
<th>OEM</th>
<th>Model</th>
<th>Observation [days]</th>
<th>Traveled distance [km]</th>
<th>Engine Type</th>
<th>Power [kw]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daimler AG</td>
<td>C320</td>
<td>821</td>
<td>71,308</td>
<td>Otto</td>
<td>160</td>
</tr>
<tr>
<td>Daimler AG</td>
<td>C200</td>
<td>618</td>
<td>38,980</td>
<td>Otto</td>
<td>135</td>
</tr>
<tr>
<td>Daimler AG</td>
<td>C320</td>
<td>798</td>
<td>54,257</td>
<td>Diesel</td>
<td>165</td>
</tr>
<tr>
<td>Daimler AG</td>
<td>C220</td>
<td>245</td>
<td>28,711</td>
<td>Diesel</td>
<td>125</td>
</tr>
<tr>
<td>Daimler AG</td>
<td>C220</td>
<td>449</td>
<td>51,783</td>
<td>Diesel</td>
<td>125</td>
</tr>
<tr>
<td>Daimler AG</td>
<td>C320</td>
<td>186</td>
<td>13,494</td>
<td>Otto</td>
<td>160</td>
</tr>
</tbody>
</table>

The signals available to be recorded trough the BUS communication network are listed in the Table 2, together with the corresponding units in the second column of the table. Drive recorders recorded the vehicles movements between each ignition on and ignition off called one “driving event”. Recording is done at a rate of every 100[ms] meaning that ten times per second for each signal one measured value is registered.

Table 2. List of recorded signals.

<table>
<thead>
<tr>
<th>SIGNALS NAME</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside temperature</td>
<td>Celsius degree [°C]</td>
</tr>
<tr>
<td>Ignition switch state</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>Gear selection</td>
<td>value between 1 and 6</td>
</tr>
<tr>
<td>Actual engine rotation speed</td>
<td>[RPM]</td>
</tr>
<tr>
<td>Steering wheel angle</td>
<td>Degree [°/s]</td>
</tr>
<tr>
<td>Vehicle longitudinal acceleration</td>
<td>[m/s²]</td>
</tr>
<tr>
<td>Vehicle lateral acceleration</td>
<td>[m/s²]</td>
</tr>
<tr>
<td>Vehicle yaw rate</td>
<td>Degree [°/s]</td>
</tr>
<tr>
<td>Front left wheel speed</td>
<td>[RPM]</td>
</tr>
<tr>
<td>Front right wheel speed</td>
<td>[RPM]</td>
</tr>
<tr>
<td>Rear left wheel speed</td>
<td>[RPM]</td>
</tr>
<tr>
<td>Rear right wheel speed</td>
<td>[RPM]</td>
</tr>
<tr>
<td>Brake intervention by ESP active</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>Brake torque requested by driver</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>Brake pedal state</td>
<td>Newton metre [Nm]</td>
</tr>
<tr>
<td>Brake torque gradient requested by driver</td>
<td>Newton metre per second [Nm/s]</td>
</tr>
</tbody>
</table>

The data collected is transferred on a PC where is analyzed using dedicated software developed using MATLAB.

A sample of drive recorder data is presented in Figure 3. where three signals are represented, vehicle velocity, lateral and longitudinal acceleration. This particular recording represents one driving event which has a length of 300[s]. One recording is starting each time vehicle ignition is on and last till the driver switches off the vehicle ignition.
3. DATA ANALYSIS

3.1. General analysis

In order to obtain graphical representation showing the load during vehicle life time a detailed statistical analysis has been carried out and results are presented using histograms. This type of statistical graphical representation is showing a visual impression of how data is distributed over a defined interval. In this matter several types of histograms have been selected as important to highlight the loads over a vehicle life time:

a) Driving cycles of the vehicles;
   This histogram representation has been done by using the ignition state signal and time between each ON/OFF ignition state. The Figure 3 shows that an average “driving event” duration which is lasting for 877[s]. This proves that many of the drive cycle events are performed during so called “cold start phase” event which is defined as starting the car in the morning and then driving almost immediately. There are also a significant number of 23 events were the car is driven without stopping for about 3 hours.

b) Distribution of velocity during vehicle operation;
   In Figure 4 is represented the vehicles velocity distribution over the range between 0 and 250 [km/h]. On the x-axis of the diagram are the represented the classes of the vehicles velocity with step of 5Km/h and the vertical y-axis represent the time measured in hours for each particular class. From the diagram result is showing that 50% of the time vehicles are operated under the speed of 60 [km/h] and can be counted as “city driving”.

c) Distribution of distance travelled over the velocity range;
   Total distance travelled during the observation period summarise around 180 thousand kilometres and the highest peak from Figure 6 shows that 9000km out of total number of kilometres have been travelled at a speed of 120[km/h]. This chart shows very accurate information’s regarding the velocity regime at which the vehicle is exposed in real life.

d) Histogram of engine speed;
   This type of histogram reveals information regarding the engine speed regime in real life exploitation. Histogram is obtained by defining classes for the engine speed between 800 and 6400 with a step of 200. Figure number 7 reveals that 67% from the total observation time vehicle engine speed range is up to 2000[rpm]. Maximum achieved engine speed belongs to the class interval 6200 and 6400 rpm and lasted in total for 435 seconds.

e) Histogram of temperature;
   The histogram presented in Figure 8, reveals the temperature distribution during vehicles operation. Classes for temperature have been defined between -16 °C and 40 °C with a step of 0.5 °C. Y-axis duration shows that is an all most equal distribution in the range between 0 and 23°C.
f) Distribution of longitudinal and lateral acceleration;

During vehicle life time vehicle is exposed to different levels of acceleration and decelerations, this histogram presents the time duration for each class of acceleration. The histogram is created by defining classes with a step of 0.25[m/s²]. Figure 9 shows a zoom in chart in such a way that can be seen that that level of deceleration is achieving a maximum 1G and the acceleration (positive side) reveals ca level of 0.6G. Duration in time for this extreme accelerations and decelerations values is low under few seconds.

Second type of histogram Figure 10 is showing the corresponding time for each class of deceleration. This histogram is done by quantifying only the decelerations during the moment of braking manoeuvre. Positive values in this chart belong to the brake events where the vehicle is driving in reverse and the braking.

In the first step of the brake applies analysis braking situations are classified into five different categories. The definition of each category depends on the state of motion of the vehicle when brake pedal is applied and when the pedal is released.

a) **driving**: Vehicle is moving continuously during the braking time and it counts the brake pedal until its release;

b) **stopping**: The vehicle is in motion when the brake is applied and vehicle reaches zero velocity when brake pedal is released;

c) **standstill**: vehicle is continuously standing still during total brake apply from the moment when brake is applied until the moment the brake is released;

d) **stop & go**: vehicle is driving, comes to stand still, reaccelerates again and brake is released when vehicle is moving already (typically for automatic transmissions);

e) **drive off**: vehicle is standing still at brake apply and brake is released when vehicle is moving already (typically for automatic transmissions);

Using the braking classification patterns described above result of the analysis shows in Figure 7, that from the total number of events, 77% of the braking situations are part of the first category called “driving” where the initial and final velocity is above zero. The next category “stopping” summarize 15.8% out of all braking situations and 2.7% for the “standing still” situation where brake is applied during vehicle zero velocity (typically for waiting at a traffic light). The next two categories stop & go and drive off are brake events at very low velocities up to 5kph and are mainly caused by driving in busy traffic situations.

The importance of having a classification of this type is very useful for making an accurate calculation when working to topics related to kinetic energy recuperation or driver skills pattern recognition. Due to this reason in the next section are analysed the brake events correlated with the deceleration level this has as well another major contribution in detecting the area where efficiency of energy recuperation is highest.

### Table 3. Braking events overview

<table>
<thead>
<tr>
<th>Data</th>
<th>value</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total recording time</td>
<td>2998:02:50</td>
<td>hh:mm:ss</td>
</tr>
<tr>
<td>Total distance travelled</td>
<td>180.244</td>
<td>[km]</td>
</tr>
<tr>
<td>Braking events number</td>
<td>324.160</td>
<td>event number</td>
</tr>
<tr>
<td>Braking events number per kilometre</td>
<td>1,8</td>
<td>event / km</td>
</tr>
<tr>
<td>Braking events number per hour</td>
<td>108,12</td>
<td>event / h</td>
</tr>
<tr>
<td>Total braking time</td>
<td>501:26:19</td>
<td>hh:mm:ss</td>
</tr>
</tbody>
</table>
4.1. Statistical analysis using 3D histograms

In all the cases analysis presented in the previous section vehicle dynamics under real life exploitations are revealed by creating 2D histograms of the signals recorded. To obtain a more detailed analysis in this section are used 3D histograms using data vectors correlated in such a way that one brake event can be better evaluated. For this reason several types of histograms have been created:

a) Number of brake events versus initial and final velocity

Figure 13 shows the number of brake events applied during vehicles operation where initial velocity is classified on the y-axis and end velocity on the x-axis. This chart shows with red dots that most of the brakes are applied without inflicting a high deceleration to the vehicle velocity. The difference between the vehicle initial velocity and end velocity is less then 20km/h in most of the cases. There are also 40 brakes events which can be defined as emergency brakes where initial vehicle velocity is above 100km/h and end velocity is zero. In the below table several categories have been define for the braking conditions. Each category definition depends on the vehicle state of motion and initial and final velocity. Quantities presented in the analysis table are number of brake applies, corresponding ratio in percentage and the duration in time, and as well the corresponding percentage ratio from the total time of braking.

<table>
<thead>
<tr>
<th>Type of brake apply</th>
<th>initial velocity [km/h]</th>
<th>final velocity [km/h]</th>
<th>brake number</th>
<th>Number of brakes in percentage [%]</th>
<th>duration [s]</th>
<th>duration percentage [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>total</td>
<td>all</td>
<td>all</td>
<td>248971</td>
<td>100%</td>
<td>1394650.1</td>
<td>100%</td>
</tr>
<tr>
<td>stopping</td>
<td>&lt;10</td>
<td>[0 5)</td>
<td>4965</td>
<td>2%</td>
<td>4282.9</td>
<td>0.31%</td>
</tr>
<tr>
<td>stopping</td>
<td>&gt;5</td>
<td>[0 5)</td>
<td>17563</td>
<td>7.05%</td>
<td>40981.4</td>
<td>2.94%</td>
</tr>
<tr>
<td>driving</td>
<td>&gt;20</td>
<td>&gt;5</td>
<td>141436</td>
<td>56.81%</td>
<td>323320</td>
<td>23.18%</td>
</tr>
<tr>
<td>driving</td>
<td>&gt;20</td>
<td>&gt;10</td>
<td>135422</td>
<td>54.39%</td>
<td>295980.3</td>
<td>21.22%</td>
</tr>
<tr>
<td>driving</td>
<td>&gt;20</td>
<td>&gt;20</td>
<td>118271</td>
<td>47.50%</td>
<td>242684.4</td>
<td>17.40%</td>
</tr>
<tr>
<td>driving</td>
<td>&gt;30</td>
<td>&gt;30</td>
<td>99334</td>
<td>39.90%</td>
<td>201948.1</td>
<td>14.48%</td>
</tr>
<tr>
<td>driving</td>
<td>&gt;60</td>
<td>&gt;30</td>
<td>66602</td>
<td>26.75%</td>
<td>168345.3</td>
<td>12.07%</td>
</tr>
<tr>
<td>driving</td>
<td>&gt;60</td>
<td>&gt;40</td>
<td>63432</td>
<td>25.48%</td>
<td>157076.7</td>
<td>11.26%</td>
</tr>
</tbody>
</table>

b) Number of brake events initial velocity and average deceleration;

Histogram number 14 is created in order to bring more information regarding vehicle deceleration during each braking manoeuvre. Therefore, initial velocity of the each brake event is classified on the y-axis and on the x-axis the corresponding average deceleration during braking. Table 4 presents all break events classified in five categories depending on the deceleration values. The categories are defined with a step of 0.1g and the table columns presents a overview regarding the number of brakes applied corresponding to each category and as well the percentage ratio.

<table>
<thead>
<tr>
<th>Deceleration level category</th>
<th>Brake number</th>
<th>Brake number [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>brakes 0 - 0.1g</td>
<td>73779</td>
<td>29.63%</td>
</tr>
<tr>
<td>brakes &gt; 0.1 - 0.2g</td>
<td>123646</td>
<td>49.66%</td>
</tr>
<tr>
<td>brakes &gt; 0.2 - 0.3g</td>
<td>42487</td>
<td>17.07%</td>
</tr>
<tr>
<td>brakes &gt; 0.3 - 0.4g</td>
<td>6473</td>
<td>2.60%</td>
</tr>
<tr>
<td>brakes &gt; 0.4g</td>
<td>1526</td>
<td>0.61%</td>
</tr>
</tbody>
</table>
c) Number of stops and deceleration distribution:

The following last histogram, Figure 15 presents the deceleration distribution versus initial velocity only for the brake applies where final velocity is zero. This histogram helps to understand how deceleration is distributed during brake event where final vehicle velocity is zero. Table 15 shows that brake events where deceleration level is higher than 0.4g are quite rare and represents 0.27% from the total number of stops, and in addition corresponding time duration for this stops is 0.18%.

Table 6. Table Classification by level of deceleration.

<table>
<thead>
<tr>
<th>Deceleration level category</th>
<th>Brake number</th>
<th>Brake number [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>45197</td>
<td>100%</td>
</tr>
<tr>
<td>brakes 0 - 0.1g</td>
<td>16302</td>
<td>36.07%</td>
</tr>
<tr>
<td>brakes &gt; 0.1 - 0.2g</td>
<td>20026</td>
<td>44.31%</td>
</tr>
<tr>
<td>brakes &gt; 0.2 - 0.3g</td>
<td>7283</td>
<td>16.11%</td>
</tr>
</tbody>
</table>

Table 7. Classification by level of deceleration

<table>
<thead>
<tr>
<th>Deceleration level category</th>
<th>Brake time duration [s]</th>
<th>Duration in percentage [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>215331</td>
<td>100%</td>
</tr>
<tr>
<td>brakes 0 - 0.1g</td>
<td>51605</td>
<td>23.97%</td>
</tr>
<tr>
<td>brakes &gt; 0.1 - 0.2g</td>
<td>113192</td>
<td>52.57%</td>
</tr>
<tr>
<td>brakes &gt; 0.2 - 0.3g</td>
<td>7283</td>
<td>3.38%</td>
</tr>
<tr>
<td>brakes &gt; 0.3 - 0.4g</td>
<td>4473</td>
<td>2.08%</td>
</tr>
<tr>
<td>brakes &gt; 0.4g</td>
<td>381</td>
<td>0.18%</td>
</tr>
</tbody>
</table>

5. CONCLUSIONS

This article had the purpose to present an in depth statistically overview regarding vehicles exploitation in real-life. The motivation was to cover the lack of information available to describe the vehicle dynamics and load over the systems in a sufficient way. This data may help in future engineers and researchers from automotive industry to answer questions where before was difficult and in many cases based on estimations. We plan to investigate forward based on this data a possible driver behavior evaluation based on classification of braking patterns and a vehicle driving cycle driving pattern recognition. Other target is to investigate better solutions and to make new proposals for developing more realistic driving cycles as European driving cycles, US driving cycles, Japanese driving cycles used in vehicles testing for compliance to emission regulations.

6. REFERENCES

THE ANALYSIS OF THE TRAFFIC NOISE, IN AN AREA DENSELY POPULATED, WITH GIS SOFTWARE USED IN THE EDUCATIONAL PROCESS

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ABSTRACT: In this paper we present how Geomedia Professional software is used to analyze the influence of urban transport noise in a densely populated area. This software, used in the educational process, allows for concrete measures in real time and long time, to reduce the harmful influence of noise on human factor. Noise maps presented are the result of measurements at the centre of Sibiu at various times of day, several days of the week. One of the objectives of this paper is to present a solution for the protection of citizens who live in an area with heavy traffic. Another objective of this paper is to present the advantages of using GIS products in the study of road transport.

Key words: GIS software, traffic noise, educational process, Geomedia Professional System, noise map.

1. INTRODUCTION

In the current conditions of the company, the man lives in a continuous sound environment. On the street, at work, at home, he is accompanied at all times by a motorcade of noise and vibration from the most different intensity and affecting more or less aggressive about comfort and even health. He is forced to move frequently and wishes to do so as soon as possible. As a result, the cities roadways moving strings endless cars, trucks, motorcycles, buses, trams, thus illustrating suggestively the pace at which the pulsating life of the city. All these means of transport, the constitute, one of the most important sources of pollution limits. Noise pollution was always a problem, but today has become a major problem. Although there are several sources of noise that industry, trains, aircraft, motor vehicles, this paper will focus on road traffic noise. Due to the damage caused to the environment, transport policy of the European Union attaches to the medium - transport relationship. Recent studies have shown that more than 20% of the world's population live in unacceptable conditions and a sound level which is over 60% of the population of Europe is exposed to worrying levels of noise during the day [1], and over 30% during the night [2]. In Romania this percentage is lower due to lower intensities at night and the fact that a large percentage of the population (45%) lives in rural areas where traffic is very low [3]. It is proved that the road traffic noise has a contribution of approximately 80% of all urban noise under present circumstances, becoming an important issue due to land-use planning adapted from the past. The Sibiu city is located near the top of the polluted cities in Romania-proofed. Until next year the city will be a strategic noise map [4]. Noise in the city often exceeds the threshold of 55 decibels, which is the maximum extent permitted by the European Union. Blocks and houses with exit from the major avenues and apartments located on the lower floors are the most exposed. Until the mid of next year, 25 cities in Romania will have to submit to the European maps of noise, the noise level. A detailed study lasts 12 months and includes residential areas, central areas, traffic, road traffic nodes.

2. ROAD TRAFFIC NOISE

The finer human ear can hear the sound of 20 µPa which would mean a pressure of less than 5 \( \cdot 10^{-9} \) than normal atmospheric pressure. Variation 20 µPa is so small that variations in ear eardrum will be less than the diameter of the molecules. In view of this, at the top of the ladder we will have to deal with huge numbers are difficult to use and therefore use another scale, that of decibel (dB). In other words, the value 20 µPa will correspond to the value of 0 dB, when a man cannot normally hears nothing, representing the threshold of hearing, and the value of 130 dB is the threshold for pain. Also, the human ear responds logarithmically increasing sound pressure. This means that whenever you multiply the sound pressure (µPa) 10 times, add 20 dB level measured. Thus, at 200 µPa correspond to 20 dB at 2000 µPa correspond to 40 dB, and so on[5].

In other words we can say that the noise levels not adding up arithmetic, but logarithmic. According to the decibel scale, the result Assembly identical two-level of noise is not a double level of noise, but the noise level increased by 3 dB. Variations in the pressure of air or noise are measured using the microphone. It is built in different variants including the one with the ceramic capacitor and dynamically. You create the impression that it is relatively simple to build an electronic device whose sensitivity varies with frequency in the same way as the human ear. Electronic appliances which possess this property uses four characteristic curves, internationally, the weighting curves called A, B, C and D (figure 1).
2.1. Noise Pollution Caused by Traffic Road

Noise pollution is part of the General pollution of the environment along with the pollution of air, water and other forms of pollution. Under the sound, the noise pollution caused by road vehicles in motion, or parking is the most important factor with noise from other means of transport.

2.1.1. Analysis of factors generating noise from motor vehicles

Below you will analyse each component in turn generating noise from motor vehicles. In the figure 2 are listed the main elements that emit sounds if one car in operation, at runtime.

2.1.2. Noise from engine

The main sources of noise emissions from passenger cars are systems of inlet and outlet, and the areas of the cylinder block, cylinder heads and lids distribution. Noises occur as a result of periodic variations in the main load of the engine mechanisms, because of periodic variations of pressure variation of gas in cylinders, and couples forces of inertia to the sliding, and as a result of oscillating processes in systems of inlet and outlet. A characteristic of automobile engine operation is to change in the arrangements, which increases the intensity of the noise [12].

Noise emitted by the engine is also influenced by factors of operating such as: dosage mixing, fuel quality, load and engine speed that influence the processes of motor and hence the forces which take birth in the mechanisms of the engine. In this category may be involved and vary according to factors of ignition advance illiterate or injection advance [9].

2.1.3. Noise intake system

In the intake system noises occur as a result of pulses current of air. The column of air in the intake system consists of oscillations and forced oscillations. The fundamental frequency component of the oscillations forced is equal to the number of inlets on the second. If you do not take into account the exhaust noise, noise dominates the overall intake of the motor. Increase the sound power level of the engine because of the noise in the intake system, is 8-10 dB. In each case, this increase may be determined by experiment, by turning the ignition engine by means of an electric motor with the intake system open and closed.

Components of high frequencies in the spectrum noise of motors are given by:

\[ f_1 = \frac{k \cdot n}{60} \]
\[ f_2 = \frac{k \cdot n_i}{60 \tau} \]

Where \( k = 1, 2, 3 \ldots \)
\( n \) = speed of the crankshaft of the engine;
\( n_i \) = number of cylinders;
\( \tau = 1 \), for two-stroke engines;
\( \tau = 2 \), for four-stroke engines.

The vibrations of the column of air in the intake system are the fundamental frequency, the frequency admissions:

\[ f_a = \frac{(2k - 1) \cdot v}{4(l - r)} \]

Where \( v \) = speed of sound in m/s;
\( l \) = length of the tube (the intake system), in m;
\( r \) = radius of the tube, in m;
\( k = 1, 2, 3 \ldots \)

At the air leakage through the valve

\[ f = 0.05 \frac{ku}{d} \]

Where \( k = 1, 2, 3 \ldots \)
\( d \) = gap size in m;
\( u \) = the linear air speed in m/s;

2.1.4. Noise from the tires

Airborne noise from the interaction between Tyre and road remained a problem, if we take into account the fact that over the years have been reduced significantly the noise caused by motors, exhaust systems and transmissions.

It grows at a rate of circulation of more than 50 km/h for light vehicles and more than 80 km/h for heavy vehicles. Tyre noise stands out clearly against the background of the other vehicle noises. The solution currently existing practice for reducing the noise of the rolling stock is completed by on the characteristics of the tyres, or by restriction of speed on the roads in towns and villages.

Tyres with absolutely smooth, protective noise levels are lowest. You have approximately the same level and tyres with four channels on the periphery of the protective layer straight. Tyres that produce high levels of noise are those on which the skid coating consists of a combination of transverse circular indentations and channels, as well as those of type "off-road" ground no direction, with adhesion.

Between the various types of tyres used there can be a difference of up to 10 dB. Noise generated by tyres in contact with the ring road is influenced by properties of the Beltway but also on the characteristics of the tyres. Stiffness of rubber is the main characteristic of pneumatic. As it is higher, the tyres are noisier. Rotational speed of the wheel tyres is the main
functional parameter: rolling noise increases with increasing speed.

**Figure 3.** Graphic representation of the noise emission from the engine group and brake system running, increased speed of a car

2.2. Factors of influence on the level of noise in road traffic

The motor vehicle is a source of noise pollution. The intensity and spectrum of the sound of noise depends on a number of factors involving first the existence of the vehicle. Sound level of motor vehicle traffic is influenced by:

- traffic conditions owed factors;
- infrastructure of circulation factors owed;
- factors owed to weather conditions;
- human-factors owed interaction-road motor vehicle.

Sound pollution emissions of motor vehicles and are influenced by factors related to road infrastructure, as well as profiles of the streets of the composition of the surface of the road[7].

**Table 1.** Correction of sound-level meter of the type of road surface

<table>
<thead>
<tr>
<th>The type of road surface</th>
<th>Correction of noise level in dB depending on the speed of movement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-60 km/h</td>
</tr>
<tr>
<td>Porous surface</td>
<td>-1 dB</td>
</tr>
<tr>
<td>Fine asphalt</td>
<td>0 dB</td>
</tr>
<tr>
<td>Concrete cemented and striated asphalt</td>
<td>+2 dB</td>
</tr>
<tr>
<td>(corrugated)</td>
<td></td>
</tr>
<tr>
<td>Smooth texture paving stones</td>
<td>+3 dB</td>
</tr>
<tr>
<td>Rough texture with paving stones</td>
<td>+6 dB</td>
</tr>
</tbody>
</table>

Among those listed, the noisiest area is the rough texture paving stones, noise caused by large spaces between just rocks. At the opposite pole of the noise generated is porous asphalt. In the project [10], is due to the adjustments area of the road in terms of noise, indicating a possible difference of up to 15 dB (A) under conditions of different road surfaces, recording for the same vehicle and same speed. The surface of the carriageway influences much noise at runtime but porous asphalt and road surfaces that may affect and noise due to ‘drive’ group.

Noise can be influenced by the characteristics and condition of the road, a road in ramp and with many tight curves and fluctuations in the level of intensity gradients can increase noise. This is possible just adjusting speed of movement to the requirements of the road, by changing the frequency of the steps, through frequent and fast acceleration and deceleration[8].

**Figure 4.** Types of roads in cities

In urban areas, streets are classified in relation to traffic intensity and have their functions (Peeters B., Gijsjan van Blokland, 2007). The street is the element which is part of the urban architecture, used for the carriage of goods and persons by means of vehicles and for pedestrians.

In terms of characteristics, the streets are classified as follows:

1. Main-Street with 6 lanes, design speed of 60 km/h, width -3, 5 m, the length of the sections of relatively large intersections, taking over major flows, urban area and transit traffic;
2. roads link – Street with four lanes, the design speed of 50 km/h, width bandwidth de3, 5 m, major movement, and ensures the link between the areas of concern of the locality;
3. collection-Roads with 2 lanes Street, design speed of 40-50 km/h, width -3 or 3 m, taken traffic flows in the functional areas and major roads to drive them;
4. local roads – single-tape Street, design speed of 20-45 km/h, width -3 or 3 m, ensure the access in areas with low traffic

Evaluation of road traffic noise for streets with different structures are adapted to the European legislation in this area, but is based on the Romanian standardization, will present some points. Propagation of noise in an urban space and architecture reflect the street in terms of section transversal of the street, a section that includes elements that could constitute evidence of reflecting sounds (most are could be found buildings).

Thus, the road to category I and II, in accordance with STATE STANDARD 10144-1/1980, are grouped in three variants of roads:

1. Road with free structure – is that type of road that has no buildings or other reflective elements on either side, and if they exist, their heights do not exceed 0 72 in the opening of the road; on this type of road noise propagates mostly free.
2. Road in the section “L”.-is that type of road that has one of its sides fronts of buildings or other reflective elements; such roads, for a period of a part of it, in addition to the direct noise component that propagates from the source to the point of acceptance, and the reflection on the sides of buildings, resulting in an increased amount of noise at a point in the section (figure 4).
3. In the section "U" is that type of road that has both sides of the door fronts of buildings greater than 0.2 drop out of the open road (the distance between the fronts). Such roads, for a period of a part of it, besides direct noise component that propagate from the source to the point of acceptance, there are components of reflections on the walls of the buildings of the repeated two fronts, resulting in the increased values of the noise level at a point in the opening section is smaller.

For figure 4:

<table>
<thead>
<tr>
<th>R</th>
<th>the receiver point reflexion noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>H, h</td>
<td>height of building fronts</td>
</tr>
<tr>
<td>D</td>
<td>distance between fronts (open road)</td>
</tr>
<tr>
<td>L, l</td>
<td>road’s width, the width of the road pavement</td>
</tr>
</tbody>
</table>

3. DEVELOPMENT OF NOISE MAPS USING A GEOGRAPHIC INFORMATION SYSTEM IN AN AREA WITH HEAVY ROAD TRAFFIC.

Further research undertaken aims at providing solutions for the reduction of the pollutant in the urban areas ring the city of Sibiu. It is used for evaluating spatial analysis using GEOMEDIA software. It offers support for the adoption of decisions by local or regional authorities of measures which lead to the reduction of noise pollution in urban agglomerations, pollution coming from the road surface. Among the objectives measurable that result from the carrying out of such works may refer to:

- analysis of noise from an area of intense circulate Sibiu;
- the application of techniques and methods of measurement for road traffic noise in that area;
- collection, introduction, storage and analysis of data related to road noise;
- the use of a computer system as the medium of instruction in the sound of the pollutant;
- development of a noise maps for the area selected

Strategic noise maps shall be made for specified areas. The starting point for achieving large-scale, noise is a digitized model of these zones, which must contain all the obstacles (any kind) of the sound source (emission) and emission which may affect the propagation of noise (sound).

Colour code for the representation of the noise on the map of level curves:

<table>
<thead>
<tr>
<th>Colour</th>
<th>RGB (Red-Green-Blue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light green</td>
<td>85-190-71</td>
</tr>
<tr>
<td>Green</td>
<td>0-114-41</td>
</tr>
<tr>
<td>Dark green</td>
<td>15-77-42</td>
</tr>
<tr>
<td>Yellow</td>
<td>228-228-0</td>
</tr>
<tr>
<td>Orange</td>
<td>255-95-0</td>
</tr>
<tr>
<td>Cinnabar</td>
<td>219-12-65</td>
</tr>
<tr>
<td>Red carmine</td>
<td>174-0-95</td>
</tr>
<tr>
<td>Magenta</td>
<td>146-73-158</td>
</tr>
<tr>
<td>Blue</td>
<td>79-31-145</td>
</tr>
<tr>
<td>Dark Blue</td>
<td>33-18-101</td>
</tr>
</tbody>
</table>

A noise map is based on calculations to be performed by means of indicators. In accordance with (Legea protecției mediului nr. 137/1995, 2005) noise indicators for the achievement of the strategic use of noise map are $L_{eq}$ and $L_{night}$.

$L_{eq} - (L_{day}+L_{evening}+L_{night})$ is harmonised with EU noise indicator for the degree of stress caused by noise over a period of 24 hours, which is expressing the relationship:

$$L_{eq} = 10 \times \log \left( \frac{L_{day}}{24} \times \left( \frac{12 \times 10^{-10}}{4 \times 10^{-10}} + \frac{4 \times 10^{-10}}{10^{-10}} + 8 \times 10^{-10} \right) \right)$$

In which:

- Associated discomfort of $L_{day}$ during the day (between 7 and 19)
- Associated discomfort of $L_{evening}$ in the evenings (between 19-23)
- Associated discomfort of $L_{night}$ – night (between 23-7) [3]

An assessment parameter (indicator) the noise level is equivalent to 24 hours, L$\text{Aeq}$. Evaluation indicator L$\text{zsn}$ is also an equivalent noise level for 24 hours but with a weight of + 5 dB during the Evening and + 10 dB for the night period

For maps of road traffic noise is in need of retrieving data from the field. These data are varied and complex, they concern: the type, medium-speed flow of road traffic regulations, road traffic, component infrastructure characteristics, meteorological conditions, the heights and the number of buildings, etc. Modelling of noise may not be an accurate copy of the actual surface mapped. Certain approximations must be made in relation to the ground, the shapes of buildings, the building of the road, etc. If the line-are too rough noise modelling accuracy and hence the strategic noise maps will be of low quality. If a copy is performed as faithful to the actual surface mapped, this process will take a lot of calculating methods on an interim basis and are not detailed enough to qualify for the high precision of digitized pattern.

In order to achieve a sound using GIS maps are required:

1. GIS Map, photos, or a map of cadastral sphere;
2. computational Modelling in the specialized data on urban area. This is accomplished on the basis of the map (it's the height of the buildings, and knowledge);
3. information on road traffic (vehicles per hour, the categories of vehicles, average speed, distribution per 24 hours for 3 time slots);
4. calculation of the distribution of noise in urban area using the program mentioned. So far the map can be achieved only on the basis of power on the computer. The result of
the power plant, processing of data obtained as a result, but one theory, such as acoustic measurements must be validated by specific.

5. Validation outcome is achieved by determining the noise level in a number of positions, followed by automatic or manual update of the map, in order to get the plenitude of simulation data and real ones. The number of measurements in traffic is greater than, the end result is closer to the exact [3].

That's why it is, furthermore, a city unbearable for sensitive ears. Due to road traffic noise exceeding, 90 per cent of cases, the limits allowed by law. The final report of the Environmental Protection Agency Sibiu, drafted in 2006, shows that cause road traffic, in 90 per cent of cases up of legal limits for permissible noise levels. Environmental inspectors have conducted measurements in new intersections in the city. Sibiu city dwellers that live in the area have to withstand everyday dust and infernal noise caused by extremely heavy traffic, on the perimeter.

The law stipulates that the permissible sound level on the streets of contact shall not exceed 70 decibels, squares do not exceed 65 decibels, and the lines shall not exceed 85 decibels.

The area of research is represented in the figure 12 in relation to a map of the city, she is framed in a border that marks the position, and with the same colour colourful arteries can delimit the edges of the area studied. To ensure that the results of this work to be conclusive, I chose an area in the central part of the city of Sibiu, the area in which road traffic is especially heavy during peak hours.

Traffic noise was measured by means of sound-level meter portable 2100 Quest Technologies in each of the eight points of observation. In each point of measurement, the time interval allocated measurements was 10 minutes, during which it has been observed evolution in real time the level of noise in the area, and has established an average noise level equivalent (LAc), a maximum (LAmax) and a minimum (Lamin). Traffic noise level varies within 24 hours, with the maximum in hours with some heavy traffic.

To record the volume of traffic, it turned to the manual method of collection of data by a team of observers made up of four human operators. In this process was basically a count up feature of motor vehicles to pass through a section of the road. The vehicles were classified in two categories depending on the weight: < 3 t and vehicles > 3 t. Action registration traffic volume has been in around 81 dB. This is due to the high value and because of the opening of the road is very small for a road with 4 lanes of traffic regulations, the terms of a structure in the shape of "U" of the section sector. Although the movement speeds are lower during the day, for this sector you can see high values of the noise caused by road traffic, this is favoured by the location of the buildings, and that there are no spaces between them for the absorption of sound waves. So here is what creates the effect of the aisle, that intensify the noise and has the damaging effects on the residents and pedestrians.

As a result of the investigations carried out and to measurement I could determine, using Geomedia software, sector affecting the health of residents and feature pedestrian. A solution proposed could be making a tunnel for capturing the sound of the pollutant for the artery most affected by road traffic noise. In the area of study, the most affected portion of the road is the Andrei Saguna Street, to which reference was made in the paper here by signing up for the most levels of noise inflate. This is due mainly to high traffic volumes, as well as the small opening of the road and fronts of buildings that have different heights. Another aspect contributing to the increase of noise on this section is due to the fact that there are no spaces between buildings to promote sound propagation. So this solution might look like in the picture below (figure 7).

This solution consists in the construction of a tunnel, made of boards-absorbent coverings made of acrylic glass. It can be set to pedestrian sidewalks, leaving place. This solution would greatly reduce the noise on the street, but the costs would be quite large, but investment is required. There are, however, and cheaper solutions such as those relating to limitation of speed, making the green light to heavy vehicles, restricting certain times, winning in the latter case a reduction of 6 DB(A), which is not negligible.

The use of a GIS software allows getting information on a certain overall geographic area. The area studied is a map that may get to express themselves through various shades of blue, to make the difference between the three intervals in which the measurements were made.

In Figure 6, it was determined that the sector presents the noise intensity. Thus, the sector has been tainted with black. The average noise level observed here over the course of 10 minutes has been in around 81 dB. This is due to the high value and because of the opening of the road is very small for a road with 4 lanes of traffic regulations, the terms of a structure in the shape of "U" of the section sector. Although the movement speeds are lower during the day, for this sector you can see high values of the noise caused by road traffic, this is favoured by the location of the buildings, and that there are no spaces between them for the absorption of sound waves. So here is what creates the effect of the aisle, that intensify the noise and has the damaging effects on the residents and pedestrians.

![Figure 6. The way most noise](image)

![Figure 7. Proposed solution for reducing the noise on the street in research area](image)
these works were developed, 4 maps noise indicators $L_{eq}$, $L_{den}$, $L_{den}$, and $L_{night}$. The final product can be viewed both 2D and 3D for each of the indicators mentioned (figure 8).

Figure 8. Maps of the area of study for noise generated by road traffic

Noise maps illustrate the fact that noise is quite high, and there are areas where we see value in excess of 75 dB for the indicator $L_{den}$ and $L_{night}$ 65dB for the pointer. This will considerably influence these indicators for the population, with the following limit values are required by law: 70dB respectively 60 dB, as well as target values: 65 dB, 55 dB, you want to be achieved by 2012. The maximum value is obtained by 81.2 dB(A) for the indicator $L_{den}$ and $L_{night}$ for other. These maximum values were obtained in the first sector (segment A), and pointed to graphs made from measurement of land. These measurements have been carried out to check the framing of data collected, but also to validate acoustic modelling results. After compiling the noise map they can be validated, we compare the results generated by the software, with levels of noise measurements makes in traffic.

4. CONCLUSIONS

This paper approaches the issues relating to the noise generated by road traffic, methods and ways of measuring and reducing its intensity. As a result of research carried out for the preparation of this paper, and consulting with specialized bibliographic I come to the conclusion that in this there is a growing awareness of the harmful effect of noise on human health. This leads to a serious approach to the phenomenon of sound pollution produced by surface transport. In the side's acoustics, traffic there was a tendency to move from standardized, objective measurements based on noise indicators, measurements that are based on assessment of the population of the area bother investigated study. It should be mentioned that currently, in our country there is not an advanced system of real-time monitoring of rail-road circulation pathways.

Noise map made using GIS software is a tool for evaluating how accurately the situation in the field of pollution by noises. It is the tool through which you can take the necessary decisions to reduce the risks to which it is put to the population by subjecting the noise thresholds which exceed the limits deemed normal. On the basis of noise map for the area is researched elaborated conclude that in certain segments are exceeds the permitted. This has an effect as possible harmful to the population that lives in the area. Based on these results obtained, appeared the need for measures to reduce noise. There are several solutions such as:

- Re-routing of traffic to yield a uniform distribution of the emission of noise, setting meanings unique synchronization between traffic lights for establishing green wave, speed restrictions;
- the total prohibition of movement of certain categories of vehicles in the heavily polluted acoustic time slots;
- the ban on movement of certain categories of vehicles on certain arteries;
- getting traffic from or in specified areas by ground and underground passages;
- the location of the local boards absorbent coverings and/or green areas.

The solution you propose this work: a tunnel of panels-absorbent coverings made of acrylic glass is feasible (figure 7). It’s effect would be beneficial to the population that lives in the area where it was recorded the highest level of noise. This proposal is justified in terms of the economic development of such a tunnel involve lower costs, than producing a underground tunnel. Realization of noise map of road traffic in urban environment, is an important utility for future development planning. As a result of research carried out for the preparation of this paper, I think making the noise map population urban is a very important thing.

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DESIGNING EDUCATIONAL MATERIALS THROUGH PRODUCT LIFECYCLE MANAGEMENT

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ABSTRACT: The paper analyses the situation of teaching materials in technical schools in Romania via a marketing research that takes into account stakeholders, the microenvironment, as well as the macroenvironment. The research has shed light on a number of problems that require a new approach to the design of educational tools. The paper proposes that this design of educational tools be performed through the product lifecycle management (PLM) perspective. All phases of the design and lifecycle of such products are analysed, and concrete solutions for realising each of these phases are proposed. Finally, some examples of educational products are presented, which have the purpose of aiding the teaching of technical drawing, and which have been devised using this very methodology.

Key words: educational material, product lifecycle management

1. INTRODUCTION

The major transformations occurring within society are also mirrored in education. Scientific breakthroughs and new technologies get to be made available at an increased rate. This also means that the work force is required to adapt to new expectations and be qualified to use new technology at a similarly accelerated pace. On the other hand, students are increasingly reluctant towards traditional teaching methods, as for instance can be seen in the diminishing in the number of books read by students. Educational systems are now required to adapt rapidly to face these increasing pressures. One solution in this situation is the use of more suggestive and attractive educational materials.

The teaching equipment can be classified into two categories: the tangible products (tools, devices, machines, etc.) and intangible ones (software, virtual products). They have to be selected on the basis of psychological and pedagogical criteria in order to achieve educational goals.

Teaching equipment and curriculum must evolve with technology, so that the students know the new trends in the field and, at the moment of graduation to easily integrate on the labour market.

The current paper endeavours to analyse the current situation of teaching equipment in technical education in Romania and to propose a methodology for designing them, based on modern concepts.

2. TEACHING EQUIPMENT USED IN TECHNOLOGICAL EDUCATION

In technological high schools from Romania a wide range of teaching resources are used; in this case we refer specifically to the technical equipment used in the mechanical educational modules. These materials can be either built by specialized companies, by teachers or by students [4].

The most common equipment used in classes that specialize in mechanics is aimed towards the acquisition of technical drawing skills, and the ability to use measuring instruments, laboratory instruments, machines, devices, as well as other technical equipment and software.

2.1. Study on how users perceive the teaching equipment

A marketing research was performed at first. This research shed some light on the importance of proper teaching materials, but also on numerous pitfalls concerning the construction, functioning and management of these materials.

The research was performed at the „Grupul Şcolar Brătianu” and encompassed on the one hand 50 teachers with various didactical degrees (from beginner to 1st degree teacher) and a sample of 648 students from Drăgășani on the other hand. A questionnaire was devised so as to study the opinion of both teachers and students with respect to the use of teaching materials as well as their influence to the development of the pupils’ technical ability and competence. [5]

The objectives of this research were:

• to find all types of educational materials in use in school education;
• their level of use in teaching;
• their influence on teaching (how well they aid the students’ understanding);
• to what extent students manage to use the aforementioned technical equipment as instructed by the teacher during laboratory classes;
• their contribution to the acquisition of technical competences.

The research led to the following conclusions:

The technical are mainly obsolete, they fail to completely and correctly represent the studied phenomenon, and there is no management and maintenance system for them. Furthermore, many theoretical aspects are taught without supplying proper practical insights.
The most widespread teaching equipment is the blackboard and chalk, followed by overhead projectors, computer projectors and computers. Technical equipment and functional models are moderately used. Educational software and functional models are seldom used.

Apart from the main results, the research also led to a number of additional observations:

- In order for teaching materials to be effective in teaching, the teacher also needs to have a good overall knowledge and understanding of what is being taught and how this happens. A good connection between the taught items and the materials explaining them is of great importance;
- Teaching technical subjects requires a complex infrastructure and adequate working space (mainly laboratories and workshops), all correlated to the school curriculum;
- Laboratory activities require additional effort on behalf of the teacher, as the technical equipment needs preparation;
- The investment, the functioning and maintenance costs associated to technical equipment are large and therefore it is important for institutions to find solutions that are efficient, effective and original;
- The structure and use of the education equipment have to be comprehensible to the students and accessible to their possibilities.

3. DESIGNING EDUCATIONAL MATERIALS THROUGH PLM

A viable approach to managing educational materials is from the perspective of product lifecycle management (PLM).

Product lifecycle management (PLM) is the management process of all phases in the existence of an item, from concept, design and manufacturing to its time in service and ultimately to its elimination from the market and return to the environment. PLM is a coherent ensemble of solutions aimed at managing, broadcasting and using the information defining the product and its necessary resources [1], [2].

The phases and characteristics of product lifecycle management for educational materials are presented in figure 1.

The requirements analysis is an important part of our study. For this, the educational process has to be taken into account together with all its influencing factors, i.e. the stakeholders, the microenvironment and the macro environment (fig.2). The characteristics of the product have to be based on user demand and are obtained by applying such methods as the Function Analysis method (FA) and the Quality function deployment method (QFD).

The macro environment encompasses the following components: the social-demographic environment, the cultural environment, the technological environment, the political-legislative environment, the natural environment and the competition environment. It influences the educational process and therefore also the construction of educational tools.

There are a number of aspects that are influenced by the macro environment, such as the teaching style, the student’s perception, the level of preparation of the student, associated costs, etc. They themselves leave an important fingerprint on the overall concept of educational tools.

After identifying the necessities, the construction of a hierarchy for them follows. By using creative methods technical solutions can be found for the implementation of these tools. The optimal solution is identified, modelled, verified and lastly, its function is simulated. Optionally some prototyping may be performed, after which the manufacturing technology has to be designed.

It should be noted that designing an optimal solution must necessarily take into account the given necessities and the functions associated with all the other phases of the product’s lifecycle (manufacturing, sales, exploitation, maintenance and recycling). The product will eventually come into all of these phases of its lifecycle.

![Figure 1. Steps in designing educational materials through PLM](chart.png)

3.1. Choosing the functions of the product based on the needs of the users of teaching materials

The needs of the users of teaching tools are influenced by the external factors with which the school interacts. Knowing them is a prerequisite to making these tools to be effective. These factors are the demographical structure of the students and their evolution correlated with sex, age, ethnicity and family education. It is also important to note that the student’s perception bears a strong influence of family, cultural, religious and educational needs, and this perception must also be modelled.

Demographically speaking, the school population in Romania has reached 4.03 million in 2010/2011 and is decreasing...
steadily. It is smaller by over one million when comparing to the year 1990 (data taken from the National Statistics Institute).

The cultural level has also been on the decrease, as students read less and are more attracted to the interactive environments.

Figure 2. Factors that influence de educational process and the need of educational materials

The national budget for education in the year 2011 has been 3.64% out of the GDP (161,629 million $) which is a lot less than other countries, such as Finland with 5.4% of the GDP (239,232 million $). The average income per capita places Romania on the 70th place in the world (based on data from the IMF) with 7,542$ per capital.

The technological level of the world is continuously rising and also new educational methods emerge, such as E-learning.

Environmental issues require that new approaches to building educational tools also gain an ecological dimension and use non-polluting sources.

The national laws concerning education are unfortunately continuously changing, which hinders the teaching activities.

Researches about human perception [6] show that the perception of people via the senses is distributed as follows: eyesight 83%, hearing 12%, smell 2.5%, touch 1.5%, and taste 1%. This implies that the efficiency of teaching has the potential to become a lot more effective as soon as different types of media are combined, especially visual and audio materials.

When asked what you find important to teaching equipment, students felt that simulation of the phenomenon is very important 42% (12% appearance, 21% availability, displaying results 18%).

Regarding the posting of results, they find the educational equipment with digital display 84% (analogical 12%, with graded scale 4%) to be the most attractive.

Colours that influence them positively were classified in the order of preference as follows: green, white, orange, yellow, purple, blue and red.

When it comes to capturing their attention, most stated that they preferred simulation processes on machines (44%), while others opted for educational equipment and information resources (31%), in the detriment of functional models.

Regarding the use of teaching equipment, most students preferred multidisciplinary tools (71%).

Figure 3. The functions of an educational material

Figure 4. Quality house (needs-function matrix for educational materials)
The research carried out revealed the following functions of the teaching equipment to be equally important from the students’ point of view: Simulation of phenomena and processes; Easy to be used, Automation; Ergonomics (microclimate conditions, positioning, posture of the user); Reuse at several disciplines; Display of the results; Weight; Colour components; Material; Noise level during operation; Environmental impact. From school point of view maintainability and cost are also important. The functions that an educational tool needs to possess, as shown by the marketing study is synthesised in figure 3.

For the ranking of perception criteria, which help in determining the functions of the teaching methods, an advanced multi-criterion analysis was performed.

Marks were awarded for each analysed criterion. Weighting coefficients were calculated from Frisco expression and a criterion ranking matrix was developed [3].

The study revealed the top most important criteria: Simulation of phenomena and processes; Display of the results; Ergonomics (microclimate conditions, positioning of the user).

After the functions are set, the Quality house is used to evaluate the tool according to the user expectations (fig. 4). This is a systematic method for analysis, documenting and evaluation. The centralisation of data was performed with the aid of the Qualica software. At the end of the analysis, a set of functions help us to correctly design the educational tool.

Of course, other methods can also be used in order to build a hierarchy and to select the functions, such as Value Engineering.

The next phases all require as input this phase of determining the product functions.

3.2. Implementing solutions for satisfying the functions of the educational tool

To conceive the product, a number of phases are required: determining the solutions through creative methods, modelling and simulation, computations and tests, evaluations and optionally quick prototyping.

By applying the creative methods, more solutions can be found. Out of these the best one can be selected.

For instance, by applying the Osborn procedure, an analysis of educational tools can be performed creatively, functionally and constructively with respect to their exploitation and recycling.

Through the creative method (the Osborn method of interrogative verification lists) some general questions concerning educational tools are asked. This method is simple and so are the questions: Why? Where? When? Who? What? How?

Osborn suggests that a wider spectrum of questions of type “what if?” is required to creatively solve the problem.

The modelling of the constructive solution is performed in creativity sessions and by using specialised design and drawing software, such as CATIA.

The design of the optimal solution is performed after functional, resistance and dimension calculations. Specific software such as Finite Element Method (FEA) can also be used. The functioning can either be verified by simulation or by quick prototyping.

Simulations of the manufacturing process from a recycling perspective are also gaining popularity, as environmental protection becomes a necessity.

What follows are the manufacturing itself, marketing and sale.

The next activity, exploitation, is a very important activity in the case of educational tools, as the entire educational process largely depends on their effectiveness. Management and maintenance systems are required to be put in place in the case of all these educational tools.

The last activity is recycling. It is not only meant to prevent pollution, but also recover some of the production costs by reusing the unused materials.

4. EDUCATIONAL MATERIAL SOLUTIONS FOR TECHNICAL DRAWING

The aforementioned methodology was applied for a number of types of needs. One of the requirements was to build educational tools to help the acquisition of technical drawing skills.

When drawing, there are a number of complex mental processes that occurs, such as: fixation of the piece in the visual field, measuring, decomposition, recomposition, grouping, analytical and spatial thinking, and ultimately knowledge transfer and a multidisciplinary approach.

With technical disciplines, the notions are usually grasped sequentially, without them being connected to one another. This often leads to issues in drawing the pieces.

Therefore, it is important to find constructive solutions to these confusions that have been noted to appear. In order to bridge the gaps between teacher and student, a number of methods have been devised that aid the comprehension of technical drawings, of how the pieces are measured and checked and of how the surfaces are being generated during mechanical manufacturing.

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Figure 5. Educational materials as compact geometrical bodies in which the edges are highlighted using phosphorescent paint or phosphorescent cables

Some examples of educational tools to be used in technical education are:

- transparent geometrical bodies with darkened edges and illuminated contour;
- representative modular pieces;
- projections equipment.
When a student beholds a geometrical body, it is not always clear what he or she has to draw. Therefore, a number of solutions have been devised to make the body easier to perceive.

The novelty in these educational sets is the fact that they are complex representative pieces with highlighted contours. They are manufactured out of Plexiglas and on each edge a circular channel is engraved, in which a rubber cord or metal string can be inserted. Another possibility is to have compact geometrical bodies in which the edges are highlighted using phosphorescent paint, phosphorescent cables or fibre optics. By looking at these bodies from different angles, the student can associate the lines in the technical drawing with these edges.

Another method coming to aid students to better visualise contour projections is by using an equipment made out of a webcam, a computer, a piece holder, the piece and a smartboard. By placing the piece accordingly, the view to be drawn appears on the screen. Using edge detection software, the students can even see the route that the pencil has to follow (fig. 6).

The proposed educational tools:
- Do explain of the phenomena of projection, so as for the student to better perceive what has to be drawn and how;
- They are modern and attractive tools, such as the webcam-based system. They can also be integrated with E-learning platform;
- Are modular and enable more pieces to be drawn;
- They allow for an efficient maintenance. Being modular, pieces can be changed, leaving the rest of the ensemble intact;
- Are easily stored;
- Can be built out of recyclable materials.

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![Figure 6. Educational material for technical drawing with web camera and smartboard](image)

5. CONCLUSIONS

Studies have allowed the detection of the causes that led to some problems of educational resources and pointed out that the most important issue is that the existing teaching equipment are not relevant and not correctly explains the phenomenon / process.

This leads to the need of finding new constructive solutions and new ways of implementing them. The paper presents an approach to designing educational tools by using the product lifecycle management methodology.

Two examples of teaching equipment for the explanation of the design methodology are presented. The shape and characteristics of this equipment were all obtained by following the aforementioned methodology. The solutions do correspond to the present user needs.

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ABSTRACT: In the increasingly interconnected contemporary society, employers commonly expect the engineering graduates to possess, alongside academic success evidence, a range of soft skills, of which scientific and technical communication, particularly in a language of international circulation, ranks first. This demand has led to creating and implementing a modular flexible Scientific and Technical Communication in English - STCE original course of the CLIL (content and language integrated) type. The paper aim is to evaluate the course impact, with a view to increasing its effectiveness and success by further amendments. This has been done by designing research, based on triangulating questionnaires and interviews addressed to both graduates who took (or not) the STCE course during their Master’s or Doctoral education, as well as to their employers.

Key words engineering education, scientific and technical communication, STCE

1. CONTEXTUALIZING THE STCE COURSE RATIONALE, DESIGN AND IMPLEMENTATION - GROUNDWORK

Graduates of higher education technical institutions have to face at present a series of expectations from the job market, whether they are looking for employment in engineering and/or business organizations or in education and/or research.

They are expected to possess a range of significant skills that can enable them to communicate both in writing and orally. This phenomenon is valid worldwide, in a society that has undergone the effects of globalization, and which requires a higher mobility of (young) skilled workforce.

As not only research studies but also the media maintain, engineers in both business and technological environments are expected to develop what has generically been called in recent years soft abilities, as maintained, among others, by Kotler [5].

As opposed to the strictly technical hard ones, soft skills have received various labels in various countries, which are listed by Nor [6] as: key skills (UK); essential skills (New Zealand); employability skills (Australia, Canada); workplace know-how (USA), transferable skills (France) etc.

Irrespective of their name, skills can be grouped under three main lines of competences, according to Sharatkumar [7], viz. Communication skills, Psychology and Subject matter knowledge. This is a useful division when they come under focus in the process of training learners at university level or later, in the employing company.

As Ziegler [10] points out, currently we can note that there is an acute insufficiency in the engineering graduates’ soft skills. It is also shown that a job candidate possessing good technical (hard) abilities but who is lacking soft ones, such as communication, has definitely lower chances to get a job today.

Already in 2002 a representative of a powerful automotive industry employer [1] would emphasize that soft skills should be included in the engineering education of the future specialists as a must, not only for those who would work in industrial companies or in business ones, but equally in R&D.

According to Clemmer [4], in recent years soft skills, calculated as a quotient, account for an engineer’s productivity up to the very high rate of 85%, as compared to the low 15% attributed to the hard abilities contribution in this respect, particularly under economic recession conditions.

Youth mobility on the job market is strictly connected with the level of soft skills of the engineering and/or business graduates – a phenomenon that is growing fast in most domains of activity. It is therefore imperative that engineering tertiary education should anticipate the long term expectations and needs of the very competitive job market and foster the integration of soft skills oriented disciplines in the curriculum.

Recruiters will favour mainly those applicants who can demonstrate that they can tip the scales in their favour as they have developed the soft skills expected from them by most employers, be they small, average or large companies. This has been confirmed by authoritative sources such as the US Labour Department [9], with over 450 employers admitting that: (i) besides the fundamental hard skills, soft ones are more important in the recruiting process, and (ii) most young candidates dramatically lack them.

It is generally accepted that English is currently the international language of communication, alongside German or French – to a lower extent, which raises a complementary challenge to the education in foreign languages at tertiary level: it should not only develop undergraduates’ linguistic competences, but also identify best ways and means of doing this while teaching soft skills, such as communication in written/oral forms at the same time.

What is more, teachers of foreign languages and soft skills should try to receive acceptance of the main stakeholders in the instruction process in their educational contexts: university management, curriculum developers at all levels in tertiary education, the students and the potential employers. This can be obtained on the basis of appropriately principled proposals from the pedagogical viewpoint, of implementing courses whose efficiency and relevance must be demonstrated by empirical research.
There are some countries, such as India, where this curricular reshaping is already taking place, with a focus – according to Clemmer [4] – on soft skills education based on modular employable skills courses. However, this is not the generalized policy of higher education organizations worldwide. In many places, soft skills training is carried out by specialized training firms upon request, but, although quite necessary, it is seldom afforded by most employers. It may be of interest to analyze one such prestigious training program, provided in the USA [8], which offers units on: the spoken communication, the written communication, handling meetings and the media, a.s.o.

Against this needs and expectations general background, which was valid both nationally and internationally in 2007, an attempt to designing and implementing a Scientific and Technical Communication in English – STCE course emerged. We had in mind a CLIL (Content and Language Integrated Learning) type of course, in an interdisciplinary approach to the teaching of soft skills within the English language course, a dual aim where the soft skills component is communication in the fields of science and technology, with the advantages that exposure to the foreign language takes place during/together with the soft skills acquisition, which solves the issue of requiring extra time in the curriculum.

The students – in general Master’s and/or Doctoral levels – use English in order to acquire content, which is quite motivating for them, as they fully understand how useful such skills will be for them as job applicants. Similarly, at these stages in their education, the students will be able to easily transfer some of the soft skills they might have already developed in their mother tongue.

The course is among the few, if any, of this type in our country, as well as in the repertory of specialized training firms in Romania. It has been designed as a course, authored by Catelly [3], taught based on electronic support, as well as its corresponding applications and assignments, which also exist in electronic format.

The principles underlying the course design are those of an eclectic approach to teaching, with a communicative core and a modular structure comprising three parts: (i) linguistic support; (ii) written communication; (iii) oral communication, allowing room for flexibility in the selection of the units for each particular group. Each part is divided into several units (14 altogether, making it adaptable to the university similar 14-week term structure).

The final course structure – choice of units – has been based on a baseline study carried out at the pre-course stage, which comprises a thorough needs analysis, but readjustments are always possible upon negotiation with the learners – and indeed they took place on more than one occasion, with a view to eliminating certain issues or adding new ones, such as poster design and presentation at conferences (see Catelly [2] for an ampler presentation of the manner in which the STCE course was supplemented) or participating in video or telephone conferences.

The students receive a course syllabus outline – an excerpt of which is provided in Table 1.

<table>
<thead>
<tr>
<th>Week No.</th>
<th>Main Course Topic</th>
<th>Emphasized Aspects</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>WRITTEN COMMUNICATION - 1 – The ‘Tools’</td>
<td>Paragraph structure; Elements of Style and Register; Emphasis on clarity, conciseness, and accuracy of expression; Modes of expression: descriptive, expository, narrative, scientific; Level of formality; Avoiding biased language</td>
<td>Developing a paragraph; analyzing various text from the purpose and structure point of view</td>
</tr>
<tr>
<td>6</td>
<td>WRITTEN COMMUNICATION – 2 – The ‘Process’</td>
<td>Main stages in the writing process; the Audience; the Process of writing: Collecting material; Planning; Outlining; Structuring; Drafting; Editing; Visual aids; Proof reading</td>
<td>Writing two paragraphs with the same content, adapting them to different types of audience</td>
</tr>
<tr>
<td>7</td>
<td>WRITTEN COMMUNICATION TEXT TYPES – 3 – TECHNICAL CORRESPONDENCE (e-mail messages, memos, letters)</td>
<td>Structure of letters and memos; Email Netiquette – Guidelines; Logical connectors</td>
<td>Selecting appropriate type of message to content to be transmitted – writing of one e-mail message, one memo and one letter</td>
</tr>
<tr>
<td>8</td>
<td>Written Communication Text Types – 4 - REPORTS</td>
<td>Report types; Technical report structure: procedure, results, discussion, conclusions, and recommendations.</td>
<td>Technical report (300 words) in specific professional context</td>
</tr>
<tr>
<td>9</td>
<td>Written Communication Text Types – 5 - ABSTRACTS</td>
<td>Main requirements in abstract writing - Guidelines</td>
<td>Abstract to a scientific article of the student/of a colleague</td>
</tr>
<tr>
<td>10</td>
<td>Written Communication Text Types – 6 - SCIENTIFIC JOURNAL ARTICLES</td>
<td>Scientific journal article structure: main requirements; citation issues; avoiding plagiarism</td>
<td>Scientific journal article – acc. to IEEE citation style.</td>
</tr>
<tr>
<td>11</td>
<td>Oral Communication – 1 – PRESENTING A WRITTEN PAPER IN A CONFERENCE</td>
<td>Requirements of a PowerPoint presentation; turning written content into oral presentation; designing the appropriate visuals aids</td>
<td>PowerPoint slides for the scientific article written in week 10 – delivery of presentation (approx. 5 minutes)</td>
</tr>
<tr>
<td>12</td>
<td>Oral Communication – 2 – PARTICIPATING IN TECHNICAL DISCUSSIONS/MEETINGS</td>
<td>Expressing personal opinions, ideas, arguing etc.; Communication strategies/functions: negotiating, contradicting, evaluating, synthesizing etc.</td>
<td>Simulation of panel discussion on a given topic</td>
</tr>
<tr>
<td>13</td>
<td>Oral Communication – 3 –</td>
<td>- Guidelines for making an oral presentation;</td>
<td>An off-the-cuff oral presentation</td>
</tr>
</tbody>
</table>
Feedback is generally obtained throughout the course (teacher – student discussions and Assignment Portfolios), and an End of Course Evaluation Survey is administered to all the participants.

The STCE course has been held for three Master’s profiles: Electrical engineering, IT and Automatic translation, as well as for one post-doctoral school (Electrical Engineering) in the POLITEHNICA University of Bucharest - as a piloting stage.

Therefore, the aim of this paper is to find out about the course impact, in order to:
- check to what extent it really meant an aid to the participants;
- identify prompts that could be conducive to amending it so as to better respond to the identified learners’ needs;
- analyze the relationship between the course structure and the job market expectations.

2. CHECKING STCE COURSE IMPACT – RESEARCH OUTLINE

In order to measure course impact, an empirical research project was designed and carried out. The research objectives were reflected in the working hypotheses formulated.

The main hypothesis states that if the students receive a STCE type of course, then there are good chances that they should meet the job market expectations better, i.e. the course impact could be seen as good. To this, secondary hypotheses were added, that refer to:
- the manner and quality level of the higher education answer to the job market expectations by providing a STCE course;
- the relationship between the engineering graduates’ expectations from the university in terms of being offered or not a STCE course;
- the labour market approach to providing in-service soft skills training courses versus their expectations from the engineering job applicants, and, implicitly, their assumptions that universities should equip graduates with such skills.

In order to collect data of both quantitative and qualitative type, a range of instruments were created, namely:
- a STCE+ Graduate Questionnaire - meant for all the author’s STCE course graduates in the university;
- an ENG Graduate Questionnaire - meant for any technical university graduates who did not receive the STCE course;
- an EMPLOYER Questionnaire – meant for employers (small, medium or large companies) that employ technical university graduates.

The three questionnaires were structured based on four common content questions, as shown in Table 2, to facilitate a good triangulation of the answers, and thus to ensure a good validity of the research. Obviously, the corresponding questions were formulated according to the profile of the respondents to each of the questionnaires.

Table 2. Common questions to all questionnaires

<table>
<thead>
<tr>
<th>Question about:</th>
<th>Qstce</th>
<th>Qeng</th>
<th>Qempl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance of STCE skills</td>
<td>Q1</td>
<td>Q1</td>
<td>Q1</td>
</tr>
<tr>
<td>STCE skills as must/asset in hiring</td>
<td>Q2</td>
<td>Q2</td>
<td>Q2</td>
</tr>
<tr>
<td>Company policy in offering STCE type courses</td>
<td>Q4</td>
<td>Q4</td>
<td>Q4</td>
</tr>
<tr>
<td>Ticking STCE skills useful at job</td>
<td>Q5</td>
<td>Q5</td>
<td>Q5</td>
</tr>
</tbody>
</table>

The basic information envisaged in each of these four common questions was the same, and it is essentially presented as entries in Table 2. It should be noted that the list of skills the respondents were asked to tick in Q5 – useful skills at job actually represents the very content of the STCE course units, as shown in the course syllabus in Table 1.

The questionnaires also included differentiated in point of content questions, as shown in Table 3. Thus, in the STCE+ Questionnaire, Q3 is meant to obtain data about the parts of the course which the graduates specifically needed to refresh after getting employment, while Q6 aims to get information about other soft skills they may need at job. The third question in the ENG GRADUATE Questionnaire checks whether engineering graduates who had not been given the course in faculty would have considered it useful, as compared to the kind of course(s) they actually took in faculty – checked by Q6. In the EMPLOYER Questionnaire, the role of Q3 is to check the general expectations of the job market that the job applicants, graduates of technical universities, should possess or not written/oral communication skills in English for the fields of science and technology.

Table 3. Differentiated questions per questionnaire

<table>
<thead>
<tr>
<th>Question:</th>
<th>Qstce</th>
<th>Qeng</th>
<th>Qempl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you used STCE course materials as a resource after course?</td>
<td>Q3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>What other skills now necessary to you at work would you have liked to be taught at the STCE course?</td>
<td>Q6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Would you have welcomed a STCE type course in faculty?</td>
<td>-</td>
<td>Q3</td>
<td>-</td>
</tr>
<tr>
<td>What English courses were taught to you in faculty (type/duration/usefulness at your current job)?</td>
<td>-</td>
<td>Q6</td>
<td>-</td>
</tr>
<tr>
<td>Do you expect that your newly hired employees should have written/oral communication skills in English?</td>
<td>-</td>
<td>-</td>
<td>Q3</td>
</tr>
</tbody>
</table>

The sampling of the persons answering the questionnaires is represented by the STCE+ students of the author, whose email addresses were easily recovered, and personal contacts who are all technical university graduates – ex-students, fellow teachers in the technical university and other engineers working in various domains – for the ENG Graduate Questionnaire. As
regards the EMPLOYER Questionnaire, emails were sent directly to a series of firms that presumably employ engineers, or other contacts were used in order to collect answers. All the questionnaires were sent by email, with an explanatory message in the email field, in English, requiring them to answer the attached questionnaires and also to disseminate them to other potential respondents fulfilling the requirements of the respondents’ profile, which actually increased the rate of response.

A brief letter of transmittal to the respondent preceded the set of questions in each questionnaire, specifying the rationale for the questionnaire and guaranteeing the confidentiality of the answers. As after the first emails the response was actually not too high, a reminder email was sent to all the addressees, raising the final response rates, which were as follows: 42% for STCE+, with 30 answers, 77% for ENG, with 54 answers and 60% for EMPL, with 24 answers.

Certainly, the number of respondents is not as high as to ensure more than an illustration of the main trends in the context described. However, in spite of this limitation and of other restricting aspects, such as the no-classes summer period when it was administered or the rather short deadline up to which the answers were expected, the general picture that the data configure is able to fairly accurately approximate the course impact. Moreover, some respondents added their own free comments in an informal manner, on email or in discussions, which also contributed to a better triangulation of the data.

In what follows, the data collected by means of each questionnaire will be presented in turn, in order to facilitate their comparison and, further on, the triangulation of findings with a view to correctly interpreting their meaning.

Thus, as far as the STCE+ Questionnaire is concerned, 60% of the respondents were from the Computer Science Master, 40% graduated from the Automatic Translation Master and 10% from the Electrical Engineering one. As expected, the domains they are employed in range from a bulky IT zone, to some in the aeromilitary industry and telecommunications, with only a few in call centres or with retailers.

At job (Q1) their STCE skills are Important – 60% or Very important – 40%. When they were hired (Q2), the STCE skills were a must to a considerable extent for 70% (while for 20% they were mandatory to a very high extent). For those who answered that they were a must, naturally the answer to the possibility that STCE skills should have been an asset upon being hired became useless; however, it is mentioned by 70% of them as an asset to a very high extent.

Only 20% of them felt the need to refresh their STCE course input after being hired (Q3), among the aspects listed being: email writing, grammatical rules, writing conventions in general. As they graduated in very recent years – 2010 to 2012 – this percent seems to be normal. In 90% of cases, their employers do not have it in their policy to provide training to newly employed engineers.

As regards their answers to Q5 – the most frequently skills used by them at job, these are: Technical and business correspondence, always clustering around the 3. Frequently and, mainly, 4. Very frequently values, with 30 - 40%, as well as Participation in technical/business discussions – around 60 - 70% - again at levels 3 and 4 of frequency, as well as Making oral presentations, which is seen as 3. Frequent by 60 % of the respondents.

Other aspects necessary at job (Q6) produced the following suggestions: technical translations (2 respondent), main functions of speech used in discussions (4 respondents), listening to examples of discussions (4 respondents). Finally, although a direct evaluation of the STCE course usefulness/relevance to their current job was not expressly required in the questionnaire, in answering Q6 around 30% of the STCE+ respondents added remarks of the qualitative type, clustered around a good appreciation of the course, for instance: ‘the course has helped me and it will help me in the future, too, in my career’, ‘the skills taught are enough for the level of competence expected from me’, ‘the course was very well structured, covering most areas of interest for us, engineers’.

As regards the ENG Questionnaire, the years of graduation were: 1985 – 1995 for 11%, 1996 – 2005 for 39% and 2005+ for the remaining 50%. Engineers who responded this questionnaire are currently employed in: Research and Education (approx.22%), while the rest of 78% have jobs in technical areas in Industry, Business and Consultancy.

Under Q1 – they answer that the STCE skills at job are 4. Very important – 72.2% or 3. Important – 16.6%. No respondent answered 1. Not important, and only 11.1% considered they are 2. Relatively important. Upon hiring, STCE skills were seen as a must: 4. To a very high extent – by 42.2% and as 3. To a considerable extent – by 27.7% of the engineers, with quite similar percentages for the second option: STCE skills seen as an asset upon hiring. There were no answers under option 1. Not at all a must or an asset. This is confirmed under Q3 – as 94.5% would have welcomed such a course in faculty. Among the reasons they provide are: ‘it would have taught me to express myself more clearly’, ‘it would have been a plus in getting hired’, ‘it would have helped me to carry out research’, ‘it would have given me technical language support’, ‘it is essential, especially at managerial levels’.

As regards Q5 – the frequency of skills use at job, the results should be analyzed with the taking into consideration of the domain the respondents work in, which explains the 42.2% of 1. Never answers for Abstract writing and for Scientific articles/papers writing, because only researchers and professors do use the skills in such types of written communication frequently, while the rest cluster with high values for: Writing technical/business correspondence – 61.1% do this 4. Very frequently, Reports – 50% of them do this 4. Very frequently, Participating in technical/business discussions – 50% with 4. Very frequently and, with 42.2% - Making oral presentations also appears under option 4. Very frequently.

None of them took a STCE type of course in faculty – Q6; they only list ‘standard’ or ‘traditional’ General Language courses, or, in more recent years, ESP ones, making references to the short duration of such courses, or their optional character.

The EMPLOYER Questionnaire was answered by representatives of small companies – 22.2%, medium - 33.3% and large companies – 44.4%, out of which over 80% came from companies directly involved in industry/sales of technical products, while the rest were research/education organizations. 55.5% answered that STCE skills are 4. Very important for their employees, while 33.3% consider them 3. Important (Q1).

Q2 – abilities of STCE type as are seen as a must or an asset upon hiring people returned 55.5% seeing them as a must to 4. A very high extent; similarly, 44.4% of employers consider them an asset 3. To a considerable extent.

The companies’ expectations that the newly hired employees should already have these skills are of over 90%. In correlation, only 66.6% of the employers do have in-service training.
courses in their current policy (Q4). Only two answers mentioned that they offer Leadership or Professional management soft skills courses, but no one actually offers STCE type training.

The answers to Q5 depend to a high extent on the company profile, with consistently high scores for Technical/business correspondence and Participating in technical/business discussions (55.5% - Very frequently), followed by Making oral presentations – 33.3%, also Very frequently. The respondents standing for research/education organizations naturally included Abstract and Scientific Paper writing, which thus raised the total for this item to 33.3% - as 3. Frequently necessary.

The significance of the quantitative and qualitative data obtained is discussed in the last section in order to check the hypotheses and draw a range of conclusive guideposts that could document our research and provide support in optimizing the STCE course in the future.

3. DISCUSSION OF RESULTS AND OPEN CONCLUSIONS

The triangulation of the questionnaires in terms of the common content questions confirms the main hypothesis as a trend, given the fact that both STCE course graduates and most engineers actually make full use of their skills, or express a need for them, respectively, which is also confirmed by the high scores of frequency of use obtained for Q5 in all three instruments.

In direct correlation, the high scores of frequency of use of the various skills included in the STCE course structure (Q5) show that the job needs of the engineering university future graduates’, as suggested by the needs analysis conducive to establishing the course modules and units topics, were quite correctly estimated in most of the cases, which made the course both relevant and useful for the students in their jobs, be they in industry or in research. It is then a positive feature of the course the fact that it was designed based on the principles of modularity and flexibility, as the teacher could/can always adapt the course by resetting priorities from case to case.

As a comment, the three Master’s groups to whom the STCE course was taught had profiles requiring a number of adjustments in order to match the needs of the trainees – and this was done based on negotiations with the students and the Directors of the Master’s courses. In this respect, new units were designed and included in the course, for instance the Poster making and presentation. The course allows the teacher to thus allot different weighting in terms of focus and time to those units that are most appropriate to the students’ medium and long term interests.

As regards the analysis of the relationship between the work market approach to employing engineers in our country and its expectations from the engineering higher education as far as the graduates’ soft skills of the STCE type is concerned, the results confirm the fact that employers actually expect to a high extent that job applicants should come from school endowed with a wide range of soft skills. Moreover, under the current economic conditions, most companies cannot afford providing such courses as in-house training, but they see them as a must to a (very) high extent, or at least as an asset – but those answers came from employers that make use of another language of international circulation, such as German or French, as the official language of the workplace.

What is more, if we search all the results obtained to Q5 – skills frequently used at work, the returns from the three sets of questionnaires did not produce any one answer of 1. Never used at work for any of the skills included in the list, which can be conducive to strengthening the opinion that the initial choice of soft skills included in the STCE course was appropriate. Certainly, the qualitative data collected from all three categories of respondents add other proposals of topics to be included in the STCE course – as these are prompted by their current job requirements, but no respondent actually considered the list of skills proposed in the course, which is given in Table 1 and was fully included, with seven main entries under Q5 in all three questionnaires, as irrelevant or useless.

At this stage in checking the STCE course impact, a range of concluding remarks should be made. Firstly, as confirmed by the results of the research carried out and presented in this study, the STCE course was evaluated as a useful one for the Master’s level. Its relevance for the engineering education graduates has been confirmed, and the components included are of interest for them at job.

Consequently, we advocate that such a course should be included in the Master’s programs of engineering higher education, with, if necessary, certain amendments of the structure and choice of units, as suggested by needs analyses, which play an important part in establishing the course outline from case to case.

We also plea for a necessary curricular change with good perspectives for the technical universities in this respect, with a higher weighting given to soft skills development in general, thus granting a well deserved and fully demonstrated better visibility to this type of instruction (inter)nationally.

Moreover, taking into account our own experience in designing and applying the STCE course, we maintain that foreign language teachers can embark upon working out CLIL type courses of soft skills blended with the language component, thus contributing to the upholding of their technical universities image and their attractiveness as study destinations for further candidates.

4. REFERENCES

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INNOVATIVE NEW METHODS FOR ENGINEERING EDUCATION. CASE STUDY IN FOOD ENZYMOLICAL SIMULATION-BASED LEARNING

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ABSTRACT: Simulation-based learning as a broad modern technical high educational method offers through students’ research projects, more advantages: performing individual and team student work, originality and practical usefulness, interdisciplinary fields. The student’s personality is stimulated and also well developed and many professional major skills in food engineering are assimilated. The aim of this paper is to assess, in a case study of some technological food enzymes features, the simulation-based learning using simulation means. The results of this educational method prove a higher motivation in students’ research work; the study environment is nearest of the real applications from the food industries.

Key words: Simulation-based learning, professional major skills, technological food enzymes features, engineering education.

1. INTRODUCTION

In the food engineering higher education a major objective is concerned to apply the principle of an active student involvement in conscious and active assimilation of the theoretical and practical knowledges.

From among the new methods for engineering education, as inquiry-based approach [1] or simulation based learning, the case study was elected as analysis method of simulated situation, especially simulated enzymological experiments in food technologies. The educational method proves a higher motivation in students’ research work since the study environment is nearest of the real applications from the food industries environment.

In the own dynamic of the case study the student covers some steps [2], as:

a) targets identification
b) simulation-based case
c) analytical study as reasons, relations and functions
d) data reorganization
e) solution variant established and optimal solutions chosen
f) and experimental data homologation.

Method offers, by students’ research projects, some advantages: team students work, interdisciplinary fields and practical usefulness.

The instrument used for the simulation is the CPN Tools environment [3], based on the Petri Net formalism. The Petri Net (PN) language is a modelling language [4] that is suited for the description of system in which processes are taking places concurrently and the transition between the state are discrete (event base).

A big advantage of the PN language is that it has a graphical representation that makes both the modelling and the simulation more intuitively as the equation based languages. This makes it an ideal support for learning and teaching.

The components of this graphical representation are the places which contain the state information and the transitions which indicate the possible transformations that the system can undergo. Directed arcs bind places to transitions indicating the possible processes in the system. On this structure tokens are moved from a place to other by passing through the connected transitions. The totality of tokens at a moment in the net (called a marking) is the visual representation of the state. The passage of tokens trough a transition is a sign that the corresponding process has taken place [5].

The language used by the CPN tools is an enhanced version of the PN (Colored Petri Net CPN) that:

- use coloured tokens: each token has a associated value that is typed and can be manipulated trough a programming language
- is timed: every event has a time stamp and every transition can have a duration
- admits both deterministic and stochastic transition events [3].

The case study in food enzymological simulation-based learning is on a vegetable biomarker, as peroxidase. The enzyme brings important informations about positive food events (as mildew cheese flavour getting, the prolongation of the preservation length at fresh milk, the pasteurization efficiency or glucose measurement in vegetables tissues). The peroxidase has also a negative action, causing vegetable enzymatical browning, ascorbic acid wasting or carotenes bleaching [6].

There were also achieved amperometric horseradish peroxidase biosensors, which are wide employed in order to measure directly in food and also in live tissues the hydrogen peroxide concentration, by high sensitivity and good stability devices [7].

The students make the peroxidase study, through this new methods for food engineering education, for a native enzyme simultaneously with an adsobtion immobilized one.

The peroxidase immobilization on an organic holder has some application advantages as enzyme stability increment, work in...
a continuous flux, gradual peroxidase recycling or lower total costs manufacture.

But the enzyme immobilization causes some changes in enzyme behaviour and also in reactions kinetics [8]. Quite the enzyme stability increases, it changes the enzyme affinity for the substrate and sequely it also changes the catalysis feature, from homogeneity catalysis to a heterogeneity one. The rate of the reactions suffers a decrease in case of immobilized peroxidase.

The paper presents the steps reached in simulation-based learning: from experimental data obtained by the students in their practical method (measurement of enzymatic rate reactions for a native peroxidase and for immobilized one) to the simulated enzymological experiments on native and immobilizes peroxidase. After the steps a, b, c, d in own dynamic of the case study, the students look for solution variant established and optimal solutions.

2. METHOD FRAMEWORK

2.1. Experiment

The students are doing two kinds of experiments. In the first one, they immobilize the peroxidase trough adsorption on an organic support (cellophane TM) in conditions of different time of adsobtion. In the second one, they are using both native and immobilized enzyme on the same substrate and measure the enzymatic activity.

Native peroxidase extracted from a rich vegetable source (horseradish) by an aqueous salted solution [9] has been used for two practical experiments: spectrophotometrical measurement of the reaction rate after an enzymatic reaction between native peroxidase and the peroxide water substrate.

Another portion of native peroxidase has been immobilized on a cellophane TM support, by adsorbtion. The membranes of cellophane were inserted by the students in different glasses having the same quantity of peroxidase solution, at pH 5.4, and 230°C. There were applied different times of adsorption, between 20 to 180 minutes. Then, for each sample, the peroxidase activity was spectrophotometrically established by the students, by the same analytical method.

2.2. Modelling

The students build models of the both processes: immobilization and enzymatic reaction.

As against the classical method based on the mathematical models, the simulation method has the advantage that concept of modelling process trough the flow and accumulation of a quantity is highly intuitive being used also by the System Dynamics method of Forrester [10].

In these models the implied molecules are represented through tokens. The colour of token individualizes the type of molecule: enzyme, enzymatic support, the ensemble enzyme-support, enzymatic substrate, the complex enzyme-substrate and products.

The places of the PN are the pools of each type of molecule. The number of tokens existents at a simulation moment in each of these pools can be correlated with the quantity of each type of molecule. The transition represents the reaction at which the molecules participate. The process of drawing the corresponding PN for modelling an experiment is easy to use and understand by the students. They define a colour for each type of molecule used in the experiment and draw a pool for it.

In the next step, they define a transition for each reaction they suppose taking place and connect this transition with the corresponding pools of reactants and products by using arcs.

On the arcs, they specify the number of token needed for the transition occurrence and the number of token produced by the transition, thus expressing the stoechiometry of the enzymatic reaction.

Two models are to be build: model of immobilization process and model of enzymatic reaction with immobilized enzyme.

2.3. Simulation

The three build models are used to simulate their corresponding processes. For this, a number of tokens are placed in the pools corresponding to the starting molecules, which represents the PN initial marking.

The simulation is performed interactively. By clicking on a transition, the associated reaction occurs by taking token from the reactants pools and putting it in to the products pools. Each transition has a time, so that the evolution in time of the enzymatic reaction can be simulated.

3. RESULTS AND DISCUSSIONS

The experimental data obtained for the immobilized vegetable peroxidase are presented bottom (figure 1). The optimal rate of enzymatic reaction function of the immobilization time shows an increment of the rate, followed by a plateau. Then the rate reaction has a minor decrease.

![Figure 1. Experimental data for immobilisated enzyme](image)

Based on the experimental bellow results, the students build the models.

The model for the immobilization process consists of three places: one for the enzyme (E), one for the support (SP) and one for the enzyme-support ensemble (E-SP). The model is presented in the figure 2.

Each place has associated the corresponding token color. The adsorption of the enzyme on the substrate is represented through a transition that needs one EZ token and one SP token to occur and an EZ-SP token as final product.

![Figure 2. Model of the immobilization process](image)
the enzyme binding to the substrate is weak and reversible, the reverse reaction is represented, too. The main direction is the binding process, so a small probability (2%) was associated to the reverse transition.

In a first attempt of simulation, the students use this simple model assuming that the presence of the reactants is the only condition for the reaction occurrence. The resulting model is linear and doesn’t fit completely with the experimental data.

A new probability function is introduced, which describes the probability of coupling E to SP (to form E-SP) as function of the already existing E-SP ensembles. This function was empirically fitted to the experimental data. In the model of the enzymatic reaction with immobilized enzyme (figure 3), E-SP is the enzyme-support ensemble, S is the substrate and P is the product.

![Figure 3. Enzymatic reaction model with immobilized enzyme](image)

The model is similar with the previous one. At the building of the model of enzymatic reaction with immobilized enzyme, E-SP is the enzyme-support ensemble, S is the substrate and P is the product. The model is similar with the previous one.

The models were use for the simulations. Simulations were performed by placing the initial markings corresponding to the initial concentrations in the experiments (E, S, and SP) in to the PN. The simulation advanced until the experimental time was reached. The token existent in each place at the end of simulation were automatically counted. The token present in the E-SP place in the PN corresponding to the immobilization process were used as initial marking for the simulation of the enzymatic reaction with immobilized enzyme.

Multiple simulations were performed for each experiment and the statistical mean are presented in figure 4, company the experimental results.

Model 1 was produced taking in account only the adsorption of the enzyme on the organic support. The students have adjusted the formula of the probability of adsorption as a function of the current adsorbed enzyme, until the simulation results fitted the experimental data. The students have then tried to fit the model to the descendental portion of the model. They have implemented two alternative solutions in the model.

![Figure 4. Experimental and simulations results](image)

The first one was the decrease in the quantity of the adsorbed enzyme which was implemented in the immobilization model through the probability function associated with the detaching transition. The second one was through a probability function dependent on the enzyme concentration associated with the reaction transition in the reaction model. The first one gave better results and is represented in figure 4 as Model 2.

At this point the students were challenged to find an explanation for each model. With the help of the teacher and the literature they have proposed and discussed each of the alternatives.

The detaching can be due to a change in the equilibrium of the adsorption process due to transport phenomena in the solution and in the limit layer at the surface of the support. The reducing in enzyme activity can be explained by reciprocal hindering due to the increase in concentration of enzyme on the support for example trough deposition in a multilayer.

4. CONCLUSIONS

Having in foundation an enzymatic experiment (vegetable peroxidase immobilization) so much important in food engineering education, the students were pointed out of the hypothetical status of their explanations and were given the task of planning experiments for their validation. The experiments will be carried out in another training session.

There were distinguished some advantages of the simulation-based learning in enzymological food engineering education as against the classical education learning, based on the mathematical models:

- the process is represented in a discrete manner more suited for representing chemical reaction than the continuous approach of the differential algebraic equation system
- the models are constructed graphical which is more intuitive than writing equation
- through step by step simulation the students can visualize the stoechiometry of the enzymatic reactions and the concurrent character of the processes conducting to a chemical equilibrium
- colored token are an intuitive method to model discrete population balance
- the probabilistic character of the food enzymatic reaction is easier to model and simulate, making it accessible for the students (the use of stochastic differential equation, which are needed by the classical method, is far beyond the undergraduate level)
the model can be easy and intuitively extended by adding token colours, places, transitions for each new hypothesis formulated.

The student’s personality was stimulated and also well developed; many professional major skills in food engineering were assimilated.

5. REFERENCES

A TRANSDISCIPLINARY APPROACH TO BUSINESS EDUCATION THROUGHOUT FAMILY FIRMS AS COMMUNITIES OF PRACTICE

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ABSTRACT: The paper explores the relationship between family businesses (FB), communities of practice (CoP), and entrepreneurship education in the context of the knowledge production and sharing within and between these communities. The relationship between these three spheres of knowledge is presented from a transdisciplinary point of view. The contextual legitimacy identifies the communicational channels between the fields of family businesses and the communities of practice and entrepreneurial education in a transdisciplinary generative synergistic context. The notion of CoP suggests that organizational community boundaries do not correspond with typical functional boundaries, including practice - and person - based networks, while family businesses underlie the necessity of sustainable business education which can be achieved through collaborative interaction in a creative entrepreneurial framework. The paper proposes to find the common ground of the three fields of knowledge and the way these points develop new knowledge windows towards a new entrepreneurial understanding of life, and generating new alternatives.

Key words: entrepreneurship education, family business, communities of practice

1. INTRODUCTION

Knowledge and its management represent the heart of the informergic economy, with the unprecedented possibilities of production and sharing of knowledge, of learning and change in knowledge place organizations and individuals alike under the imperative of capitalizing on this new reality [1]. In order to meet the knowledge imperative economic actors resorted on various organizational solutions, some of these solutions brought teams as a central element (e.g. cross-functional teams), others have focused on the customer as a central element, and others were interested on business model [2]. The search for better solutions that capitalize on knowledge continues, the paradigm shift regarding the approach of knowledge needs consider the conservation of fundamental elements of knowledge, of invariants as relevance, correctness and value, reconfiguring the approach of the knowledge process in terms of a synergistic generative methodological approach. In this context transdisciplinarity approach is considered the best way to be chosen in order to understand the different channels the entrepreneurial learning could work in family business as a community of practice, even they are partially distinguished incompatible systems, with potential tensions and conflict [3, 4, 5]. The transdisciplinarity as a new way for knowledge has to manage, to redistribute and to share the new spaces opened up by new opportunities through specific processes [6]. The CoPs become an important source of learning and innovation in connection with family business in an entrepreneurial learning context as new knowledge spaces [7, 8, 9, 10]. Such a synergistic generative approach is better to explain processes of learning and innovating then the monodisciplinary approach. The purpose of this paper is to contribute to a better understanding the way entrepreneurial learning is working in the family businesses as community of practice, offering insights and stimulating to reflections on the challenges and processes involved in transdisciplinary knowledge production. Several studies have emphasized that knowledge production is socially, historically, culturally and materially situated [11, 12, 13, 14, 15]. To understand knowing in practice is necessary to go beyond the local level and look at how it is distributed into larger socio-technical networks, connecting different levels of reality in the new context of the informergic knowledge based society [5]. The knowledge search window, with top-down as theoretical approach and bottom-up levels, as practical experiences allows to put together things, people, and events that are distant and only partially congruent, because they allow the coexistence of old and new, because they are able to deal with change and disorder while explaining persistence and order, in the new synergistic generative perspective [4, 16, 17, 18].

2. MONODISCIPLINARY APPROACH

2.1. Communities of practice

CoPs are important as they weave the organization around competencies without reverting to functional structures, facilitating an informally environment formally structured, supported by knowledge, people, organizational processes and infrastructure [7]. These CoPs hold a vast base of knowledge ranging from bottom-up level, working as practical experiences, to top-down level, as theoretical concepts. CoPs are considered as the engines for acceleration in an organization, as knowledge fabrics for apprentices of CoP in order to acquire communitarian identity with shared passion, relationships, roles and ways to achieve a common knowledge, practices, based on detailed empirical evidence of a globally operating organization [8, 9]. CoPs feature distinctive characteristics from other organizational forms such as project teams, formal work group or informal networks, which are also present in organizations for managing knowledge [19]. CoPs, unlike the other three organizational forms, spring from the
members’ interests and passions (glue) with the purpose of developing the auto-selected members’ (membership) capabilities and to create and share knowledge (purpose) and therefore their span of life is directly connected to the interest to maintain the group (duration). Communities of practice are fertile environments where knowledge is produced but also they themselves function on the basis of knowledge. These environments foster genuine learning through a corroborate of collectively participatory interaction around issues that are of interest for its members [8]. A community of practice (CoP) draws its identity from the domain component, which sets the direction in which it will evolve and ensures a purpose driven activity. Through its participatory dimension the CoP allows members to get involved and interact socially with members which are situated on different levels of the knowledge spectrum of the particular domain, creating in the midst of that interaction new resources, which belong to the community. The community’s resource heritage is also enriched by the stock of experiences and practices that each individual member brings from his participation in other communities. On the premises that CoP is not functioning on imposed hierarchy the communication process is characterized by accessibility [8, 12, 20].

2.2. Family businesses

Although family businesses are commonly recognized as long-standing phenomenon and important contributors to the economic development and wealth creation around the world [21], yet the literature indicates that 30% of these types of entities survive over the second generation of family, and just 15% survive over the third generation [22]. The family business body of literature has long struggled to reach a consensus regarding the definition of family business [23] and rightly so since every family business has its own history, culture and idiosyncrasy that differ in various ways. The essential elements which define this rather diverse typology of business are: identity (the collective idea that the business is a family business and that the family issues matter in the management and ownership of the business), intention to maintain family control of the dominant coalition; a unique, inseparable, and synergistic resources and capabilities arising from family involvement and interactions; a vision held by the family for trans-generational value creation; pursuance of such a vision [24, 25, 26, 27].

The family business is a complex and dynamic system composed of other subsystems that interact with each other and within themselves in a particular way given by the pattern of cycles that can be identified in the life span of family business [21]. They give birth to idiosyncratic resources namely “familliness” (unique, inseparable, and synergistic resources and capabilities arising from family involvement and interactions [25] and which is source of competitive advantage [26]. The “familliness” resources are not merely characterized by uniqueness which derives from the interactions and involvement of family but are also shared resources, in a sense a shared repertoire of the family business creating a mutual or involvement (to know by doing)”, and reactive intrinsic transdisciplinary approach, “learning to understand to be by living with others”, represents a multiple transdisciplinary paradigm, working as guidelines to achieve both necessary integrative semiophysical skills in a synergistic communicational context, through the structural-functional semiophysical system, with its technical efficiency (knowing what and how we know), and ethic-semantic value of semiosial products in an ethical authoritative context with its axiological coefficient (knowing how and why we live) [41, 42, 43]. The rational knowledge process „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. The relational knowledge process “learning to understand to be by living with other people”, presupposes „authenticity through integrity and excellence (to be-who, how)”, together with „participation towards its survival [28]. Yet in order to perform successfully, family businesses also require a tacit collective knowledge embedded in the routines of the business, which to integrate, coordinate and mobilize its idiosyncratic resources and capabilities [29]. In this sense, the family business’ capacity to create and transfer its specific knowledge is crucial not only to its performance but also to its survival over generations [30]. Because the founding generation, generally possess a substantial stock of tacit knowledge regarding the business firm, the nature of the relationship between the first generation and succeeding generation is of paramount importance in the transfer process [31]. Another weak point of the family business is that they often falls into path-dependent developments and historical legacies [32] which hinder their renewal and their pursuit of entrepreneurial strategies, therefore the very survival of the family business depends on the capacity of the members to foster a trans-generational entrepreneurial orientation [33].

3. SYNERGISTIC GENERATIVE APPROACH

Transdisciplinarity as understanding (top-down approach), learning and practicing (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 [1, 38, 39]. The four pillars of the transdisciplinary knowledge learning to know, learning to do, learning to be and learning to live with other people [40] are presented in a new framework, learning as achieving information and knowledge, as an objective rational extrinsic logical issue, and understanding as an ethic-semantic issue, the subjective relational dimension of knowledge. The active extrinsic transdisciplinary approach, “learning to learn to know by doing”], and reactive intrinsic transdisciplinary approach, “learning to understand to be by living with others”, represents a multiple transdisciplinary paradigm, working as guidelines to achieve both necessary integrative semiophysical skills in a synergistic communicational context, through the structural-functional semiophysical system, with its technical efficiency (knowing what and how we know), and ethic-semantic value of semiosial products in an ethical authoritative context with its axiological coefficient (knowing how and why we live) [41, 42, 43]. The rational knowledge process „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. The relational knowledge process “learning to understand to be by living with other people”, 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 [44, 42, 1]. Learning to know becomes a ring of the extrinsic active knowledge chain, with “what, how and why” epistemic questioning paradigm [45, 46, 47, 44], related with the message (quantitative and qualitative aspects, know what), with the manner of the communicational process, code and channel (know how), and finally with the context (know why) [1]. The ring “by doing”, of the extrinsic active knowledge chain represents the “acquiring a profession necessarily passing through a phase of specialization in a challenging world, with changes induced by the computer revolution with excessive specialization risks, reconciling the exigency of competition with equal chance and opportunity for all” [39].

3.1. The spheres of authority in the knowledge process

In the midst of globalization, knowledge processes can no longer be treated separately, mono-disciplinary but rather there is a need to overcome the disciplinary barriers and find connections between different domains as channels of interdisciplinary and transdisciplinary communication [38, 17, 43]. Insights regarding the sources of entrepreneurial learning process can be drawn from the application of “Model of authority spheres” – a triadic approach which considers the existence of three spheres of authority: leadership, education, and relationships. This model is relevant for the study of entrepreneurial learning because it incorporates the most frequent sources of learning presented in the literature (cognitive learning, experiential learning, and social learning) [41].

In the leadership sphere, entrepreneurial learning takes place “by-doing” in specific situations faced by the entrepreneur in the enterprise - from business opportunity identification, entrepreneurial step, to actual management of the venture for growth and development. The evolution of the entrepreneur throughout all these phases springs the development of entrepreneurial skills, the accumulation of a heritage of contextual entrepreneurial knowledge and the refining of entrepreneurial instinct. The leadership sphere presents two dimensions in which the entrepreneur learns: the dimension of the apprentice/employee and that of head of a business. In the position of apprentice/employee the entrepreneur learns from previous experiences of participating in activities/ventures in which someone else is the expert. From the position of head of a business the entrepreneur learns to work with others and through others. In the relationships sphere entrepreneurial learning occurs through participation in a variety of relationships and through exposure to the knowledge and experiences of those who the entrepreneur is interacting with in different communities. This sphere includes participation in both cultural and sector specific networks, which can be formal as well as informal. The positions that the entrepreneur has in variety of relationships and communities favour an all-levels learning. The educational sphere fosters cognitive entrepreneurial learning through exposure to formal professional training, which allows an accumulation of general methods, techniques and instruments in a specific field as well as the development of expertise and know-how [5]. Learning by doing could be, in the transdisciplinary approach an apprenticeship in creativity, discovering what is new, bringing in actuality as innovation the creative potentialities, generating the conditions for the emergence of the authentic person, working at the top level of the creative potentialities [48, 49, 50]. The step “learning to be” is a permanent communitarian apprenticeship in which teachers inform the disciples, as much as disciples inform the teachers, in a continuous teaching-learning process, so that the shaping of a person passes inevitably through a transpersonal dimension with fundamental tensions between the rational and the relational approach, discovering the harmony or disharmony between individuals and social life, testing the foundations of the personal believes in order to discover that which is found underneath, questioning in a scientific spirit being a precious guide for all the people [38, 39, 17, 41, 51]. This can be done only by living together with other people in communion, supposing that the transgressive attitudes can, and must be learned, allowing to a better understanding of own culture, to better defend the personal and collective identity with all its components [52].

The synergistic generative of the knowledge integration is based on the equilibrium between the outside (with its extrinsic active knowledge aspect) of the person and his inside (with its intrinsic reactive knowledge aspects) [53, 4, 43, 54]. In the context of practical perspective regarding the unification of knowledge in domains that go beyond traditional disciplinary limits, the transdisciplinary model of synergic synthesis can be used to establish the systemic approach of transdisciplinarity [43]. This process of integrating knowledge evolves on the ascendant spiral of knowledge through the hierarchical integration of various sequential, special, and temporally heterarchic functional structures with the relationships specific to each sequence of data [5].

3.2. Entrepreneurial learning in family business as a community of practice

Every knowledge space of this transdisciplinary integrative study, entrepreneurship, family business, and communities of practice has specific communicational channels in order to configure the new synergistic generative space, as it is pointed in the figure. As an inherently creative process entrepreneurship brings forth its renewing capacity generated by the progress creation solutions it provides, which could help family businesses to escape the path-dependent trap. The family business through its natural relationships that generate a high level of trust and commitment provides the fertile soil for the functioning of community of practice framework. The community of practice through its domain dimension allocates meaning to the activities that are taking place in the family business ensuring a shared understanding and fostering collective participatory learning within the family business.

**Figure 1.** Synergistic generative model for Entrepreneurial education in Family business as Communities of practice

the family businesses organized as communities of practice the process of knowledge achievement takes place through the
multiple transdisciplinary paradigm of teaching-learning and understanding approach [42]. In the context of family business the members engaging in day-to-day running of the business participate in a complex social and economic context of learning and ultimately work at producing “their own future” [12]. In the family business functioning as community of practice, knowledge is achieved by understanding, learning and practicing skills [20] and learning is embedded in the participation in everyday social practices of family and business as overlapping communities of practice [55]. The family business as a community of practice functions in a new trans-disciplinary educational model, fostering a learning process where the “student” is educated in an experiential setting [20]. In the family business community of practice the different generations learn from each other through participation in a ‘constellations of interconnected practices’ [56] and interact according to a APA (active-passive-active) model of participation [5]. The family business incorporates the accumulated knowledge and experience that the founders bring in from their own families, education, previous work experience and that of the new-generation joining the business which also bring their accumulated knowledge and learning from other communities that they are members, in this developing together a new community of practice that is the family business. In the family businesses organized as communities of practice the process of knowledge achievement takes place through the multiple transdisciplinary paradigm of teaching-learning and understanding approach [42]. In the family business community of practice the different generations learn from each other through participation in a ‘constellations of interconnected practices’ [42, 57], and interact according to a APA (active-passive-active) model of participation [5].

4. CONCLUSIONS

The transdisciplinary approach to achieve, transmit and implement knowledge, through its multiple paradigm, with extrinsic active (learning to know by doing) and intrinsic reactive (understand to be by living with others) components can be applied to understand the way entrepreneurial learning, family business and community of practices are working together in the new synergistic generative integrative process. The transdisciplinary approach is bringing together separated systems as entrepreneurial learning, family business, and community of practice, which implies that learning occurs in a context of potential tensions and conflict. However, a transdisciplinary way knowledge makes possible to manage, to redistribute, and share the new spaces opened up by new opportunities through processes of ‘perspective making and perspective taking’ [6]. The CoPs [7, 58] become an important source of learning and innovation in connection with family business in an entrepreneurial learning context. Such a synergistic generative approach is a better explanatory process of learning and innovating then the monodisciplinary approach [59].

In order to contribute to a better understanding the way entrepreneurial learning is working in the family businesses as community of practice, offering insights and stimulating to reflections on the challenges and processes involved in transdisciplinary knowledge production. It is important to emphasize the social, historical, cultural and material context to evaluate the real knowledge production. To understand knowing in practice, it has to go beyond the local level and look at how it is distributed into larger socio-technical networks. Simply fostering links across professions and different spheres of knowledge may not result in knowledge integration where the organizational and/or institutional context reinforces separation between the practices of those professionals, as well. This implies to take into account the epistemic context, tools for knowing in the projects, the influence of professional identity, legal and formal regulations surrounding experience and division of labor in research. Knowing is participation in a complex web of relationships among people, activities and functional structures [60, 16]. To know is not a static capability, but a practical accomplishment as actors engage in the world [61], the practical implications being therefore that we only get knowledge about a new way of working by practicing it in an integrating transdisciplinary network in very new knowing and practicing way [62], in order to lead to path dependent teaching/learning processes to solve the challenges to manage the radical changes in the knowledge process, to avoid or to cancel the barriers of incompatibility between the existing stock of knowledge, embedded into epistemic cultures [59, 64], and the knowledge required by new and radically different practices, not just locally defined, but working as networks extending beyond the immediate context [65, 66].

5. REFERENCES


IMPROVING SYSTEMS THINKING SKILLS OF SECOND YEAR ENGINEERING STUDENTS BY AN INTRODUCTORY PROJECT

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ABSTRACT: In 2011, the course Introductory Project in Electrical Engineering took place for the first time at the Department of Electrical Engineering of the Technion – Israel Institute of Technology. The course was devised to expose sophomore students to the discipline of electrical engineering and improve their systems thinking skills. The core of the course was a design project of a window cleaning robot. This task was carried out by teams of five students, with personal instruction by a mentor, a senior engineer in the Department. The present research, which used quantitative tools alongside qualitative ones, indicates significant improvement in systems thinking skills of students who took the course.

Key words: systems thinking, electrical engineering, project based learning

1. INTRODUCTION

The course Introductory Project in Electrical Engineering was devised to expose sophomore students to the discipline of electrical engineering and improve their systems thinking skills. This type of thinking is necessary for engineers in general and electrical engineers in particular, in view of the inter-disciplinary character of the profession. The course took place for the first time at the Department of Electrical Engineering of the Technion – Israel Institute of Technology in 2011. The core of the course was a design project of a window cleaning robot. This task was carried out by teams of five students, with personal instruction by a mentor, a senior engineer in the Department.

Introductory courses with similar objectives are offered by universities to first and second year electrical engineering students [1-3] and mechanical engineering students [4]. Literature reports that such courses have managed to improve students' comprehension regarding the areas included in the discipline [1] and improve their systems thinking skills [4].

The study described below examines changes in students' systems thinking skills following their participation in the course. Unlike the above studies that took the constructivist-qualitative approach, the present research is a mixed method study using quantitative instruments alongside qualitative ones.

2. THEORETICAL BACKGROUND

2.1. Systems Thinking

Systems thinking provides a framework for observing interaction between the system's different components [5]. Contrary to traditional thinking, based on the reduction approach – whereby in order to understand a system one can suffice with reducing it into its components and understanding each of them separately – systems thinking argues studying the properties of system components alone is not enough, but one must also learn the interaction between the different components [6]. Such thinking is required nowadays in view of the fact that technological systems are becoming more complex and interdisciplinary than before.

According to [7-9], the prominent features of systems thinking skills are:

- Seeing the entire system beyond its components.
- Understanding the interaction between the system's components.
- Understanding system function without requiring all the details.
- Ability to find analogies between systems.
- Comprehending the synergy within the system.
- Observing the system from several different perspectives.
- Ability to consider non-engineering aspects (e.g. financial, marketing, organizational, etc.).

2.2. Project Based Learning

Project based learning is learning in which students are involved in executing a project [10]. During this type of learning, students experience design, problem solving, decision making and investigative activities. The students have an opportunity to work in relative independence for lengthy periods of time and learning ends in building an actual or virtual product [11].

Grant [12] identifies several joint components of project based learning:

- Introduction – the introduction introduces the activities and contributes to the students' motivation.
- Task – the task should be challenging, but within the students' reach.
- Resources – resources, including content experts and written or online databases, are at the students' disposal and assist them in their task.
- Inquiry process – the inquiry process the students undergo involves high-order thinking skills.
• Guidance – guidance is provided by the teacher and experts.
• Teamwork – learning is carried out in teams to promote cooperation.
• Reflection – the reflection takes place at the end of the learning process and offers an opportunity for closure and debriefing.

From the cognitive aspect, project based learning improves students’ systems thinking skills [13], while from the social aspect, learning of this type enables experiencing teamwork that is vital for success in the real world [14].

3. DESCRIPTION OF THE COURSE

The course Introductory Project in Electrical Engineering that took place for the first time in the winter semester of 2011, was comprised of one-two-hour weekly meeting and awarded the students with one credit. The course was based on the books Creative Problem Solving and Engineering Design [15] and Thinking Like an Engineer: An Active Learning Approach [16].

The course was divided into two equal parts. The first half of the course included lectures and instruction that provided the students with the tools they would use throughout the course, particularly in the second half that focused on carrying out a design project. The opening lecture compared science and engineering, described prominent engineering achievements through history, named the Draper Prize winners and presented the great engineering challenges of the 21st century. Additionally, it specified the abilities required of an engineer, including teamwork. In the second meeting, major engineering databases and popular search engines were reviewed, and training was provided on efficient search of these information sources and how to build an effective presentation. In the third lesson, an overview of the various topics of electrical engineering was provided. At the end of the meeting, the students were requested to prepare, based on search of databases, presentations that include profound reviews of a particular teaching and research topic at the Technion's Department of Electrical Engineering, comparing it to leading departments around the world. This task was carried out by teams of five students, with personal instruction by a mentor, a senior engineer in the Department. In the fourth session, every team presented its work to their colleagues and the course teachers. The next two meetings focused on the engineering approach to problem solving. After a short discussion of mathematical and scientific problems, the engineering approach to problem solving was presented, including the following stages: defining the problem, collecting data, examining alternatives, making a decision, detailed design, examining the proposed solution and documenting the above process. This approach was demonstrated using the well-known travelling salesman problem. The seventh session was dedicated to a discussion of systems thinking. The concept of system was introduced and the characteristics of systems thinking were presented. A weekly syllabus of the introductory lectures and accompanying tasks is specified in Table 1.

As mentioned, the core of the course was a design project carried out in teams counseled by mentors from the eighth week of the semester. The project dealt with designing a window cleaning robot. The project opened with an introductory lecture about robotics and presentation of design stages on a weekly basis. Each week dealt with one of the following focused subjects: defining the robot’s structure and movement (week 8), physical design (week 9), block diagram, (week 10), integrating sensors (week 11), selecting microcontrollers and drivers (week 12), and navigation algorithms (week 13). Additional details in Table 1. Every stage opened with a review of the design subject at hand and at the end the students received a task they were requested to complete using the engineering approach to problem solving taught in the first part of the course. On the final week (week 14) every team presented the design of its robot to their colleagues and the teaching staff.

In carrying out the different tasks, the students used tools acquired in the introduction lectures. Beyond ongoing application of the engineering approach to problem solving described above, the students examined alternatives for their robot and selected the different components (motors, energy sources, sensors, microcontrollers and drivers) after carrying out a comprehensive search through online databases. Additionally, the block diagram of the robot was based on the lecture on systems thinking and the final presentation was built and displayed based on the principles taught during the relevant lesson.

Table 1. Weekly syllabus.

<table>
<thead>
<tr>
<th>Week</th>
<th>Subject</th>
<th>Description</th>
<th>Team task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The essence of engineering</td>
<td>Comparison between science and engineering, great engineering achievements, Draper Prize winners, 21st century engineering challenges, abilities required from engineers, teamwork</td>
<td>In-depth review of a particular teaching and research topic at the Technion's Department of Electrical Engineering</td>
</tr>
<tr>
<td>2</td>
<td>Database searching and building an effective presentation</td>
<td>Engineering databases, search engines, efficient searching, Types of presentations, presentation structure, building an effective presentation</td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>The discipline of electrical engineering</td>
<td>Overview of the various topics of electrical engineering, teaching and research activities at the Technion's Department of Electrical Engineering</td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td>Engineering approach to problem solving</td>
<td>Classification of problems, problem solving methods, the engineering approach to problem solving, the travelling salesman problem</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Systems thinking</td>
<td>Definition of system, characteristics of systems thinking</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Introduction to robotics, defining the robot’s structure and movement</td>
<td>Introduction to robotics, pros and cons of window cleaning robots, robot requirements, major challenges</td>
<td>Collect data on window cleaning robots, examine alternatives, choose a solution</td>
</tr>
<tr>
<td>9</td>
<td>Physical design</td>
<td>Motors: types, properties Energy sources: types, properties</td>
<td>Select motors and energy sources for the robot</td>
</tr>
<tr>
<td>10</td>
<td>Block diagram</td>
<td>Objectives, structure of block diagrams, examples (mobile phone, robot)</td>
<td>Draw block diagram of the robot</td>
</tr>
<tr>
<td>11</td>
<td>Integrating sensors</td>
<td>Light sensors, position sensors, tactile sensors, proximity sensors, bend sensors</td>
<td>Select sensors for the robot</td>
</tr>
<tr>
<td>12</td>
<td>Microcontrollers and drivers</td>
<td>Microcontrollers: history, basic components, properties Drivers: types, properties</td>
<td>Select microcontroller and drivers for the robot</td>
</tr>
<tr>
<td>13</td>
<td>Navigation algorithms</td>
<td>Vehicle positioning, path planning, map making</td>
<td>Prepare final presentation</td>
</tr>
<tr>
<td>14</td>
<td>Project presentation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. METHODOLOGY

The research goal was to characterize changes in students’ systems thinking skills following their participation in the course Introductory Project in Electrical Engineering. The study population comprised 25 students in their third semester of studies for an undergraduate degree at the Technion’s Department of Electrical Engineering who chose to take the course in the winter semester of 2011. These students, used as the experimental group, were requested to fill out an anonymous questionnaire at the beginning and end of the course. The questionnaire was designed to characterize the students’ systems thinking skills. Furthermore, at the end of the course, five semi-structured interviews were carried out with students in order to complete the information received from the questionnaires. In addition, 30 undergraduate electrical engineering students in their third semester of studies who did not participate in the course took part in the study. These students, compromising the control group, were asked to fill out the questionnaire at the beginning and end of the semester.

The questionnaire that characterized systems thinking skills is a Likert-like questionnaire based on the systems thinking assessment questionnaire (CEST) developed by [17]. The questionnaire includes 20 statements that reflect the characteristics of systems thinking specified in the theoretical section, including: “When I am responsible for a product, it is important for me to see how it functions as a part of the system” or “When I am involved as an engineer in an engineering project, it is important for me to be familiar with the financial aspects of the project”. The statements were validated by two experts on education in electrical engineering. Cronbach’s alpha was found equal to 0.80, indicating a good level of internal consistency.

5. FINDINGS

Figure 1 displays the experimental group members’ mean systems thinking score (ranging between 20 and 100) on the pretest, completed at the beginning of the course, and the posttest, completed at the end. The chart shows systems thinking skills improved from a mean score of 74.32 to 82.51.

Table 2 specifies the systems thinking score (mean M and standard deviation SD) of the experimental and control groups. The t-test shows no significant difference between the pretest score of the experimental group and that of the control group. However, there is a significant difference (P<0.01) between the posttest score of the experimental group and the posttest score of the control group.

Quotes from students’ interviews show that during the course they began to assume some of the systems thinking characteristics proposed by [7-9]:

“When we began to design [the robot] we focused on fine details of everything separately... Later we understood the importance of an overall view.”

“Before the course I only had to solve exercises... Now for the first time we have to design an entire system together and consider every person’s actions.”

6. CONCLUSIONS

The study indicates significant improvement in the systems thinking skills of the students who took the course as they began to assimilate some of the systems thinking characteristics proposed by [7-9]. This result conforms to the findings of [4, 13] that showed project-based learning improves systems thinking skills.

7. ACKNOWLEDGEMENTS

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8. REFERENCES


TEACHING SKILLS ACROSS DISCIPLINES – AN EXPERIENCE REPORT

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ABSTRACT: In the knowledge society, it is particularly important for professionals and managers to respond flexibly to changes and to be able to form cross-disciplinary networks. The European reference framework defined eight key competences for the purpose of lifelong learning. Special attention is given here to the multi- and interdisciplinary approach. The University of Wismar has, since 2009, developed and tested their model of an interdisciplinary Student research and development team. These teams consist of students from various disciplines who work together on an innovative product or service idea. The ideas always come from a regional company which also handles the technical support for the student team. In the triangle of research, teaching and innovation, cooperation with the local economy is of particular importance. The following paper is intended to highlight important aspects of the combination of innovative ideas from business and creative know-how from the university and to present the initial results.

Key words: lifelong learning, key competences, interdisciplinary

1. INTRODUCTION

With their reference framework for lifelong learning, the European Parliament has defined eight key competences [3]. In recent years the focus on interdisciplinary areas has intensified.

This also corresponds to the needs of the economy for flexibly trained personnel. An increasing complexity of production processes requires, in particular for highly educated employees, a regular exchange of information across various disciplines.

Today’s labour market analyses indicate that today’s graduates will go through at least three career changes in their professional life. This does not mean three completely different jobs but they will however have to demonstrate their knowledge and skills in at least three different practice areas. This requires not only a willingness for lifelong learning but also interdisciplinary or multidisciplinary competences. This is the ability to work together with representatives of other sciences on a common problem with their respective methods. These methods are learned across disciplines. The stakeholders thus acquire methodological skills of other disciplines and can develop new strategies. This goes far beyond the mere exchange of partial results of multidisciplinarity.

Worldwide higher education institutions respond to this challenge. At the Quest University Canada the training of students culminates in work on issues that always involves an interdisciplinary and international component, as well as experiential learning with a practical application [15]. Other universities, including Harvard University in the United States invested considerable effort in building up interdisciplinary departments [11] and the University of Applied Sciences North Western Switzerland, has established a professorship of interdisciplinary teaching and learning [14].

The University of Wismar with the three faculties of economics, design and engineering has the ideal conditions for the integration of interdisciplinary issues in teaching and training.

An important pilot project established in 2009, are our interdisciplinary student research and development teams. In this paper we have presented both our experiences with this model and the ideas and interdisciplinary skills required for its further development.

2. STUDENT RESEARCH AND DEVELOPMENT TEAMS (R&D TEAMS)

The University of Wismar sees it as a shared responsibility of education and the economy to prepare their students for the demands of companies.

As already mentioned, the current work practice not only demands increasing division of labour and subject-specific competencies but also skills for interdisciplinary collaboration. A university without direct reference to the economy cannot fulfill this requirement. Therefore it has to cooperate with innovative regional companies from the start. They provide the research topics (ideas) for the R & D team along with the professional support.

As a result of this all three players – university, students and companies – enjoy a win-win situation. The companies will gain access to the resources of the university, they can take advantage of the fresh ideas of the students and recruit talent. The students gain practical experience in interdisciplinary work in the real world, they participate in the activities of the company, develop networks and acquire excellent references. The University itself grows by being able to make this attractive offer to prospective students, open up new research areas and form strong company partnerships.

The University of Wismar started the first interdisciplinary student research and development teams (R & D teams) in 2009 with the objectives
- Dissemination of entrepreneurship at the University through successful interdisciplinary projects
- Placement of interdisciplinary and entrepreneurial skills to students
- Interweaving of applied research capacity of university and research capabilities of regional companies
- Strengthen or generate cooperation between the University of Wismar and regional companies for mutual benefit.

As of today the Robert Smith Institute (RSI) of the University of Wismar has initiated 13 R & D teams. Of these four teams are currently active.

Each R & D team works on a complex product or service idea of a regional organisation, the idea giver. The idea giver has a significant influence on the composition of his team, he oversees the team and makes technical and research resources available when needed. Each team includes students from various disciplines working together for at least one and up to a maximum of two semesters.

In order to implement this teaching and learning model the RSI faced a variety of challenges. First, appropriate idea givers have to be found. It is important to always check whether an idea giver can provide technical assistance to the R & D team. Next is to ask whether the idea is ambitious enough to challenge the students academically and if it promotes interdisciplinary work.

Next, the RSI has to mobilize all interested students who must be prepared to tackle project work without being able to assess exactly how extensive the effort will actually be. Another problem for students is the time management of the team, taking into account semester schedules and curricula for the various fields of study. The team members must find a way to coordinate their cooperation.

In the process of teamwork, the RSI staff has to moderate sensitively in the case of conflict within teams or between teams and their idea givers.

Students are offered assistance to find a compromise between their participation in an R & D team and the normal academic requirements of their studies. This requires recognition by ECTS points. However, R & D teams do not sit for traditional examinations. In addition, it is often difficult to assess the partial performance of individual students on team results. Again, we have gained experience.

And finally it comes to the rights of students over the commercial exploitation of their results by their idea giver.

2.1. Flow of the R&D teams

In 2009 and 2010 two R & D teams started, in 2011 this number increased to five. The number of participating students has also risen. In the first year; 2009, 10 students took part. In the following year, 2010, there were 14 and in 2011, 28 students took part.

With this number of students and teams, the load limit for the RSI team has been reached. In future therefore we are planning to have four teams per annum.

The university provided each team with a permanent working space, but without technical equipment. In addition the ministry of economic affairs of Mecklenburg-Western Pomerania supported the first Teams in 2009, 2010 and 2011 with fixed budget funds. This enabled the team for example, to participate in trade fairs or the construction of prototypes. And last but not least, the teams were supervised by members of the centre for entrepreneurship (since June 2011 part of the Robert Smith Institute). This was a supportive and not a direct leadership role. Students should demonstrate the highest possible degree of personal responsibility and scope for creative design.

The idea givers assume the responsibility for specialist supervision. Depending on the direction of research they provide laboratory and workshop materials or working facilities while also allowing the students access to their networks.

The fields of work in which the R & D teams were employed were widespread. They included the areas of hydrogen technology, nano-sensors, wind energy, medical technology, control technology, Internet-based social networking, recruiting models for small and medium-sized enterprises, regional marketing and temperature measurements in hot rooms.

Some of the first R & D teams built several prototypes. Several teams took part in competitions or made successful presentations at trade fairs. And one innovative company was founded in hydrogen technology.

Despite their small number, the R & D teams act as innovative models in the entire university.

3. METHODS AND EVALUATION

The evaluation of R & D team is based on two sources:

1. The main source for the evaluation is the master's thesis „Analysis of interdisciplinary students' research and development team working at the University of Wismar – evaluation based identification of problem areas of organizational units as a base process-optimizing recommendations “ from the business students Christian Forch and Benjamin Mock.

This thesis was inspired by the RSI.

Quote: “The focus was generally gaining of knowledge. It should be examined whether the program flow of R & D teams to function well, which needs the target groups (Students who participate in the project) and the primary stakeholders in this program have (university of Wismar, idea givers and the centre for entrepreneurship). Furthermore, should evidence be obtained, whether the action taken (including the support) of the primary stakeholders reached the target group of students. Another focus for the attainment of knowledge was to determine if the target group implements the program effectively and efficiently. Another aim was also to, to discuss possible optimization potentials within the framework of this master's thesis.”

Structured interviews were conducted by the two master's students with the teams that finished in 2009 and 2010 and with the four teams that began in 2011. The fifth team in 2011 had, at the time of the survey, not begun its work.

Furthermore, the students interviewed the eight idea givers and the two project coordinators for the centre for entrepreneurship (later part of RSI). In addition, an accompanying observation was made during the period of formation of the first four R & D teams which started in the summer semester of 2011.

2. The second source of this evaluation is the participant observation of team processes and conflict situations by the project coordinators.

3.1. Results of the evaluation

1. Results of the Master-Thesis

In summary, the authors come to the following conclusions:

The evaluation clearly showed that the centre for entrepreneurship (and subsequently, the RSI) as a central
administrative office of the university takes good care of the R & D teams. The investigation also revealed that the teamwork of an R & D teams functioned well although there were still some problem areas. These problems could be grouped into three areas in the written evaluation and subsequent analysis.

Collaboration within the R & D teams:
- Many students find it difficult to realistically assess the time needed for completing given tasks / necessary groundwork. Or they have difficulty coordinating the punctual completion of their tasks in the R & D team with the demands of their studies. As a result, problems occur (lack of groundwork, ...) throughout the team process causing conflicts within the teams.
- Frustration or lack of motivation can lead to turnover.

Cooperation between idea givers and R & D teams:
- The communication was perceived by several teams as hierarchical. The idea giver’s decisions and guidance was not always, from the teams perspective, communicated satisfactorily. Consequently teams felt it difficult to express their own desires pertinently. This affected, for example, participation in the further processing of the results obtained. The mediation in this conflict by the RSI-team has been repeatedly described as very helpful. This helped the students in particular to assess their own “market value”.
- Sometimes information that was important to the work of R & D teams, was provided reluctantly or was incomplete. The idea givers were concerned about an uncontrolled loss of inside knowledge.

Cooperation between RSI project team and R & D teams:
- Assistance with problems was perceived to be good. However, positive feedback on developments was rare. This inadequate positive attitude to praise, was a result, from the teams perspective, of the limited capacity of the project team personnel.
There was no didactic preparation (in the form of seminars, or otherwise) on group dynamic processes or fundamentals of dealing with conflicts. As a result, the (described as good) coaching by the RSI-team was only called upon when a difficulty was identified.
- There was almost no sharing of experiences between the teams. i.e. each pairing of idea giver and R & D team was managed separately. But through the exchange of learning success between the teams the Soft-Skills of both were improved

Overall, the collaboration with the project team has been rated better than with idea givers.

The R & D teams complained about the slow technical assistance from the respective departments and of individual professors. It was suggested, that from their side, they saw almost no responsibility for the R & D teams as they were not “legitimate” students.

2. Reflections from participant observation

The interest of students in participating in the R & D teams is continuously increasing. The proportion of female students also increased from 10% in 2009 to 36% in 2011. The participating students come from all three faculties of the university.

Due to the increased number of teams and average team strength of more than 6 students, the number of potential lines of conflict which had to be moderated by the project coordinators also increased. (3 team members = 3 lines of conflict, four team members = 6 lines of conflict, 5 team members = 10 lines of conflict, etc.). These challenges could be easily dealt with.

2011 was the first time two teams recruited new team members of their own accord. Through conversations with other students the RSI employees were able to determine that both awareness as well as the perceived attractiveness of the R & D teams has increased. This positive development is the result partly from the variety of information work of the RSI and partly from the informal interaction of the R & D team members. The students supported the entire Robert Schmidt Institute in numerous other activities working voluntarily as multipliers.

The statements and recommendations of the Master’s thesis can be fully confirmed.

4. CONCLUSION FOR FURTHER DEVELOPMENT

The authors of the Master’s thesis developed an ideal-typical sequence for the development of an R & D team. They suggest the following improvements and enhancements from the model. These recommendations have been implemented since the winter semester 2012.

- The previous agreements with the idea givers on the technical support of an R & D team should be maintained. In addition, agreements should be made about the desired communication and interaction between ideas and students. This supports the equal relationship with each other and promotes the early identification of and resolution of conflicts.
- The dissemination of information on R & D themes, the idea givers and the R & D teams should be intensified and expanded to include interactive media.
- A joint kick-off event for all teams should be held. A joint meeting should be organised to agree milestones for all teams. The RSI employees should support more than ever the exchange between the students and teams on problems and solutions.
- In addition to instruction in the technical project specifications, the RSI should offer all team members a workshop on communication, teamwork and conflict management. Participation would be voluntary. These seminars should always be used by students of several teams.
- R & D teams should get “pilot lists” of professional contacts in the faculties and departments. These contacts should support and complement the technical guidance of the idea givers.
- The previous instruments, especially the coaching accompanying the process is essential and should be maintained at this intensity.
- At the culmination of the teamwork and the expiry of the scheduled project duration all stakeholders should discuss whether a continuation of the theme is appropriate and possible. This may be done as further group work, individual work or through the acquisition of team members in the companies (idea givers). This promotes the sustainability of the results.

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ENRICHING EXPERIENTIAL LEARNING IN MUSIC TECHNOLOGY

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ABSTRACT: The paper documents and outlines the theoretical context for an intervention into teaching practice designed to enrich experiential learning activities within Music Technology. The notion of a teaching intervention is explored along with relevant theories of learning and teaching. The original teaching scenario is outlined before looking at the changes made and the subsequent outcomes.

Key words: Graduate Migration; Professional Intentions; Career Choice Motivations; Universities; Germany, Namibia

1. INTRODUCTION

This paper explores the contextual, practical and theoretical aspects of a ‘teaching intervention’ carried out with undergraduate Music Technology students studying a second year module titled Music Technology and Composition. The notion of the teaching intervention as proposed by the PGCthE being undertaken by the author is that some aspect of existing teaching practice is considered or reflected on in some way before being modified. The new practice is then subject to this same process of reflection, perhaps with reference to some form of data collected, and with view to assessing whether or not any pedagogical improvement has been achieved. This cycle of action, reflection, action etc is considered in more detail when we look at some theories of learning and teaching specific to this particular teaching scenario in Music Technology (see the Kolb learning Cycle below). But in general terms it is useful to note that the intervention itself is loosely based on the action research model although as the PGCthE guidelines point out, it could probably be best described as a case study or episode of evaluation research as there is limited opportunity for the continued, iterative process of practice followed by reflection that could be identified as true action research.

In her paper ‘Developing a Pedagogy of Music Technology’ (Bowman, 1996) Judith Bowman proposes some useful definitions of the relevant subject area. Useful, particularly, because Music Technology is a relatively new area of academic practice, it is inherently interdisciplinary and quickly developing. ‘It includes the use of technology both as a teaching tool and as content’ (Bowman 1996) where ‘aligning technological considerations with goals and standards involves….determining how the technology is used, i.e., as a tool to enhance learning and teaching or as the subject matter itself’ (Bowman 1996). In the second year undergraduate module that we are concerned with, students use music software to explore elements of music composition and use elements of music composition to explore music software. In the first scenario the technology is a pedagogical tool, in the second it is the subject matter of the learning. One of the challenges of this study has been to find ways of aligning both these scenarios within the same teaching context. One reference that would support the need for this would be the quality assurance agencies benchmark statement for music degree programmes, revised in 2008. Here we find it clearly stated that ‘Music technology is a broad subject encompassing the scientific study and manipulation of sound’ and, ‘all degree programs are characterised to some extent by the same fundamental, linking concerns (including) enhancing musical creativity through performance (and) composition’. (QAA 2008). It is clear then that a second year undergraduate module titled ‘Music Technology and Composition’ needs to have at its core both technological and creative processes and learning outcomes.

2. THE ‘PROBLEM’

The original situation that needed attention can possibly be best summarised by the image of a group of students individually working at computer-based workstations wearing headphones. This is obviously a necessary part of the practical work required for the module and here the students are ostensibly ‘active’ which would imply a teaching method orientating students towards a higher level of engagement (see Biggs 2003: 4). The module delivery design and assessment at this point was such that group lectures and seminars would take place discussing various aspects of compositional theory and use of technology before students completed their own composition for summative assessment accompanied by a report. An exam was also set at the end of the year accounting for just 30% of the assessment. The particular group in question was generally mature, interested, attendance was reasonable and the quality of the work was average or just above average. So where is the problem? During the practical sessions when students were able to put into practice creative ideas using the technology, there was a sense that they were retracting into their shell to carry out work in an isolated and private way. The supposedly active task seemed to create a rather passive environment. With students effectively shut off from the group with headphones on and a computer screen to stare at, it is difficult for a facilitator to assess the quality of engagement with the activity. On reflection it was clear that elements of this pattern were also detectable during seminar and lecture sessions, with student contribution often low, and the same one or two students being the only active participants. It was clear that here was a missed opportunity for learning. The supposedly active task was in many ways quite passive and as such the extent to which students were progressing
towards a higher level of engagement and moving towards a deeper approach to learning (see Biggs 2003: 14) was questionable. The starting point for improving the situation was to explore possibilities of enriching the experience of the learning activity.

3. THEORIES, LITERATURE AND POSSIBLE SOLUTIONS

Learning takes place through the active behaviour of the student: it is what he does that he learns, not what the teacher does (Tyler 1949: 63 quoted in Biggs 2003: 25).

‘Academic courses which do nothing to link theory into practice through situated cognition and harnessing learning from experience will be sterile’ (Beatty 1999: 146)

You do not have to look hard to find literature supporting or examining the notion of learning through experience. Biggs makes much of the improved student engagement resulting from greater levels of activity (see Biggs 2003: 4). Here you will also find the often-referenced table below:

Most people learn:
- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they see and hear
- 70% of what they talk over with others
- 80% of what they do in real life
- 95% of what they teach others

(Biggs 2003: 80, attributed to William Glasser 1988)

In ‘The Handbook for Teaching and Learning in Higher Education’ (Fry, Ketteridge, Marshall 1999) there is both a theoretical context of experiential learning (pp14) as well as a practical overview of possible applications (pp 134) which looks at the areas of work based learning, problem based learning, laboratory exercises and simulations. Fry et al suggest that ‘most of the current ideas about student learning, including experiential learning, the use of reflection etc are based in constructivism’ (Fry et al 1999: 11). We are reminded here that constructivism tells us we learn by fitting new understanding and knowledge into…. old understanding and knowledge’ (Fry et al 1999: 11). We construct our learning from what we already know. This theory leads us back to Biggs and his theories of constructive alignment, (see Biggs 2003: 11) which sit neatly next to his already sited ideas of active and experiential learning.

In his book ‘Freedom to Learn’ (Rogers 1994) Carl Rodgers succinctly summarises the positive aspects of learning by first considering its antithesis as the rather difficult task of trying to memorise nonsense syllables such as ‘baz, ent, nep, art, lud’ (Rogers 1994: 35). Of course with no meaning attached the ‘learning that takes place is “from the neck up”. It does not involve feelings or personal memories; it has no relevance for the whole person.’ (Rogers 1994: 35). By contrast he then goes on to reference Marshall McLuhan who considers the example of a five-year-old child who is moved to a foreign country and allowed to play freely for hours with her new companions. The child, he suggests, will learn the new language in a few months and will acquire the proper accent. (Rogers 1994: 36).

One model of experiential learning particularly relevant to this teaching intervention is the Kolb learning cycle. Kolb, according to Fry et al is credited with the most popular theory of learning from experience. The Kolb learning cycle is relevant here in two ways. Firstly, the teaching intervention as defined by the PGChE, is based on the notion of action research (or perhaps action reflection would be an equally appropriate term) and the Kolb model illustrates this cycle. The other relevance of the Kolb model is that it helps us to identify what is possibly missing from the Music Technology learning activities described above.

Fry et al offer a useful clarification of the terms used in the learning cycle. Concrete experience is defined as learners ‘involved fully and freely in new experiences’ (Fry et al 1999: 14). They must then have the time and space to reflect on these experiences (reflective observation) such that they can ‘take ownership of their ideas and integrate them into sound logical theories (abstract conceptualization)’ (Fry et al 1999: 14). Finally these theories must be tried and tested possibly to an end of problem solving or the like (active experimentation) and this in turn provides the material for a new concrete experience. Phil Race, when considering the Kolb model in the ‘Lecturers Toolkit’ (Race 1998), suggests the parallel terms of ‘doing’, ‘feedback’, ‘digesting’ and ‘wanting / needing’ as replacements for concrete experience, reflective observation, abstract conceptualisation and active experimentation respectively (Race 1998: 10) Fry et al also note that the reflective observation phase of the cycle ‘will be strongly influenced by feedback from others’ (Fry et al 1999: 14). Interestingly, Race questions the usefulness of these stages of experiential learning being placed in a cycle. He proposes the model be considered without arrows implying a direction or sequence of events and even suggests the stages as appearing like ‘ripples on a pond’ (Race 1998: 11) with wanting and needing at the centre and feedback on the outside (see Race 1998: 11). His rational for this is as follows:

- It is important to keep on wanting while doing
- It is useful to seek feedback while doing as well as after doing
- It is useful to be continuing to seek feedback while digesting
- It is useful to be continuing the doing while receiving feedback and while digesting
- It is important to digest both the experience of doing and the feedback that is received

(Race 1998: 11)

However you choose to approach or navigate your way around this model for experiential learning it is clear that the value inherent in concrete experience needs to be unlocked through reflective observation and feedback. The digesting and conceptualising of this reflection then becomes a need to experiment. Identifying these stages in this teaching intervention would align my initial concrete teaching experience as facilitating some learning activities for a second year group in Music Technology and Composition, my reflection on this experience then identified a passive environment around what should be an active task, and this
was considered a potentially problematic situation. The digesting and conceptualising of this situation includes this review of theories of experiential learning, and the active experimentation will be addressed in the next part of the paper as ‘actions and experiments’.

Relating the Kolb learning cycle and related issues to the particular teaching scenario in Music Technology outlined above as the ‘problem’ we see immediately that the reflective observation stage is not made as explicit or explored as much as it could be. It may be that students are, in fact, going through the full cycle of doing, reflecting, digesting and experimenting but it is very difficult to know if they are, and if so where they are in the cycle at any particular time. There is clearly a missed opportunity here for offering and receiving feedback, an element that we have seen is so important in reflective observation. Feedback from peers particularly would seem appropriate when we consider McLuhan’s scenario of the five year old child learning a new language so efficiently through play with friends, and when we consider Biggs’ statistic that we learn as much as 70% of what we talk over with others. It is clear that a teaching intervention in some way needs to support and develop reflective observation. This should, in turn, support the abstract conceptualisation and active experimentation stages of the learning cycle.

4. ACTIONS AND EXPERIMENTS

A peer review session was introduced as an opportunity for the group to listen to each other’s work, share their ideas and comments and consider some of the theories of composition and application of technology discussed during lecture sessions. The students were given due warning of the session and it was made clear that any useful feedback or observation would be used as data for the PGChE intervention. The students were also given an opportunity to air any concerns they may have had around this proposal but there were none students were also given an opportunity to air any concerns they may have had around this proposal but there were none. The evidence seemed to suggest the intervention had moved the learning activity in a positive direction and this prompted a restructuring of the module delivery. This was primarily geared to including more opportunity for peer review sessions by increasing the number of learning activities and attaching at least one peer review session to each one. A model used while designing the new structure of the module delivery can be seen below.

The ability to hear how others have approached the task as well as discussions based on the various styles is a plus. Nearly every completed questionnaire mentioned feedback as a positive aspect of the session (see appendix for completed questionnaires). Many students said that they would implement changes to their work as a result of the session and a good number said they would like to have more sessions like it. One or two expressed concern that too many sessions like this could detract from the time they have allocated for working on the equipment to create their compositions.

Aside from the completed questionnaires there was positive verbal feedback from the students about the peer review session. Much of it alluding to the fact that the session had been ‘fun’ and had improved the enjoyment factor of subsequent sessions where people were continuing work on their compositions. It was clear in these subsequent sessions that student interest in each other’s work had generally increased, and there was more of a buzz around the learning activity.

The quality of the work submitted following the session was better than previous work from the group. Time restraints limited this improvement to a certain extent. There was not the time to return formally to the reflection and feedback phase of the learning cycle and hence the benefits in terms of conceptualisation and experimentation had not necessarily been absorbed to the core of the students work. But there was a sense of commitment and enthusiasm present in the work that had not previously been noted. The group as a whole, having listened to the compositions of the more able and focussed students, now had higher expectations of themselves and each other. As less able students worked towards improving their music they could not help but improve their skills with the technology.

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Figure 2. Learning process design

Different subject areas of the module were defined by their learning outcomes and learning activities were designed in accord with these. The peer review sessions were built into the timetable of the module delivery and the assessment became a portfolio of the different activities presented as an audio compact disk with sleeve notes.

In her chapter on experiential learning, Beaty (1999) includes a useful section on the role of the teacher. Here we find definitions of the various roles that a lecturer will need to adopt in the various stages of experiential learning: tutoring, coach or trainer, mentor, supervisor and facilitator (see Beaty 1999). It is noted here that ‘in experiential learning the word facilitator is often used. Facilitation implies that the activity is one of
support rather than initiating.’ (Beaty 1999: 145). This is reflected in the module design, and the model above, where the necessary lectures are seen as being in support of the learning activities. The lectures in this sense are coaching or training the student ‘through the steps of how to perform some action’ (Beaty 1999: 144). The learning activity is uppermost and central to the learning (see model above) and the learning outcomes and peer review sessions are directly aligned to it. Here the role of the lecturer may be more mentor-like, by offering feedback through discussion or more supervisory by monitoring progress from a more remote stance (see Beaty 1999: 145).

5. CONCLUSIONS, DEVELOPMENTS AND FUTURE PRACTICE

In conclusion it is worth revisiting why experiential learning is appropriate for Music Technology. We have seen that the subject is one where the pedagogical tools of technology are part of the field of music to be studied. The QAA benchmark statements for music acknowledge both the technical and creative strands of the subject area. With such an inherently interdisciplinary subject area as music technology students need to find their own starting point from which to construct their learning and a freedom to learn experientially is an important part of this. Existing theories of experiential learning such as the Kolb cycle show us the importance of reflection of our experiences in learning, and feedback is a very important part of this. By introducing peer feedback sessions in the Music Technology classroom, learning activities were enriched and the learning environment was perceived as becoming more active. Student response to the sessions was good and the quality of work began to improve.

This intervention has a number of implications for future practice. The first, outlined above, was a re-structuring of the module delivery to include more opportunities for active learning and peer review. This has led to a proposed modification to the module that would make the assessment 100% assignment based (previously it had a 30% exam assessment) allowing more space for experiential learning and peer review. A similar model for teaching and learning would be easily applicable to other modules in the degree programme and the notion could also be taken further by introducing a formal element of peer assessment into a module. Both of these possibilities are being considered for future developments within the Music Technology programme. More generally and more importantly, however, this intervention has proved the importance of running student peer review and feedback sessions in the future. These could be conducted as described above, or through other means such as virtual learning environments, wikis, live performances etc. The intervention has also proved the worth of the group feeding back to the facilitator on how useful they found the session, and this dialogue should also be maintained in future practice.

6. REFERENCES

ABSTRACT: The paper intends to implement the use of theoretical models and computer aided simulation based on FEM for improving the teaching of cutting metals theory for the students of Machine Manufacturing Technologies and Machine Tools. The advantage of simulation, especially animated is to transpose the normal classroom into a virtual model where the skills can be evaluated under similar realistic conditions. It helps the students to be able to face the complexity of the real complex processes inside the production environment. A review of the most important models in cutting processes shows that the majority of the researches in this field tend to replace the traditional methods of calculating the cutting data parameters based on mathematical models with new complex models. The paper tries to relieve the importance of using the FEM models and simulation software for a better understanding of the process and also for providing more accurate and more detailed information. In the case studied in this paper a series of experimental models were performed for a validation of the theoretical models created by comparing the results. The advantages of using 2D and 3D animated models in the teaching and training process are also mentioned in the paper.

Key words: modelling, simulation, cutting metals, FEM

1. INTRODUCTION

The traditional teaching methods in engineering often provide engineers with integration of theoretical knowledge problems with the practical ones. As result, they have difficulties in transposing their classroom knowledge in real manufacturing practice. This gap was remarked by the Manufacturing Engineering Society in: 1999 Critical Competency Gaps [1].

They remarked a gap in practical knowledge of the graduates and also problems in correlation of communication skills. Introducing the teaching by modeling and simulation in engineering education the students have the possibility to better understand the real production environment where they are challenged to apply the theoretical knowledge for solving the operational problems in real companies.

2. THE MAIN COMPONENTS OF AN ASSISTED TEACHING MATERIAL

The concept of using modeling and simulation has proved to be a very powerful tool in explaining, optimization and implementation of any kind of process. Especially in the higher technical education this method is widely used in all fields and mainly since the extraordinary development of computers, in all complex processes that could be simulated and modeled. Combined with multimedia facilities offered also by actual PCs this instrument became the most used tool in teaching methods.

Concerning the topic of the present paper the introduction of the FEM in the field of deformation in elasto-plastic media made possible the use of this method in the metal cutting process, thus helping the teacher to explain much easier and in a visual context all analytical models used before in this area.

Even if the simulation was considered only if the application of analytical models is not possible due to the development of special simulation programming languages, the increase of the PC power the progresses of the simulation methods transformed the method in an usual one.

Some of the advantages of simulation are presented below:
✓ we can test the assumptions of a problem using different scenarios;
✓ the interaction between variables can be observed very easy;
✓ associated with animation for visualization of the process it can highlight some important aspects that can help the understanding of the phenomena;
✓ on the simulation models the conditions of an experiment could be controlled better that in the real process;
✓ the time can be reduced or expanded in function of the needs imposed by user;
✓ simulation models are cheaper that the real models and the parameters can be changed very easy.
Between the disadvantages of the simulation we can notice:

✓ the construction of the model needs a special training and complex software;
✓ the simulation model is always simplified and the results could be wrong.

3. THEORETICAL APPROACH

Introduction of simulation in the teaching process of a technical discipline can be made using the analogy of the use of visual management for an industrial process with the teaching approach. Considering the six steps of the visual management: Information deployment, Field Standards, Integration of standards, Default alert, Stop all defaults, Prevent defaults, we can develop a similar approach for the learning process. The similar six steps proposed in the paper are shown in figure 2.

![Figure 2. A pyramid of an assisted learning steps](image)

This way of organizing the training process helps the trainer to complete the information given in the first step with the next levels, thus helping the student to understand the essential of the problem by a very important use of visual memory.

Also, the student can build a procedure for learning and understand the logic of the process and not only memorize a certain aspect.

4. MODELLING AND SIMULATION OF THE CUTTING METAL

4.1. Introduction in software DEFORM 2D Machining

The most recent version of DEFORM 2D Machining software developed by Scientific Forming Technologies Corporation, Columbus, Ohio includes also a facility for predicting the tool wear [8].

As literature shows the DEFORM 2D Machining software is extremely useful both in research and industrial applications and the Scientific Forming Technologies Corporation develops and supports further the system [7].

DEFORM 2D Machining software is used for modeling and simulating the cutting process using the assumptions of orthogonal cutting. The software can simulate the cutting process using different cutting parameters like cutting speed, feed and depth for computing cutting forces, temperature of cutting zone, stress and strain state in chip and work piece, appreciation of chip form and estimation of the tool wear and tool life.

The program is structured in 3 parts [6]:

✓ **PRE-processor**, in which we choose the operation, simplified model and cutting parameters and tool parameters

![Figure 3. The simulation model and the selected field [6]](image)

The tool geometry can be selected from program library or designed in a CAD software and imported as „STL”.

✓ **The simulation** After the control of the input data and generation of the necessary data base the computation for the cutting simulation is run:

![Figure 4. The design of simulation model](image)

The control of the simulation is made by the number of simulation steps combined with the length of the cut. Even if the number of steps is greater the simulation stops when the length is reached. (figure 5)

![Figure 5. Simulation control window](image)
After the number of computed simulation steps are reached the simulation stops and the last component could be started.

✓ **Post-processor** presents the output data in graphical mode. Also, the tool wear can be computed using a wear analytical model for this.

### 4.2. Application - simulation of turning operation

For explaining the above assumptions a simulation model was developed for the turning operation with a hard metal tool. The model was constructed using Deform 2D Cutting software which has the possibility of dynamic simulation of the cutting process.

The FEM model is based on the application of elasto-plastic finite element using Usui analytical model.

\[
\frac{dw}{dt} = C_1 \cdot \sigma \cdot \nu_s \cdot e^{-\frac{C_2}{T}}
\]

where:

\[
\begin{align*}
\frac{dw}{dt} & - \text{the rate of wear;} \\
C_1, C_2 & - \text{coefficients depending on the tool and work piece material} \\
\nu_s & - \text{the chip flow speed, [m/min],} \\
T & - \text{cutting temperature} \\
\sigma & - \text{normal stress (cutting pressure)}
\end{align*}
\]

Besides the cutting tool made of TiCN coated hard metal the next simulation condition were used: work piece material AISI 1043 COLD (OL 42), dimension of the work piece $\Phi 30$ mm, cutting speed $v = 100$ m/min., feed rate $f=0.1$ mm/rot, initial temperature $T_0=20^\circ$C.

For simplification the tool was considered rigid because only the influence of temperature is considered neglecting the stresses and strains in the tool body.

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**Figure 6.** The distribution of the temperature

**Figure 7.** The effective strain and the corresponding graph

**Figure 8.** Video sequence under the microscope

In this stage are introduced the terminology and standard notation for the movements in the turning process: cutting movement with cutting speed ($v_c$), feed movement and feed rate ($f$ and $v_f$).

Subsequently is presented a short video with the real operation of turning for understanding the other parameters of the operation and with this occasion we reached the 3rd step in integration of standards of the field (figure 8). With this video we introduce the kinematic of the turning operation and notions...
about technological system structure: machine tool-tool-device-piece.

Next step consists in the presentation of different turning operation and make the difference between the simple orthogonal cutting and other operations. In this stage we can emphasize upon the common elements which make the essential and notice only the differences. Thus we reach the 4th and the 5th stage for eliminate the redundant elements of the process to facilitate the understanding.

The last step emphasize on frequently mistakes that can appear in the interpretation of the theory of metal cutting in the studied case and the general availability of this model for all cutting operation.

The materials for the course are designed for hard copy in the library of the university, in PDF format for eLearning and also .html with multimedia links for presentation.

This approach permits an easy integration of the courses in e-learning and distance learning. The notion of e-learning has the meaning of a learning process using a computer connected at internet. It is based on a virtual classroom, an instructor (tutor) who plans the activities of the group. Using the slides the teaching can be as good as the traditional class teaching and even better if the support is well designed. The term of e-learning is known also as on line learning and it is derived from “electronic learning”.

The electronic form of the course can be placed on an e-learning platform in .pdf format, slide show in ppt and html format with links to the animated models and video demonstrations of the cutting operations.

In this conception the course is accessible also for the continuous education for the interested people working in companies, who want to update their skills or have to re-qualify due to economic changes.

5. CONCLUSIONS

This approach in teaching a technical course like cutting metals makes understanding of the fundamentals elements very easy.

Also, the integration of the simulation with the multimedia elements introduces the students in the virtual plane of simulation and also in the real environment by the video presentation even we are in a course room.

Animated models also help the student to develop skills in using modern methods in learning and research and help the improvement of designing capabilities.

The presented example combines two teaching methods: the theory from the classroom and process simulation by computer. Also a sequence of a real video record is presented for a better observation of similarities and resemblance of the simulation with the real process. Due to the facilities in changing the input parameters and the use of different scenarios in the cutting process in computer simulation this become a powerful tool for teaching and increase the level of understanding of the complex processes by the student.

In this way the competences of the graduates of engineering studies are higher and this prepare the graduate engineer for a better and easier integration in the companies.

The method is recommended even in the course room for explanations of the instructor and also in the practical work in the laboratory for observing the differences between the experiment and the theory.

6. REFERENCES

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8. www.deform.com/products/deform-2d
EVALUATING THE EFFECTIVENESS OF PROBLEM-BASED LEARNING (PBL) IMPLEMENTED IN THE TEXTILE ENGINEERING COURSE - A CASE STUDY ON AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, BANGLADESH

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ABSTRACT: Problem-based learning as a teaching tool is now used globally in many areas of higher education. It provides an opportunity for students to explore technical problems from a system-level perspective and to be self-directed life-long learner which is mandatory for equipping engineering students with the skill and knowledge. This paper presents a case study illustrating the effectiveness of implemented Problem-based learning (PBL) during five semesters in the undergraduate programs of Textile Engineering in Ahsanullah University of Science and Technology (AUST). An assessment has been done on the basis of feedback from the students as well as their employers by conducting an empirical survey for the evaluation of PBL impact to enhance the student’s competencies. The Evaluations indicate that students have achieved remarkable competencies through PBL practices which helped them to be competent in their professional life.

Key words: Problem-based learning (PBL), textile engineering, self-directed learning, teamwork

1. INTRODUCTION

The Journey of Bachelor education in Textile Engineering of Bangladesh started in 1978 with the establishment of former College of Textile Technology; recently it has been upgraded as Bangladesh University of Textiles (BUTex). Alongside Bangladesh University of Textiles (BUTex), two other public universities and some private universities are also offering textile engineering courses. The education system is running based on the old and few modified British undergraduate curriculum of those entire institutes, where education is more or less instruction-based and focused on teaching rather than learning. Scoring good grade is the main concentration for students.

In recent times, due to the rapid industrialization in Bangladesh, textile engineering education has been booming throughout all these years. Textile engineering discipline is highly preferred by the students due to high market demand, social prestige and diversity.

On the other hand the global scenario is changing rapidly with the changes in technology and socio-economic structures which will affect the responsibilities of the today’s engineers.

Rugarcia at al. had pointed out seven features that will pose challenges to future engineers, which are as follows: expansion of information, diminishing boundaries between the disciplines, globalized economy, endangered environment, resource constraints, emerging social responsibilities and rapid changes in technology [1].

Undergraduate engineering educational curricula are facing an emerging challenge to be compatible with the rapid technological evolutionary changes. The realization that for the engineers to retain a competitive edge, they need the knowledge, skills and attitudes that will provide them with futuristic problem solving skills, the expertise to visualize the ability to adapt the change. To be a successful professional engineer in the International corporate world of the 21st Century, they must be equipped to be global engineers who are technically versatile (multi-disciplinary), able to solve problems from a system-level perspective, effective communicators, function in diverse ethnic teams and demonstrate social responsibility [2].

To equip with such skills, some changes are needed in the curriculum, teaching methods and delivery modes. To cope with the changes and advances in the technological fields, as well as, to bear out the requirements of a developing country, the engineering curricula in Bangladesh needs to go through continuous modernization [3].

In engineering education system real-life problem-based learning (PBL) is an effective way as it helps students to solve open-ended engineering problems [4]. A potentially effective approach to prepare students to solve authentic problems is problem- based learning (PBL), an instructional methodology that focuses student learning on relevant problems [5].

This paper describes an overall view of the initial implementation of PBL in undergraduate textile engineering education at AUST, Bangladesh to develop technically skilled, innovative and self-directed engineers with a strong sense of professional responsibility.

2. PROBLEM-BASED LEARNING (PBL) IN ENGINEERING EDUCATION

Problem-based learning as a teaching tool is now used globally in many areas of higher education, such as schools of dentistry, health sciences, nursing, pharmacy, public health, veterinary medicine, architecture, building, business, computing, education, engineering, forestry, law, policies science, social
work, and other professional fields [6]. Although the pedagogical models were used in many different subject fields, they have become most famous in the medicine and engineering models [7].

It is possible to find successful PBL implementations in engineering education in different countries throughout the world, such as Australia, Canada, Denmark, Mexico and USA [8], in South America such as Argentina, Peru, Brazil [9], in Colombia at the Universidad Nacional de Colombia and Universidad de Antioquia [10], in Portugal at the University of Minho [11], in Belgium at the Universite Catholique de Louvain [12]. In recent year Asian Universities like Kanazawa Institute of Technology in Japan [13], National University of Singapore in Singapore [14], Sinhgad Institute of Technology in India [15] also adopted this pedagogical method in different domains of engineering education.

3. PROBLEM–BASED LEARNING (PBL) IN TEXTILE ENGINEERING EDUCATION

As other domains of engineering education, the University of Manchester has implemented PBL in their textile engineering curricular and Sayer et al. [16] evaluated as follows: PBL is a type of enquiry-based learning and is a suitable method for teaching weaving as it allows students to learn actively. It also encourages team-working skills, which are highly valued by employers [17].

PBL is a good fit in apparel design and merchandising course work (Which is a part of Garments manufacturing technology courses) since the methodology is very “hands-on”. When implementing PBL, students are typically presented with a problem that practitioners in their industry face on the job [18]. Bye [19] pointed out that apparel designers of the future must be strong team members, communicators, and problem solvers – all skills that PBL enhances.

Farr, Ownbey, Branson, Cao, and Starr [20] used a factorial analysis quasi experiment to analyse 155 students’ responses. Student groups were introduced to textile science principles regarding colourfastness and resistance to light and heavy abrasion. A course experience questionnaire and a content analysis of student comments and instructor observations indicated PBL was an aid to learning and comprehension and more beneficial to students than traditional lectures alone.

Carpenter and Fairhurst [21] detailed the design and implementation of a capstone course using PBL in retail merchandising. Participants were required to design a workable business plan using a real business. Participants interacted with the business employees to discover problems, create a mission statement, and propose solutions. Evaluation of the program was based on student and industry partner comments, which were guided by an assessment rubric. Specific areas in which students showed improvement included problem solving, critical thinking, thinking of alternatives, and applying previously learned principles to real-world problems.

In addition, Kimmons and Spruill [22] designed a capstone course for interior design, retail merchandising, and graphic arts students utilizing PBL. The final group projects were judged by industry professionals. Researchers assessed the project based on formal and informal evaluations, finding it to be highly successful in achieving success in regard to several pedagogical objectives, including teamwork, practice for the real world, problem-solving skills, professional behaviour, ‘self-directed’ learning, and written communication.

Cao, Frey, Farr, and Gam [23] used a PBL approach in a specialized textile design and merchandising course emphasizing environment friendly apparel design. Case studies and two projects were used. Specific areas of benefit included teaching students to think outside the box and broadening the student’s scope of innovation. In addition to the learning outcomes, participants indicated the method was ‘‘inspiring.’’

While several of the studies examined included apparel design students as participants, most of the courses highlighted were merchandising courses, which is one part of the undergraduate textile engineering curriculum. Teaching methods specific to garments manufacturing technology (GMT), particularly in regard to PBL, were not found. This research will contribute to teaching methods in (GMT) by showing how PBL will be effective to teach in that specific domain.

4. RESEARCH METHODOLOGY

Department of Textile Engineering of Ahsanullah University of Science and Technology plays a vital role for Textile Engineering Education in Bangladesh providing 4 (four) years bachelor degreeB.Sc. in Textile Engineering). The 4 years program is running with the bi-semester system has two 14 week semesters in a year. The students are taught common subjects 6 (Six) semesters out of total 8 semester. In Last 2 semesters, the specialized subjects are allocated among the students according to their choice like; Yarn Manufacturing Technology, Fabric Manufacturing Technology, Wet Processing Technology and Garments Manufacturing Technology.

In this study the PBL frame work has been applied since fall semester 2009 only on the specific courses that have been taught in different semesters and related to the specialization in Garments Manufacturing Technology.

An Overview is presented in the Table (Table: 01) below according to the course, semester and year.

As a pilot study, a modified model of the traditional Aalborg PBL model was applied to the above mentioned all courses in conjunction with its regular load of the university curriculum. That required the students to put in more efforts which were gladly accepted. According to previous system of AUST curricular, in all courses students have to appear individual examination carrying 70% of the total marks. Another 20% marks are allocated for quizzes and 10% for class attendance (which is taken during the semester). As a modified model we introduced another Problem-based project work in above mentioned all courses which has been executed by fulfilling the key elements [2] of PBL activities like,

- Team building with students by an Instructor/Facilitator (Course Teacher)
- Identify the course related problem from Industry
- Detail the Parameters necessary to solve the problem
- Encourage students to brainstorm with teammates
- Develop an action plan to achieve the time-line for the project
- Implement the action plan
- Summarizing the result both in written and oral reports.

Implemented PBL activities were evaluated within the 30% marks by a group examination, both in written and oral presentation in front of evaluation committee members.
nominated by Head of the department. PBL introduced Courses according to Semester

<table>
<thead>
<tr>
<th>Student Year/</th>
<th>Course Code</th>
<th>Name of the Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd Year/2nd Semester</td>
<td>Tex-209</td>
<td>Garments Technology-I</td>
</tr>
<tr>
<td>3rd Year/2nd Semester</td>
<td>Tex-309</td>
<td>Garments Technology-II</td>
</tr>
<tr>
<td>4th Year/1st Semester</td>
<td>Tex-409</td>
<td>Garments Technology-III (Specialized)</td>
</tr>
<tr>
<td>4th Year/2nd Semester</td>
<td>Tex-429</td>
<td>Garments Technology-IV (specialized)</td>
</tr>
<tr>
<td>4th Year/2nd Semester</td>
<td>Tex-437</td>
<td>Application of Computers in GMT</td>
</tr>
</tbody>
</table>

5. ASSESSING STUDENTS PERFORMANCE

The Students who have started the PBL activities since fall semester 2009 (in their 2nd year and 2nd Semester), have passed their 4 years course end of Spring 2011 and later on absorbed by different Apparel Manufacturing Industries in Bangladesh as an employee. To assess the working performance of those students (Only specialized in Garments Manufacturing Technology) in the industrial environment, an empirical field survey has been done within the students and their related employers after six months of their working experience.

5.1 Assessment from Students Feedback:

To get the feedback from students consisting a sample size of 24 (students only specialized in Garments Manufacturing Technology), a set of questionnaire contained questions in the form of a 5 point Likert-type scale (1 - Poor, 2- Satisfactory, 3- Good, 4- Very good, 5- Excellent) was supplied to know about the following: i) Communication Skill ii) Team Work capability iii) Acquired Technical Knowledge iv) Problem Solving Ability v) Punctuality vi) Professional Skills vii) Research Ability. The student’s feedback was collected with a 100% response rate. The Results are depicted in the graph below:

As the above graph (Figure: 01) indicates that, from employers view point, a 60% of respondents considered as good Technical Knowledge achieved by the PBL experienced students. Fifty percent (50%) respondents mentioned “good” Teamwork capability and Professionals Skills. “Very Good” Communication skills, Problem solving ability and Research ability were found within the PBL experienced students according to 50%, 40% and 40% respondents respectively. A majority percentage (70%) of respondents gives their consent on “Good” overall performance by the PBL experienced students rather than non-PBL experienced students are working in their Organization.

According to the response both from PBL experienced students as well as their employers it can be assumed an overall view regarding the progress of their competencies and also their professional performance in the Industrial Environment. It is also very important that employer’s satisfaction is shown on those students performance. So our result suggests that the implemented Problem-based learning system has a direct impact on enhanced competencies as well as professional performance of those students.

5.2 Assessment from Employers Feedback

A number of 10 (Ten) reputed Apparel Manufacturing Industries in Bangladesh were selected to get the feedback regarding the working performance of those students, where they have the employee both with PBL experienced as well as non-PBL experienced from the same university (Only we considered Ahsanullah University of Science and Technology). It was also supplied questionnaire to the General Manager of those Industries contained questions in the form of a 5 point Likert-type scale (1- Poor, 2- Satisfactory, 3- Good, 4- Very good, 5- Excellent) to know the same as students with extra criteria “Overall Performance” and collected with a 100% response rate.

The Feedback is summarized in the Figure below:

As 50% of respondent considered very good technical knowledge and also research ability, they have achieved by PBL exercise. A 41.67 % of the respondents gave their opinion as very good achievement of Team Work ability and Enhancement of Professional Skills. A few respondents also mentioned that they achieved excellent Technical Knowledge and Problem solving ability through PBL practice.
6. CONCLUSIONS
This paper shows a relatively successful implementation of the Problem-based learning in undergraduate textile education with a modified Aalborg PBL model though it has limitations of wide range of curricular change and also a change of mind-set. But it was experienced that the students seem to have a better learning process, taking into account that the learning process and activities were focused on the learners. Even employers satisfaction is increasing day by day due to their better performance in practical field. So it can be recommended to implement PBL covering the entire curriculum in textile engineering education of Bangladesh as other engineering curricula have been adopted all over the world.

8. REFERENCES
ABSTRACT: The educational goal of the Kanazawa Institute of Technology (henceforth, KIT) is to develop innovative and self-directed engineers. KIT developed a new curriculum, of which main pillars are engineering design education and engineering ethics education, and established an innovative facility “Factory for Dreams & Ideas” (henceforth, “Yumekobo”, which is the original Japanese name for the factory), to achieve its educational goal. Assessment of educational objectives and data are discussed in the paper. Students developed original, viable, and ethical design solutions in engineering design courses using either appropriate technology, advanced technology, or a suitable combination of both. Students' understanding and behaviour with regards to engineering design and engineering ethics advanced steadily during the courses. Students, who actively worked on Yumekobo projects, developed their technical competencies and professional skills.

Key words: engineering education, self-directed, engineering ethics, engineering design, Yumekobo

1. INTRODUCTION

In recent years, the engineering education community has shown increasing interest in Project-Based Learning (henceforth, PBL). With PBL, students are encouraged to assume responsibility for their learning experience and to shift from passive to more active learning patterns. The pedagogical methods and benefits of PBL are illustrated by a considerable literature [1], [2].

Technologies can bring great benefits, but can also bring harm to the environment. The impact of technology has been expanding and accelerating because of widespread economic activities and rapid progress in distribution and communication. Under such circumstances, engineers should do their best to employ their engineering knowledge to maintain the global environment. The engineering accreditation agency, ABET, regards engineering ethics as an important component of engineering education. ABET’s Criterion 3(f) states that "an Engineering Program must demonstrate that their students attain an understanding of professional and ethical responsibility" [3]. Thus, engineering ethics has become a required component of engineering education at institutions of higher education.

KIT places strong emphasis on providing excellent education to develop innovative and self-directed engineers. The strategy KIT employs to achieve its educational goal includes a combination of engineering design education, engineering ethics education, and extracurricular activities, which take place primarily at Yumekobo, as shown in Figure 1.

KIT established an innovative facility “Yumekobo” in 1993 [4]. The mission of Yumekobo is to enhance students’ motivation and creativity through extracurricular activities. KIT started to offer three engineering design courses, which employs PBL, for all freshmen, sophomores, and seniors, regardless of major in 1996: Engineering Design I (ED I) for freshman, Engineering Design II (ED II) for sophomore, and Engineering Design III (ED III) for senior. The three courses enable students to identify and solve open-ended problems, generate a set of distinct and creative design solutions, and implement the engineering design process, while working as a team. Furthermore, the course series encourages them to develop expertise and abilities for tackling open-ended problems independently and to acquire important skills such as communication and leadership [5].

KIT implemented engineering ethics education in technical courses in order to achieve its goal of “Ethics Across the Curriculum (henceforth, EAC)” [6]. In response to the engineering ethics education at KIT, the authors implemented engineering ethics into the three engineering design courses.

This paper describes the details of the engineering education at KIT to develop innovative and self-directed engineers with a strong sense of professional responsibility.

Figure 1. Engineering Education at KIT.

2. ENGINEERING EDUCATION AT KIT

2.1. Engineering Design Education

2.1.1. Learning objectives

Program outcomes expected from the engineering design education include the following:

1. An ability to work effectively in teams
2. An ability to communicate effectively in oral, writing, graphical, and visual forms
3. An ability to apply the skills and knowledge necessary for scientific and engineering practice
4. An ability to design a product to satisfy a client’s needs.

2.1.2. Mechanisms to help students learn autonomously

The following four mechanisms are employed in the engineering design courses in order to help students learn autonomously.

1. Learning style

Students tackle problems independently, not by directions given by an instructor. The instructor is a facilitator who advises, identifies technical resources, and gives tutorials as needed. In addition to classroom learning, office hour meetings are arranged to help students improve the quality of their design work.

2. Self-evaluation of progress in achieving course objectives

Course objectives of ED I and ED II are divided into 28 elements and shown to students. 18 objectives are related to professional engineering skills, e.g. an ability to communicate effectively in oral, writing, graphical, and visual forms. The remaining 10 objectives are related to understanding and following the engineering design process, e.g. an ability to carry out a conceptual design by generating multiple solutions that address client needs, evaluating the feasibility of the solutions, and choosing the best one. Students are asked to evaluate their performance and progress in achieving course objectives at the beginning, middle, and end of the course. Students are able to recognize their current level of achievement and try to attain higher levels. This process is referred to as the Plan-Do-Check-Act Cycle of Self-Learning.

3. Peer evaluation from team members

Peer evaluation is used to evaluate individual contributions to team efforts. The peer evaluations are conducted twice during the term: in the middle and at the end of the course. The peer evaluations conducted in the middle of the course are used to advise students whose contributions are judged insufficient. At the end of the term, instructors evaluate both the team results and the individual effort invested by each team member. The information from peer evaluations can provide instructors with insights regarding the work distribution inside a team.

4. Facilities for extracurricular activities

- Yumekobo

KIT requires students of ED I and ED II to develop innovative and viable design solutions on paper. Some students thereafter build models and prototypes at Yumekobo to see if their designs are feasible and useful, or find out what needs to be improved. The details of Yumekobo will be discussed in the following section.

- Self-study lounge

A 24/7 self-study lounge was established in 2001. This lounge provides students with space for group activities related to engineering design courses after classes. Individual students accessed the self-study area more than 600,000 times last year. Figure 2 depicts students working in the 24/7 self-study lounge.

2.2. Engineering Ethics Education

2.2.1. Ethics across the curriculum (EAC)

Engineering ethics is (1) the study of moral issues and decisions confronting individuals and organizations involved in engineering and (2) the study of related questions about the moral ideals, character, policies, and relationships of people and corporations involved in technological activity [7].

![Figure 2. Students working in the self-study lounge.](image)

KIT takes a campus-wide approach to integrating engineering ethics into its curriculum through the freshman, sophomore, junior, and senior years. This approach is referred to as “Ethics Across the Curriculum (EAC)” [8]. EAC is a pervasive approach to ethics, infusing a discussion of ethics in existing courses at all levels: throughout the freshman, sophomore, junior, and senior years. Micro-insertion techniques, which introduce ethics and related topics into technical courses in small units so as not to push out technical material, are employed in integrating ethics education into these classes.

2.2.2. Engineering ethics courses

KIT implemented engineering ethics instruction in nine engineering courses in order to achieve EAC as shown in Table 1. Ethical outcomes taught by EAC are:

- Ethical Sensitivity
- Knowledge of relevant standards of conduct
- Ethical judgment
- Ethical will-power

<table>
<thead>
<tr>
<th>Year</th>
<th>Courses</th>
</tr>
</thead>
</table>
| Freshman | Introduction to Engineering I, II, and III  
Science, Technology, and Society  
Engineering Design I |
| Sophomore | Engineering Design II                                      |
| Junior  | Science and Engineering Ethics  
Humanity and Nature III                                       |
| Senior  | Engineering Design III                                       |
2.3. Engineering Design Education including Engineering Ethics

2.3.1. Ethics education in engineering design courses

The contents of the engineering ethics education are as follows:

A) Engineering ethics lecture
   An instructor gives a short lecture on some fundamental strategies for approaching professional responsibilities and engineering ethics.

B) Advice during office hour meetings
   Students follow the engineering design process to develop design solutions which will contribute to the welfare and happiness of the human race. An instructor gives advice tailored to each group to enhance the ethical sensitivity, ethical judgment, and ethical will-power of the students to help them deal with the specific ethical challenges of their project.

C) Ethical judgment
   Students are required to judge their project and make ethical decisions through the design process so that they can develop ethical design solutions.

D) Assessment of ethical performance and progress

2.3.2. Requirements for design solutions

Students are required to generate design solutions which satisfy the following:

1. Do not harm the global environment.
2. Do not endanger human life or health.
3. Contribute to the welfare and happiness of the human race.
4. Do not infringe intellectual property rights.
5. Be original using either appropriate technology, advanced technology, or a suitable combination of both.

3. EXTRACURRICULAR ACTIVITIES AT YUMEKOBO

3.1. Role of Yumekobo

The mission of Yumekobo is to enhance students’ motivation and creativity through extracurricular activities. Any KIT students with technical dreams can realize them, in the engineering sense, at Yumekobo.

Yumekobo is designed to be available to all students from 8:40AM until 9:00PM, 305 days a year. Yumekobo is equipped with a wide range of machines and tools, and is staffed with 14 skilled full-time technical staff and 5 skilled part-time technicians to support students’ extracurricular activities.

Students’ activities at Yumekobo fall into the following three categories:

(1) Building prototypes for engineering design courses

KIT requires three engineering design courses: ED I, II, III. In these classes students are asked to develop innovative, viable, and ethical design solutions on paper. Some students thereafter build models and prototypes at Yumekobo to see if their designs are feasible and useful, or find out what needs to be improved. Throughout the engineering design courses, students analyze, synthesize and evaluate information, which was gathered from both in-class instruction and activities of engineering design courses, and outside-class activities, e.g. hands-on practice at Yumekobo. The details of Yumekobo will be discussed in the following section.

(2) Yumekobo Projects

The Yumekobo Projects are creative team-based extracurricular activities which are financially supported by KIT. Yumekobo presently houses thirteen Yumekobo Projects with participation from more than 450 students. Project examples include the Solar-Powered Car Project, Robot Project, Fuel-Efficient Car Project, and Human-Powered Airplane Project. Yumekobo Projects win high esteem at various domestic and international competitions.

(3) Personal creative activities

Yumekobo is designed to be available to the entire campus population. Therefore, any KIT student with a dream can realize it, in the engineering sense, using the tools and knowledge available at Yumekobo. The details of Yumekobo Projects will be discussed in Section 3.4.

3.2. Safety Program at Yumekobo

Students are not well trained in building prototypes and are not familiar with safety control before entering KIT. The possibilities of accidents and/or injuries of inexperienced students working at Yumekobo are immeasurable without safety education and training. Yumekobo holds paramount the safety of students.

The strategy of safety management at Yumekobo is to combine the safety education and the environmental improvement as shown in Figure 3. The safety of education is composed of technical courses on safety, accident prediction training, training to eliminate potential hazards, safety training and campaign, periodic safety patrols, human error training, etc. The environmental improvements are composed of hanging a plate showing potential hazards on each machine, dissemination of emergency procedures and first-aid treatment, safety patrols to eliminate potential hazards, etc.

Figure 3. Measures to secure safety at Yumekobo.

3.3. Technical Courses

Yumekobo offers twelve technical courses: safety guidance, courses on the operation of machine tools, electrical engineering & electronics courses, and woodworking courses as shown in Figure 4.

Students must take Step1 “Safety guidance” first. Those who completed Step 1 course may proceed to Step 2. Those who finished Step 2 “Operation of machine tools” may proceed to Step 3 “Advanced courses”. All technical courses start after classes and end for the day. Each of the twelve courses is offered approximately thirty times a year.

3.4. Yumekobo Projects

3.4.1. Objectives

The Yumekobo project is defined as a student project in which students experience the full creative process from planning, market survey, design, fabrication, and operation to analysis and evaluation in team work. Students control their schedule and run the organization on their own. Project objectives include collecting the abilities and knowledge of students from
different departments and academic year into teams, taking up tasks that cannot be achieved by individuals’ efforts alone, and in doing so, enabling students to enhance their technical capability and personal/interpersonal skills. The Yumekobo project is conducted basically by students independently and voluntarily.

3.4.2. Management of Yumekobo projects

Table 2. Primary technologies developed by Yumekobo projects.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Solar-powered car</th>
<th>Fuel efficient car</th>
<th>Robot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green technology</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-saving technology</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ergonomics</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Robotics</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Modelling technology</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Simulation technology</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Yumekobo presently houses thirteen Yumekobo Projects that draw participation from more than 450 students. These students join projects as part of their extracurricular activities and they are free to choose the area that they will like to work in. Thus, these activities are not as structured when compared to the classes that make up the regular curriculum. All of these projects are self-directed with minimal guidance from professors. Students generally work on Yumekobo projects as a part of independent teams, only seeking help from their professors or external engineers in industry when the need arises. Yumekobo projects include the Solar-Powered Boat, Solar-Powered Car, Robot, Fuel-Efficient Car, Human-Powered Airplane, etc. Table 2 shows the primary technological areas that students working on Yumekobo projects’ need to gain skills in order to achieve their goals.

4. STUDENTS’ ACCOMPLISHMENTS

4.1. Students Achievements

One of the EDI design teams of freshmen, whose major is Electrical and Electronics Engineering, selected a project theme “Developing photovoltaic panels of a solar tracking system”. Usually photovoltaic panels are installed on a roof facing south. Their design goal is to increase the amount of electricity by installing photovoltaic panels on both roofs facing south and north. In order to maximize the amount of electricity produced by photovoltaic panels installed on a roof facing north, the panels should be oriented appropriately to collect sunlight as much as possible.

The design team developed an original, viable, and environmentally friendly solar tracking system as shown in Figure 5. It was found that the design solution can produce electricity twice as much as an ordinary solar power system. The solar power system is a good combination of high-end photovoltaic panels and appropriate technology of a tracking system.

4.2. Progress in Capabilities and Understanding of Engineering Design and Engineering Ethics

4.2.1. Engineering design

Course objectives of ED I and ED II are divided into 28 elements and shown to students. 18 objectives are related to professional engineering skills. The remaining 10 objectives are related to understanding and following the engineering design process. Students evaluated their performance and progress at the beginning, middle, and end of the course.
Some of the examples of performance and progress in achieving course objectives of ED II of 2011 are shown in Figure 6 through Figure 10.

Remarks: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Very Good.

**Figure 6.** Progress in presentation & communication skills.

Remarks: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Very Good.

**Figure 7.** Progress in ability to work as part of a team.

Remarks: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Very Good.

**Figure 8.** Progress in ability to analyse problems and clarify objectives.

Figure 6 shows an average progress in presentation and communication skills. Figure 7 shows an average progress in ability to work as part of a team. Figure 8 shows an average progress in ability to analyse problems and clarify objectives. Figure 9 shows an average of ability to generate solution to engineering problems. Figure 10 shows the average of progress in course objectives related to professional engineering skills (D1) and the one related to understanding and following the engineering design process (D2).

Remarks: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Very Good.

**Figure 9.** Progress in ability to generate solution to engineering problems.

Remarks: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Very Good.

D1: Professional engineering skills
D2: Ability to understand and follow the engineering design process

**Figure 10.** Progress in achieving course objectives.

It was found that students of ED II achieved steady progress in achieving all of the course objectives.

4.2.2. Engineering ethics

Students evaluated their performance and progress in two ethical capabilities

Question 1: Can you confirm that your design specifications and design solutions do not harm the global environment and do contribute to the welfare and happiness of the human race?
Question 2: Can you judge and behave from an ethical point of view?

The self-evaluation results for these two objectives were analyzed and the results are shown in Figure 11. It was found that students' understanding and behaviour with regards to engineering ethics advanced steadily during the engineering design course.

Figure 11. Progress in engineering ethics capabilities.

Remarks: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Very Good.

Q1: Can you confirm that your design specifications and design solutions do not harm the global environment and do contribute to the welfare and happiness of the human race?

Q2: Can you judge and behave from an ethical point of view?

4.3. Progress in Technical Competencies and Professional Skills Cultivated by Yumekobo Project

A survey was conducted to evaluate if Yumekobo projects were useful in enhancing technical competencies and professional skills of students. Student evaluated their performance and progress by six levels: from 1-not at all, to 6-definitely. Figure 12 shows that Yumekobo projects help students to enhance technical competencies and professional skills of students.

Figure 12. Progress in technical competencies and professional skills.

Remarks: 1 = not at all, 2= low, 3 = slightly, 4 =moderately, 5=very, 6 = definitely

5. CONCLUSIONS

The educational goal of KIT is to develop innovative and self-directed engineers. The strategy of KIT to achieve its educational goal is to combine an engineering curriculum and extra-curricular activities. The major components of the curriculum are engineering design courses and engineering ethics courses. Yumekobo is the most important facilities for extra-curricular activities. Important information obtained through this study is as follows:

(1) Students developed original, viable, and ethical design solutions in engineering design courses.

(2) Students achieved steady progress in developing professional engineering skills and abilities to understand and follow the engineering design process.

(3) Students' understanding and behaviour with regards to engineering ethics advanced steadily during the engineering design course which included engineering ethics education.

(4) Members of student body went to the Yumekobo facilities more than 110,000 individual times in recent years.

(5) Yumekobo projects helped students to enhance technical competencies and professional skills of students.

(6) The strategies used by KIT to develop innovative and self-directed engineers seem to be successful judging by KIT's employment rate of 99.8% and the fact that it has been ranked by the Asahi Newspaper as the number one college in the category of undergraduate education in Japan for the past eight consecutive years.

6. ACKNOWLEDGEMENTS

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7. REFERENCES


IDENTIFYING THE OPTIMAL PRODUCT STRATEGY BY APPLYING PORTFOLIO SEGMENTATION METHODS – CASE OF SMES IN BANKING SECTOR

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ABSTRACT: Small and Medium Enterprises (SMEs) are a high potential target for banks to attack, but also a risky segment; high potential because the need for financing is increasing, but risky because the crisis affected a lot the solvability and profitability of these companies. On the other hand, loan facilities are some of the most complex banking products (if we analyse diverse financing needs of small companies, but rather due to the analysis and approval processes in banks). In defining strategic alternatives for financing products for SMEs, the following steps are essential: evaluating potential market segments and/or sub segments, always focusing on the general and particular commercial objectives of the bank, analysing the strategies used by the major competitors and last, but not least: developing motivational systems for the employees of the branches - the main distribution channel for a banking product.

Key words: SME, banking products, portfolio segmentation, credit strategies

1. INTRODUCTION

Segmentation is an essential step in defining the product strategy for existing clients, but for potential clients also (if extrapolating the conclusions of existing data base analysis to the potential data base estimation). The aim of each segmentation is to identify similar behaviours, by grouping different clusters (set up by different criteria), and also to identify the correlation with the commercial results and with the potential of each cluster (potential from the client's business point of view, but also potential in terms of turnover, revenues and so on - from bank point of view).

Calculation of profitability per each segment (the segment concept including also the sub segment concept, the difference between the two concepts being only the level of details) even by the simplest method of average net revenue per client generated to the bank, is leading to establishing the most profitable segments from the existing portfolio. It also leads to identify the highest potential segment (in terms of business increase), while correlated to the company criteria (for example, comparison between the company annual turnover and the turnover made by the company through the bank in the same year of analysis). Based on the segmentation analysis and conclusions, different strategic alternatives are proposed for each important segment (for example: retention and loyalty increase for very profitable clients of the bank; turnover increase, loan volume increase, cross sell, up sell for non profitable clients with high potential and so on).

On the other hand, segmentation process and calculation of profitability leads to identification of clusters which are generating loss. For sure it is important to consider also these clusters/ segments and to establish an action plan in order to minimize the loss and increase the profitability.

2. BANKING SERVICES - CHARACTERISTICS AND PARTICULARITIES

In the banking sector, the service provision implies the presence of the customer: face to face with the service provider (usually a so called Relationship Manager or an Operational Officer from a Branch) or even self-service, if using Internet Banking, specific equipment and so on.

Usually, pro-active selling by need identification and maintenance of the portfolio of clients is the relationship manager’s responsibility, while the operations officers are involved in re-active responses to transactional needs of the customers in a certain moment of time. For acquisition and offering to potential clients, the responsibilities can be split, and even the branch manager can take action (depending on client value and potential).

Another aspect to be considered is the involvement of the customer in the structuring of the product; the Relationship Manager will identify the need of financing, for example, only based on information provided by the customer; the customer itself can propose to the Relationship Manager the optimal solution considered. Face to face meetings play an important role if the need and therefore the service to be provided are more complex. In these cases, the involvement of the customer is crucial. There is a really strong business relationship between the client and the provider, especially when tailor made approach is needed, implying a higher degree of interaction. We are speaking about a low interaction with the service provider when the need is characterized by low complexity and the client is able to use specific equipment (other channels, such as: Automatic Teller Machines, Points Of Sales and so on or the most common: internet banking).
The success of persuading the client to buy the banking service is strongly related to the soft skills of the Relationship Manager, together with his knowledge of the products and internal procedures. It is demonstrated that the profitability and the market share growth is directly related to the efficiency of the Relationship Managers. Another characteristic of the banking service would be low seasonality (with some exceptions for clients activating in industries with high seasonality or specific business cycles, such as: agricultural companies).

For increasing the quality of the service providing, the focus is on creating strong long-term business relationships with the clients, the loyalty of the most profitable customers being a key success. On the other hand, loyalty can lead to referrals, which are well known as important acquisition hooks.

The banking services are very different when considering segments of clients. The segmentation strategy and process can be done based on many criteria. Usually, the banks are addressing specific offers (and have different divisions and departments) to the following categories:

- Mass Individuals
- Affluent clients
- Private clients
- Small and Medium Enterprises (SME)
- Large companies (Corporate)
- Freelancers
- Non-Profit Organizations
- Public Institutions

3. SME BANKING PRODUCTS AND SEGMENTS

Each company is different and therefore the banking services are unique. The dependency between the company’s characteristics and the service is very high. For some companies, the service is standard, for some is tailor made (this approach is appropriate to be used for more complex companies and needs).

3.1. Value and Quality of the Banking Services for SMEs (SME banking “product catalogue”)

The quality of the banking services for SMEs is very hard to analyze, especially because the customers’ expectations are hard to anticipate and the evaluation of the customer satisfaction can be done only after the banking service is purchased. However, requesting constant feedback during service providing is very helpful.

How a customer perceives the value of the banking product is directly related to customer satisfaction with the condition of meeting the expectations. This leads to a need of standardizing the service in order for the customer satisfaction conditions to be met.

When addressing to small companies, customer satisfaction standards are easier to identify, anticipate and design. For a medium company, for example, it is recommended to address a combination of standard features and tailor made ones.

A banking service feature is designed and established through the document called product card (to be noticed that the concept of banking service was replaced by banking product. Any new product or modification of existing products is approved through this document. The product card contains all the standard features of the product and also details about the non-standardized approach (rules of approval, criteria to consider etc.).

Sometimes the same product card will be used in order to offer standard products to a specific segment of clients, while for other segments, the same product card will become a tailor made offer through applying the existing non-standard rules.

Another special feature of the SME banking product is related to the decision process.

The term of customer has in the end an individual person that will take a decision. That person could be an administrator, shareholder or general manager of the company. For bigger companies, the decision can be taken also by the Financial Manager. Even so, when appreciating the quality of the banking product, or when taking the decision of acquiring the banking product, the customer (individual decision maker) is influenced by his own experiences, claims and expectations; the influencers can be someone from the family (for example, if a family member had a similar experience with the same bank/ branch of a bank etc.), a business partner (client, supplier etc.), even subordinates (financial manager, accountant etc.) and other parties (brokers, consultants etc.).

Sometimes, situational factors influence the decision (for example lack of parking space in the proximity of the branch, no privacy and so on can lead to a negative decision).

While taking the decision to contract a loan, maybe the most important factor is the credibility and confidence inspired by the Relationship Manager. The explanation is simple: the financial situation of the company is important for any administrator/ shareholder (profit is source of dividends and so on) and the risk that a wrongly granted loan could destabilize the financial balance leads to the need of competent advice. That is why professionalism of the Relationship Manager (proven by very well knowing the products, understanding the business, financial indicators knowledge and so on) is also influencing the decision.

As a conclusion, the decision is influenced by the ability of the Relationship Manager to inspire confidence, by:

- Very well knowing the banking product, with all its feature (including all costs)
- Understanding the business of the client and correctly identifying the need (a common mistake of low experienced Relationship Manager is offering a Working Capital line instead of an Investment Loan; experienced clients know very well that the company’s financial situation can be seriously damaged if acquiring, for example, fixed assets with 5 years amortization, with a working capital line with maturity of 1 year)
- Continuously providing consultancy and advice
- Interactivity and relationship management; the clients need to be involved in the structuring of the banking product (when tailor made approach needed). Face to face meetings are a great premise for identifying further business opportunities for cross selling and future financing (for example, in the meeting, the client may mention a small detail regarding a future investment for building a new warehouse)
- The quality of the banking product cannot meet the clients’ expectations unless the Relationship Manager demonstrates fairness; this approach needs to be part of organizational culture, as the values reflect in day to day activity
- Trained on soft skills development: communication, sales, negotiation etc. are a must
- Becoming a single point of contact with the client, “the bank is me”; high expertise and very well knowing the business, together with financial advice and well knowing to identify the needs, are the
features that make a Relationship Manager become the face of the bank in front of the customer. That is why the entrepreneurship skills are also very important.

As a conclusion, the skills and know-how of the Relationship Manager is definitely very important for the decision taking regarding loan facilities. Knowing very well these aspects, the members of the marketing department are very interested in applying the marketing strategies first of all by “selling” them to the Relationship Managers. The scope is very well illustrated in the figure below.

![Figure 1. The impact of Marketing Strategy over Commercial Results.](image)

3.2. Loans for SMEs – Particular Features

The loans are some of the most complex banking products, especially because of the diversity of financial needs of the companies, but also because of the approval process.

Loans can be categorized as follows:

- Working capital lines (Revolving facilities, the limit stays the same), with general expenses purposes (usually: payments to suppliers or state budget and so on)
- Working capital loans (Non-Revolving facilities, the limit diminishes while paying the principal), for financing current needs
- Factoring Facilities, based on Assigned Debtors (no other collaterals requested)
- Discounting instruments (CECs and Promissory notes, Invoices)
- Investment Facilities (with different purposes: building a warehouses/ premises of the company, acquiring a fixed asset and so on)

Each loan has a loan limit and a loan exposure (or loan outstanding). The loan limit is the maximum limit amount which can be granted to the client (for revolving loans, this is the amount that appears in the loan contracts). The loan exposure (outstanding) is the amount utilized by the client at a certain moment. The limit is always above the exposure, the only case when the outstanding exceeds the loan limit occurs if the client didn’t pay its debts to the bank, being in overdue.

The risk management is a very important feature of each loan. In general, small companies have higher risk than bigger ones, but a good rating is only given by a strong financial situation. The collateral coverage is also a very well known feature of a loan; depending on the collateral type (mortgage, cash, contract, equipment etc.), a certain weight is applied to the value of the guarantee, so the coverage is usually >=100%.

Rating and collateral structure and coverage determine the amount of the provisions that the bank needs to constitute for each loan. The provisions are costs (cost of risk, calculated as the percentage of the provision evolution applied to the amount of the exposure).

While calculating the profitability of a loan, there are three components: the interest rate and the fees paid by the client (IF), the funding rate of the bank (cost of financing; F) and the cost of risk (as described above, CoR).

The profitability of the loan is calculated by the following formula:

\[ RL = IF - FC - CoR \]

where:

- RL = net Revenues generated through the Loan
- FC = financing cost
- CoR = Cost of the Risk

3.3. Portfolio Analysis and Segmentation

While designing a loan strategy, the first step is to analyze the behavior and potential of the clients from the potential target. If on the market, information about the potential target is limited (meaning expensive of lack of information), a good solution is to deeply analyze the existing portfolio of clients.

In this respect, it is important first of all to clean up the portfolio data base, by flagging and excluding the clients with negative signals (categorized as “non-active clients”). At this stage, the portfolio analysis focuses on identifying the unwanted “behaviors”, the clients that generate losses or who have a high potential to generate losses.

So, the first step consists in analyzing the clients’ portfolio structure and eliminating from the database the clients that have one or several problems. An example for the structure of an SME portfolio and the most common negative signals met are shown in the figure below.

![Figure 2. Portfolio structure: Active and Non-Active clients](image)
1. Legal issues for the database filtration:
   - Bankruptcy
   - Insolvency
   - Legal reorganization
   - Activity suspension and so on.

2. Financial issues for the database filtration:
   - Continuously dropping incomes
   - Operational loss and so on.

3. Issues related to not honoring the obligations towards the bank/banks:
   - Overdue loans
   - Loans with a high risk of becoming unpaid
   - Unauthorized overdrafts (also known as current account debits, resulted through not paying the commissions for the held banking products)
   - Garnishments on current accounts and so on.

In some cases, the elimination from the analysis of the clients with social capital accounts and of those who haven’t used their accounts for a long period of time (dormant clients) can be chosen.

After cleaning up the data base, the next step consists in establishing the segmentation of the remaining clients (so called active portfolio of SME clients). The segmentation takes into account different criteria, the most common being the related to company characteristics and banking behavior. The purpose is to identify common behaviors, in order to establish the categories of clients with a high potential in terms of profitability (in the specific sense, of course, of the profitability gained through offering a crediting facility). The most common segmentation criteria are:

1. Criteria related to the company characteristics
   - The company’s turnover and other financial indicators (profitability, personal capitals, and so on)
   - The industry from which its field of activity is part of (because the credit risk policy could impose to avoid offering credits to clients belonging to industries with a high risk; it’s well-known that, once the economic crisis appeared, the building field of activity suddenly became a sector where credits were being offered only as an exception)
   - The geographic region (for example, Bucharest’s potential is significantly higher than the potential of other regions from the country)
   - The debt service (including the debt payment to the state budget)
   - Identified product potential (for example, according to the industry, or basing on the realized market research)

2. Criteria referring to the banking behavior
   - Creditor turnover (receipts directed through current accounts) in a certain period of time
   - The incomes generated for the bank in a certain period of time and their structure (incomes from interests, incomes from commissions, incomes from deposits and current account, incomes from other banking services)
   - The banking products held at a certain period of time (usually, the last available reports), compared with the identified products potential.

- The credits volume, the deposits volume in balance at a certain period of time
- The seniority of the client (beginning with the date when the account was opened)
- The payment behavior of the clients who have credits
- The credit warranty coverage level
- The commercial campaigns which had an impact upon the client/which didn’t have an impact (basing on the campaigns that work with predefined lists, a report may be extracted, regarding the clients who answered positively and negatively to certain commercial actions – of sales, of retention, administrative and so on)

An example of segmentation analysis from banking behavior perspective is shown in the following figure.

![Figure 3. Segmentation analysis results – example based on Banking Behavior criteria](image-url)

Segments become real targets when the potential is considered large enough and when the characteristics and banking behavior of the segments allow a special positioning which can create a value proposition for the clients in the segment.

A market watch analysis is mandatory, so is a qualitative research in order to identify the most adequate solutions for the implementation. If needed, a testing session will be set up.

Usually, before roll-out of the new strategy, a pilot is done in order to identify aspects to be improved/removed/added.

After the implementation, the monitoring of the results and the constant communication is very important. Sometimes lack of monitoring may influence the profitability.

Sometimes, negative signals can be identified only after the segmentation is already designed and the strategy is already set up. This happens because the risk profile and the eligibility of the client is analyzed only after receiving detailed information from each client; for example, some filters will include the rating, the debt service, possible to be made only based on documents (usually financial and legal documents) provided by the client’s representatives.
3.4. Credit strategies for SMEs

Every banking product strategy follows at least three essential stages: the Design stage, the Implementation stage (which includes: the release itself, the testing – before and/or after the release – and the “technical” implementation) and the subsequent Monitoring (with the purpose of identifying the strengths or the possible optimization alternatives; sometimes it leads even to a radical strategy change).

The effort while designing a strategy is orientated towards the existing clients’ portfolio. This is widely accepted as being an efficient strategy, being less expensive than the strategy of attracting new clients. It is also profitable to simultaneously focus on various transactional segments. The portfolio selection (clean-up) and segmentation is applied for developing a model, taking also into account a perspective based on risk management - clients with less risk and high profitability are preferred.

Once the market segment/segments have been defined, the establishment of the crediting strategy target is made taking into consideration the potential of the chosen segment (which has to be large enough), but especially the possibilities of creating a special positioning, that will be able to generate a value proposition for the clients within the segment.

After establishing the target segment characteristics, the companies whose risk profile don’t meet the eligibility conditions will be eliminated from the database. The conditions will always include the company’s financial rating (based on the scoring developed by the financial institution), the debt service, the client’s profitability and so on.

A competition analysis is a mandatory step, especially when the target segment is composed of small companies. In this case, the strategy will be a standard one, generally available for all companies included in the segment. For larger companies, where a level of service personalization appears, the competition analysis becomes harder, reflecting through the clients who are willing to offer information regarding the offers which they received from the competing banking institutions.

The strategic alternatives when offering credit facilities can regard any aspect below, but the decision regarding optimal strategy is taken on segment level:

- The market share increase, by increasing the number of clients with credits and/or the total volume of granted loans; if focusing on volumes, the segments with highest potential will be attacked.
- Optimized version/ new version or product to be included into the product catalogue of one or more segments (working capital lines; investment loans for equipments/ tools acquisition of for building branches/ deposits/ working points; factoring; lines for issuing letters of guarantees and letters of credit; lines for discounting payment instruments; credit cards and so on); segments with low results and potential can be attacked by offering optimized products which meet their expectations.
- Client portfolio migration from credit products with a higher risk to credit facilities with lower risk and/or higher profitability (transforming the credits with work capital into factoring facilities, for which the default risk is lower); segments with high risk (sensitive portfolio) always need a special strategy and action plan.
- The creation of products and services “packages” (for cost optimizing); elite and complex segments can be attacked with innovative products which are leading to turnover increase through the bank (and therefore to non-risk revenue increase); for example, a package with unlimited incoming and outgoing payments and a lot of banking and non-banking benefits included, at a monthly fixed price.
- The establishment of loyalty methods for the existing clients/acquisition of new clients through a simplified flow of offering certain credit facilities (for example, preapproved facilities); segments with good financial performance and with loan appetite will be attracted through a pre-approved limit of money (working capital or credit card), granted by a very simple flow, with no bureaucracy.
- Encouraging certain favorable behaviours (the turnover increase through the current account, which leads to the banking institution’s profitability increase), by offering preapproved working capital lines (according to the client’s previous behavior)
- Some modifications of the existing products are mandatory due to legal rules (especially NBR Regulations)

Furthermore, also part of the strategy’s design stage, the afferent procedures and flows will be designed (together with the product card, the necessary set ups and flows will also be subject for approval). Sometimes the procedures include also the next steps, such as monitoring (usually also detailed in a working instruction/guide). A so-called pilot project may be built, for testing the strategy’s efficiency and for identifying on time the issues that need to be improved/eliminated/added.

The results’ subsequent implementation and monitoring, and also a constant communication within them are very important. Sometimes, the strategy’s success is widely determined by constant monitoring, because the profitability can be influenced through quick measures.

As a conclusion, while defining the product strategy, the segmentation plays an essential part. The identification of certain similar behaviors through grouping them into categories, and also the correlation with the development potential (from the client’s business perspective and also regarding the relationship with the bank) can lead to the establishment of a right and impactful strategy which will be further found in the results.

The identification of the correlations and the calculation of certain profitability indicators generated by each identified segment, can lead to the establishment of the most profitable segments from the existing portfolio, but also to the identification of the segments towards which the attention must be focused, with growth purpose. According to these, different strategic alternatives for each segment will be proposed, taking into account also the cluster specificities and the objectives that derive from the analysis. For profitable clients but without growth potential the optimal strategies are focused on retention; for unprofitable clients but with a high potential, the optimal strategy will consider the increase of the turnover through the bank, the increase of the product penetrating degree or the increase of the credit volume.

4. REFERENCES

ABSTRACT: Using blended learning method, Blast Furnace subject was analysed inside the DidaTec Project. The analysed factors were the quality of presentation, quantity of information per page and human – computer interaction. The analysis shows the preference of students to work with different learning environments.

Key words: Blast Furnace, engineering education, LMSs, virtual environments

1. INTRODUCTION

Using the opportunity to be part of DidaTec Project, the authors have discovered the blended learning methodology to combine traditional and modern learning environments by means of the advancement of computing in education. Blended learning method has 3 components: Classroom Learning, Online Learning and Mobile Learning, as seen in Figure 1.

Figure 1. Components of the Blended Learning Methodology

The DidaTec project was initiated by Technical University of Cluj-Napoca and several large universities from Romania joined this project too. One of them is Lucian Blaga University represented by professors, assistant professors and other members of academic community.

The project emphasises on different synchronous and asynchronous learning methods, one of them being presented with regard to materials engineering.

DidaTec is an association of words, that contains the word “Didactic” and the word “Technology”, but the synergy of the two words refers to modern learning technologies applied in the educational process.

The stated goal of this project is to provide a framework structure for the implementation of informational technologies in engineering technologies.

The general objectives of the DidaTec project are [1]:

- The consolidation of cooperation between Romanian universities in regard with the development of an efficient system of education from the field of engineering;
- The elaboration of guidelines for professors in the field of engineering education for higher education institutions;
- Acquiring of competences in the development of procedures and methodologies for training programs and continuous education on the institution level;
- Training and assistance for academic professors to achieve a higher level of success in teaching and learning techniques using electronic instruments;
- The improvement of personal or professional development for young teachers of entry-level in a mentoring program;
- The improvement of human resources involved in teaching activities by creating didactic materials and communication platform.

The DidaTec Project was divided in several components. The first component was referring to blended learning concept using information technology and communication as a combined teaching using traditional and electronic methods, where students can learn engineering concepts in a modern environment using on-line and off-line tools. Online tools available for blended learning techniques are: webcasts, virtual classes, conference calls, video broadcasts, virtual laboratories, instant messaging and online collaborations. Traditional tools for blended learning techniques are: laboratory activities, courses, seminars and projects. Materials used are tutorials, quizzes and assessments, simulations, virtual libraries and multimedia records, LMSs, blogs, wikis, expert systems, mobile services. The communication methods were instruments used to implement the procedures of transmitting the messages from emitter (teacher) to the receiver (student) using communication channels and feedback in an environment without perturbations or noises that might interfere with the communication process.

The second component refers to the infrastructure needed for blended learning, combining the traditional class with a virtual learning environment in order to improve the educational process. It was studied the hardware and software elements connected to the Learning environment and Learning Management System. Along with the network services used to communicate without perturbations in audio-visual manners.
The third component analyses the structure of the didactic materials. First, defining the objectives is the main structural element of the didactic material, afterwards the curricula is the element of communication and finally the assessment is the element of evaluation of the achievements obtained in the educational process. The curricula was analysed with concerns for intellectual property and plagiarism.

The fourth component is referring to seminar activities, using active learning, cooperative learning and inductive learning methods. The implementation of seminars was realized by using software products specialized on virtual instrumentation, virtual collaboration and virtual presentation of important concepts presented in the curricula. Also an important factor here was the management of documents, the annotation process, sharing process and dissemination of the theoretical concepts presented in the curricula. The seminars are usually activities of communication in form of workgroups that needs to work, communicate and assess the results of their work.

The fifth component refers to electronic evaluation of individual or group activity inside of the educational process. The process of evaluation requires the measurements, comparisons and estimations in order to obtain useful information regarding the student level of education, the quality of education process, followed by decisions with regard to optimisation of the didactic activity for the evaluated field.

The sixth, also the last component, refers to advanced instruments and technologies to communicate inside the educational process. They are named generic as web 2.0 technologies, like RSS, blog, wiki, collaborative bookmark systems, social networks. Another advanced instrument is the audio/video conferencing system, used to increase the awareness of student regarding the importance of the educational process while the professor is situated geographically in a remote location. This instrument keeps the advantage of face to face presentation while the other person is away by maintaining the visual contact, the awareness of being on screen or hearing its own voice, especially by knowing that the session is recorded. Virtual classrooms are learning environments that allows the interaction between different persons with different roles of host or guests using didactic materials.

The DidaTec Project allows obtaining improved results in the education process, by implementing the blended learning concept, using tools and instruments to complement the theoretical education with skills and abilities by means of electronic and virtual instruments in the field of engineering education.

2. BLAST FURNACE
A blast furnace is a metallurgical installation used for smelting to produce industrial metals, especially iron. The blast furnace is continuously supplied at the upper level with iron ore, coke, flux (limestone) and the oxidizing agent (preheated air) at the waist level activating some chemical reactions to obtain iron, slag and blast furnace gases based on a counter flow exchange process.[2]

The iron ore is a compound material, rich in ferrous and other mineral components. The concentration of Fe must be 20-55% in order to make the ore profitable to process. Various ferrous components meet in iron ore are: magnetite Fe₃O₄, hematite Fe₂O₃, limonite 2Fe₂O₃ · 3H₂O, siderite Fe₃CO₃ and pyrite FeS₂.

The metallurgic coke is a solid combustible obtained by high temperature carburising process in the absence of air of coal, which must have high calorific power, high porosity, high mechanical resistance, low level of water retention, and a low ash percentage.

The flux has the goal to melt the sterile component that moves the slag impurities from the ore and coke, which are hard to separate from the iron.

The oxidizing agent is a gaseous product, rich in oxygen, which must be inserted on the lower level, under the waist line. It has the goal to activate the chemical process through exothermal reactions, which gives the heating energy to activate the coke and to melt the iron ore. This gas starts from the bottom and raises itself to the higher levels, where it is transformed into furnace gases, after the interaction with coke dust and combustion process.

The results of the metallurgical processes from the blast furnace are the main product, iron, and residues, like slag and blast furnace gases.

Iron comes out from the blast furnace at the lower level through a notch, called iron notch, while the slag is eliminated from the blast furnace through a different notch, called the slag notch, which is situated at a higher level, since the slag floats at the surface of the liquefied metal, as presented in Figure 2.

The slag is eliminated first, in order to clean up the surface of the molten metal. The resulted slag is transported to a concrete factory situated nearby, used afterwards in the production of concrete and cement for the home construction industry.

The iron is eliminated from the blast furnace as a special metallic material called pig iron, with a high level of carbon and impurities in its composition. The pig iron is re-processed through a second elaboration in order to reduce the carbon level and impurities level and to be transformed in iron metal, or steel.

![Figure 2. Metallurgical products supplied and eliminated from the blast furnace.](image)

The furnace gases are eliminated at the superior level, through an exhausting system on lateral position to avoid losing the heat, but eliminating the gases that can interfere with the metallurgical process.

The blast furnace construction is presented in Figure 3 with all the functional components needed. This representation has been obtained in a virtual 3D environment and the components can be presented individually, along with their functionality.

![Figure 3. Blast furnace components.](image)
Construction elements of the blast furnace start from the bottom with the foundation, the cast house, metallic cover, slag notch, iron notch, nozzles, supporting columns, at the middle level, refractory firebricks, water cooling pipe system and receiving hopper, distributing chute and exhaust system at the superior level.

The ore, the flux and the coke are continuously charged into the blast furnace in the distributing chute and enter into the blast furnace through the receiving hopper, deposited as successive layers.

The air is injected into the blast furnace through nozzles as it arrives from the Cowper stoves under a pressure created by the turbocharger.

The Cowper stoves are heat exchanger installations that capture the heat from the blast furnace gases and pre-heat the fresh air, injecting the air with a turbo-charger. A maximum number of three Cowper stoves are needed for one blast furnace installation.

The blast furnace is made of thick steel plate of 25 ÷ 45mm, also called metallic cover, being padded with refractory firebricks.

The physicochemical processes inside the blast furnace

The furnace operates on the counter flow. The charge of ore, flux and coke goes from the upper level to the inferior levels, while the oxidizing agent enters into the blast furnace through the nozzles that act as air vents that blow fresh air needed for combustion process and goes in the opposite direction as the air heats transforming the air into furnace gas. [3]

This furnace gas needs to be eliminated from the blast furnace through the exhaust system.

The highest temperature inside the blast furnace is above the cast house, the temperature in the blowing zone lowering as the pre-heated air rises at the superior level.

The study ends with a thermal analysis of the smelting process inside the blast furnace, as presented in Figure 4.

![](image)

**Figure 4.** Thermal analysis inside the blast furnace.

In the nozzle area, the combustion process is defined by the chemical reactions:

\[ C + O_2 \rightarrow CO_2 + 97650 \text{ Kcal}, \]

rising the temperature at 2173°K.

The CO₂ is raised at the superior levels where is reduced by the carbon from the coke layer, according to the chemical reaction:

\[ CO_2 \rightarrow 2 \text{ CO} - 7100 \text{ Kcal}, \]

cooling down the combustion atmosphere inside the blast furnace.

In the higher levels, the carbon oxide is disintegrated in the presence of iron, which is catalysed by the chemical reaction:

\[ 2\text{CO} \rightarrow \text{CO}_2 + \text{C} + 3700 \text{ Kcal}. \]

Therefore, inside the blast furnace there is a mix of CO₂ and CO, whose proportions will depend on the excess air injected through the nozzles.

The iron ore is reduced to iron by the carbon monoxide, according to the following chemical reactions:

\[
\begin{align*}
3 \text{Fe}_2\text{O}_3 + \text{CO} & \rightarrow 2 \text{Fe}_3\text{O}_4 + \text{CO}_2 + 8870 \text{ Kcal} \\
2 \text{Fe}_3\text{O}_4 + 2\text{CO} & \rightarrow 6 \text{FeO} + 2\text{CO}_2 - 9980 \text{ Kcal} \\
6 \text{FeO} + 6\text{CO} & \rightarrow 6 \text{Fe} + 6\text{CO}_2 + 19500 \text{ Kcal}
\end{align*}
\]

Magnetite and siderite suffers a prior a roasting process. Siderite by calcination process suffers a simple roasting at 873-973°K, eliminating the CO₂, becoming more porous and more reducible.

Magnetite through an oxidative roasting turns into an easier subject oxide in the blast furnace operations, according to the following chemical reaction:

\[ 4 \text{Fe}_2\text{O}_3 + \text{O}_2 \rightarrow 6 \text{Fe}_2\text{O}_3 \]

The reduction of the FeO may also occur via direct reduction

\[ \text{FeO} + \text{C} \rightarrow \text{Fe} + \text{CO} - 34460 \text{ Kcal} \]

It also reduces the manganese ore placed into the blast furnace in order to reduce the harmful action of sulphur.

\[ \text{MnO} + \text{C} \rightarrow \text{Mn} + \text{CO} - 64830 \text{ Kcal} \]

Alongside it also reduces the P, Si, S, Ti and K hence results the slag.

The slag evacuation and pig iron evacuation from the blast furnace is realised in 2 ÷ 6 hours, first through slag notch until it cleans completely the slag from the surface of smelted metal and afterwards the pig iron through the iron notch.

3. STUDIES

In order to analyse the impact of learning environments over the learning subject it was created a study group where participating students were assessed by survey method. The study group had 20 students for the analysed subject, called Blast furnace.

Each student have analysed the subject for 20 minutes, afterwards they had to fill up a questionnaire for evaluation.

The questionnaire asked the student about:

- **Quality of presentation, Figure 6**
- **Quantity of information per page, Figure 7**
- **Human Computer Interaction, Figure 8**

![](image)

**Figure 5.** Comparative image (classic schematic representation vs. 3D representation).
In order to establish the influence of the **quality of presentation** over the educational process there were ergonomic considerations regarding the colour palette, the size of images and the text size. All 20 students appreciated that the quality of the presentation was good.

The actions identified by the students were move over the image action, click and double-click and drag-and-drop action, in the evaluation module of the Blast furnace presentation.

The results of the survey were:

1. Quality of presentation was considered good - 100% (It was an exception for a student who requested to make dynamic size text for students with eye problems).
2. Uneven quantity of information per page, or per slide - 85% (No remarks on text-image ratio per page).
3. Identified correctly the move over the image, clicks and drag and drops actions - 90%.

## 4. CONCLUSIONS

Using Blended Learning Methodology, professors from Lucian Blaga University had the opportunity to give their students alternatives to learn mandatory engineering curricula using different environments. Romanian students have been familiarized themselves to work with the computers since they were young, therefore their survey answers shows the preference to work with virtual environments.

## 5. REFERENCES

ENTERPRISE TRANSFORMATION THROUGH SUPPORTING INFORMATION SYSTEMS. THE CASE OF A ROMANIAN HOTEL CHAIN

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ABSTRACT: The present paper analyses and exemplifies the role of information systems in the processes of enterprise transformation, by presenting the case study of a hotel chain that elaborated a new integrated information system in order to increase efficiency of the room booking process. The theoretical literature will outline the main theories concerning enterprise transformation and its role in the knowledge-based society, and in particular, its importance in efficiency-driven economies, such as Romania’s. The case study will also describe the IS in terms of motivation, options, anticipated benefits, related risks, implementation costs and duration, assessment of investment. A detailed activity plan will be provided, as well as an analysis of resources involved. Of extreme relevance is the presentation of the expected social impact of the development project, which proves the multifacetedness of enterprise transformation, through its large outreach to all stakeholders, not only employees and customers, but the society at large.

Key words: integrated information system, enterprise transformation, social impact

1. INTRODUCTION

Change is undeniably a driver of business efficiency. Ouyang et al. [10] have admitted the importance of change in the modern workplace. “To remain effective and competitive, organizations must continually adapt their business processes to manage the rapid changes demanded by the dynamic nature of the marketplace or service environment.” (p. 402) In particular, business / enterprise transformation concerns change, however, not only routine change but fundamental change that dramatically alters an organization’s relationships with one or more key stakeholders, e.g., customers, employees, suppliers, and investors [11]. A relatively new discipline, Business Process Management (BPM) has been created as a holistic, all-encompassing merger between several inter-related disciplines, all upholding the tenet that a process-centred approach is conducive to dramatic improvements in both performance and compliance of a system. Not only does BPM contribute to increased productivity, it also brings about innovation and continuous business transformation, as well as cross-organisational value chains changes. According to vom Brocke and Rosemann [12], BPM consists of six core factors: Strategic Alignment, Governance, Methods, Information Systems, People, and Culture. In the present paper we will turn our attention to Information Systems and their role in the processes of enterprise transformation.

2. BACKGROUND

2.1. Enterprise transformation

According to the above mentioned author, “enterprise transformation is driven by experienced and/or anticipated value deficiencies that result in significantly redesigned and/or new work processes as determined by management’s decision making abilities, limitations, and inclinations, all in the context of the social networks of management in particular and the enterprise in general.” [11] Along the same lines, the author states that transformation is determined by value deficiencies (defined in relation to both current enterprise states and expected states) and involves examining and changing work processes. This analysis takes heed of how changes are likely to affect future states of the enterprise. Potential impacts on enterprise states are evaluated in terms of value consequences. Projected consequences can, and should, influence the way in which investments of attention and resources will be allocated. Other factors that influence the course of enterprise transformation are the problem solving and decision-making abilities of management, as well as the social context. [11] Further on, work processes enable transformation, so that transformation initiatives triggered by external factors such as opportunities and threats are likely to adopt strategy-oriented approaches, e.g. Markets Targeted, Market Channels Employed, Value Proposition, Offerings Provided; whereas transformation initiatives triggered by competitors’ initiatives and internal crises tend to adopt operations-oriented approaches, such as Supply Chain Restructuring, Outsourcing & Offshoring, Process Standardization, Process Reengineering, Web-Enabled Processes. It is particularly this last approach that will be exemplified in the following chapters.

2.2. The role of Information Systems in business management

The business applications of information systems have greatly increased over the past decades. An important new role for information systems emerged in the 1980s and further on through the 1990s: the concept of a strategic role for information systems, often called strategic information systems (SIS). Within this concept, information technology represents an integral component of business processes, products, and services that assist a company in securing a competitive advantage in the global marketplace. The mid- to late 1990s witnessed a groundbreaking outgrowth of enterprise resource planning (ERP) systems. This organization-based form of a strategic IS encompasses all aspects of a firm as well as all business functions, from planning, manufacturing, sales,
resource management, customer relations, inventory control, order tracking, financial management, human resources, and marketing. The main advantage of these ERP systems resides in their common interface for all computer-based organizational functions and their tight integration and data sharing, that are needed in flexible strategic decision making. Mention should also be made of business intelligence (BI), which refers to all applications and technologies in the organization that are oriented towards the collection and analysis of data and information that can be used to trigger strategic business decisions. Last but not least, the amazing spread of the Internet, intranets, extranets, and other interconnected global networks in the 1990s essentially changed the capabilities of information systems in business at the beginning of the 21st century.

The figure below [9] represents graphically a conceptual classification of information systems applications. Information systems are thus classified to highlight the major roles each plays in the operations and management of a business.

![Classification of Information Systems](image)

**3. CASE STUDY. A HOTEL CHAIN BOOK RESERVATION INTEGRATED INFORMATION SYSTEM**

3.1. Economic justification of IS implementation

Following a diagnosis analysis, it was identified that the room booking process of the HTC hotel chain was in need of improvement in order to increase efficiency. The room booking process is an essential process for the hotels’ activity, and all ensuing hotel activities are dependent upon it: conference organization, spa and balneal treatment programmes, etc. Initially, the booking process was carried out either via telephone or partner travel agents. This booking process could be optimized through the integration of an Internet-operated CRM (Customer Relationship Management) module, as part of the hotel room booking IS. The online booking process consists of several phases: informing the client, booking the room, confirming the booking, after-booking service. The advantages of online booking through the implementation of the CMR web-enabled module are:

- facilitating clients’ access to information on the range of services available;
- simplifying the booking process and traceability of clients’ bookings;
- improving the response time to clients’ requests;
- assisting the clients so that they may most benefit from services available.

In analysing the possible options to approach the implementation of the IS, several geographical areas were taken into consideration: The Northern Area (the traditional one), The Seaside and the Mountainous Area. The area where the IS was to be implemented was chosen based on the following criteria:

a) economic criteria:

1. Personnel costs (salaries and taxes);
2. Equipment costs (hardware and services);
3. Transportation costs;
4. Duration of IS implementation project.

b) Technical criteria:

1. Availability and reliability of the working environment where the IS will be implemented;
2. Availability of trained workforce.

The highest score was obtained by the mountainous area, followed by The Northern Area and the Seaside, therefore this was the order in which it was decided that the IS project should be implemented. The anticipated benefits of the IS implementations were considered to be the following:

- The profit is expected to increase, since the information on the hotels services is public, published online and updated daily on the Internet;
- The increase in clients’ being informed, counselled and served;
- The decrease in the response time and simplification of the way in which booking is carried out and followed up;
- The electronic storage of information on hotels’ clients created the premises for utilising and analysing this information in future personalised offers addressed to clients;
- The study of offers and availability of rooms that may be booked in a hotel may be made 24/7, therefore there is no limitation imposed by working hours;
- The status of a booking may be tracked electronically, as there exists at any moment a written confirmation (in electronic format);
- The social impact of the IS implementation is extremely significant, as initially we started from only one implementation area (The Mountainous Area), but later on this will gradually extend to include all hotels in area with tourist potential in Romania.
- The access to information via Internet may be done more easily, with less effort and with increased efficiency, both for Romanian tourists and for those from abroad.
Related risks include:

- Estimated profits may be overvalued in the conditions of new competition and a crisis situation. The initial study is based on existing competition and current economic situation.
- Costly human resources. The IT market is quickly evolving, so that human resources become scarce and more expensive;
- No funds are obtained to continue the implementation of the project / One of the sponsors backs out of the project.

Implementation costs entailed an estimated initial 900,000 Euros, which was allocated for the following purposes:

- attracting personnel in the implementation of the project;
- payroll costs;
- hardware equipment costs;
- software licence costs;
- travel costs: equipment installation and infrastructure setting up (van rental, fuel, etc.);
- administrative costs;
- advertising and marketing costs.

The IS project was scheduled to be finalised within one year since it had started. The estimated initial 900,000 Euros was provided for two years since the implementation of the IS started in the first geographic area and took into account the assessment of total operating costs against income generated following the implementation of the project. Therefore, the estimated gross profit two years after the completion of investment is 80,000 Euros for one geographical area.

3.2. Background of IS project

The main objective of the IS creation and implementation was to make online booking for the hotel chain and took into account several components: informing the client, booking the room, confirming the booking, after-booking service. It represented an important enhancement of the hotel chain activity, through accessing electronic services field, which eliminates the barriers between national and international clients. The specific objectives of the IS were:

- results interpretation of diagnosis analysis previously carried out in order to identify the economic criteria that determined to the implementation of this booking system;
- organisation of marketing campaign for the new service;
- identification of technological needs (software and hardware);
- setting up an efficient infrastructure;
- piloting the IS and extending this implementation for all identified area;
- organization of training courses for the employees involved in booking services;
- bringing novelty into the current market context.

Generally speaking, the online information in tourism is very dispersed across Romania. There have been attempts to create online guides, for one geographical region, which included the most important tourist companies that operate in the field, a short description and a link to the company’s website (if applicable). This tendency towards online databases and even tourism portals started to gain ground and are heading towards a laudable direction, and most of the companies understood the importance of being registered with such a catalogue. Among the portal-type sites (with a complex database) mention should be made of www.infotravelromania.ro, which contains a large array of information on tourist and related services, such as: travel agents, medical insurance agents, transport companies (road, air travel), information centres, hotels, latest news, tourist fairs, tourist offers from Romania and abroad, ticket reservations, important links, tourist courses and magazines. A similar site is www.tourromania.info, where one can find information on tourist agents, accommodation places, restaurants, transport, and airlines. As far as rural tourism is concerned, which enjoys great success, especially amongst foreign tourists; there is another site, www.turismrural.ro, which contains information related to guest houses, tourist circuits, tourist attractions, traditional products, regional rural tourism, theme-based tourism (e.g. ski). Lately there have been attempts from the large international tour operators to enter the Romanian market. One of the strategies used was to buy hotels and include them among their own hotel chain. Two of the most important such multinationals that entered the Romanian market are Continental Hotels and BestWestern Hotels. One can notice the shared corporate (visual) identity, also present on the Internet; on www.continentalhotels.ro and www.bestwesternhotels.ro respectively, where all hotels in the chain are presented in an integrative manner and similar to all the groups’ hotels across the world. On the same site one can also find a booking form. Besides its role in informing tourists, the Internet has its ever increasing role in tourism, in terms of the booking process through computerized booking and global distribution systems. Practically, through the implementation of this IS, the hotel chain becomes aligned with the services offered on the tourist market. The novelty brought about by the hotel chain is the fact that online booking through the web-enabled CRM module resides in the advantages already mentioned in 2.1 above.

3.3. IS project plan and WBS

In the assessment of alternatives, several hypotheses were considered:

A. Worst-case scenario

Too high costs (resources, materials, difficulty installing hardware equipment) – lead to an increase in the price of implementation of tender offers. Due to this, market demand is low (lower buying power in the rural areas), being only represented by foreign tourists and organized groups. Private individuals from the rural areas are not interested in the new means of communication. The traditional factor is powerful, rendering impossible a speedy development of the Internet services that may be offered.

B. Middle-case scenario

Moderate costs: relatively inexpensive costs, a part of the workforce exists locally. This leads to the setting of a moderately accessible price of offers. The demand for services is generally accessed by clients - private individuals from the age group up to 35 years old, from the urban area and organized groups from Romania and abroad.

C. Best-case scenario

Costs are moderate, doubled by the possibility of limited-time offers to attract and preserve clients. This is possible through finding advantageous offers on the market. Demand is high because services entered the area of ecommerce, have been supported by an advertising campaign and had positive outcome. Electronic services couldn’t have bee accessed 24 hours a day, 7 days a week. The online booking system may be now regarded from a comprehensive perspective, as there is now the possibility to resort to an IS integrated with airlines, car rental companies, travel insurance and travel agents.
The strategy adopted was to implement the IS stepwise, in order to carry out the following activities: facilitate clients’ access to information on the range of services available; simplify the booking process and traceability of clients’ bookings; improve the response time to clients’ requests; assist the clients so that they may most benefit from services available. The action packages decided upon as part of the strategy adopted were conducive to the realization of the IS concept, as well as to the adherence to the aforementioned strategy:

- **WP 1.1 – IS project management.** The objective of this WP is the coordination of working teams, management of activities to comply with deadlines, with the allocated budget, and the supervision of appropriate implementation of the project.
- **WP 1.2 – Detailed planning.** The objective of this WP is the detailed description of the application functions and the hardware and software solution for the new version of the IS.
- **WP 1.3 – Content acquisition and processing.** The objective of this WP is the acquisition of hardware and software necessary for the development and implementation of the new version of the IS and the realization of training sessions necessary for the developers of the new IS.
- **WP 1.4 – Application redesign.** The objective of this WP is the creation of a functional prototype of the web-enabled IS application.
- **WP 1.5 – Installation and testing.** The objective of this WP is the creation of the IS user’s manuals, the realization of training courses for the future IS users, the organization of the marketing campaign and the piloting of the application.

The figure below summarises the IS creation and implementation activities in a tree Work Breakdown Structure:

![Figure 2. WBS of IS activities](image)

### 3.4. IS resources

Human resources were mainly provided by the supplier. Material resources needed to be purchased together with the cost-type resources by the supplier. In order to achieve the general objective of the project within the allocated timeframe entailed the use of the following types of resources:

A. Human resources (allocated cost: 22,500€ - 25% of the budget), with the following structure:

<table>
<thead>
<tr>
<th>Role performed</th>
<th>Number of people</th>
<th>Cost (Units per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Project manager</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Coordinator of working team</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Financial coordinator</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Administrator of material resources</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>IT Specialist</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Hardware specialist (HW)</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Software specialist (SW)</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>IT Support / Clients support</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Infrastructure technicians</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>22</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1. Human resources structure.**

Description of human resources’ roles:

- **Management.** The structure of the project management comprises:
  - the project manager, who ensures the coordination of specific objectives, so that the achievement of the general objective is made within the established budget and time limits and
  - the coordinators of working teams, who ensure coordination within the teams: analysis and design, HW infrastructure, training and documentation, testing, implementation.

- **Financial / Accounting department.** It performs the role of keeping the project budget, cashing in clients’ payments, effecting payments to suppliers. At the same time, this department administers all resources and concludes contracts with suppliers.

- **IT specialists.** They ensure the design, development and implementation of the IS:
• Hardware specialists. These are specialists in administering databases, Web portals, network and web applications.
• Software specialists. These are specialists in web applications development and databases.

IT support specialists. They will provide IT support in the final stages of the project. Their main roles are: network administrators, Unix administrators, Web administrators. Resources may be recruited from among IT specialists, this role being necessary after infrastructure is completely implemented.

Infrastructure technicians. These will ensure the optimal functioning of the whole distribution system in physical terms. The main activity will be building/monitoring/maintaining the network of cables and terminals.

B. Material resources (allocated cost: 45,000€ - 50% of the budget):
• Hardware: routers / switches / modems / converters; servers; work stations; satellite communications installations;
• Software: database system; software for the design and development of web portal integrated applications; project portal;
• Machinery / equipment / parts: optical cables, other materials.

C. Cost-type resources (allocated cost: 22,500€ - 25% of the budget):
• Marketing campaign (delegation to the marketing company);
• Offices rental (delegation to the real estate company);
• Surveys and statistics;
• Travel;
• Workshops /presentations.

3.5. Associated risks
Several risks were identified, both active and dormant. Risks were divided into several categories, according to their functional assignments:

• Legislative framework (changes in legislation that influence project results – the passing of a law that pertains to the IT field of activity that triggered legislative changes directly influencing the web-enabled application);
• Personnel (changes that occurred during the lifetime of the project – a member of the team leaves away);
• Management (non-achievement of the project within the designated timeframe – during the functional test it was revealed that the testing scenarios were not successfully completed);
• Financial (insufficient financial resources – in the second part of the project planned payments were delayed);
• Environmental issues relevant for the project (insufficiently defined requirements during the analysis stage – certain new / additional requirements were formulated during the testing stage, as different from those during the analysis stage);
• Management/ Leadership (insufficient involvement of decision makers – decision makers do not always have the time to meet the project requirements and do not always delegate responsibilities to the project leader);
• Technology (appearance of a newer version of the software used for the development of the web-enabled IS application);
• Personnel (lack of time for beneficiary’s representatives to validate stages / results / deliverables by planned deadlines);
• Personnel (attracting outside personnel for training courses – an external trainer must be hired to hold two training courses);
• Suppliers (insufficient involvement of outside partners in providing services – external suppliers did not deliver by the planned deadline the equipment necessary for the IS implementation).

3.6. IS social impact
At present, online reservations represent one of the most dynamic segments of Internet-based commerce, as was initially conceived by large airline companies. As a matter of fact, direct ticket sales represent at the moment 60% of the volume of transactions of internet based travel agents. The Global Distribution Systems have been created by airlines, to which later on adhered via internet travel agents, tour operators, independent guest houses, hotel chains, car rental companies, cruise operators, etc. These ISs allow users (in particular travel agents and companies, and to a lesser extent, private individuals) to obtain information on available places, tariffs, ticket reservation and sales. Therefore, we may notice that, through getting connected with these computerized networks, travel agents may conceive themselves tourist packages, without resorting to tour operators.

On the international tourist market there are recognized Global Distribution Systems enjoying international renown, whose number of users and available services are in permanent evolution. Global Distribution Systems initially accessible only via tour agents, connected with these networks, started to develop direct access means (for online information and booking) and for individual customers, via Internet and Minitel.

Undoubtedly, the new technology has made its way irreversibly in the field of tourism as related services as well, as interconnectivity is one of the underlying factors for globalisation at the same time it is an essential condition for competitiveness. Internet is today not only a source of information and a means of information circulation, so that, for example, we may make an online booking for a hotel situated a few hundreds of kilometers away, similarly we may book a hotel room at the other end of the world, and we may receive instant response or consult the list of available places thanks to the new technologies. Today Internet may reach tourist companies, from small guesthouses to large hotel chains or online booking companies that created the Global Distribution Systems.

Thus, the achievement of this web-enabled IS allows the adaptation of online booking functions so that it can be integrated as a web-enabled service within Global Distribution Systems, tourist portals, etc.

4. CONCLUSIONS
We have made an introduction to the importance played by information systems in the processes of enterprise transformation in the knowledge-based society. Particular reference was made to the context of the Romanian economy. The case study under scrutiny is the implementation of a web-based integrated information system in order to increase the efficiency of the room booking processes run by a Romanian hotel chain. The aspects analysed pertained to:
• the economic justification of the IS creation and implementation;
• background of IS project (general and specific objectives; current state of affairs in the Romanian hotel business);
• IS project plan and work breakdown structure (hypotheses considered, strategy adopted and action workpackage);
• IS resources (human and material);
• associated risks (active and dormant);
• IS social impact.

We have tried to demonstrate that indeed business transformation through supporting information systems is possible and has dramatically positive effects on the business environment at large.

5. REFERENCES

STUDY ON IMPLEMENTATION OF TABLET COMPUTERS IN ENGINEERING
DESIGN COURSES

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ABSTRACT: Rapid development and employment of modern technologies has changed humankind life style drastically. Education has always been an essential human virtue and a necessity for society. The question of how to engage technological tools in order to expand teaching benefits and increase learning capacity is on the rise. This paper is intended to contribute in assessing usage of stylus and tablet in place of traditional pencil and paper in design oriented engineering courses offered to undergraduate engineering students. The paper presents suggestions for how to use the tablet computers to deliver course material along with results of student surveys on how tablets are being used in class, their usefulness and effectiveness.

Keywords: tablet computers, design courses, engineering, effectiveness

1. INTRODUCTION

The development of ways to facilitate a deep understanding of course content, based on the course outline and specific principles designed for the offered course (curriculum), the teaching approach to train a set of technical, professional and even communicational skills (instructions) and evaluation of the success rate and measuring the depth of understandings on different concepts (assessment), is the goal of every instructor. This is called “effective learning experience” [1]. The challenge for instructors in engineering design courses is to engage students in this experience and encourage them to be active and independent learners. The present paper and other related studies [2] show that replacing pencil and paper for drafting applications with the computer tablets and stylus, appears to be a successful method in teaching and learning design related courses.

In regard with the students’ learning, it is a reality that an effective CAD package speeds their ability to produce a useful drawing within a few hours of practice, but what is being lost is the ability to make useful freehand sketches. Different studies have shown that students who are not exposed to hand-drawn sketching do not gain maximum visualization skills. For this reason, freehand sketching was considered a very important module in the activities associated with engineering design. As the technology part us from traditional sketching tools (pencil and paper), one can still find ways to attract the students to nurture their creativity with hand drawn sketching. One of the alternatives is to use stylus and tablets, as presented in this study.

2. THE RELATIONSHIP BETWEEN C-I-A TRIAD AND ENGINEERING DESIGN COURSES

The Curriculum-Instruction-Assessment triad as shown in figure 1 is used as a core model for understanding how effective the knowledge is transferred from the instructor to the student. The answer to “How People Learn” can be different base on how each part of the triad is being conceptualized in other word the type of curriculum, method of instruction, and form of assessment are critical [3]. Each element of the triad is being explained based on the approach designed for engineering design courses at University of Windsor:

![Curriculum/Instruction/Assessment (CIA) triad model.](image)

Curriculum: The knowledge and skills that the instructor uses and the students grasp is called curriculum [3]. The learning outcome of these courses was to prepare students to tackle design oriented problems. Some of the key points of the curriculum were expansion of engineering graphics to include statistical tolerance design and geometric dimensioning, schematics for standard components, design for manufacture and assembly (DFMA) and reverse engineering.

Instruction: Is referred to the methods of teaching as well as learning activities that are used to help students to develop their understanding of the course content and the curriculum objectives [3]. The instructions were transferred to the students by the instructor and teaching assistants. In addition to tutorial sessions, lab sessions were added to give more time to students in order to practice what they were taught.

Assessment: The outcome of the education and students achievement is measured by variable assessment methods [3]. In this course, bi-weekly progress tests helped the instructor to gauge student’s weakness and strengths. Traditional formal midterm and final exams were also used. These tests along
with assigned course projects prepared the students to demonstrate their level of critical thinking and problem solving skills. Being part of a team and working on real challenges of engineering design process, communication skills were also practiced among team members.

In all these three areas mentioned in the C-I-A triad the use of the computer tablet was analyzed and implemented.

3. DESIGN PROCESS INVOLVED WITH THE ENGINEERING DESIGN COURSES

Problem-based teaching and project-based teaching techniques were used as inductive teaching methods. Employment of effective problem solving algorithm [4] (figure 2), helped with addressing all aspects of a design engineering course such as making students familiar with design concepts in real world, design restraints in engineering profession, learning to integrate various scientific and mathematical roles and applying them correctly to overcome a problem and solve design issues. Since directed project-based learning approach was introduced and practiced during lectures, students were encouraged to brainstorm different solutions for the specific design problem and communicate the outcome using graphical communication techniques on a computer tablet using the stylus. This model assists the students to demonstrate and master research skills, problem definition methods, critical thinking and problem solving techniques, interpersonal and communication skills and teamwork and creativity. Following the engineering design process and focusing on learning, the active role of the students in the class, the importance of acquisition, application and integration of different parts of science, make this model compatible and aligned with CEAB criteria.

![Figure 2. Effective problem solving algorithm used in the engineering design process](image)

4. IMPLEMENTATION OF TECHNOLOGY DEVICE: COMPUTER TABLET

Hand sketching is an essential part of an engineering design courses. A variety of engineering design softwares is available for engineers and designers in the market and instructors try their best to familiarize their students with as much as software packages as possible. However, as mentioned before, maximum visualization skills can only be gained by free hand sketching. Figure 3 shows some of the software used in engineering design courses at University of Windsor.

![Figure 3. Design and sketch tools.](image)

Tablets are effective devices because of their mobility and convenience. In this study, Lenovo Think Pad Tablets with 2 Dual-Core 1GHz processors and Android™ 3.1 were used [5]. A popular professional grade drawing and sketching software, SketchBook Pro was installed on the tablets. User friendliness and simplicity were the most important factors in choosing this software. Students tested the software through a self learning process with specified instructions provided by teaching assistants. An image of the software interface is illustrated in figure 4.

![Figure 4. Sketch book Pro software interface [5].](image)

During lab sessions, students were asked to use the tablet for their assignments. They were also instructed how to save and upload their work on university server. All the saved assignments could be easily accessed by teaching assistants and were checked and graded using the tablet and stylus. A sample of a student submitted assignment can be seen in figure 5. Students were required to use the third angle projection theory to sketch the top view of a part, the front view as an offset section view, and to dimension the part.

![Figure 5. Sample of submitted assignment using the tablet.](image)
The use of the tablets eliminates the need for paper and pencil and makes it easier for the instructor and teaching assistants to keep track of the assignments, to grade and archive the submissions. This also does not compromise the initial intent to develop specific student skills such as free hand sketching and spatial visualization.

Preparing the students with visual thinking skills through free hand sketching on computer tablets would speed their learning ability and develop their graphical understanding of digital modelling software. Therefore, along with learning the basic drafting and visualization skills, specific CAD packages were used during the tutorials (figure 3). As shown in this paper, in order to train students to understand and interact with up-to-date virtual world of design, the free hand sketching software should also be introduced and taught to students along with other CAD software’s such as CATIA and AutoCAD.

5. PRESENTING MATERIALS USING COMPUTER TABLETS

After over a year of using tablet computers in the classroom, the major teaching needs identified were presenting or working with Office documents, displaying PDFs and web pages, and drawing or annotating. The preloaded application Docs To Go [5] allowed the users to view, edit and create Word, Excel and PowerPoint files, and high-fidelity viewing of PDF files.

The students and the instructor used SketchBook Pro by Autodesk [6] to sketch or annotate images. This software allows free hand sketching using either a finger or a capacitive-touch screen stylus. SketchBook also has the concept of layers, allowing users to import an image from the tablet and, on another layer, “draw” on the image. This allowed the presenter, the teaching assistants, and the students to annotate existing images or diagrams.

The tablet computer proved useful for showing videos, displaying class information, documents, and other web content, including relevant articles. Finally, note-taking applications have proven useful to keep track of the issuance of assignments, discussion questions, tests, and grading.

The instructor and the students must be familiar with the applications to be used, the file formats the apps support, how to transfer files and associate them with apps, and how to access files from applications. The basic requirements needed for the use of the tablet in the classroom consist of:

- Access to a wireless network for displaying web pages and showing video from internet is required
- Familiarity with all the applications that will be used during class and tutorial sessions
- Familiarity with the file formats and how to transfer and access files for each application to be used
- The sleep mode on the tablet must be disabled
- The instructor must ensure that the classroom has either an HDMI or VGA input to projection system and any password protected sites/accounts are logged into before turning on the projector

6. CASE STUDY CONDITIONS

In order to have both qualitative and quantitative aspects of an effective research study, a case study was designed and quantified by surveys. Case study [7] can be a helpful tool in the study of a new approach in a classroom however the biggest problem with the case studies is the problem of selection bias. This can affect the validity and reliability of the research. Yin in his research [8] on case study conditions, defined three conditions under which the study is considered credible:

1. The research should address a “Why” or “How” question
2. The research should not influence the student’s behaviour
3. The focus on the research topic should be in real time

All the above conditions were satisfied during this study. Research Ethic Board of University of Windsor was also involved with this study to assess and minimize common risk factors of involvement of students in this study. A set of pre and post surveys were administered before and after the use of tablets. These surveys were anonymous, no risk, discomfort or inconvenience was associated with participation in this study.

7. RESULTS AND DISCUSSION

Pre and post surveys were chosen to scale students’ perspective regarding their experience with the computer tablets. Pre surveys assessed their initial level of expectation and post survey examines their final level of satisfaction.

The pre surveys had two main groups of questions: one set of questions were regarding the student’s familiarity and usability of tablets. The second set was about their initial expectation regarding the course delivery and evaluation methods.

In the post survey, almost same questions were asked in order to make it possible for the researchers to compare the results, a new set of questions were also added to this part that was related to communication skills and practices involved in team work projects.

Figure 5 shows the comparison diagram on the results obtained before and after the use of tablets. As shown 77 percent of participants thought that it is easy to use a tablet for drafting application. An increase of 35 percent was seen on the preference of replacing a tablet over a pencil and paper. The rate of student’s willingness to learn new design software was also increased by 13 percent. These results are a good indicator that their experience with SketchBook Pro software was a success.
Students were also asked to express their experience regarding project management and communication practices. The following questions were asked:

Q1: Interaction between the instructor, teaching assistant and students
Q2: Helpfulness of tablets in developing drafting skills
Q3: Helpfulness of feedbacks received from instructor or teaching assistants
Q4: Relation between the lecture contents and project requirements
Q5: Responsibility definition of each member in the team work
Q6: Fairness of amount work assigned to you in the team work

The results are shown in a bar diagram in figure 6. A linear scale of 1 to 4 was used to gauge the answers. (1=Poor, 2=Adequate, 3=Good, 4=Very Good).

![Bar diagram showing student experience](image)

**Figure 7.** Obtained data on student’s experience in this design course.

8. **CONCLUSION**

The survey results show the positive influence of tablets in this study and the suitability of their usage in the context of an engineering design course. Implementation of the tablets eliminates the need for paper and pencil, and makes it easier to keep track of the assignments and archive the submissions. It was proved that the tablet can also be successfully used for teaching purposes. Using this technology does not compromise the initial needed skills such as free hand sketching needed to be gained, practiced and mastered by the students during beginner engineering design courses. Based on the successful turn out of this study related to engineering design course and discussions with other faculty members, university agreed to implement tablets in more engineering courses in the following semesters.

9. **ACKNOWLEDGEMENT**

The authors would like to mention that this study wouldn’t have been possible without the support received from the University of Windsor Centre on Learning Innovation Fund program, CLIF, for the project entitled “A strategy to Evaluate a New Teaching and Learning Experience by Employing Engineering Concepts”.

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THE ROLE OF CLIENT – CENTERED THERAPY PRINCIPLES IN DEVELOPING PRAXIOLOGIC COMPETENCES OF STUDENTS IN REHABILITATION ENGINEERING AREA

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ABSTRACT: The paper’s purpose was to prove that teaching the principles of client – centred therapy on students from rehabilitation engineering area, is an important step in developing their praxiologic competences. The new qualification, supported by project TEORO - POSDRU/86/1.2/S/63545, “rehabilitation engineering” was developed in a new master degree program, in 3 universities from Romania, were the students are trained to adapt the environment to functional potential of persons with disabilities in order to facilitate their independence in daily activities. The research started from the observation that this kind of tools is not often found on the market. According to client – centred therapy principles, the person with disabilities should be the key point in the reasoning process, because it means that he/she will use the adjustment made by specialist. Our research was focused in the first session, on discovering the client point of view concerning the adapted equipment. The conclusion of this research confirms the hypothesis presented in the paper and from the teaching process perspective, all the students recognized as an important experience their involvement in the experimental research made by questionnaires, interview and results statistics.

Keywords: praxiologic competences, client-centered therapy, rehabilitation engineering

1. INTRODUCTION

Client centred therapy principles are set up by Carl Rogers, in 1951. He highlights elements of his model using the idea that a person involved in a therapeutically process, is the real "expert" in himself or herself.

"The curious paradox is that when I accept myself just as I am, then I can change" Carl Rogers said (1951), thinking on therapist like a co-facilitator in clients' own therapeutic journey. The role of the "patient" is replaced by the role of "the client". The difference is that a client does not require "fixing", but is valued for what he or she, bring to the session. As a client, each person has the right to negotiate the outcomes of the therapy with therapist, because he or she is the only who knows which is the most appropriate way in his or her context.

The difficult part in this relationship, at least in the Romanian context, is the fact that a client-centred therapist emphasize on not telling to client what” to do”, but enabling him and empowering him to discover his or her own solutions. This might be a little irritating for a person if he or she came seeking advice. In our Romanian medical approach, most of the patients listen the doctor and expect"instructions" from him. It is a habit with very deep roots, almost transmitted from a generation to other generation.

In this context, changing this way of thinking could be a real challenge for a professional who intent to facilitate the participation of a person in his own life, trough different devices or adapted equipment. Placing much the respon sibility for the treatment process on the client, with the therapist taking a nondirective role, is something that can be interpreted from the patient point of view. That's why, gathering information and developing the skills for observing, understanding context of client 'life is a goal which must be achieved before starting a client centred therapy or approach.

Some of the changes that this form of therapy seeks are related to foster in clients a closer agreement between the client's idealized and actual selves.

From our experience and point of view, this approach is a way to facilitate self-understanding, to lower levels of defensiveness, guilt, and insecurity. Also, is a good way for more positive and comfortable relationships with others, and for increasing capacity to experience and express feelings at the moment they occur. Offering to client more space to express these feelings, can be a guarantee for a supportive environment, which contributes to therapy success.

The human potential underlying client – centred therapy, and it takes in consideration the tendency of all human beings to grow, to develop skills, to move forward, and reach their fullest potential. Humans become pro-social when they move toward self – actualization. That means they start to be concerned for others, behave in honest, and constructive ways. The concept of self – actualization focuses on human strengths rather than human deficiencies. According to Rogers, this evolution can be blocked by an unhealthy self – concept (negative or unrealistic attitudes about oneself).

The important factor in successful therapy is not, in opinion of Rogers the therapist's skill or training, but rather his or her attitude. The therapist should have three interrelated attitudes: congruence, unconditional positive regard, and empathy. Congruence refers to the therapist's openness to relate to clients needs without hiding behind a professional expertise. Therapists who have this approach, have their feelings available to them in therapy sessions, and may share significant emotional reactions with their clients. Congruence should not mean, however, that therapist shift the focus of therapy to himself in any other way.

According to Rogers, when congruence, unconditional positive regard, and empathy are achieved by therapist, clients will be
able to express freely themselves without having to worry about what the therapist thinks of them. The therapist does not attempt to change the client's thinking in any way. Even negative expressions are validated as legitimate experiences. The aim of this approach is to facilitate clients to explore the issues that are most important to them, not those considered important by the therapist. Client is the only one who has the right to priorities his problems, according with his motivations, needs, believes. Based on the principle of self-actualization, this undirected, "uncensored" self-exploration allows client to eventually recognize alternative ways of thinking that will promote personal growth. The role of therapist is to provide a climate in which clients can engage by his own wish, in-depth self-exploration.

2. PURPOSE OF STUDY

The paper’s purpose was to prove that teaching the principles of client – centred therapy on students from rehabilitation engineering area, is an important step in developing their praxeology competences. The new qualification, supported by project TEORO - POSDRU/86/1.2/S/63545, “rehabilitation engineering” was developed in a new master degree program, in 3 universities from Romania, were the students are trained to adapt the environment to functional potential of persons with disabilities in order to facilitate their independence in daily activities.

The research started from the observation that this kind of tools is not often found on the market.

2.1. Hypothesis of study

According to client – centred therapy principles, the person with disabilities should be the key point in the reasoning process, because it means that he/she will use the adjustment made by specialist.

In this context, the hypothesis of our research was focused in the first session, on:

A. If the aim of the adjustment made by specialist is to facilitate the independence of people in their activities of daily life, than client – centred therapy’s principles are the most appropriate approach.

B. If the people are put in the situation to use features unique equipment or devices less commonly known, than interview and opinion of the client must be the first stage, before establish the strategy of intervention.

C. If the client acceptance of adapted equipment is the key point of the specific intervention plan, than teach client – centered therapy principles to students from rehabilitation engineering area is an important step in developing their practical competencies.

2.2. Materials and methods

2.2.1. Samples

In order to organise the reasoning of the research, the framework of person – environment – occupation was applied. 38 students from rehabilitation engineering area master programs from both higher education institutions, Vasile Alecsandri” University of Bacău (ERTA master program) and University Politechnica of Bucharest (ECHITERA master program) were involved in this research.

Their role was to identify potential future clients, person who seems to need adapted equipment because physical or neurological impairments.

The students were invited, in this stage, to looking the person who qualifies as the required profile in their appropriate environment: family, community and professional.

Research was conducted during 1 year, 2011 - 2012. Aleatory sampling has been used for research.

Original sample included 101 person from town Bucharest and Bacău, in order to replace the non-answers.

In the final study, the answers of 100 people were included, in different proportion from Bacău and Bucharest: 59,4% people from Bacau County and 40,6 people from Bucharest (Fig. 1)

The difference between the number of respondents is correlated to the difference between the number of students, which was higher in Bacau (20 students) from Bucharest (16 students).

Figure 1. Samples. Repartition of subjects according to cities: 59,4% Bacău, 40,6% Bucharest

In order to identify the potential client point of view, concerning the facilitation of their occupation through adapted ergonomic devices or equipment, different from the usual, we used research questionnaires. Students applied the questionnaire to selected people. The descriptive questions concerned the optional answers “Yes”, “No” or “I don’t know” for the availability to use different adaptation in hypothetic situations, from their daily activities and habits.

The second step was to find out the opinion of the students about their experience, based on reflective essay.

Registered dates were statistically processed using SPSS (Statistical Package for the Social Sciences) program.

2.2.2. Methods

The research presented in this paper is descriptive research, because its aim is to provide information about conditions, situations, and events that occur in the present.

In concrete way, we realised a survey of the opinion of the people from to different areas of Romania, one more modern and one less connected with the tendency to use everything is new. The survey is required in order to establish a descriptive profile of the people who can be the potential clients of assistive technology or adapted technology in Romania.

Short closed-ended questions were included in questionnaire in order to encourage the students to fulfil their tasks quickly and to motivate them for future tasks with increased level of difficulty.

To assure a good level of the reliability, the students were trained 1 month, before starting gathering information and collecting data. The risk of introducing errors and its impact on research was clearly explained.
From the same reason, the quality of measurements was projected starting from the idea of getting feedback from the respondents regarding how easy or hard the measure was and information about how the testing environment affected their answers.

In order to increase the level of responsibility the students were informed about the fact that present research is a pilot research and their work will contribute to develop a national research, extending the survey to other 2 regions of the country.

The period for selecting the respondents and for data collection was negotiated in a realistic way with students and it was set at 3 months. The students were trained also, to give the questionnaire to those who can be fairly sure that there would be a high response rate.

The principles of client-centred therapy and the importance of intervention in the person interest were the main core of theoretical preparation.

2.3. Ethics
Teaching and applying the principles of ethics in research was another important issue.

Participation by submitting the completed questionnaire was entirely voluntary.

People were informed about the survey aim and about the fact that answers of questionnaires would be collected and analysed anonymously, and their right to view possible publication will be respect.

3. FINDINGS AND RESULTS

3.1. Level of measurement
For the nominal (categorical) variables, numeric codes were used to represent categories in the SPSS database. The answers from questions concerning the gender, location, home, were coded as follows: 1 = man and 2 = female; 1 = Bacau and 2 = Bucharest. The answers “yes”, “no” or "I don’t know” to the questions were also coded: 1 = yes and 2 = no.

3.2. Numerical description of data
In order to analyze the data from a numerical point of view, the indicators of central tendency (mean, median) and dispersion indicators (standard deviation, variation) were used.

As seen in Table 1, the standard deviation for the answers to the questions about using adapted devices for self-care activities was between 0.674 – 0.817, negative kurtosis (standard error 0.478), platykurtic dispersion of values, with an acceptable degree of variance (between 0.454 – 0.668).

Platykurtic is said when a distribution is less peaked than the normal distribution. This distribution is characterized by less probability in the tails than the normal distribution. When kurtosis is less than 3, represent an excess kurtosis, a negative distribution of values. Lower values of kurtosis mean that data has a larger degree of variance, with extreme values.

This platykurtic distribution, guide us to expect more volatility in future returns. This means that there is a higher probability than usual for extreme answers to occur.

Concerning the statistical interpretation of respondents answers to the question about the agreement to adapt the furniture or devices from their home, or to use specific walking aids, table 2 presents the results.

| Table 1. Statistics of answers concerning use of adapted devices for self care activities |
|-------------------------------------------------|-----------------|-----------------|-----------------|
| city               | use of adapted spoon | use of adapted knife | use of adapted shoe boots |
| Valid          | 101 | 100 | 100 | 100 |
| Missing        | 0   | 0   | 0   | 0   |
| Mode           | 1   | 1   | 1   | 1   |
| Std. Deviation | .689 | .817 | .674 |
| Variance       | .475 | .668 | .454 |
| Skewness       | 1.040 | .681 | 1.046 |
| Std. Error of Skewness | .241 | .241 | .241 |
| Kurtosis       | -.177 | -1.163 | -.107 |
| Std. Error of Kurtosis | .478 | .478 | .478 |
| Sum            | 150  | 167  | 149  |
| Percentiles    | 25   | 1.00 | 1.00 |
|                | 75   | 2.00 | 2.00 |

As seen in Table 2, standard deviation for this category of questions was 0.867 – 0.776, negative kurtosis (standard error 0.478), with same acceptable degree of variance (between 0.455 – 0.602).

The frequency of answers is represented on Fig. 2, and Fig. 3 (agree to use an adapted spoon or an adapted knife in a special situation, if this could be a solution to maintain independency in eating activities). It is clear that more than half from the respondent want to keep their independency if a situation of illness can occur in their life.
In Fig. 4 and 5 is represented the frequency of answers to the questions about the agreement to adapt the furniture from own home, or using a walking frame, because in order to perform activities independently.

**Figure 4.** Frequency of answers concerning the agreement to adapt furniture or devices at home

In Fig. 4 it can be observed that the percentage of people who consider that adapting the furniture at their home could be an option in case they need it, is almost equal with percentage of people who don’t want or don’t know. Correlation with Table 2, shows that in the future, during a re-survey, these percentage can move towards extreme values, changing the results.

Concerning walking aids, the positive answers are more from Bucharest and more from women. Men motivate the negative answers because many of them refuse to think on the hypothetic situation because of proud or because of the idea to show the ”disability” to others.

**Figure 5.** Frequency of answers concerning the agreement to use walking aids

After the pilot study was finished, student’s reflective essay analyse was realized. The students were invited to express their taught, feelings about this experience, in the ”circle of concerns” frame.

Students set up a list with strong and weak points and resources.

30 students from 38, appreciated that working in this pilot project make them feeling useful and all of them considers that communication with person facilitate the understanding of the practical aspects of their work.

A number of 5 students realised the tasks working with disabled people. Their feelings, as engineers, were more focus on the emotional aspects, like compassion, the sense of powerlessness.

More than half of students wanted to be more involved in finding solutions to adapt the environment for disabled people.

4. CONCLUSIONS

The conclusion of this research confirms the hypothesis presented in the paper and from the teaching process perspective, all the students recognized as an important experience their involvement in the experimental research made by questionnaires, interview and results statistics.

5. ACKNOWLEDGEMENTS

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ENGLISH AS COURSE INSTRUCTION LANGUAGE. EXPERIENCES FROM MACHINE DESIGN COURSES

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ABSTRACT: Globalization and internationalization of higher education around the world is “forcing” many universities and colleges from non-English speaking countries to offer a significant part of their educational programs in English. The main motivation to do so is partly to successfully implement student exchange programs such as the European Erasmus Program, and partly to attract “fee-paying free-moving” students from abroad. A third long-term reason to teach in English is to educate young pre-professionals for the global market. However, the adaptation of technical courses from national languages to English cannot be done overnight. On the contrary, this process demands time-consuming preparations that typically involve the expansion of background references and careful planning. In addition, the English skills of course instructors must assure the effective transmission of information, and very often professors face certain difficulties and uncomfortable limitations. Generally speaking, instructing in a foreign language results in less “colourful” expressions. Recent investigations conducted in Sweden on higher education show that teaching efficiency is inferior for courses taught in English when compared with the same courses given in Swedish. This paper deals with various experiences related to the process of changing the language of instruction from Swedish to English in three Machine Design courses taught at Linnaeus University.

1. INTRODUCTION

The advent of new technologies in the field of transportation and communications has “shrunk” the world to a small place. Nowadays, it is very easy to communicate with people around the world. The use of emails and cellular phones, for example, has allowed people on almost any place on the earth to come in contact at any time. It is also possible to reach any continent within a day. But international communications need a common “international” language, which today is English. If multinational corporations and businesses are the “locomotive” of the internationalization “train”, higher education is one of the “wagons” in the front. Universities and colleges have a long tradition of international collaborations and scientific exchange with educators and researchers based in other countries. However, not until the last decades has internationalization reached a worldwide scope within higher education institutions. In the end of 1900s it was the mobility of faculty which was emphasized the most. Today, it comprehends all the activities that contribute to the international dimension of education [1].

The practical globalization of higher education has many purposes depending on any country or university. According to the Swedish Government Bill 2004/05:162 [1], the following points on the internationalization of higher education in Sweden should be taken into account:

- It contributes to strengthen the quality of education.
- International cooperation may contribute to acquire new perspectives in higher education.
- The internationalization of higher education also contributes to the promotion of understanding and respect for other manners, cultures and traditions, as well as for international solidarity.
- The education politics within the European Union has clearly become a part of the work towards a sustainable growth, more numbers of vacant jobs and an increased social unity.

It is also worth mentioning that according to the Swedish Higher Education Law, “The universities should in their activities promote understanding for other countries and for the international relations” [2]. There are, of course, other reasons behind the globalization and internationalization of higher education; some of them belong to such a noble feeling as the statement “Globalization has also opened a window on cosmopolitanism for universities, which have been too imprisoned in their national context. One of the logics of globalization –democratization– has been an important dimension to the extension of higher education world-wide” [3]. Other further reasons for globalization are, of course, the global market, international finances, and macro economy.

Different types of EU-funded projects providing economical support for the exchange of students and teachers, either inside or outside the member states of the European Union, has contributed to the internationalization of higher education by encouraging English as a teaching language. Such policies have allowed the mobility of students from less wealthy countries.

1.1. English as instruction language

Rather than explaining the purposes behind the internationalisation of higher education, the main aim of this article is to present a set of personal experiences encountered along the process of shifting the instruction language, from Swedish to English, in Machine Design courses given for a bachelor degree in Mechanical Engineering. Since English is the main international communication language of today, it plays one of the most fundamental roles in internationalization.
However, shifting from one language to another is not an easy task. It needs long-time preparations and overcoming initial difficulties at the beginning of the process.

The homogenization of the European higher education system through the Bologna agreement, in combination with European mobility exchange programs like Erasmus, have greatly contributed to the internationalization of higher education, and consequently to shift teaching from national languages to English in many colleges and universities around Europe. It is quite natural and helpful for the students to use a common teaching language in exchange programs as well as to educate future engineers for the European (and international) labour market.

This paper was originally motivated by a debate article in the magazine “Univesitiesläraren”, published by the Swedish University Teacher Union [4]. The author of the article states that teaching efficiency in Swedish higher education when teaching in English is about 70% of that achieved when teaching in Swedish. The reasons for that, according to Regnéll, rest in the fact that instructors and students generally possess a better command of Swedish than English. My own experiences are in total agreement; my teaching efficiency diminishes when the teaching language changes from Swedish to English. Unfortunately, the author does not explain how a teaching efficiency of 70% was measured. According to my own experience, it is not possible to quantify teaching efficiency with a plain number. Another side effect of teaching in English is that the discourse becomes less colourful, as English vocabulary is often more limited for non-natives. Some of the students involved in English-taught lectures face serious communication problems with the course instructor, especially during the lectures, although most of the students become familiar with English after attending several courses in English. There are also some communication difficulties in the beginning of the courses between program and exchange students. This is caused by the appearance of strong accents and incorrect grammatical uses, but these kind of problems are usually temporary.

The discussion so far has focused on the language itself, but in order to change the language of instruction in a regular engineering course, the basic literature for the course must also be changed to English. An essential problem to account for in the field of engineering is the application of technical standards. Course references in national languages are usually based on national standards. For example, the Swedish Standard for dimensioning and design gears [5] is significantly different from the American Standard AGMA (American Gear Manufacturers Association) [6]. Most of the English literature in the field of machine design/engineering elements has been published in the USA, and obviously based on American standards.

Since the driving force to adopt English as teaching language is the attraction of exchange students and free movers to the courses, there will normally be a mix of students from different backgrounds and teaching traditions. There exist significant differences in educational systems from country to country, and sometimes from institution to institution. For example, there are exchange students who have never worked in group projects in their home institution, and therefore may find initial difficulties to cooperate with other students in project-based courses. This problem has been further discussed in a different conference paper [7]. In addition to all the obstacles encountered in the process of changing the language of instruction into English, it is very necessary to deliver some courses in English in each higher education program. That is partly to facilitate the exchange of students and teachers, and partly to give a chance to those students not participating in exchange programs to receive some teaching in English and come in contact with international students. This is called “Internationalization at home” [2].

Overall, the advantages of student exchange programs are of greater value than the disadvantages of changing the instruction language of courses. There are always changes of paradigms in higher education, and both students and instructors usually need to face problems and consider new possibilities. It is very important to focus on the new opportunities offered and find solutions to the problems encountered rather than grappling on difficulties. The following sections describe several solutions to the problems encountered when changing the language of instruction from Swedish to English in machine design courses.

2. TEACHING MACHINE DESIGN IN ENGLISH

It is not encouraging to change the language of course instruction when you have taught your courses in your native language for many years, especially if you have gathered useful textbooks, good lecturing material, and the appropriate exercises with solutions. To change the teaching language in a situation like this, it is necessary either an order directly sent from the top of the organization, or a strong interest and enthusiasm to find the energy to start the entire procedure of shifting the course language. In my case, the latter reason was the true one. The multiple possibilities of teaching abroad through the Erasmus and other exchange programs were a good drive to teach in English. After participating in a number of teaching exchanges, there was enough material developed to switch the teaching language of one of my traditional engineering courses, in this case Machine Design II. After that experience in which the course was taught several times, a teaching model called “Teaching in action” was developed. “Teaching in action” is a phrase used here as shorthand for the observable activities related to these ways of thinking that may be described as teaching in higher education—such as relationships with students, the time devoted to preparation and course development, marking and feedback, evaluation of one’s performance, and so on [8], as depicted in figure 1.

![Figure 1. Teaching model for higher education][1]

2.1. Machine Design II

The specific contents of Machine Design II at Linnaeus University are: gears and gear transmissions, belt transmissions, chain transmission, rolling element bearings, shafts, and seals and other related parts. The course is a combination of project-based and lecture-based teaching, which in practice means that students have to undertake a transmission project, usually a combination drive as that shown in figure 2. The project is the core of the course, but a big

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[1]: https://example.com/figure1.png
number of lectures introducing the fundamentals of machine design are planned to help the students with the projects.

A compendium of Swedish standards, company catalogues, and other sources of practical data was especially prepared to be used in parallel with the recommended course textbook (figure 3). The materials included in the compendium mentioned above are not fully complete; the idea is to enlarge it with the material given during the lectures. To avoid copying cumbersome equations from the blackboard, the lecturer uses a collection of slides included in the students’ compendium. These slides are incomplete to allow the lecturer filling them up along the lecture explanations.

Figure 2. A combination drive used as a class project in Machine Design II.

Figure 3. Different folders comprising the class compendium for Machine Design II.

The experience accumulated over the past years proves that this method has been very successful because of the following reasons:

- The supporting material presented in the slides has resulted very helpful for teaching in English.
- The especially prepared (but not completed) figures and texts on the slides save a lot of time and hence improve the teaching efficiency when changing the teaching language to English.
- The need of completing the lecture materials during each session makes the students become active during the lectures. This leads to significant differences with slide presentations where everything is prepared beforehand and the students only have to listen to the lecturer (passive situation). Bonwell and Eison (1991) provide a definition of active learning as “anything that involves students in doing things and thinking about the things they are doing” [9].
- Students know exactly what they have missed when they are absent from one or a number of lectures. They can easily catch up with the help of their classmates and the material provided in the compendium.

Figure 4 shows an example of an incomplete drawing included in the gear compendia. The schematic on the left side consists of various figures without any explanation or label. The right-side version has been completed during the lecture and therefore includes explanations and mathematical equations. This procedure is an effective way to explain the mathematical background of the equations of rolling circles, mainly when compared with the straight application of the equations of pitch circles in gears.

Figure 4. Incomplete (left) and completed (right) page from the gear compendium.


Encouraged by the successful results of teaching Machine Design II (MD II) in English, and motivated by the positive response of the students measured through course evaluations, two new courses in mechanical engineering were adapted to English: Machine Design I (MD I) and Machine Design III (MD III). Apart from the improvement of the instructor’s skills as a consequence of teaching MD II in English, the opportunity of teaching abroad given by exchange programs helped in the preparation of the material for the new courses. The philosophy followed in the design of the new courses was exactly the same used in MD II, therefore lecture notes were distributed in compendia and completed in class according to the instructor directions. MD I contains the fundamentals of Machine Design and does not depend on technical standards in the way MD II does; therefore, less extra material is required to complement the class textbook. Yet, the same teaching methodology based on carefully prepared, uncompleted transparencies, is used during the lectures. This approach turned out to be a successful and efficient method to transmit the basics of machine design. This elementary course is based on lectures and exercises in parallel with a small industrial project, with a final exam at the end of the course. A generic handbook covering fundamental information of machine design (equations, tables, diagrams, etc.) has been developed to be used in the three MD courses during the exams and design projects. Figure 5 shows the course textbook, lecture notes, and the handbook used in Machine Design I.

Figure 5. Textbook, lecture notes and handbook for MD I.
The theoretical part of the course Machine Design III is prepared and accomplished in the same way as MD I. Besides theory, exercises, and exams, there is a machine design project to be carried out by the students working in groups. The project contains a theoretical part where dimensioning and design is required, and a practical part where the previously designed and calculated objects are actually manufactured according to the proposed design. This activity trains the students on new ways of thinking where the whole process of creating a product is considered, from planning and design to manufacturing and testing.

Eventually, all the students get used to technical English, especially keywords used in the area of machine design, through the three courses developed. However, given that the majority of Mechanical Engineering courses are taught in Swedish, students do not get used to English terms in the field of manufacturing and production, and as a result they end up facing communication problems when working with MD III projects. They typically ignore the English names of basic tools, machines, and processes, which in the end results in communication difficulties with group members and technicians. Overall, these linguistic problems do not lead to serious consequences, and the majority of the students manage their projects very well. Figure 6 shows the results of one of MD III projects, where the commanded task was the design and manufacture of novel types of Human Powered Vehicles (HPV).

![Figure 6. Example of projects for MD III.](image)

3. CONCLUSION

As shown in this paper, switching the course instruction language from native languages to English is not a trivial task, especially when lecturers do not have previous experience teaching or studying in English. Teaching quality and delivery efficiency not only depend on the linguistic skills of lecturers; they are also influenced by the comprehensive ability of the students. Due to the fact that English-taught classes typically comprise exchange students from different countries and continents, oral skills and English pronunciation are very variable. A relevant fact that has not been mentioned so far is that students attending certain subjects in English necessarily miss the corresponding terminology in their own language. In addition, more time is required to study a text in English than that needed to cover the same material in the own language.

In spite of all the difficulties faced up and the time demands involved in English teaching, both instructors and students highly benefit from such a rewarding experience, and consequently it is definitely recommended to teach some courses in English within engineering programs. On the whole, the benefits and advantages are much higher than the disadvantages. Furthermore, in addition to all the advantages mentioned above, English courses tend to attract students from the entire world, which results in economical benefits for universities as a result of fee-paying visitors.

There are many ways to start the process of changing course instruction languages to English. A smooth way to do it is by participating in teaching exchange programs. Hopefully, the experiences presented in this article will encourage and help professors and lecturers to switch their teaching to English.

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5. REFERENCES

THE INTEGRATION OF ENGINEERING AND BUSINESS EDUCATION IN A GLOBAL-NETWORK UNIVERSITY

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ABSTRACT: New York University characterizes itself as a global-network university. It currently offers (or soon will) engineering and business/management curricula leading to baccalaureate degrees on campuses in New York, Abu Dhabi and Shanghai. The programs are designed to be interoperable, i.e., students (and faculty) can move from campus to campus while staying on track in their particular course of study. This objective of interoperability raises interesting issues regarding the internationalization of engineering and technical education. Additionally, at Abu Dhabi and Shanghai, the engineering and business management programs are tightly integrated with classical, western liberal arts education. This paper will explore the variety of educational and philosophical issues of this approach. The paper will offer a favourable assessment of the approach while acknowledging the profound challenges it entails.

Key words: global-network university, interoperability, engineering, business education

1. INTRODUCTION

Foreign exchange programs, for both educational and research purposes, have for a long time been important to the mission of universities. Yet in the current era of rapid globalization international collaboration has frequently been seen as an imperative, essential to universities that wish to maintain their rank in the upper tiers of teaching and research institutions, only thus being able to garner the strongest students and the most financial support. The endeavour has taken many forms and has been subject to strong criticism. International collaboration is sometimes seen as leading to a dilution of core activities, diverting limited budgets that could better used for new laboratories and equipment or higher faculty salaries. In the United States and Europe questions of academic freedom and educational purpose and freedom of expression (speech and behaviour) are raised by faculty concerned about the impact on academic standards, especially where collaboration leads into regions of the world where strong cultural and political traditions challenge the dominant values of the West. Questions of this latter sort are generally raised in the context of liberal arts education. Certainly this has been the case for both Yale and NYU, two prominent American universities opening full service campuses abroad. While not questioning the importance and relevance of academic freedom and freedom of expression in general and within engineering education, some other issues seem to be explicitly problematic in the context of the liberal arts curriculum. For example, Should Augustine’s Confessions or Rousseau’s theory of the state of nature and the social contract be taught as part of a global educational core? Many might question the importance, centrality or even appropriateness of teaching either of these texts in the Asian division of an American university. But would similar reservations be expressed about teaching thermodynamics or fluid mechanics within the science or engineering programs? To frame the controversy more generically, consider whether engineering education is easily transferred from one global setting to another? Is engineering a universal discipline where cultural differences make no difference? Is technology a universal good available equally to all those who possess the requisite skills? The question has two sides: on the one hand can Western engineering programs be replanted abroad and be just as accessible and beneficial to its new constituency as it is to those it serves at home? And on the other does the global or international resituating add specific value to the program (beyond the general benefits for students of travel and broad life experience)? This presentation will focus on the implications of the growing internationalization of universities for engineering education. If an engineering curriculum is interoperable, that is if students can move freely from one campus to another and remain on track, what restraints or advantages does this freedom provide? Are the issues of academic freedom and freedom of expression different for engineering than for any other division of the university?

2. THE ENGINEERING CURRICULUM

Many words have been uttered, committees formed and battle lines drawn over the issue of just what the undergraduate engineering curriculum should include. Everybody agrees on some points, for example that mathematics, natural science and design are all essential but the consensus does not begin to answer questions about how much, what type, when, what level, etc. ABET standards are often invoked, but ABET demands explanations, justifications and assessment of results rather than compliance with a single standard or approach. In recent years ABET and the U.S. National Academy of Engineering have endorsed multiple approaches to engineering education born of the recognition that engineers are needed to perform an ever widening set of tasks and no single preparation can suit them all. The problem is compounded because the quality and depth of pre-university competence in the STEM disciplines varies widely and anecdotally is currently in a period of decline. In the international context the difficulties are again exacerbated: Chinese students routinely out perform their American peers when it comes to mathematics, for example. But is the content or the list of specific topics taught, what makes engineering education what it is? It’s reasonably
clear that mathematicians and scientists work quite differently than engineers do; their goals are different as are the ways they construct problems and likewise generally speaking their work styles are unlike those of engineers. We remember that engineering is not a single discipline and its objective is not epistemic clarity. Engineering is as much a humanistic endeavour as a scientific one and its guiding philosophy is pragmatism. What does this mean? Engineering is perhaps best characterized as a practice. As such it has agreed upon protocols, procedures, behaviours all in the service of defined ends. The ends of engineering practice are diverse but determined by society or some subset of society. Engineering is a practice in the service of society regarding material structures and devices. The responsibilities of engineers fall under the four broad categories of conceive, design, implement and operate. These categories, identified by the CDIO movement, point out clearly the diversity of engineering activity and include what society expects from engineers from invention and innovation, to the operation of complex machinery, safety assurance and maintenance. How can an educational program prepare engineers for this kind of diverse and critical practice? While there is little doubt that engineers should be well educated and thus introduced to fields and disciplines outside of engineering per se, it is important to recognize both that the learning objectives inherent in the other disciplines are quite different from those of engineering education and that engineering students are likely to approach their non-engineering work in distinctive ways and with alternative expectations from their peers in the arts and sciences. What are the differences? Perhaps engineering would share more with professional training programs such as law or medicine, but the context of this discussion is within the scope of undergraduate education at an American university (regardless of geographical location). Within this paradigm certain generalizations are valid: the sciences, natural and social, seek to preserve, validate and discover knowledge, i.e., verifiable truth; the humanities explore self and society from a reflective subjective point of view as well as refine human sensibilities; the fine arts develop technical skills for making and performing; theoretical mathematics is a science while applied mathematics is much like the fine arts. Some disciplines, history for example, can be considered both one of the humanities or a science dependent upon the approach. The interesting thing is that, apart from honesty, these academic disciplines do not invoke a strong sense of responsibility. Engineering, on the contrary, carries with it a great many responsibilities among which may be numbered many of crucial importance for the well being of humankind. With this understanding it is clear that the content presented in an engineering program, such as the laws of thermodynamics, the tensile strength of various materials, and other elements of engineering knowledge, does not comprise the essential character of engineering education. In fact one may go so far as to say that mastery of this kind of knowledge is insufficient to make one an engineer. What is the sine qua non of engineering education, that which must be implemented successfully regardless of other features of the curriculum? For lack of better terminology call this necessary component of an engineering program the development of responsibility. For the development of responsibility to be at the heart of engineering education several questions must be answered. The first obviously is responsibility for what? With the exception of a major problem area (to be addressed below) this can be answered fairly simply in keeping with the CDIO categories. The second invokes the age-old philosophical dilemma of whether virtue can be taught. Begin with the second consideration. The famous Socratic inquiry put forth in Plato’s Meno makes the issue clear. Virtue or excellence is not knowledge and the ability to name it or describe it is not equivalent to possessing it or being virtuous. Aristotle recognized that virtue is attained through practice and the inculcation of good habits. Moreover there is a certain unavoidable variability: there is not only and always just one right way to perform a task. So it is with engineering responsibility. Following Aristotle one will argue that the inculcation of those good habits that characterize the excellent and responsible practice of engineering result from the dedicated guidance of an experienced mentor. Thus the first requirement for an engineering program is a curricular structure that includes a significant mentoring component along with the presence of appropriate mentors. The next section will discuss the implications of this for an international engineering educational program. Before that attention will be given to the question of responsibility for what? Some types of engineering responsibility should be obvious, although they may be difficult to make operational. Safety issues and the reliability of devices are examples. The integrity of design goes along with this. However in the area of engineering creativity, innovation and invention, the meaning of responsibility is far from clear. The creation of something new, device or process, resulting from study and experimentation, establishes a kind of responsibility just as parenting a child implies future responsibility. But natality is renewal whereas engineering creativity introduces into the world devices and processes that may not have existed before and which may alter radically and irreversibly the fundamental order of things. Thus while the responsibility for a child extends to caring for the child, to be sure on terms that vary according to cultural norms, the responsibility engendered by the creation of a world-altering device entails care for the world more than the device. In some cases bringing a device into the world may create responsibilities for the world that cannot be fulfilled. Many have argued that the creation of the first atomic bomb was precisely such a instance. What kind of responsibility is this for the future? If the future horizon in question is far distant then the ability to estimate the likely consequences attending the introduction of a new device is diminished significantly. If the consequences are unintended or unanticipated, which to some extent they most surely will be, then whatever responsible care is possible will be ad hoc and on the fly. If the impact is adverse or deleterious and as may well be the case irreversible then the very idea of responsible care dissolves. This is the risk of engineering and the hope that benefit will outweigh adversity is a bet society asks engineers to make every day. This bears directly on the topic of the internationalization of engineering education. Is the bet one society is willing to place the same as that of another? Social risk analysis is derived from perceptions of needs. The risks of hydraulic fracturing are measured against the perceived need for new sources of energy; the risks of ever growing energy consumption are assessed on the basis of how important certain amenities (such as private cars, air conditioning, and more) are considered to be. The list is long and complex, laden with subjective values, and different from society to society. Considering the responsibilities of engineering together with the general mission of higher education to benefit the societies it serves it is clear that programs to educate engineers must be cognizant of the social structures and values of the cultural communities in which they operate. Clearly this is a matter of importance in curricular design, but it is at least as important on the plane of research when considering the connection of the engineering school to the other divisions of the university and to the variety
of agencies and organizations outside of university governance with which it will deal regularly. The term ivory tower does not apply to engineering schools. Their connection to the world in which they operate is not merely the conduit of students who enrol to return as graduates to work in their society. Engineering schools are connected to the larger society through commerce and industry, governmental agencies and NGO’s and various individual consultancies. The objective of engineering practice is not pure, abstract truth but rather programs and devices that function well and serve human and social need.

3. RESPONSIBILITY OF AN ENGINEERING SCHOOL IN A FOREIGN SETTING

With these considerations in mind what specifically is the role of an engineering school that is part of a university’s international activities operating abroad? Many of the normative operating standards will need to be revised. The relationship to government agencies is an obvious example. To answer this question two recent international experiments currently underway by NYU will be used as examples.

New York University, one of the world’s largest private universities, is a highly ranked research institution with highly regarded programs in law, medicine, business management, education and the arts and sciences. It is also home to the Brooklyn Polytechnic Institute, one of the United States’ oldest and most revered engineering schools. Like most American universities it has in recent years developed an extensive array of study abroad programs that permit students to have a meaningful international experience without interrupting their education. To serve these programs NYU has established numerous international sites around the world (in Europe alone NYU has such sites in Berlin, Florence, London, Madrid, Paris and Prague) where students and faculty from New York fruitfully spend a semester or two. In these cases the model is straightforward: students study abroad to learn from and otherwise be enriched by the host culture. As a matter of practice, the participation of engineering is such programs is limited as it is difficult to muster a sufficient complement of the required technical courses to serve the needs of engineering students.

The commitment of NYU to internationalization now goes well beyond this traditional type of program. Branding itself as the global network university NYU is now creating replications of itself in far-flung venues. The first two of these semi-autonomous versions of the university are NYU-Abu Dhabi and NYU-Shanghai. The former is in its third year of operation and the latter is scheduled to open in the fall of 2013. Since both of these campuses include engineering among their offerings attention will be directed to them. Although a stated objective is for the programs at NYUAD and NYU-Shanghai to be interoperable courses offered and the requirements for graduation are not the same at the two international campuses nor are they equivalent to those at NYU-Polytechnic.

In establishing the university at each location, Abu Dhabi and Shanghai, specific local expectations had to be addressed and resolved in a manner acceptable to both the university and the host country. As one would expect the relationship in each case is unique, the result of lengthy negotiations.

In Abu Dhabi the university is largely funded (including facilities, operations, student tuition, etc.) from the UAE sovereign wealth fund. Sceptics have feared that this funding arrangement confers inappropriate and excessive influence on the Abu Dhabi royalty behind the largess. While NYU maintains that proper regard for academic freedom, the independence of academic standards and proper respect and freedom for members of the university community (concerns were raised about the rights of women, gays, Israelis, among others) has been guaranteed – and apparently there has been no conflict to date, the financial dependence of the university upon agents of a belief system quite heterodox to that of a modern western institution remains a matter for ongoing vigilance.

NYU-Shanghai is not the benefactor of such comprehensive financial support, although Chinese authorities have granted some public funding and the provision of land for the campus. In return for the permission to operate in China arrangements have been made to assure compliance with the standards of the governing ministry of education. These include a partnership with a Chinese university (ECNU), approval in general terms of the curriculum by the MOE, and the requirement that 51% of the students be Chinese nationals. Planning is still underway and one assumes that matters of academic freedom and human rights will be articulated in a manner consistent with western standards.

So to begin with, in both examples, NYU strives to guarantee and protect academic and civil standards, norms and priorities consistent with those of an American university. Nevertheless, in both cases, the university was invited to set up shop (and receive some support for doing so) on foreign soil because of the expectations of the benefits it would bring to the host. What, generally speaking, were these expectations?

Not surprisingly key among the expectations and stated purposes behind the interest in inducing an American research university to establish a presence both in Abu Dhabi and Shanghai was the understanding that scientific and technological expertise would represent a significant portion of the university’s intellectual assets and that they would be a source of great benefit to the host country. In other words, the establishment of the university was to be a vehicle of technology transfer. This reasoning puts engineering, especially with its current proclivities toward innovation and invention, at the very heart of the university.

This realization underscores the importance of engineering responsibility and the difficulty of the wager engineers routinely make with society regarding the introduction of new devices and processes. How, in the particular instances of Abu Dhabi and Shanghai with the presence of an American university with engineering at its heart, is that wager to be played?

As an aside it should be noted that to all appearances NYU does not see engineering at its centre, neither in New York nor on its global campuses. That this may have an impact on the future standing of NYU in Abu Dhabi and Shanghai is another item for continuing observation.

But with regard to the responsibilities of engineers and programs teaching engineering in diverse cultures and polities the first question must include a reflection on whether there is any barrier, based on politics or social/cultural customs and traditions, to the practice of engineering in a way that aims to support the common good and the future of all humankind. Projects that can be seen to bring advantage only to a particular group, especially when such advantage may be at the expense of another group, should be eschewed. A word of clarification is required here. Most projects directly and immediately benefit only a specific group or only address a specific problem in a particular place. But such projects may not need to be avoided
if they are applications of a generally beneficial technology that with modification can be deployed elsewhere. For example, in the Abu Dhabi area there are many potential engineering projects related to the region’s water management problems. Desalination techniques, while of urgent importance in the UAE, can be of benefit globally. And although the proximate beneficiaries may be only a subset of the UAE population, the nature of the project does not imply a restricted good. And a project with this immediate scope may well promote other universally beneficial technologies. Since current desalination technology depends upon heavy energy consumption an efficiency engineers might strive for would be to lower that requirement. Thus it should be clear in most cases how engineering projects can be of likely benefit to all humankind for the long term.

This should be a governing principle of engineering schools. The United States’ National Academy of Engineering has promulgated a list denoted as the Grand Challenges that identifies a number of generic projects that are crucially important globally in the current era. This list or something similar could provide the foundation for the role of an engineering school that has been transplanted to a university’s international location.

To embrace the thinking behind the Grand Challenges represents a commitment to engineering responsibility. This kind of responsibility, grounded in amor mundi, may not however always satisfy commercial interests, nor yield new products to be brought to market. It is sometimes said that technology is the handmaiden to capitalism. Is engineering innovation prompted only by the lusts of the free market? How does responsible engineering relate to the worlds of business and entrepreneurship?

4. ENGINEERING AND BUSINESS EDUCATION

Modern engineering has often been the discipline that enabled the realization of the goals of other agencies, for example the military. These days with the unrelenting emphasis on entrepreneurship engineering is most often connected to business enterprise. In the world of business the watchword likewise is entrepreneurship and that generally implies technology. Of course engineering, as already discussed, should not be reduced to technology, but it is the place where entrepreneurship engineering is most often connected to business enterprise. In the world of business the watchword likewise is entrepreneurship and that generally implies technology. Of course engineering, as already discussed, should not be reduced to technology, but it is the place where business typically meets engineering.

At the risk of gratuitous oversimplification it is noted that business is for the sake of making money. One needn’t be a free-market capitalist nor subscribe to Milton Friedman’s view to agree with this proposition. Friedman argues, in his well-known essay entitled straightforwardly “The Social Responsibility of Business is to Increase its Profits,” that business should not adulterate its only purpose (which is to benefit its owners and shareholders) by taking on an agenda of social responsibilities. But for the sake of argument consider this position to be mainstream business economics. In that case engineering stands as a very different form of human activity. As argued above matters of social responsibility are intrinsic to engineering practice. If business is to eschew such concerns then it is likely that any appropriation of engineering technology by business enterprise will tend to distort or limit the best practice of engineering.

Of course in contexts where business and the public interest are closely integrated, as they allegedly are both in China and the UAE – although with different models and divergent views of the public interest – businesses may claim specific social or public responsibilities. But it is still the case that businesses strive to succeed on business terms, which means social responsibility makes sense only when it makes money. Thus it seems inevitable that engineering will stand in an antithetical relation to business enterprise under most if not all economic-political systems.

So in a university that has been established abroad, often invited on the putative grounds that it will bring benefit by stimulating the economy through the introduction of new technology, what should the relation be between engineering and business education?

Perhaps there should be no particular relationship at all. Accidental or ad hoc collaborations should not be prohibited, but the systematic coordination of business and engineering education should be avoided. Some clarification to avoid possible misunderstanding is in order. Ideally students in enrolled either in engineering or business programs will have some curricular overlaps and commonalities. Communications and mathematics courses, for example, may suit both programs equally well. But these courses are neither engineering nor business courses as such and should enrol students from diverse other programs as well. General education, if that term can be used, serves to introduce students to norms outside their specific disciplines and promotes common discourse across disciplines. For this reason these courses should not be taken over by any division, i.e., engineering or business programs, where they would be moulded to the prevailing ideology of the discipline.

What should not happen is to combine the intellectual or any other mission of engineering or business education programs. Universities have an obligation to be pluralistic in the sense that multiple and even conflicting points of view are given opportunity to flourish. This indeed underlies the true spirit of interdisciplinarity, which may be the most important condition for innovation.

This approach is likely in full accord with Friedman’s dictum without either endorsing or repudiating his larger economic philosophy.

5. CONCLUSION

This has been an argument for the importance of engineering and the autonomy and nobility of engineering education. The approach, purpose and standards of engineering education both differentiate it from the other apartments in the house of intellect as well as encourage its companionship with them. In the internationalized university there should be no difference in this respect from the values on the home campus. The nature of the friendship between engineering and the liberal arts in a university that has made its abode in a culture that does not naturally reflect or extend enlightenment values may be, because of the nature of engineering’s forays into the host society, to help establish the basis for a new enlightened discourse on the crucial issues of what humanity most needs. Business or management programs might do the same, but for engineering it is an integral part of its essential purpose.
ABSTRACT: This work is based on experiential learning theory that integrates “learning by doing” into every step of the learning process. It combines diverse teaching and learning strategies in a single platform to suit different learning styles. The combined strategy is designed to meet the following objectives:

• To enhance student comprehension of the OOP concepts.
• To stimulate deep thinking and enhance students’ capabilities in transferring what they have learnt to new situations so that the transfer of learning takes place.
• To develop and foster independent learning in which students develop the ability to discover and reconstruct knowledge by themselves.

This work demonstrates how the new method is applied to one of the sessions in OOP.

Key words: Experiential Learning, learning by doing, self-assessment.

1. THE CURRENT SITUATION

The module under consideration is a third year module, taught to students following the ESD (Engineering Systems Design) program. This module is a 10 credit module, during which students will learn the principles of object oriented programming and how to write efficient maintainable programs using the C++ language. The module is taught in a conventional classical way where theory session is separated from the practical session. Many students suffered from difficulties in understanding this module which was reflected on their final results. This work is going to address the reasons behind these issues and investigate a new approach to tackle these problems.

2. DEFINING THE ‘PROBLEM’

In order to identify the main issues which hinder the students’ understanding, a questionnaire was prepared to collect general information about motivation of the students to take the module, to assess students general knowledge of the basic concepts of programming, and to identify the most common problems experienced during their previous learning. After analysing the questionnaire’s response, a direct discussion was held with the students to discuss the main issues. The main issues are summarised as follows:

• Poor prior knowledge of programming techniques.
• Insufficient level of programming in C language which they covered during the first year.
• One-year gap in developing their skills in programming; OOP was given in the third year and no high level programming being taught during the second year.
• Some technical problems did not allow them to exercise with the C compiler.
• Lack of motivation; students had no idea how to link programming using OOP to their studies and real life.
• Homework and continuous assessment were not included within the grading scheme. This discouraged them from attempting regular practical programming activities.

3. EXPERIENTIAL LEARNING (LEARNING BY DOING)

Normally, courses are described as either practical or theoretical. Courses which contain both elements tend to be sharply divided (Neary, 2000). An academic lecturer may present theory in a lecture in the classroom whilst a practical supervisor is in charge of the follow-up practical experience in a workshop. It is common for both types of course to have limited success. Learning cannot be achieved with experience only, reflecting on experience is essential (Carrillo, 2002). Reflection will generate concepts and generalisations. With these generalisations, new situations can be tackled effectively. New learning and developed concepts should be also tested in new situations. A link must be made between theory and action by planning for that action, carrying it out, and then reflecting upon it, relating what happens back to the theory. Learning from experience must involve links between the doing and the thinking (Kolb, 1984). It is the direct result of the learners’ participation in events. Experiential learning can be achieved as a direct result of the learners’ participation in events (Cowan, 1998). Fig. 1 shows the four-stage model of learning by doing (experiential learning) (Petty, 2009).
IMPLEMENTING THE EXPERIENTIAL LEARNING CYCLE

For each phase of the experiential learning cycle there are practical learning and teaching methods which are described as follows:

A. Planning for experience
The methods of this phase are aimed to prepare learners prior to experiences for example through action planning and the negotiation of learning contracts.

B. Increasing awareness of experience
During this phase methods are aimed to heighten learners’ awareness of their experiences so that they notice more and have more material upon which to reflect afterwards (e.g. through the use of log books).

C. Reviewing and reflecting upon experience
This phase is concerned with the learning points that can be drawn out through structured reflection on the learning experiences (through the use of video recordings and self-assessment).

D. Providing substitute experiences
This phase is concerned with ways of providing classroom-based experiences as substitutes for work or other experience (through the use of role-plays).

5. THE CLASSICAL PRACTICAL APPROACH IN TEACHING OOP

A classical practical session is carried out throughout the following stages:

1. Basic principles are demonstrated by the tutor.
2. Students attempt to write a program implementing the principles of OOP, under supervision.
3. Feedback and comments from the tutor are given to the students who finished their programs.

The main problems with this approach, as observed, are:

- Lack of attention during the demonstration.
- It takes relatively a long time to write a program, some of them fail to write a complete program.
- Despite the full explanation at the beginning of the session, the tutor has to repeat the same notes again and again.
- Most of the written programs have poor standards.
- Students give no reflection about the quality of their programs. They leave it to the tutor to identify the weakness and strength of their programs.

6. THE NEW PRACTICAL APPROACH USING EXPERIENTIAL LEARNING

According to the experiential learning theory the reasons behind the problems in the classical method are as follows:

- Students have not planned for their work and have not established the way to judge their work.
- No reflection and assessment done by the students.
- No opportunity to go round the learning cycle a second time to correct mistakes.
- Students have no active role and responsibility in the learning process.

In order to tackle the above-mentioned issues, the following approach was introduced:

1. Background
Students were asked to develop a database program using the principles of OOP. During the first phase the tutor started to demonstrate the basic principles of a database system, he described the different functions of the database management program and the different files required for the application. The concepts of OOP and how to apply them in developing the program were also explained. At the end of this phase students were split in groups, three or less in each group.

2. Assessment Criteria
The second phase was related to the assessment criteria of the program. The main players were the students with the help of the tutor. The main criteria were set and defined as follows:

    In relation to the program:
    - The program should be modular.
    - The program should function properly.
    - The principles of OOP must be implemented.

    In relation to the documentation:
    - Algorithms should be well described.
    - Proper UML diagrams should be provided.
    - A testing procedure should be included.

3. Writing Program
The third phase was writing the program. The students were in need for the tutor to give them help in debugging the program.

4. Evaluation
During the fourth phase students started to check their programs against the six assessment criteria defined in phase two and short reports with their reflections were submitted with their programs.

5. Discussion
In the fifth phase, a discussion was held between the tutor and the students to investigate the different methods for improving their programs and check their level of understanding. If level
was not achieved, new tasks and new program modifications were agreed and another cycle might begin starting at phase three, if understanding is acceptable, then the assignment is fulfilled and the learning cycle will end.

The total amount of time allowed for the assignment was seven weeks. Fig. 2 shows the flow of the different phases within the session.

![Diagram of the different phases within the session]

**Figure 2.** The flow of the different phases within the session

The main features of this session in terms of experiential learning theory can be summarised as follows:

The students started with the theory (Conceptualisation), then they developed an assessment criteria and related theory to practice (Experimentation), followed by writing and running a program (Experience), then analysing and assessing the outcome of their programs (Reflection). Based on their assessment, new ideas will come out (Conceptualisation), and a new cycle will start over until the required level of understanding is achieved.

7. ASSESSMENT

The assessment of this intervention is based on questionnaire and observations. The questionnaire included the following few questions:

- I enjoyed doing the assignment.
  Disagree ◄ 1 2 3 4 5 ► Agree
  Result = 4.1
- The assignment helped me in better understanding the OOP concepts.
  Disagree ◄ 1 2 3 4 5 ► Agree
  Result = 4.4
- I got a good support from the tutor during the assignment
  Disagree ◄ 1 2 3 4 5 ► Agree
  Result = 4.5
- I found discussions with my peers helpful
  Disagree ◄ 1 2 3 4 5 ► Agree
  Result = 3.9
- The allocated time for the assignment was proper
  Disagree ◄ 1 2 3 4 5 ► Agree
  Result = 4.4
- Self assessment is helpful to develop my learning process
  Disagree ◄ 1 2 3 4 5 ► Agree
  Result = 4.0
- Any suggestions to improve the assignment!
  Some students came up with suggestions, mostly regarding the resources, asking for more reference books to be available in the library and how to get a free compiler to work on their assignment at home.

The tutor’s observations are summarised as follow:

- The students were more engaged with the demonstration during the lecture.
- The students started to take an active role in the learning process.
- The students started to make their own plans for learning.
- They started to reflect and make their self-assessment.
- They started to seek and learn new tools to debug their programs.
- More time for the tutor with less stress.
- The cyclic nature of the learning process created a better comprehension and understanding.
- Promoting responsibility improved their attendance.
- Students responded positively according to the questionnaire which followed the intervention.

8. CONCLUSIONS

This session has significantly changed the way how the assignments in OOP will be planned in the future. From the results mentioned in the last section, there is an achievement with regard to students’ understanding which was reflected on the quality of programs submitted during the assignment and the level they approached within the assignment period. On the other side, the lecturer is not under high pressure, since students are working, planning together taking responsibility of their understanding and the lecturer is there for guidance and supervision, not fully busy explaining and repeating the same material again and again to different groups. The self assessment practice practised by the students during the assessment phase motivated them to watch their level of understanding and make learning more attractive. This practice could be expanded and applied not even in OOP but in other subjects as well.

9. REFERENCES

ENGINEERING MANAGEMENT IN AN INTERDISCIPLINARY SENIOR DESIGN PROJECT

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ABSTRACT: Innovation in the changing undergraduate engineering curriculum mandates efficient management of interdisciplinary capstone senior design projects. This effort requires collaboration and management of students and faculty from multiple disciplines, and provides students an opportunity to learn from other engineering disciplines. In addition, this approach will i) emphasize problem solving and creative thinking skills; ii) provide students first-hand experience in generating a management plan; iii) expose students to multiple engineering disciplines, and work in diverse, multi-cultural teams; and iv) prepare students with an in-depth understanding of the interdisciplinary skills necessary for success. The senior design project (SDP) presented is based on the interdisciplinary collaboration of electrical, computer, and mechanical engineering students and faculty to design an integrated high altitude balloon system that would reach an altitude of 100,000 feet and return safely to earth. This paper presents methods by which all the above issues are addressed, results obtained over the recent years.

Key words: engineering management, senior design project, interdisciplinarity, HAB system.

1. INTRODUCTION

The rapid advancement in technology has laid a path for the design and manufacture of many integrated technologies. Simultaneously, these advancements have provided new avenues for the engineering educators to better prepare tomorrow’s global citizens through innovative methods capable of responding to the challenges of tomorrow [1]. One significant and innovative methodology that can be used to prepare future engineers is involving them in an interdisciplinary project that models professional collaboration. The High Altitude Balloon (HAB) system is one such platform, and it can be used in near-space region of earth’s atmosphere (about 85,000 to 100,000 ft above the sea level) for research in science, technology, engineering, and mathematics (STEM). The HAB system involves investigating a complex system with multiple engineering education and research elements, such as wireless communication; alternative energies, including fuel cell and solar radiation studies; control system design; data analysis for computing; payload material design; designing a balloon filling mechanism; flight path prediction and aerodynamics; wind data studies; shape memory composites; heat transfer analysis; and developing a self guidance system to a safe location.

Through working on this project, students delve into a complex engineering system that (1) exposes them to applied and cutting-edge design projects; (2) encourages them to participate in an integrated, inter-disciplinary curriculum that facilitates engagement by working across engineering disciplines; (3) involves them in methods of applied technology and skills necessary to transition from academic to professional environments. Major challenges in this project were formulation of design requirements; effective management of budget and resources; meeting stringent timelines; effective technical communication among inter-disciplinary team members for meeting the overall design goals; leadership skills; marketing strategies; and development of interpersonal skills to work as a team. This paper presents the various challenges of engineering management in this interdisciplinary platform, and presents solutions to these challenges.

2. INTERDISCIPLINARY TEAMS

The conventional senior design projects in the engineering curriculum limit the bounds to just one discipline and focus on improvement rather than innovation. A student-focused curriculum is required to address some of these limitations. Undergraduate education is a stimulation and nurture process where students are open and eager to learn new things. It is up to faculty mentors to provide opportunities to actively involve and guide the students. Engineering education, on one hand requires the adaptive grasping of basic theories, and on the other hand, emphasizes hands-on experiences, innovative ideas and creativity that meet societal needs. There is a genuine necessity to bridge the gap between theory and practice. A practical approach is to improve student participation in innovative design methods and education.

Two critical success factors for an engineer in the “flat-world” are their ability to adapt to changes, and be able to work at the interface of different disciplines [2]. In this “flat-world”[3], engineers and scientists need to constantly absorb and teach others new ways of doing old or new things, and mostly learn how to work well with others. By working with others, students: (a) obtain opportunities to experience a different domain; (b) combine knowledge and skills from different disciplines; (c) work as a team member; and (d) solve real-time research
problems. Also, interdisciplinary collaboration provides students with significant personal development opportunities [4].

ABET describes that engineering programs focus on theory, and engineering graduates spend their time planning, while technology programs focus on application and technology graduates spend their time making plans work [5]. Additionally, this platform is in accordance with the National Academy of Engineers recommendation that, “Engineering schools should introduce the interdisciplinary learning in the undergraduate environment, rather than having it as an exclusive feature of the graduate program” [1].

In addition, one primary advantage of interdisciplinary teams is that instead of each student team requiring initiation of a project from ground zero, they can work on the project based on a platform that has been set in stone previously. This provides ample time for the students to deal with integrated and complex projects, and have a deeper understanding of new concepts. Engineers recommendation that, “Engineering schools should introduce the interdisciplinary learning in the undergraduate environment, rather than having it as an exclusive feature of the graduate program” [1].

In addition, one primary advantage of interdisciplinary teams is that instead of each student team requiring initiation of a project from ground zero, they can work on the project based on a platform that has been set in stone previously. This provides ample time for the students to deal with integrated and complex projects, and have a deeper understanding of new concepts.

3. HAB SYSTEM

Studies indicate that it is important to focus on systematic, integrated technology research and design approaches such as a HAB system as an educational tool for undergraduate STEM curriculum [6]. By developing students' instruction around a laboratory setting, and using a systematic design and research approach throughout a project, students can fully conceptualize and understand an engineering system. This approach fosters student engagement and creativity by enabling them to learn science and engineering in a tangible context as opposed to simply a theoretical or computational modeling approach. This systematic research and design approach is in line with an engineering education movement that emphasizes integrated engineering curricula that challenges undergraduate students to form connections between current technological topics and their applicability to societal needs, as well as to envision future challenges in the engineering profession.

High altitude airborne platforms such as airplanes and unmanned aerial vehicles have presented huge advantages in the US military’s arsenal over the past several decades through environmental monitoring, precision navigation, communication, missile warning, and intelligence surveillance and reconnaissance (ISR) platforms. They have been used to provide a low cost, persistent sensor coverage option for tactical operations, and have great ground resolution. Conventional aircraft have a practical upper altitude limit (60000-80000 ft above the sea level), where engine efficiency greatly diminishes due to lower oxygen levels, causing internal-combustion, turbine engine failure. Also, there exists a region of the earth’s atmosphere (about 60000 ft above the sea level) that remains underutilized for Science Technology Engineering and Mathematics (STEM) research. High-altitude maneuvering lighter-than-air platforms such as HAB uses the principle of buoyancy to take advantage of this region and became potential platforms for ISR, precision navigation, environmental monitoring, communication relays, missile warning, and weapon delivery. These vehicles can provide persistent coverage over large areas of the earth’s surface with a substantially lower cost than an earth-orbiting satellite, while providing longer loiter times and larger ground footprints than conventional aircraft.

HAB systems have a fairly standard configuration involving a latex balloon, parachute, control box, and re-entry vehicle as in figure 1. The re-entry vehicle is a capsule that contains the tracking and communications equipment necessary for tracking and recovering the balloon system. It also contains cameras for recording images during flight and a microprocessor for operating the various sensors and systems onboard.

The HAB system allows a student to: (a) attain a higher level of competence in STEM; (b) understand the complex industry standards and methodologies for a design; (c) make judgments regarding technical and ethical matters pertaining to a design; and (d) communicate and work efficiently in a diverse research teams from different engineering backgrounds. The primary pedagogical objective of HAB platform is to inspire the students in research, design, and project management methodologies, e.g., problem identification, literature survey, critical thinking, problem formulation and solving (analysis, simulation, validation, data analysis, implementation, and empirical evaluation), communication skills, documentation, management of resources and budgets, keeping up with the deadlines, independence, collaboration, and participation in a diversity setting. Involvement in a student-focused integrated holistic program will help students to re-conceptualize their view of engineering in a context which addresses societal needs that are driven and influenced by the global market place for engineering services of the future [7]. The section below outlines some of the student projects using the HAB system.

Figure 1: High Altitude Balloon System
3.1 Sample Sensor Networks for Environmental Monitoring

In this project, students designed and prototyped an application running on wireless sensor networks for environmental monitoring and displaying the environmental data on the web, e.g., obtaining a temperature map of the sensor field. The application required execution with limited resources available on sensor nodes and robust to sensor failures. Students had to determine what data to transmit, as well as when and how often to transmit data to the base computer due to limitations in available bandwidth.

3.2 Software Design for Sensor Networks

As the application of wireless sensor networks for environmental monitoring and displaying the environmental data on the web is closely coupled with the physical network, an embedded system programming approach and computer language was used. Data collection software was developed and experimented on the sensor network. Also, a website that visualizes the environmental data, such as a temperature map, was developed so that the environmental conditions can be viewed in real-time from anywhere via the Internet.

3.3 Thermal and fluid dynamics of HAB System

According to NASA-Wallops research, there are many unknowns/uncertainties in finding thermo-fluids variables, including convection coefficient, radiation properties, and pressure variables etc., which are related to the HAB. As a result, a need exists for experiments to obtain information that would help to identify and solve the problems. One potential area includes data for the measured skin temperature and the temperature of the helium inside a balloon at high altitudes.

4. TEAM MENTORING AND MANAGEMENT

The HAB system team comprises of 4 to 6 undergraduates, one graduate student, and four faculty mentors with various research backgrounds spanning from computer, electrical, engineering education, industrial, materials, and mechanical engineering from different institutions. The role of these faculty mentors is multidimensional as their primary responsibilities involve the overall administration of the HAB program, and management of activities for the project. Due to the wide scope of their responsibilities, they need to be individuals with a unique set of skills and abilities that include broad knowledge of STEM fields and appreciation and valuing of diversity, so as to serve as “champions of change”[8]. These mentors have developed skills in interdisciplinary research and education, and also served as spokespersons for the program, emphasizing its focus on competence and its contribution to the advancement of engineering education.

These mentors are aware that that one key strategy in recruiting and retaining students in STEM disciplines is peer mentoring. Accordingly, students are required to participate in workshops/seminars while working on this project, and also learn about STEM issues to develop a good rapport with the professors and individuals from the industry. This helped towards a) enhanced communications skills in the students; b) increased knowledge of contemporary issues; c) increased ability to function in a multidisciplinary team; d) understanding professional and ethical responsibilities; f) networking to secure jobs and find mentors for their further career. This method provided a benefit to the participating faculty by enhancing their rapport with the industry to seek more projects.

There were multiple tasks that needed to be completed to make the project a success. The first step in the project was to assemble a team and brainstorm on the approaches and experiments to be performed. Some of the experiments proposed for the project were solar cell studies of voltage and current at high altitudes, guiding the payload to land in a desired location, achieving high bandwidth communication with the ground, obtaining temperature, pressure, and humidity measurements during flight, and taking pictures from the payload. A timeline was then set for the completion of tasks, and duties were assigned to team members. Once the group came to a consensus concerning the desired outcomes of the project, research began to determine the optimal process to follow. Each group designs and performs experiments and builds off of other groups’ successes and failures. This communication and sharing of information rather than being in strict competition allows future projects to evolve and to be more successful.

4.1 Project Timeline

At the beginning of the academic year, faculty mentors deliver a presentation on a few design projects that might be of interest to students. Students were given one week to choose from the existing project or design a new project. During this time, faculty and graduate students work closely with the seniors to help them identify a project that suits their interests and primarily, requirements from the industry. Throughout the duration of the program, students met the faculty mentors and graduate student once every week to discuss the progress and plan the week ahead. By the end of fall quarter, students complete a trial HAB system launch and present their preliminary findings and a time plan towards project completion. During the winter and spring quarters, students work on a specific topic of research. At the end of the spring quarter, the students gave their final presentation to fulfill their senior design project requirements.

4.2 Cultivating Ethics and Professional Standards

Through the HAB educational model, students learn the significance of making engineering decisions that are consistent with engineering design safety while maintaining the welfare of the public. In the HAB project, some problems that students encounter address ethical issues such as adherence to FAA regulations, management and selection of safe radio frequency range for communication, etc. Students were involved in a technical writing course to help them with their writing and publication of their HAB project. In this technical writing course, students discussed ethical issues such plagiarism, referencing and learning how to differentiate between their contribution and prior knowledge. The HAB students were also encouraged to take EGR 482: Engineering Fundamentals to prepare for the Engineer-In-Training (EIT) state exam (the first step towards becoming a licensed professional registered engineer). In this course, students learn the code of ethics for engineers as described by the National Society of Professional Engineers.
4.3 Leadership, Service Learning, and Civic Engagement Activities

The service learning and civic engagement component in a project must involve a relationship to the theory and practice of the academic discipline and student reflection through community outreach or service [9]. The service learning and civic engagement activities address the context within which engineering education must help students in addressing professional, geopolitical, economical; and societal needs in the future [10]. Some of the needs are diversity initiatives and role models in the STEM fields from the Wright STEPP pre-engineering program where majority of students come from underrepresented groups and disadvantaged backgrounds.

Relation to the theory and practice of STEM principles involved the participating students teaching HAB principles to the Wright STEPP pre-engineering program. One of the mini projects developed to aid in this process is the weather balloon system [11]. Similar to HAB system, the weather balloon system is an integrated technology project that encompasses multiple STEM principles. The hands-on activity for the Wright STEPP students on this project involved soldering components onto a printed circuit board; calibrating and testing the system for optimal functionality; launching the system and analyzing data received during flight to study the temperature profiles in the atmosphere.

4.4 Technical and Professional Development

In the HAB project, students participated in weekly lectures, seminars, and workshop aimed at enlightening them in issues and activities related to the engineering profession. One of the most difficult endeavors in the engineering curriculum is encouraging students to develop creative, independent thought and a deep level of understanding [12]. One major goal in this HAB program is to prepare students for the engineering profession. Through the HAB experience, students focus on learning about independent research and design methods such as conducting literature review to research a HAB topic, writing a technical manuscript for group presentations and publication in an archival and conference proceedings. The HAB participants were required to attend at least one professional meeting and present their research work to gain confidence in public speaking and have a better understanding of the professional environment.

5. CONCLUSION

As a part of senior design class, all students were required to participate in background research, design, integration, testing, and documenting the progress of the project. While working on HAB project, students got the opportunity to work with students from other disciplines. One of the essential aspects students learned is effective communication of technical concepts and ideas to students from a different discipline. The most valuable experience students gained from the interdisciplinary project is development of teaming skills required to work in the real-time projects, where individual engineer rarely works alone on a project. Through working on this real-time project, students not only enhanced their technical skills, but also their interpersonal skills to work as a team, and were able to improve their intellectual self-confidence.

Some of the other projects the HAB teams work on include: a) relaying real-time still and video images to ground as a surveillance mechanism; b) stabilization mechanism to counter the forces acting on the command module during flight, thus creating a platform for science experiments; c) a self contained fuel cell system that could power the whole HAB system allowing for longer duration flights.

6. REFERENCES

UNIVERSITY PROMOTION – KEY FACTOR OF THE USE OF MARKETING STRATEGIES, IN THE CONTEXT OF IMPROVING THE ROMANIAN HIGHER EDUCATION. CASE STUDY

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ABSTRACT: This scientific approach was triggered by the interest to analyze the ability of Romanian higher education to use the marketing strategies, such as the use of promotion, (as instrument of the marketing mix), as strategies of boosting their competitive advantage. The research final conclusions highlight, however, an incipient crystallization of this ability, standing by the initial statement, according to which the Romanian higher education institutions have not yet reached the maturity level in using the marketing instruments, which calls for, in a fairly foreseeable future, the need to adjust their using manner.

Key words: university promotion, marketing strategies, improving. Romanian higher education

1. INTRODUCTION

Our scientific approach consists in the performing of a research in the field of educational marketing and, more concretely, with respect to promotion, as instrument of the marketing mix [2] used by the Romanian higher education institutions.

The consolidation of the attractiveness of the higher education institutions at the international level correlated with the national level, classifies within the set of objectives promoted by Europe 2020 Strategy, [6] which calls for a real involvement of these institutions.

The „substance” (objectives, evaluation and operational elements) and institutional (agreement between the actors, resources, procedural rules) reconfigurations to which the educational system is subjected, as well as the results of these transformations, significant as depth, extent, but also from the perspective of the limited time within which they must be achieved, raises the interest in capturing an image of the ability of the Romanian higher education to use strategies for boosting their competitive advantage, such as the marketing strategy.

The new reconfiguration must demonstrate the ability of the higher education system to ensure the correlation between its educational offer and the labour market, for the purpose of facilitating the gaining of the key competences promoted at the EU level and of raising the awareness of the social partners towards the education-related issues.

The main goal of this paper is represented by the supply of clear and concise information with respect to the key-aspects noticed in relation to promotion in the area of the Romanian higher education, inserted in a high competitiveness context. From this perspective, the paper aims to highlight the improvement degree, qualitative and quantitative, of the manner of information spreading by the Romanian state and private universities, with respect to everything that their public interaction, for the purpose of stimulating these interactions, in a direct or indirect manner (according to the concrete instruments used: publicity, public relations etc.) [4].

The paper is structured in two main parts. A first part consists of the synthetic presentation of the research results at the moment of presenting the work in progress, preceded by the evocation of the objectives targeted in the research, as well as of the main difficulties that the Romanian universities face in their process of promoting their own values and images. The second part of the work consists in the comparison of the results of the two stages, the current one, and the one mentioned in the work in progress, for the purpose of painting a picture, as faithfully as possible, of the problems faced at present in the promotion of the Romanian higher education.

2. RESULTS OF THE STUDY REGARDING THE PROMOTION DEGREE OF THE ROMANIAN HIGHER EDUCATION

The methodological approach associated to the preliminary research, but also undertaken by the subsequent research, analyzing the experience of the last years with respect to the promotion policy used by the Romanian universities, identified in a first stage a structured set of problems.

They mainly refer to:

- a common base, of the bachelor degree university studies cycle and of the master degree cycle, which indicates problems regarding the difficulty of putting together the enrolment file by the candidate (high number of documents, registration fees); weak organization of the admission process; lack of modern technology for data centralization; slow admission process; high number of candidates; difficult information communication, in what concerns the admission.
- problems specific to the bachelor degree university studies cycle, namely, lowering of the quality of the Baccalaureate exam (high passing degree, but the results do not reflect the training of the future university students).
- problems specific to the master degree university studies cycle, involving mainly the inability to coordinate the studies graduated with the offer of the labour market and the high
diversity of the candidates’ profiles (the background of the bachelor degree different from the field of the master studies).

- The identification of the marketing measures that contribute to a better anchoring of the positions of higher education institutions and which lead to an improved attractiveness, as well as to the maintaining of the students enrolled, within master degree studies, is possible by analyzing indicators which preponderantly reflect:
  - degree of visibility and impact of educational institutions on the educational market.
  - degree of using the marketing instruments for the purpose of attracting customers – current students.
  - candidates’ perception with respect to certain characteristics of the educational institutions: experience and tradition, degree of trust, national and international recognition, prestige of the teaching staff, conditions for studying and housing, publicity.
  - candidates’ perception with respect to the range of specializations offered by the universities in relation to the labour market requirements.

Within the methodological framework followed, the educational market is limited to the 87 universities in Romania (56 public higher education institutions and 31 accredited private higher education institutions), the candidates for admission to the universities, as well as the university students (undergraduates, postgraduates and doctoral students).

In the preliminary stage of research, the evaluation of the manner of promoting the university values and image focused on the field of administrative sciences, taking as reference the Faculty of Public Administration within the National School of Political Studies and Public Administration, hereinafter called FPA-NSSPSPA.

In this sense a pilot-questionnaire was elaborated, which comprised 10 questions and was especially aimed at: dimensioning the image of the university perceived by the candidates; identification of the manner of attracting the candidates towards the university; the degree of trust given to the university by the candidates.

In addition, in order to complete the information, indirect sources were also used, sources that emphasized the pro-active degree of the university behaviour, as well as the website or other documents, such as the activity reports or other decisions of the university structures or those involved on the educational market (for instance, those regarding the offers of scholarships and jobs) a.s.o.

The conclusions derived from the first stage of research, from the comparative analysis performed on the 87 state and private higher education institutions, were not at all encouraging, highlighting an incipient use of promotion as instrument of the marketing mix, in spite of its possibilities.

These results are due to the low effort made by the universities in order to consolidate their position on the market served and it could be consolidated by running sustained activities in the following directions:

- providing the concordance between the offered studies and the labour market, with focus on presenting the finality, namely the perspectives after completion of studies and the possibilities of employment after graduation.
- promoting the modelling of the communication skills by means of the Erasmus mobilities, for the purpose of stimulating the professional abilities and training and the development of the human personality.

- participation of the Romanian universities to promotion events occurring on the national educational market etc.

The disfunctionalities occurred as a consequence of using promotion in an incipient form and reflected mainly by:

- a low percentage of trust granted by the candidates to the Romanian universities, on the basis of their personal perception.
- a high percentage of use of informal sources by the candidates.
- a high extent of the criterion the average is more important than the option, which exceeds even the value of the weight of the criterion afferent to the quality certification (Quality certification is performed by RAQAHE (Acronym – Romanian Agency for Quality Assurance in Higher Education. In original, ARACIS)). This organism verifies if, from the institutional point of view, there is a management that ensures the quality of the study programs and that the academic standards for granting the graduation diplomas are observed) of the universities analyzed, within the set of criteria used to analyze the degree of promotion of the educational offer, have high incidence, being, in general, a characteristic of universities holding a position of monopoly on the educational market, supported by its geographic positioning and the supply of an educational offer in a specialization field in which the university has no competition.

On the basis of these preliminary observations, the research concentrated its efforts within an extended analysis, both from the viewpoint of the number of universities studied, and from the perspective of enlarging the investigation area, more precisely on the cycle of master degree university studies, special attention being given to the study of the monopoly position, in this second part of the scientific approach.

3. ACTUALITY AND PERSPECTIVES

The results and conclusions of the initial approach deepened the research directions, such as the pilot-questionnaire was modified in order to include a thorough investigation on the area of the problems raised in the work in progress. The modified variant was sent, in a first stage, by means of emails, to a number of 50 state and accredited private universities.

The difficulties in the communication sphere with these universities were immediately felt, in the sense that only 4 universities, all in the category of state universities, answered and showed wide openness, either by including the questionnaire in their monthly newsletter, or distributing it to the candidates at the moment of registering for the bachelor degree or master degree university cycles. The communication barriers significantly made the research more difficult, as time, procedure, volume of information, and, for this reason, the complexity of certain aspects could not be captures through an exhaustive research.

In order to complete the lack of information, but also to compensate the need of a wider research team, a selective research was performed, on the basis of samples, for which a reduced number of universities were selected.

In order to obtain the representativeness required by proper sampling, the territorial criterion was used, the universities being selected from every historical province of Romania (Moldova, Dobrogea, Muntenia and Transylvania).

Following the application of the questionnaire, on a sample varying between 60, and, respectively 475 subjects, depending on the number of candidates registered for admission to the two university cycles, the centralization of the answers, aimed at
the main objectives targeted by the questionnaire applied in the second stage of research, is illustrated in Tables 1, 3, and 4.

Table 1. *You found out about our faculty from...?*

<table>
<thead>
<tr>
<th>Informal source</th>
<th>Formal source</th>
<th>Other formal or informal sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendations from different persons</td>
<td>Value within the interval 20-30%</td>
<td>Value within the interval 1-17%</td>
</tr>
<tr>
<td>Banners, flyers, posters</td>
<td>High weight: Moldova, Transylvania</td>
<td>Low weight: Montana, Dumbrava and Dobrogea</td>
</tr>
<tr>
<td>Faculty/ University website</td>
<td>Value within the interval 4-25%</td>
<td>High weight: Moldova, Transylvania</td>
</tr>
<tr>
<td>Mass-media</td>
<td>Value within the interval 25-40%</td>
<td>Low weight: Montana, Dumbrava and Dobrogea</td>
</tr>
<tr>
<td>Different educational events (ex: fairs)</td>
<td>Value below the threshold of 1%</td>
<td></td>
</tr>
</tbody>
</table>

*Observations:*

1. The results contained in Table 1 represent the average weight at the national level and are valid for both university cycles, bachelor, respectively, master degree.

2. Table 1 highlights several important observations regarding the impact of the informal and formal information sources on the candidates’ perception with respect to the visibility of universities.

In what concerns the weight of the informal information source, „word of mouth” marketing, this places, for all historical provinces and for both university cycles, within the interval 20-30%, the distribution of the contribution of each type of informal source (Friends / family members/ High school colleagues/ Teachers/ Students/ graduates of the university analyzed) within this interval varying from one province to another, but also from a level of the university studies cycle to the other.

With respect to the weight of the different types of formal sources, the situation presents as follows:

- Advertising materials (banners, flyers, posters) determined an increase of the university visibility, with a percentage situated, at the level of the entire country, for both university cycles, within the interval 3%–25%, the concentration of minimum values being observed preponderantly in Muntenia, Transylvania and Dobrogea, and the one corresponding to the maximum values in Moldova.
- The degree of coverage of the promotion campaigns by means of mass-media presents a similar evolution, the maximum weight of its contribution being, however, inferior to the one given to advertising material, the layer of its contribution presenting a value comprised between 4-20%. The distribution of minimum values maintains in Muntenia and Dobrogea, but the one corresponding to the maximum values, comprising Moldova, also extends to the other province, Transylvania.
- An important information source is the Internet page (the official site) of the faculty/university, which significantly contributes to the increase of the degree of attraction of candidates. From these pages gathered information a number of candidates whose average weight at the national level, for both university cycles, is situated within the interval 30-40%, higher, got the master university cycle (36-40%).
- Promotion by means of participating to different educational events (ex: fairs), which present a high degree of university-candidate interactivity, presents a significant weight in the areas Moldova, Muntenia and Transylvania, and a low one in Dobrogea, the average weight at the national level, for both university cycles, being situated within the interval 1-17%. This value is supported by the reports regarding the organizing of a largest educational event in Romania and in Eastern Europe, Romania International University Fair (RIUF), which is being organized in Romania starting with year 2005.

According to the own evaluation reports [5], in the 6 editions organized in Romania, a low number of Romanian universities participated, but a constant trend can be seen for the last three editions (2008, 2009, 2010), as can be notices in Table 2.

Table 2. Evolution of the participation of Romanian universities to RIUF within the interval 2005-2010

<table>
<thead>
<tr>
<th>University year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Romanian universities, at the level of historical province, participants to RIUF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muntenia</td>
<td>3 (1 IS, 2 IP)</td>
<td>7 (3 IS, 4 IP)</td>
<td>7 (2 IS, 5 IP)</td>
<td>7 (3 IS, 4 IP)</td>
<td>5 (4 IS, 1 IP)</td>
<td>5 (4 IS, 1 IP)</td>
</tr>
<tr>
<td>Moldova</td>
<td>0</td>
<td>0</td>
<td>1 IS</td>
<td>5 (3 IS, 2 IP)</td>
<td>6 (5 IS, 1 IP)</td>
<td>6 (5 IS, 1 IP)</td>
</tr>
<tr>
<td>Transylvania</td>
<td>0</td>
<td>1 IS</td>
<td>1 IS</td>
<td>4 (3 IS, 1 IP)</td>
<td>9 (7 IS, 2 IP)</td>
<td>9 (7 IS, 2 IP)</td>
</tr>
<tr>
<td>Dobrogea</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>IS</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Legend: IS = state higher education institution; IP = accredited private higher education institution

- Also, a very low percentage of candidates mentioned other sources of information, apart from those presented in the questionnaire (outdoor means, magazines dedicated to university admission, national newspapers a.s.o.), at the national level, for both university cycles, registering a value below the threshold of 1%.

Table 3. *What is the degree of trust you give the university, in what concerns.....?*

<table>
<thead>
<tr>
<th>Indicator/Level</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>Very low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational offer</td>
<td>At the national level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of prestige of the teaching staff</td>
<td>At the national level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offer of scholarships and other facilities</td>
<td>At the national level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of study and housing conditions</td>
<td>At the national level</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Observations:*

1. The results contained in Table 3 are valid for both university cycles, bachelor, respectively, master degree.

2. The results cover two levels since, for each historical province, there were recorded values belonging both to the High and to the Medium level.

In what concerns the factors that influenced the candidates’ option to enrol in certain universities, these are illustrated, for the bachelor degree university cycle, in Table 4.

Table 4. *Did you choose to enrol in our bachelor degree university studies because...?*

<table>
<thead>
<tr>
<th>Influence factors / Historical province</th>
<th>Muntenia</th>
<th>Moldova</th>
<th>Dobrogea</th>
<th>Transylvania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendations of different persons</td>
<td>25%</td>
<td>25%</td>
<td>30%</td>
<td>60%</td>
</tr>
<tr>
<td>Faculty image</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Competences of the teaching staff</td>
<td>25%</td>
<td>30%</td>
<td>35%</td>
<td>20%</td>
</tr>
<tr>
<td>Existence of accreditation for the faculty</td>
<td>35%</td>
<td>35%</td>
<td>35%</td>
<td>35%</td>
</tr>
<tr>
<td>Legal form of the university</td>
<td>80%</td>
<td>85%</td>
<td>95%</td>
<td>97%</td>
</tr>
<tr>
<td>Admission modalities</td>
<td>35%</td>
<td>40%</td>
<td>30%</td>
<td>93%</td>
</tr>
<tr>
<td>Existence of the correlation with the labour market requirements</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Localization of the university in the vicinity of the candidate’s home</td>
<td>10%</td>
<td>10%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Relevance of the faculty profile in the candidate’s residential area</td>
<td>5%</td>
<td>8%</td>
<td>7%</td>
<td>20%</td>
</tr>
<tr>
<td>Level of the university year fee</td>
<td>5-15%</td>
<td>5-15%</td>
<td>5-15%</td>
<td>5-15%</td>
</tr>
<tr>
<td>Other factors</td>
<td>5%</td>
<td>15%</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>
1. The values in Table 4 represent the maximum values reached by the influence factors, for each historical province, and are valid for the bachelor degree university cycle.

2. Table 4 confirms one of the initial research hypothesis, namely the fact that one of the factors tremendously influencing (almost 100%) the candidate’s decision to enrol in a particular university is represented by the legal form of the university, state or private, the candidate choosing one form or another, depending on his/her personal interests.

In second position, with a maximum weight that reaches almost 100%, but not for the entire national level, is the admission modality. This criterion is leading for the historical province Transylvania, together with other two factors with dominant influence within this area, namely the recommendation of different persons (a maximum of 93%), as well as the relevance of the faculty profile in the candidate’s residential area (a maximum of 60%).

The rest of the influence factors presented in Table 4, although with an important impact on the candidates’ perception (covers one third of the total candidates registered for the bachelor degree university cycle), presents the same distribution throughout the country territory, from the point of view of the maximum reached by their weight.

For the master studies university cycle, as dominant criteria that were at the basis of the candidates’ option to enrol in a particular university there are the criterion of competences of the teaching staff (weighted average 30-40%) and of the existence of the correlation between the educational offer and the labour market requirements (weighted average 45-55%). The criteria admission modality and legal form of the university are losing importance, placing on a low level, 25-30%, respectively, 35-40%. For the other influence factors, the picture of their distribution is similar to the one for the bachelor degree university cycle (Table 4), with the observation that the maximum value of the weight for each of these factors registers an overall drop of 40-50%.

For the master university cycle, the modifications occurred in the decrease or increase of the weight held by certain influence factors is justified to a high extent by the fact that for these studies are enrolled candidates who graduated the bachelor degree university cycle within the same university (average weight is around the value of 80%), thus being “familiarized” with the faculty image, with the degree of competence of the professors, as well as with the educational offer.

The increase of the interest of the registered candidates for the master university cycle, for attending specialty course that facilitate their insertion on the labour market, is also due to the fact that obtaining a bachelor degree diploma, in general, did not ensure their integration in a categorical manner, fact also reflected by the answers obtained for the question To what extent did the graduation of the bachelor degree university studies correspond to your needs of professional training and development...? and with are polarized to an equal extent (an average of 35% for the entire national territory), by the scores sufficient and to a high extent.

3.1. Modern promotion instruments. ECTS Label and DS Label

The elaboration by the university of the marketing strategy is preceded, as an obligation, by the achieving of an important pillar, namely positioning: of the institution, the service provided by it etc. [1] It allows a solid joining of the strategy with the subsequent marketing instruments, since it facilitates the construction of a distinct and favourable position on the educational market, in relation to the competition, contributing to the increase of trust of the target-audience targeted by the strategy, implicitly of promotion and of the probability to attract its future candidates. A manner of achieving this positioning and, at the same time, a modern marketing instrument, is constituted by the obtaining by the higher education institutions of the honorific distinctions awarded by the General Direction Education and Culture within the European Commission, if they demonstrate excellence in the application of the European Credit Transferring System (ECTS) and/or of the Diploma Supplement (DS).

The institutional advantages are significant, the obtaining of at least one of these two distinctions contributing to a very high extent to the increase of the national and international prestige, to the consolidation of the institutional identity, to the obtaining of the statute of trustworthy partner within international cooperation. However, another important advantage, from the perspective of the objectives targeted in this research, is the increase of trust and loyalty of the future candidate in the entire range of educational services offered by the university in a responsible and standardized manner at a very high level quality, thus consolidating the university promotion policy, as well as the policy for attracting and keeping the future candidates.

In a very practical and innovative manner, ECTS Label and DS Label represent, in fact, differentiation mechanisms of the educational offers (The expressions ECTS and DS Label represent European certification instruments that offer guarantees to the „clients” of the universities holding these distinctions, in relation to the observance by these universities of the European standards in the field in which they are awarded) which reveal an increased quantity of information, for the purpose of increasing the trust of the final „consumers” of the services offered by the universities. It facilitates nearness within solidarity relations of the educational market actors.

However, surprisingly, especially due to the fact that the execution of the application by the universities does not consist in a very laborious procedure, a low number of universities that obtained these distinctions are registered.

The results obtained following the round on the date of January 15th, 2010, by the universities that applied for obtaining the ECTS distinction, respectively DS Label distinction, according to the data presented by the Education, Audiovisual and Culture Executive Agency (EACEA) (EACEA is responsible for the management of certain parts of the EU’s programmes in the fields of education, culture and audiovisual) are comprised in Table 5.

Table 6 illustrates the national results obtained by the Romanian universities within this round, comparatively to those obtained in 2009 for the obtaining of the same distinctions, resulted presented by ANPCDEFP (Acronym for the National Agency for Community Programs in the Field of Education and Professional Training. Public institution with legal personality in the subordination of the Ministry of Education, Research, Youth and Sport in Romania.), within the Erasmus Seminar organized by the agency in the period September 9th-10th, 2010 in Bucharest.
Table 5. Situation of the ECTS and DS label awards results in 2010

<table>
<thead>
<tr>
<th>Country of origin of the applicant universities, as well as the number of applications obtained</th>
<th>ECTS Label</th>
<th>DS Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria (1), Czech Republic (1), Slovakia (1), Turkey (2)</td>
<td>15/5</td>
<td>73/53</td>
</tr>
<tr>
<td>Austria (3), Belgium (1), Cyprus (1), Czech Republic (4), Denmark (1), Finland (12), France (2), Greece (1), Island (4), Italy (3), Lithuania (4), Latvia (2), the Netherlands (1), Norway (4), Portugal (4), Sweden (2), Turkey (4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6. *Situation of the national results for years 2009 and 2010

<table>
<thead>
<tr>
<th>Selection year</th>
<th>ECTS</th>
<th>DS</th>
<th>Eligible</th>
<th>CE proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candidacies submitted</td>
<td>Candidacies</td>
<td>Candacies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2011</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Observation:

1. The only higher education institution that applied for obtaining the ECTS Label distinction is a state university from the historical province Moldova, however, within the selection, the candidacy proposed was rejected.

4. CONCLUSIONS

The scientific approach performed highlights the crystallization in incipient stage of the ability of the Romanian higher education, state and private, to use strategies for boosting their competitive advantage, such as the marketing strategy. The comparative analysis performed by means of selective research, by sampling, supports the observation derived from the final conclusions of the work in progress with respect to the incomplete use of promotion, as instrument of the marketing mix.

The observation is visibly reflected in Table 4, where we notice that, on the average, at the national level, for both university cycles, bachelor degree and master, continue to be recorded a weak progress in what concerns the increase of the institution visibility.

In this sense, we notice, for instance, a weak dominance of the informal source by the formal source (the value of the average weight of the formal source exceeds by only 10% the value of the average weight of the informal), as well as a weak contribution of the university/faculty official site to increase the institution visibility (maximum weight at the national level for both university cycles is of 40%).

Also, as indicated by the results illustrated in Tables 2 and 6, the Romanian higher education institutions do not make sustained efforts to access modern marketing instruments.

If we analyze the situation of the participation of these institutions to the educational events, we notice a stagnation of the degree of participation for the last two years, 2009, respectively 2010, at the level of the value of 22.98% (the public sector being better represented than the private one). In what concerns the obtaining of the honorific distinctions ECTS Label and DS Label, by the Romanian universities, the results are null.

We notice that at the national level, for the bachelor degree university cycle, two factors with considerable influence over the candidates’ decision to chose a particular faculty/university are established, namely the legal form of the university and the admission modality.

We reiterate the observation captured by the preliminary research and presented in the work in progress, according to which this situation is preponderantly seen in universities that have a consolidated position on the educational market, via certain advantages, among which we can mention: geographic position and supply of an educational offer in a specialization field in which the university has no competition.

The research final results conform, however, a small variation on this statement, in the sense that these advantages confer a statute, considered only by the universities, as monopoly, since from the candidates’ perspective, this does not transform into a factor with categorical influence on their decision to enrol in a faculty/university (average weight at the national level of 10%).

The maintaining of the decisional rigidity and the lack of proactive attitude before the evolution of the educational market, of the spatial availability of candidates, but also of unforeseen events with a major impact at the legal and institutional level (for example, the change of the legislative framework), may create a quick and deep unbalance for these universities, which can be felt at different levels, such as: number of candidates, position held, European and international cooperation etc.

The results obtained within the analysis for the master degree university cycle indicated a high interest of the candidates for specialization, on the basis of an increased degree of trust given to the faculty/university, underlined, in its turn, by a relatively important percentage of the insertion of bachelor degree university studies graduates on the labour market.

For these reasons, we can state that the picture of the negative effects mentioned previously for the bachelor degree university cycle can be faded by far, through the adoption in due time of strategic marketing measures.

As a general conclusion, we maintain the statement according to which the Romanian higher education institutions, regardless of their legal form, have not reached the maturity level in using the marketing instruments, which calls for, in a fairly foreseeable future, the need to adjust the manner of using the marketing mix instruments, especially of promotion, which to confer them a better anchoring of these institutions on the educational market.

5. REFERENCES


COLLABORATION IN ENGINEERING AND BUSINESS EDUCATION
ABSTRACT: This paper presents the collaborative work that, the fluid mechanics, hydraulics or hydraulic machineries departments, from 6 Romanian universities, have put together in order to build up a web based platform to be used, by students as well as by teachers, in the study of fluid engineering. The different components of the platform are presented and discussions are made on the main problems that appeared in the creation process of the PiiF (PiiF stands for “Fluid Engineering Informatics Platform” which in Romanian is: “Platforma Informatica de Ingineria Fluidelor”) platform. Of course, adopted solutions to the problems are also explained thoroughly. We consider this project to be a good example on both: collaboration in engineering education and new innovative methods for engineering education.

Key words: fluid engineering, informatics platform, engineering education

1. INTRODUCTION

The “Fluid Engineering Informatics Platform Project” (i.e. PiiF Project) is developed in Romania, within the ESF Sectoral Operational Programme Human Resources Development 2007-2013. It started in September 2010 and will end in August 2013. The purpose of the PiiF Project is to renew and modernize the Romanian education system dealing with Fluid Engineering.

This objective is achieved by a collaborative effort performed by 7 departments, each having different names from the Fluid Engineering field, coming from 6 Romanian technical universities, namely: the Technical University of Civil Engineering Bucharest (PiiF Project Coordinator), University “Politehnica” of Bucharest, “Politehnică” University of Timisoara, Technical University of Cluj-Napoca, “Dunarea de Jos” University Galati, and “Gheorghe Asachi” Technical University of Iasi.

The different names of the above mentioned departments, was the main reason why the term “Fluid Engineering” was chosen. In fact fluid engineering includes many fields such as: Fluid Mechanics Engineering, Fluid Measurements, Computational Fluid Dynamics, Fluid-Structure Interaction, Geophysical Flows, Fluid Flow Visualization, Fluid Machinery and Systems (pumps, turbines, hydropower), Hydraulics, Fluid Power, Fluidics and Fluid Control, Bio-fluid Mechanics, Fluid Mechanics Instabilities, Multiphase Flows, etc [1].

Many cooperation projects between each of the “Fluid engineering” departments of the above mentioned universities existed before. Such cooperation projects can be traced back, up to the sixth decade of the 20th century. Nevertheless the start-up project that included all 7 departments dates from 2005 when the Romanian national committee for scientific research in higher education launched the “consortium” type of grants. A consortium called ACCORD-Fluid (ACademic COnsortium for Research and Development in Fluid engineering) was created between the 7 departments and a grant was obtained to study “Vortex dominated flows”. In the 3 year period of the grant, 3 conferences on “Vortex dominated flows” were organised with the participation of members of the 7 departments that were thus able to know each other, to understand the work of the partners in the consortium and assess its quality. At the end of the grant a monograph on “Vortex dominated flows” was published with contributions from members of each department involved in the project.

In the period between 2008 (end of the consortium grant) and 2010 (start of the PiiF project) several excellence grants were obtained in collaboration by members of the ACCORD-Fluid consortium but they usually concerned groups of 2 or 3 departments. A fourth conference on “Vortex dominated flows” was organised in 2008 based on founding provided by one of the “excellence” grants.

In 2009 no conference was organised by ACCORD-Fluid, principally due to economical crisis constrains but the consortium was reactivated (all 7 departments as partners) for the start of the PiiF project that took place in 2010.

2. THE PIIF PROJECT

One of the constant concerns of nowadays employers is for their new employees to have, not only a solid knowledge of basic principles, but also to be able to perform a rational and correct analysis of an unusual situation, come up with a solution and implement it. Thus, engineering education (not only the one concerning fluid engineering) must be targeted at such a goal, i.e. teach students that “basic concepts + correct scientific logic = solving applications”. Unfortunately, what we teach students today looks more like a collection of information/recipes that can, apparently, only be applied in some particular situations [2]. Nowadays students lack the exercise of extrapolating the “recipes” or “information” they learned at the university to slightly different situations and come up with solutions to unknown problems. The main purpose of the PiiF platform is to try and change this aspect within the Romanian fluid engineering community by teaching students how to apply the correct scientific logic to the basic concepts they learned in order to obtain a solution or to solve a problem.
The web-based platform that we are building within the PiiF project is organised around this main idea “basic concepts + correct scientific logic = solving applications” [3].

From the start, we must emphasize that we are not trying to build up a single standard line of study in fluid engineering. Although all 7 departments involved in the project basically teach the same discipline, each of them has its own specificity from emphasis on ship propellers to emphasis on aircraft propellers, from accent on pumps to accent on hydraulic turbines, from highlight on geophysical flows to highlight on urban sanitation systems, from stress on bio-fluid flows to stress on water supply systems, etc. By the consortium approach, we also hope that the web-based platform (www.piif.ro) will help widen the engineering horizon of students that will find next to the concepts or sample scientific and engineering logic in their own line of study other adjacent applications, of the same basic principles with different engineering logic used to solve other problems.

We also hope that, at the end of the project, the web-based platform will prove useful to teachers also, providing them with a tool that will help them build-up a modern and appealing course in fluid engineering regardless of the specificity existing in each of the partner universities (as long as each of the partner departments will deal in addition to general concepts with its specific applications).

Once the project is completed in 2013 the platform will still be opened to teachers that will still be able to add new concepts or new samples of scientific or engineering logic, new interactive applications or new visualizations or numerical simulations and to students of the 7 involved departments.

3. PROJECT MANAGEMENT

The PiiF project is lead by a project manager and a deputy manager, both from the Technical University of Civil Engineering Bucharest. Each of the teams from the other 5 partner universities has a team director. They are all responsible for the communication between the teams, compliance with the deadlines for the reports that have to be created during the project and financial aspects for each team.

As long as the scientific aspects are concerned, materials uploaded on the platform by members of the consortium are reviewed by a scientific committee composed of the project manager, the deputy manager, and four activity coordinators.

The activity coordinators are each responsible for one of the databases that compose the PiiF platform (see below “platform description”). For the database with basic concepts and sample scientific or engineering logic the activity coordinator comes from the “Politehnica” University of Timisoara, for the database with interactive applications of the basic concepts and/or scientific logic the activity coordinator comes from the “Politehnica” University Bucharest, for the virtual database of significant laboratory experiments the activity coordinator comes from the Technical University of Civil Engineering Bucharest and for the database containing flow visualizations and numerical simulations of flow phenomena the activity coordinator comes from the “Dunarea de Jos” University of Galati.

In order to become available to other users each material uploaded on the platform must have the final approval of the corresponding activity coordinator.

In this stage of the project access to the platform is granted upon request to all teachers from the 7 partner “Fluid Engineering” departments and to any student of the partner universities.

The PiiF Project progress and results are shared to the Romanian academic community through 3 Summer Schools, 2 National Conferences, as well as many Training Sessions and Study Visits between students and teachers of the partner universities.

4. PLATFORM DESCRIPTION

The PiiF web-based platform is mainly composed of four databases linked together in order to assess the major idea of the project, that is: “basic concepts + correct scientific or engineering logic = solving applications”. The four components of the PiiF platform are:

- A database with basic concepts and sample scientific or engineering logic;
- A database with interactive applications of the basic concepts and/or scientific logic;
- A virtual database of significant laboratory experiments;
- A database containing flow visualizations and numerical simulations of flow phenomena.

As stated above, each of the partner departments involved in the PiiF project will deal, in addition to general concepts, with the concepts, sample engineering logic, applications, laboratory experiments, flow visualizations and numerical simulations in its own line of expertise.

The four databases are linked together so that any teacher will be able to use any of the resources on the platform to build up his own course or to indicate to students a given path through the existing information on the platform. Of course, individual study is also possible. Navigation through the platform can also be performed based on keywords that link different objects in the same data base or different objects from different databases together.

Figure 1. PiiF platform start-up page.

The data base with concepts and sample scientific or engineering logic is the core of the PiiF platform. A concept is organized as a word processing document that presents a single aspect of fluid engineering or a single demonstration of a formula or calculus relation. Its length can not exceed what could normally be explained to students in half an hour of a course.
The database is divided into three major categories: basic concepts; sample scientific logic for simple applications and sample engineering logic for complex applications. Each of these categories is further divided into subcategories that match specific chapters of fluid engineering. Each of the subcategories contains several related concepts.

When choosing to view a concept the user is presented a short abstract of the concept (that can contain pictures) the name of the author as well as buttons for: the download of the e-paper containing the concept (a word processor file), the links to other related downstream concepts, the related interactive applications, the related laboratory assignments or the visualisations or numerical simulations directly related to the visualised concept. Another button is provided for the download of the notations used by the author of the e-paper.

The interactive applications database will permit the students to apply the basic concepts and sample scientific or engineering logic to other situations than the ones described in the concept itself, to get used to the needed data in order to solve a given problem, to the order of magnitude of certain physical quantities and last but not least, to the order of magnitude of the results.

This database is composed of two categories of applications. The first category is composed of simple solvers (the spreadsheet type of applications) that require the users to input data in some areas of the spreadsheet while the results are automatically computed in another area of the same spreadsheet. The second category is composed of complex applications that generally require the use of a third party computer software. In this respect the platform contains a collection of third party educational software that is available at the partner departments involved in the project. In order to be able to use the software any student or teacher from the partner universities can use a special remote control access software “2X” that was adapted for the PiIF platform by the Romanian representatives of the producing company. In this way the educational software does not need to be installed on each of the computers that use it. It is enough that the educational software runs on the server of the partner university that provided it, while each user should install a “2X” client to be able to run a remote desktop from the server and thus run the software.

The interactive applications contain apart from the application itself, word processor files presenting some explanations about the application, the requirements and links to related concepts that should be read before attempting to solve the application.

The most expensive resources involved in the engineering teaching process are laboratory experiments. This is the reason why we have chosen to add a virtual laboratory experiments database in our project. Virtual laboratory does not mean numerical simulations. The laboratory experiments that we will perform within the PiIF platform are real laboratory measurements on real experimental systems existing at each of the partners. Perhaps the term “remote measurements” would be more appropriate.

In fact, some laboratory experiments, existing at each of the partner universities, will be refurbished so that they can be remotely accessed by the other partner universities upon request. Measurements will be performed remotely while data processing and interpretation will be performed locally. For the remote operation the same “2X” client will be used (just as in the case of the interactive applications.

In figure 2 we present the experimental set-up for the study of a circular jet, before and after the refurbishment. Figure 3 represents the user interface that the students will use to acquire experimental data from the circular jet experimental set-up. Another good example of refurbished experimental set-up is the one presented in figure 4, the water-water ejector where it is obvious that all pressure gauges (that permitted only local measurements) were replaced with pressure transducers and a computer interface was added for communication with the server. Those are only 2 examples for the six experimental stands that are in operation in this stage of the project.

This approach will, on one hand, decrease the time in which an experiment is performed (as long as all the data are digitally collected on a computer) and on the other hand, increase the number of experiments that can be performed in each of the partner universities without a substantial financial effort. It’s just like putting all our experimental resources together each of us being able to use all the resources upon appropriate scheduling arrangements [4].

As long as the flow visualization and numerical simulations data base is concerned, it will be mainly linked to the basic concepts and sample scientific or engineering logic database. This will enable the concepts to be more appealing to students as long as the e-paper containing the explanations of a concept or a sample scientific or engineering logic will contain links to flow visualizations and different simulations trying to depict the studied fluid flow phenomena.

In addition to the four data bases that were anticipated in the project request, three new sections were added to the platform after the beginning of the project.
A section containing reference books and relevant scientific papers was added. This database is divided just as the concept database is. Links to the books and relevant scientific papers can be inserted in each of the concepts, interactive applications and virtual laboratory data bases.

Another added section is the one containing educational films and visualisations that can be freely downloaded from the internet.

Figure 4. Water-water ejector experimental set-up before (up) and after (down) the refurbishment.

Finally a third section, containing relevant information about the platform was also added. This section can only be accessed by the members of the scientific committee of the project. It presents data regarding the number of people having accounts on the platform, frequency of access to the platform, status of the concepts, applications, laboratory experiments and visualisations, number of items existing in each category, active authors, active students, etc.

5. CONTENT REALISATION ISSUES

The realisation of the platform was not really an issue as long as the acquisition (both for software and hardware) was only performed by the Technical University of Civil Engineering Bucharest (TUCEB). The hardware needed in each of the partner universities were later transferred from the TUCEB to the partners. Filling in the contents of the platform was a different matter.

Some of the issues we encountered were somehow expected by the scientific committee due to the fact that we had already worked together in other projects. One of those issues was the difference in notations between authors [5]. In order to by-pass this issue, from the start, the scientific committee, stated that there should be a list of notations for each author, a link to the list being added to each concept the author up-loads on the platform.

Another expected issue was that multiple authors would consider writing and up-loading the same basic concept on the platform. In this respect, the scientific committee announced from the beginning of the project that during the project, no duplication of any concept will be permitted. The rule for assigning concepts to authors is “the first that requires writing a concept is the one that will write it”. Fortunately this issue (that was a concern of ours especially for the basic concepts) did only occur three times up to this implementation stage.

The last expected issue was related to the links between concepts. Such a platform can become useless if the author of a concept is specifying links to both upstream and downstream concepts while other authors (that did not have the opportunity of writing that particular concept) would like to see other links. To solve this problem the scientific committee acknowledged that only downstream concepts could be linked to a given concept and that the author is fully responsible of the links provided.

To list also some unexpected issues encountered up to this stage of the project we must mention issues related to: the visualisations and numerical simulations database as well as related to the virtual laboratory data base.

Some of our partners understood that visualisations or numerical simulations of fluid phenomena are referring to still pictures of those phenomena while we, when we wrote the grant request, thought about some films and animations. We had to convince our partners that this is the good way to follow for an appealing fluid engineering course (this is one of the reasons why a film data base was later added to the platform).

For the virtual laboratory data base, the experiments that will be shared between partners were chosen by the scientific committee based on the offers made by partner universities (each partner university had to provide at least to experimental set-ups to be shared between partners). After the choice was made (based mainly on economical criteria, as this type of project does not encourage equipment acquisitions), in the implementing stage, we realised that some major aspects were omitted by our partners, such as lack of internet access in the building or lack of continuous power supply to the experimental set-ups and/or servers. All those issues had to be solved before the experimental set-ups were included in the platform with supplementary costs.

6. CONCLUSION

We hope that at the end of the project, the PiiF platform will prove useful to both teachers and students. To the teachers, it will provide a modern tool that will help them build-up a modern and appealing fluid engineering course. To the students, it will provide a modern on-line instrument that will help them understand basic concepts in fluid engineering as well as teach them to apply correct scientific or engineering logic in order to solve given problems.

7. REFERENCES

FACE TO FACE INTERCULTURAL WORKSHOPS: ARE THEY WORTH THE MONEY?

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ABSTRACT: A series of two-week international workshops was held in Joensuu, Finland during February 2010, in Glasgow, Scotland in February 2011 and again in Nicosia, Cyprus during February 2012. Entitled “Intercultural Innovation Insight Workshop” (3EYES), they were sponsored by the European Lifelong Learning programme. Students from Portugal, Cyprus, Czech Republic, Finland and the United Kingdom were placed in multi-cultural teams of five. Each team had two product designers, one graphic designer, one financial and one marketing student. They were set the task of devising new product ideas for a local company and they had two weeks within which to do it. These intensive workshops comprised lectures and practical tutorials as well as ideation sessions for the new product ideas and represent one way in which international issues may be appreciated and accommodated. During the first innovation camp the students examined product futures for a fairly large Finnish ceramics company, the Glasgow workshop liaised with a micro-company and during the third 3EYES workshop, the Municipality of Nicosia was helped in its bid to become the European City of Culture 2017. All three events dealt with a completely different clientele: the first was a medium sized company, the second a micro company and the third a Municipal authority. The output of the first two was expected to be a physical product or product idea whereas the third did not need to be a product of any sort. The previous paper, which was delivered in the South African conference last year, compared the first two events and discussed issues of social responsiveness, shared goals and identity. Now that the third (and last) event has taken place, it is time to take stock. We conclude that the students gain greatly from both cultural and functional interaction on a way that cannot be reproduced by means of local teaching. This experience is attitude forming and can transform motivation. It also has the desired effect of increasing the desire to go on Erasmus placements in subsequent years. The perceptions from staff who attended are compared with similar reflections from staff who worked on a different, video conference based, approach. The differences in the financial sustainability of such projects are discussed and the benefits of each model evaluated.

Key words: Intercultural workshop, innovation, functional interaction

1. INTRODUCTION

This paper will reflect on three workshops financed by the European Union under the banner of the Erasmus “Intensive Programme” (IP), an element of their Lifelong Learning programme [1], [2], [3]. They were entitled “Intercultural Innovation Insight Workshops” (3EYES)

For the European Commission an IP, as expressed in the application form, aims to [4]:

General requirements

- To improve the quality and to increase the volume of student and teaching staff mobility throughout Europe, so as to contribute to the achievement by 2012 of at least 3 million individual participants in student mobility under the Erasmus programme and its predecessor programmes.
- To improve the quality and to increase the volume of multilateral cooperation between higher education institutions in Europe.
- To increase the degree of transparency and compatibility between higher education and advanced vocational education qualifications gained in Europe.
- To improve the quality and to increase the volume of cooperation between higher education institutions and enterprises.
- To facilitate the development of innovative practices in education and training at tertiary level, and their transfer, including from one participating country to others.
- To support the development of innovative ICT-based content, services, pedagogies and practice for lifelong learning.
- Specific requirements
- Present a strong multidisciplinary approach.
- Focus on subject areas which are currently under-represented in Erasmus student mobility (over-represented areas: business studies, social sciences, law, arts, humanities, languages).
- Train students' entrepreneurial competences in any subject area.
- Five European universities collaborated in this venture:
  - Glasgow Caledonian University, Scotland (product design)
  - North Karelia University of applied Sciences, Finland, (product design)
  - Frederik University, Cyprus (graphic design)
  - Silesian University in Opava (Marketing)
Polytechnic Institute of Porto (IPP) (Finance)

They met the above requirements by asking students to create feasible ideas for new products according to needs expressed by a collaborating company because new product development (NPD) demands cross-disciplinary activities requiring, as it does, input from design, market, finance and manufacturing.

2. THE THREE WORKSHOPS

a) The first workshop was held in Joensuu, Finland. It comprised lectures and seminars coupled to teamwork on the assigned problem. One student from each country was assigned to a team and, working on a flat table, they were guided through a process that culminated in a presentation to the SME of their suggested new product. During the course of their team discussions, there was staff available to facilitate progress. At the end of each day, the teams’ work was displayed and they were asked to explain and answer questions on their work. To help them, and to encourage a technical understanding of the issues, students were taken to the company to inspect their products. One particularly important part of the IP was the cultural experience. A number of typical events were staged to help them appreciate this aspect of the country within they worked.

b) The second workshop was held in Glasgow, Scotland. In contrast, this workshop helped a micro-company comprising just 2 people: a father and son. The arrangements were similar to the previous year but, in reaction to criticism, the lecture series was curtailed to allow more team time.

c) The assignment for the third IP was different again. The teams worked for a Municipal Authority of Nicosia, Cyprus to develop promotional products. Working again around flat tables the teams were guided in a more formal way by means of timetabled team meetings with two assigned tutors.

3. STUDENT REACTION TO THE WORKSHOPS

At the close of each workshop, the IP required students to complete a questionnaire. It was used to ask about motivation, information and support, accommodation and infrastructure, recognition, and evaluation of the IP. The main aim of the analysis was to understand what were the points in need of improvement for the following workshops of the programme.

Table 1 indicates the student average response to their motivation to attend the workshop on a scale of 1 to 5: 5 being the most enthusiastic agreement. Of the five criteria, the European experience was the greatest factor.

<table>
<thead>
<tr>
<th>Table 1. Motivation to attend.</th>
</tr>
</thead>
<tbody>
<tr>
<td>academic</td>
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<tr>
<td>FI</td>
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<td>UK</td>
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<tr>
<td>CY</td>
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</tbody>
</table>

A student said in the second workshop: “It was a very good experience in my life to work in a real project, this project improved my skills gave me a good opportunity to have a job after my graduate, and to have friends from different countries and see their traditions.”

This was by no means untypical.

Generally, the students felt that the experience was very positive. Table 2 shows very encouraging support for this form of workshop. In fact, more than 80% of students (85%) evaluated the programme as 4 or 5. Very rewarding for the organization team.

<table>
<thead>
<tr>
<th>Table 2. Evaluation of the workshop</th>
</tr>
</thead>
<tbody>
<tr>
<td>academic</td>
</tr>
<tr>
<td>FI</td>
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<tr>
<td>UK</td>
</tr>
<tr>
<td>CY</td>
</tr>
</tbody>
</table>

A student, from the first workshop in Finland, wrote: “I personally think that 3 EYES project in Joensuu, Finland, was overall very beneficial for every involved student, especially for me. (...) I evaluated the whole stay in Finland as very creative, funny, interesting.”

In the second workshop a student said: “I consider this workshop a good life experience. This workshop gave me the opportunity to find out that the theory and practice are two totally different things. I also found out that the cooperation in multicultural team is really difficult.”

In terms of dates and duration of the programme students were very satisfied, especially during the first and third workshops. Almost 80% of students responded 4 or 5. The second workshop, in Glasgow was less successful in that only 70% of students responded 4 or 5. A student commented about Glasgow: “I thought the IP could last longer, we only had two weeks to learn about the subjects and to start and finish the project. We could have participated in more activities together, like the caileigh, which was very fun. But in a general perspective, the program was very good, and well structured.”

Accommodation in the host country was not thought to be very good except for the first workshop, in which almost 80% of students responded they were satisfied or very much satisfied (i.e., responded 4 or 5), the other two workshops had lower results. Only 18% of students responded 4 or 5 during the second workshop, which improve to 42% of students in Cyprus. During the second workshop a student said: “Also there was a problem about the accommodation because we didn’t have hot water for a few couple days, it was really cold in there and it was pretty far from the school.”

However, it is nice to receive very positive feedback from students (what happened during the first workshop). A student affirmed: “The way in which we were accommodated was a very positive aspect. Students from four countries were put up in the same hostel. This gave us more time to get to know each other and so we were more comfortable when working in our groups. This also gave us time to socialize together and relax within the hostel in the mornings and evenings. The short distance between the hostel and the university meant that each group could walk together giving us better sense of direction around the area. This was a real pleasure for us to walk every day and would not have changed this if given the choice.”

As this text suggests, it was the social activities that received the most praise. Table 3 shows how the average response was greater than 4 for “other activities”. All three venues were able to give the students a truly cultural experience which, for some students who had never travelled abroad before was both life enhancing yet scary in the sense that so many experiences were completely outside of their experience: things such as food, music and dance. Students believed very strongly that this
experience will help them in their further studies / career, in fact over the three workshops, 85% of students chose 4 or 5.

### Table 3. Pedagogy and organisation

<table>
<thead>
<tr>
<th></th>
<th>nr hours</th>
<th>equipment used</th>
<th>profs</th>
<th>quality of facilities</th>
<th>learning outcomes</th>
<th>other activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI</td>
<td>3.7</td>
<td>4.4</td>
<td>4.3</td>
<td>4.0</td>
<td>3.8</td>
<td>4.0</td>
</tr>
<tr>
<td>UK</td>
<td>3.1</td>
<td>3.7</td>
<td>3.8</td>
<td>3.4</td>
<td>3.3</td>
<td>4.3</td>
</tr>
<tr>
<td>CY</td>
<td>4.1</td>
<td>3.5</td>
<td>4.2</td>
<td>4.3</td>
<td>4.0</td>
<td>4.3</td>
</tr>
</tbody>
</table>

### 4. TEXT ANALYSIS OF THE STUDENT REACTIONS

Course of the last workshop, students were required, as part of their assessment to write an essay that reflected on the workshop itself. These have been subjected to a sentence analysis and to date, of the 3042 sentences written by the students, 2280 have received a preliminary analysis to identify the primary objective of the sentence and of these, 683 have received more detailed examination to identify additional (secondary) implications.

Each sentence was placed into one or more of 31 categories as either a positive or a negative comment. Subsequently, the 31 were consolidated into 8 categories for ease of analysis, table 4

### Table 4. Eight consolidated categories for analysis of the student essays

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Communications issues: culture, language, etc</td>
</tr>
<tr>
<td>CU</td>
<td>Cultural issues other than communication: food, building, crafts, ways in which problems are approached etc</td>
</tr>
<tr>
<td>E</td>
<td>Education: lessons learned</td>
</tr>
<tr>
<td>G</td>
<td>General comments</td>
</tr>
<tr>
<td>P</td>
<td>Issues regarding the way in which the academic part of the workshop was delivered.</td>
</tr>
<tr>
<td>PR</td>
<td>Issues on how the workshop was organised: time, culture, accommodation etc</td>
</tr>
<tr>
<td>M</td>
<td>Market issues</td>
</tr>
<tr>
<td>T</td>
<td>Team work issues: integration, bonding, procedure etc</td>
</tr>
</tbody>
</table>

Figure 1 shows the number of responses per category for the 683 sentences that have been vigorously analysed. It is encouraging to note that there are approximately 10% negative (critical) responses because it is not unknown for students to write a more saccharin report to gain marks.

As an example, here is a sentence within the “C” category that relates to both C and T: “We all helped each other and at times they would help explain my point in different English to another for example if they didn’t understand something I had said they would change into different English to explain to another (sic).”

On the other hand, here is a sentence from the M category:

Applications and websites are something that most of the people use nowadays in order to inform themselves about everything in their everyday lives.

Since the workshop is based about team working, it might be expected that there would be a good proportion of secondary comments related to the T category, and so it proved. Table 5 displays the analysis of the 683 sentences in which it can be seen that the most common secondary category is T for all but G, M and P. The rows representing the responses within categories defined in the columns.

### Table 5. Percentage of secondary subjects per category

<table>
<thead>
<tr>
<th>Category</th>
<th>T (%)</th>
<th>C (%)</th>
<th>CU (%)</th>
<th>E (%)</th>
<th>G (%)</th>
<th>M (%)</th>
<th>P (%)</th>
<th>PR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>100</td>
<td>16</td>
<td>12</td>
<td>17</td>
<td>11</td>
<td>2</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>44</td>
<td>100</td>
<td>6</td>
<td>18</td>
<td>7</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>6</td>
<td>100</td>
<td>20</td>
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<td>13</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>E</td>
<td>40</td>
<td>16</td>
<td>16</td>
<td>100</td>
<td>20</td>
<td>2</td>
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</tbody>
</table>

Table 6 is an example of sentences from within the database of 3042. We have selected every 150th sentence so that the comments are an unbiased sample. As can be seen, there is a mix of both positive and negative comments.
### Table 6. Random selection of sentences from student reflective essays.

<table>
<thead>
<tr>
<th>sequence number</th>
<th>sentence</th>
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<tbody>
<tr>
<td>2</td>
<td>The programme allowed me to learn more about these countries and their cultures.</td>
</tr>
<tr>
<td>152</td>
<td>The main deficiencies were in our way to organize the working.</td>
</tr>
<tr>
<td>303</td>
<td>Language barriers were difficult at times, as some members of the group could not communicate as strongly as others.</td>
</tr>
<tr>
<td>452</td>
<td>Outlet electrical plugs are also quite different, to those in Central Europe.</td>
</tr>
<tr>
<td>602</td>
<td>I had lots of ideas in my mind but I wasn’t sure how to describe them in English.</td>
</tr>
<tr>
<td>752</td>
<td>I also created a financial plan and printed to present to municipal officers, because in the final presentation the time was short and we only had time to talk about the future projections of gains that Nicosia would have.</td>
</tr>
<tr>
<td>902</td>
<td>During a couple of days I started to understand to the rest of my team quite well and me wasn’t afraid to ask them meaning some words.</td>
</tr>
<tr>
<td>1052</td>
<td>and creates a great “green” image for the city due to it’s solar panel power source all within a great modern and traditional styled appearance.</td>
</tr>
<tr>
<td>1202</td>
<td>I think that sometimes having a leader in a team limits the participation of other group members.</td>
</tr>
<tr>
<td>1352</td>
<td>We wanted to come with some unique project that would people make remember Nicosia.</td>
</tr>
<tr>
<td>1502</td>
<td>Within my group this wasn’t really an issue as everyone usually came with new ideas, new research or the work that was needed for the next day.</td>
</tr>
<tr>
<td>1652</td>
<td>On Sunday, Cypriot took us by bus on trip around island.</td>
</tr>
<tr>
<td>1802</td>
<td>I think they could have been deeper and wider, not only a scratch in the issue.</td>
</tr>
<tr>
<td>1952</td>
<td>The project was stressful towards the end, but nonetheless it was an incredible trip and I really value the experience that I luckily got the opportunity to have.</td>
</tr>
<tr>
<td>2102</td>
<td>Honestly, later we did not need so much already, we had enough information and we took that from what we have learned and found ourselves.</td>
</tr>
<tr>
<td>2252</td>
<td>Our ideas were improving continuously and each of us was contributing to the team by giving their opinions.</td>
</tr>
<tr>
<td>2402</td>
<td>Why? I’m used to work with people with economic background who are used to work at least 8 hours per day and my group mates were completely different.</td>
</tr>
<tr>
<td>2552</td>
<td>Also the good concept of the pocket sized leaflet which has only the information visitors really need may be used later on.</td>
</tr>
<tr>
<td>2702</td>
<td>What I experienced during those fourteen days it just does not experience again.</td>
</tr>
<tr>
<td>2852</td>
<td>The last day in Nicosia was luckily quite nice.</td>
</tr>
<tr>
<td>3002</td>
<td>However close to the second week as one of our team members was asked to leave we started speaking to each other.</td>
</tr>
</tbody>
</table>

However, the sentences we have selected show that not all of them are of equal worth for the purposes of analysis so it is worthwhile picking out some others that are particularly useful; quotes are verbatim: “It pushed me to the next level. I had never worked in a team that had only communicate in English and learned a lot from it. I think that working in a team where you have to overcome language and cultural barriers is perhaps the biggest thing to take from the 3EYES experience.”

### 5. STAFF REACTION TO THE WORKSHOPS

Staff understood that student criticism was largely directed at the amount of time taken up by the lecture/seminar series, leaving too little time for project work. In consequence, the Glasgow lectures were compressed into a shorter number of days. However, they did include an extra, technical, lecture on solar cells to support the subject of the project. This did not go down well with students who were only slightly technically literate at best. In consequence, the rating for Glasgow “profs” (Table 3) was low.

In view of continued criticism, the lectures during the third workshop were (nominally) restricted to 30 minutes with narrowly focussed tutorials. Thus the staff were encouraged to deliver only those tools needed for the specific assignment, rather than providing an overview of the subject. This seemed to work well as the ratings improved once more. Table 7 provides an overview of the workshop timetable over the three IP.

One contributing factor to the poor performance in Glasgow was the nature of facilitating. During the first workshop, although there were nine teaching staff, only three of them were familiar with the nature of facilitating in this alien format. In consequence, there was light contact between staff and students during the team work periods. In essence, staff visited the tables informally and infrequently during the course of the workshop. However, that staffs attending Glasgow were now familiar with the pedagogical methods and everyone joined in such that the intervention was somewhat intrusive.

### Table 7. Workshop timetable: schematic for the three IP

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
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</table>

- Lecture and seminar/tutorial
- Administration/visits/cultural activity
- Formative assessment in front of whole cohort
- Team working time
- Summative assessment

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<td>11</td>
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<td>12</td>
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</tbody>
</table>

- Lecture and seminar/tutorial
- Administration/visits/cultural activity
- Formative assessment in front of whole cohort
- Team working time
- Summative assessment
One specific characteristic of the Glasgow teams was the extensive use of laptops so that teams working around a flat table, seemed as if they were a collection of individuals surrounding a defensive wall of laptop screens (fig 3).

![Figure 3. Tutor advising a team of laptops](image)

Staff wondered if this physical barrier was also a psychological barrier. In consequence, the third IP was structured quite differently so that, other than lectures/seminars, students were only required to attend for one hour per day for a formal meeting with two nominated tutor/facilitators: laptops excluded from the meetings to encourage debate! In fact, giving the teams a freedom to work either within or without the university worked very well: most teams worked mainly within the university and voluntarily called for additional tutor advice from time to time.

6. DISCUSSION

All the three workshops were well received by students, albeit with some criticisms, but staff was unhappy about teamwork. There were ice breaking activities but, while teams developed close friendships, their team working was less satisfactory. Following an initial bonding phase, the teams cooperated to generate initial ideas on new products after which they separated on discipline lines until they were forced to re-form to develop their last presentation. In consequence, the product they developed was interesting but not outstanding. Staff left the last workshop with a view that other ways need to be used to truly encourage invention.

Nevertheless, students gained immensely from the social and cultural interactions and also realised that a real project relies on contributions from many disciplines in addition to their own. They also realised how the teaching and working methods in other countries and disciplines could differ considerably from their own.

Many also expressed a desire to experience international work again.

Thus the principal reason for the workshops have been achieved and Erasmus can feel justified in their sponsorship but at what cost? All were paid both a per diem rate and travel to the venue, which amounted to many thousands of Euros so if there was no European sponsorship would the workshop continue to be run? It is unlikely unless there is either some form of sponsorship or the workshop becomes self-financing.

An alternative methodology has been reported in an earlier conference [5] where two teams, one of engineering and one of business, collaborate to develop a new product using video conference (VC) to communicate because they work in different countries.

The rationale for this format stems from increasing global specialization of work, where multidisciplinary virtual teams comprised of technical and business members are increasingly common in today’s workplace. While higher education has responded by creating opportunities for remote teams to learn from collaborative work (see for example [6], [7], [8]) engagements between significantly diverse disciplines, such as business and engineering, are few [9]. Such remotely situated diverse teams must not merely foster trust, communications, and productive relationships but must also develop a mutual understanding of each other’s disciplines despite potentially divergent goals, all via technology-mediated communications.

Equipment costs for this methodology are fairly modest but not insignificant bearing in mind a need for a professional VC to support team meetings (since web cams are good for individual communications but not for formal meetings). However, the tutor overhead is quite high to support learning by means of regular team meetings.

Co-operative learning is most effective when collaborating teams are positively interdependent upon each other [10]. Thus the team project was designed to have common outcomes, inter-dependant work processes and joint responsibility for managing the communications. Despite this, there was still a sense that engineers kept “marketing issues” at arms length and visa versa.

The similarity in behaviour between disparate disciplines is observed in both styles of project. To an extent it is understandable since there are few attempts within higher education to encourage inter-disciplinary cooperation, a trait reflected (unfortunately) within the industrial sector but which might, in truth, be merely an extension of historical attitudes encouraged throughout the education process.

In any event, the 3EYES workshop cost many tens of thousands of pounds while the VC methodology was considerably cheaper but which has not quite the same cultural impact.

7. CONCLUSIONS

Three workshops have been described that were sponsored by ERASMUS funds. The outcomes can be regarded as extremely positive as regards social and cultural learning and a desire to repeat the experience. The candidates were challenged to work in an unusual environment as compared with their home university but they learned about cooperation and the diverse needs of international projects.

It would be unlikely that the high cost of these projects would be found without EU sponsorship. In contrast, a less expensive route was introduced that achieves most but not all of the 3EYES objectives.

We believe in both these projects because some way must be found that improves the employability of students [11], [12]. Therefore it is our responsibility to move away from traditional forms and experiment even more with methodologies that promote not just the pursuit of knowledge but the pursuit of experience.

8. REFERENCES

2. Ibid. agreement number 2010/IP/13/GLASGOW08, (2010).
3. Ibid. agreement number 2011/IP/09/GLASGOW08, (2011).
A CASE STUDY OF INTEGRATION AND PENETRATION OF ENGINEERING AND BUSINESS EDUCATION IN SHIJIAZHUANG UNIVERSITY OF ECONOMICS

Wensheng, Wu¹ and Xiaolei, Liu¹
1 Shijiazhuang University of Economics, Hebei, P. R. CHINA, wwsuwensheng@163.com

ABSTRACT: In the nearly 60 years of school history, Shijiazhuang University of Economics has created and accumulated an extensive experience in engineering and business education, formed characteristics of a multi-disciplinary, multi-professional, multi-level, and multi-way integration and penetration. This paper studies the integration mechanisms, ways and extent of engineering education and business education in the aspects of power, scientific research, professional settings, the curriculum, classroom teaching and practice instruction, teachers’ training, teaching materials and teaching aids as well as in the different levels of graduate students, undergraduate students and college students in Shijiazhuang University of Economics.

Key words: Engineering and business education; fusion mechanism; Shijiazhuang University of Economics

1. AN OVERVIEW ON THE DEVELOPMENT OF SHIJIAZHUANG UNIVERSITY OF ECONOMICS

Shijiazhuang University of Economics (called SUE) founded in 1953, which was formerly known as Hebei College of Geology. Geological Financial Accounting was established in 1956, and Statistics major was founded in the next year.

Xuanhua Geological School was upgraded to college named as Hebei College of Geology in 1971, and renamed as Shijiazhuang University of Economics in 1996.

After nearly 60 years of development, she has formed the characteristics of a multi-disciplinary, multi-professional, multi-layered, multi-way integration and penetration of engineering and business.

2. THE POWER OF ENGINEERING AND BUSINESS EDUCATION’S INTEGRATION AND PENETRATION

The integration and penetration of different disciplines can share teaching resources, lower operating cost and play the advantages of economies of scale, therefore, integration and penetration between different disciplines is an inevitable trend of modern education.

From the point of view of the formation power, Integration and penetration of engineering and business education are driven by two sides [1]: one side, colleges and universities actively promote.

Educators have seen the trend of integration and penetration between the disciplines, thus consciously promote the penetration and the integration between the disciplines in the process of teaching.

Another side, the pull on the demand for talent from the industry, as the development of modern economy, industrial integration and penetration trends are becoming evident, so it requires having the talents of inter-disciplinary knowledge structure.

3. A VARIETY OF INTEGRATING AND PENETRATION WAYS OF ENGINEERING AND BUSINESS EDUCATION

3.1. Integration and Penetration in the Area of Scientific Research

Back in the early 1980s, SUE had pioneered the first study on the deposit economic evaluation in China.

The “Qinan iron ore economic evaluation for Shougang in Beijing”, which had put forward the best solution to developing Qinan iron ore for Shougang.

The sub-project of Beijing and Tianjin geothermal evaluation from United Nations “the economic evaluation on tertiary water’s exploration, development and utilization in the area of Tianjin and Wang Lan Zhuang geothermal field”, it also was the first time to evaluate the geothermal resources in China.

In 1990s, SUE undertook the National “Eighth Five-Year Plan” Key Projects “Economic evaluation on geological environmental quality and profit loss in the area of Yangtze River Three Gorges Reservoir Area”, the “Eighth Five-Year Plan” Key Projects of Ministry of Geology and Mineral Resources “Geological and economic feasibility of land utilization of Haicang Development Zone in Xiamen”, and other subjects. SUE also participated in the research on the National “Eighth Five-Year Plan” Key Project the Xinjiang 305 Project “Technical and economic evaluation on mineral resources development and utilization of Ertai economic area in Xinjiang” and the National “Ninth Five-Year” Key Research Projects, provide decision-making basis for relevant departments.

In recent years, the representative research achievements of the integration and penetration of engineering and business are “Mining property right’s price assessment”, “study on industrialization and market-oriented of water resources’ development and utilization in Hebei province”, “Economic theory of water resources”, “The Western Development-A sustainable development road”, “China's mining regulation system”, and so on.
3.2. Integration and Penetration in Professional Level

The integration and penetration of engineering and business education at professional level shows in four aspects next:

3.2.1. Professionals of Earth Sciences Set the Courses of Economics and Management

For example, the professional Mineral Geology and Exploration in 1954 offered the course:

- “accounting of exploration operations organization”;

The professional Hydrology offered:

- “economic organization, plans and technical reports for hydrogeological work”;

The professional Hydrogeology and Engineering Geology in 1984 offered:

- “political economics”, “geological work’s organization and planning”,
- “groundwater resources’ protection and management”,
- “groundwater resources’ development and management”;

The professional “Geology and Mineral Exploration” in 1985 offered:

- “Political Economics”,
- “geological work management”;

The professional “Metal and Non-metal Geophysical Exploration” in 1977 offered:

- “political economics”,
- “organization and management”,
- “econometrics”,
- “foreign economic statistics”,
- “introduction to geological economics and management”,
- “geotechnical economics”,
- “management psychology”,
- “economic geography”,
- “foreign trade statistics”,
- “public relations”
- and other Economics and Management courses;

The professional Geology and Geophysics in 1990 offered:

- “basis of management”,
- “basis of economics”,
- “systems engineering”,
- “operations research”
- and other Economics and Management courses[2];

The professional “Geology and Mineral Exploration” in 1996 offered:

- “economics”,
- “systems engineering”,
- “basis of modern management”,
- “technical and economic evaluation on deposit”,
- “Project management” and other courses;

The professional “Hydrogeology and Engineering Geology” offered:

- “introduction to modern management”,
- “systems engineering”,
- “project budget”,
- “project management”,
- “geotechnical economics”;

The professional “Applied Geophysics” offered:

- “economics”,
- “systems engineering”,
- “introduction to modern management”,
- “project management”.

In addition, the professional “Civil Engineering” offered:

- “project budget and bidding”,
- “civil engineering and project management”,
- “construction project budget”;

The professional “Environmental Engineering” offered:

- “environmental economics”,
- “technical economics of environmental engineering”,
- “environmental management and regulations”,
- “ISO14000 environmental management system”;

The professionals “Hydrology and Water Resources Engineering” and “Ground -water Science and Engineering ” offered:

- “introduction to water resources planning”,
- “technical economics”; 

The professional “Precious Stones and Materials Technology” offered:

- “marketing”,
- “selling skills and negotiation”,
- “public relationship”,
- “consumer behaviour”,
- “modern enterprise management”,
- “business economics”,
- “services marketing”,
- “jewellery trade”,
- “jewellery appraisal”
- and other Economics and Management courses and penetration courses of engineering and business;

The professional “Mineral Processing Engineering” offered:

- “Technical economics”,
- “business management”,
- and other courses. SUE regulated that all students for earth science bachelor degree from 2006 must at least learn two optional courses of economics and management which are equal to 4 credits.

3.2.2. Professionals of Management/Economics offered the Courses of Earth Science

From the profession “Geological Financial Accounting” and “Geological Planning Statistics” established in 1950s to the profession “Geological Economic Management” established in 1975, and to the “Geological Technology Economy” and “Industrial Management Engineering” established in 1984 and “Land Resources Management” established in 1999, then to “Resources Environment and Rural and Urban Planning and Management” established in 2006, the integration and penetration courses of earth science and economics occupy a large Scale, such as the professional “Geological economic management” recruited in 1977-1979, which offered:

- “the basis of geology”,
- “mineral deposit and prospecting and exploration”,
- “the basis of exploration engineering”,
- “introduction to geological economics and management”,
- “modern enterprise management”,
- “business economics”,
- “services marketing”,
- “jewellery management” and other courses.

SUE regulated that all students for earth science bachelor degree from 2006 must at least learn two optional courses of economics and management which are equal to 4 credits.
“the basis of hydrogeology and engineering geology”,
“the basis of geophysical and geochemical exploration”
and so on.

The professionals “Geological Accounting” and “Geological Statistics” in 1988 offered:
“the basis of geology”,
“mineral deposit and prospecting and exploration”,
“exploration technology”,
“hydrological geology”,
“geophysical basis”, and so on;
The professional “geological technology economy” offered 15 geological courses and 10 Economics and management courses.

And SUE regulated all the students for Economics and management bachelor degree must at least choose two of the earth science courses since 2006.

“the basis of mineral geology”
“exploration technology”.

3.2.3. Integration and Penetration at the Level of Graduate and Double Bachelor Degree

Since 1986, SUE began to recruit, train graduate students of the professionals “Geological Economy” and “Business Administration”. Offered the courses “management of geological exploration unit”, “introduction to geological economics and management”, “mineral economics”, “geological technical economics” and other courses.

Since 2004, SUE started to recruit master graduate students of the professional “population, resource and environmental economics”, focusing on the field of mineral resources and environmental economy, geological disaster economy, mineral resources development regulation, the ecological compensation for mineral resources exploitation, economic evaluation on mineral resources, the exploitation of mineral resources and environmental policy, etc;

Since 1988, SUE started to recruit double bachelor degree students. The graduates from earth science studied the courses and finished the dissertation in the area economics and management, but the graduates from economics and management studied courses and finished the dissertation in the area of earth science.

4. THE INTERDISCIPLINARY KNOWLEDGE STRUCTURE OF TEACHERS’ TEAM

SUE has being paid special attention to the training of teachers with interdisciplinary knowledge structure.

In general, three ways of training are adopted.

First, the geological teachers or geological graduates changed their profession.

In the 1980s-1990s, more than 10 young teachers diverted to study economics or management.

These teachers are good at integration and penetration of geology and economics/management.

Secondly, graduates of economics or management from other universities came to SUE and became professional teachers, through study, research and teaching practice, then gradually grew up into the type of teachers with geological and economic/management knowledge structure. Near a half of teachers of economics/management.

Thirdly, graduates of economics/management stayed on the university to teach.

Before the 1990s, a number of teachers belong to this type.

Because this group of graduate learned the integration and penetration courses of geology and economics/management at the university, their teaching is handy after graduate.

5. INTEGRATION AND PENETRATION OF TEACHING MATERIALS AND TEACHING AIDS

SUE attaches great importance to the construction of permeable textbooks and auxiliary textbooks.

In the period of Xuanhua Geological School, geological and economic integration and penetration courses such as:
“geological exploration plans”,
“geological exploration statistics”,
“geological exploration accounting” were printed[3].

In addition, SUE compiled a large number of references, exercises and operations. In the period of Hebei College of Geology and Shijiazhuang University of Economics, in addition to printing school textbooks, SUE actively encouraged teachers to publish textbooks.

6. INTEGRATION AND PENETRATION BETWEEN THEORY TEACHING AND PRACTICE TEACHING

Whether it is in the period of Xuanhua Geological School or in the period of Hebei College of Geology or in the period of Shijiazhuang University of Economics, each professional of economics and management offered earth science courses and geological and economic penetration courses in theoretical teaching. Among them, except the professionals “Geological Economics and Management”, “Geological Technical Economy” and “Land Management”, for most professionals, the geological courses are below 10% in proportion; except the professionals “Geological Financial Accounting”, “Geological Planning Statistics” and “Land Management”, for most professionals, the integration and penetration of earth science and economics and management are below 10% in proportion.

What’s more, every professional of economics and management generally arranged field geological practice from 2 to 3 weeks. Other professionals of geo-science arranged economic courses between 13% and 16% in proportion.

Except the professionals “Geology and Geophysics” and “geographic information system”, this may be relevant with the training plan revised in 1991 which regulated that crossing courses of earth science and economics and management was not less than 10%[4].
7. NEW TREND OF INTEGRATION AND PENETRATION ENGINEERING AND BUSINESS EDUCATION

One of the new trends of integration and penetration engineering and business education is that the wide application of information technology improves the interdisciplinary penetration speed and scope, new professionals, courses and research direction of integration and penetration engineering and business education.

Another new trend is that administrators and teachers pay more attention to and intend to develop integration and penetration field.

So, discipline group, professional group and course group with the characteristics of integration and penetration engineering and business education have being formed, and a number of research achievements with that characteristic have been made.

8. REFERENCES

COOPERATION BETWEEN ACADEMIA AND BUSINESS
ELECTRONIC INFRASTRUCTURE AIMED AT IMPROVING COMMUNICATION AND EDUCATION FOR BUSINESS AND ACADEMIA

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ABSTRACT: This paper will present an educational method that will help link academia and business. This method will help improve the relations between academia and business in the field of building and testing memory systems. We will provide the basic theoretical structure of our method, and will provide our readers with a case study of one particular testing method that can breach the barrier between academia and business. This method will help both parts in improving their production methods and testing techniques. Our method will promote extended communication by using electronic means (e.g. e-mail, electronic reports, etc.), which will help the two parties work together more efficiently. We will provide an electronic infrastructure that will ease the communication between the two parties. We will also provide a study on a particular example that will prove that there are significant improvements regarding communication and learning, while also reducing the time needed for the academia methods to be implemented in business.

Key words: electronic structure, communication, collaboration, academia-business

1. INTRODUCTION

One of the most pressing problems in today’s technological development is the lack of communication and collaboration between academia and business or industry. The examples are rare where the research results provided by academia are applied in industry in a time frame smaller than 10 year, especially in the field of Computer Science and Computer Architecture. For example in the field of memory testing, the tests applied by the producers, in order to test the memory systems, were developed in the early years of research in memory testing; most of them are older than 30 years, even though there has been constant academic research in the field of memory testing. The same phenomenon is encountered in most aspects of Computer Architecture research and development fields. One of the reasons for this, is the fact that most of the new methods developed by researchers are not properly simulated and tested; another being the fact that in this field the number of researchers and new methods developed have known a boom in the last two or three decades\cite{4}.

Our paper will present a method that will be able to manage and improve the collaboration between academia and business, aimed at reducing the huge delay between the development of new methods by academia and the moment when these methods are applied in practice by the industry of the field. Our method will be able to be implemented in most fields of research, the only restriction is that the academia representation should exceed the number of companies that are able to implement the methods developed by the academia researchers. In order to do that we will show the basic principles on how to develop the communication infrastructure that will be used in order to improve the collaboration and communication between business and academia. Besides providing the basic principles in building this infrastructure we will also present a case study that relates to the field of memory testing and memory reliability, where we will show the main benefits of this new method.

The remainder of this paper is organized as follows: section 2 will provide the description and implementation of our collaboration and communication method between business and academia, section 3 will provide the results obtained in our case study that relates to memory testing, while section 4 will conclude this paper.

2. COLLABORATION AND COMMUNICATION METHOD

Due to the fact that each year academia researchers develop more and more methods, these methods are harder and harder to implement by industry, one important cause of the harder implementation is the lack of collaboration. If the academia researchers would have access to industry’s roadmaps for future products the delay between developing a new method and its implementation would be greatly reduced. The simplified model for an idea becoming a new product is illustrated in Figure 1.

\begin{figure}[h]
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\includegraphics[width=0.5\textwidth]{model.png}
\caption{Simplified model for an idea becoming a product.}
\end{figure}
The main problem of this state flow is that most of the time the methods developed by academia are not implementable in products within an acceptable time delay. One of the reasons for this issue is the lack of communication between academia and business, mainly the business is looking for new products and methods to implement from the methods that have been around for a long period of time and that have been validated by the academic community. This is why a great number of methods that have been developed by academia are never implemented in real products and remain in the theoretical area.

Figure 2. Collaboration delay after applying the communication and collaboration method.

Figure 2 contrasts the current state of educational methods, with the results that will be obtained by applying our proposed method. By applying our method we will be able to increase the collaboration and communication between academia and business, thus having more specialized research results that will be easier implemented in actual products by the industry of the field.

2.1. Collaboration and Communication Description

This section describes our method called Collaboration and Communication, or CC. The CC method acts like a bridge: it takes information from business or industry roadmaps and it communicates it to interested researchers from academia. In order to be able to provide this information the business part should subscribe to our method and make available their medium and long term plans. If this is not possible, due to non-disclosure agreements or other legal issues, our method can predict, with a good accuracy, based on past projects and keywords the medium term plans of the company. This information is refreshed every quarter of a year. After gathering all this information the CC method groups businesses with similar products and interests[5].

On the same time the CC method will gather similar information from academia. The information from academia is easier to collect. This is because the data needed from academia is more in terms on general research interests and directions rather than specific product information.

After gathering all these information from both business and academia the CC method will group first the similar businesses, and then the similar ideas and research groups from academia. The second step is to try and find groups from academia and from business that can work together more efficiently. The third and most important step is the actual communication that will happen between these groups.

The communication will be done in two forms: electronically via e-mails and electronic reports, and via quarterly meetings between representatives of the two groups involved. The electronic communication will handle the progress reports of the two parts, while the physical meetings will set new research directions and will handle the development of new methods and products. The evolution in time of the steps is depicted in Figure 3, while the details of steps 1 to 3 are illustrated in Figure 4.
In the following section we will provide a case study where we apply the CC method in order to improve communication and collaboration between academia and industry in the field of producing and testing of memory systems.

One of the reasons that restricted the collaboration between academia and business is also the credit for the work that has to be shared, and sometimes when integrating the research into a new product and launching it on the market the result cannot be published by academia. In order to counteract this effect of the collaboration and the “mistrust” that comes with it our method will use a dedicated server that will store all the communication between the parties, and it will be able to accredit the results to each of the party. So for example if the business part comes up with a solution to apply one method it cannot be accredited to academia, and vice-versa.

3. CASE STUDY

In this section we will show how to apply the CC method described throughout section 2 in a specific field, the field being the testing of memory systems.

Even though the research in the last three decades has prospered in the field of memory testing, the testing methods that are used by the industry of the field were developed in the 1980s. The main reason for this lack of collaboration is the fact that there has been very little communication between the academia research communities developing new testing methods and mechanism and the producers of memory systems. Also the new methods developed by researchers are sometimes totally non-implementable, because of technological reasons. If there had been a more collaborative environment the newly developed methods would have had a much smaller delay between development and the actual implementation and utilisation in industry. In the following we will show how, by applying the CC method this delay can be significantly reduced.

3.1. Step 1: Identifying the parties and grouping the ones with similar interests

First of all we will follow the steps described by Figure 4. In step 1 we will identify the companies that produce and develop memory systems on one hand, and academic research groups that work on developing new memory testing methods. In this first step we will group these memory manufacturers, which represent the business part of the equation, by the type of memory that they produce. So we will have several categories, among which will be: SRAM (Static Random Access Memory) producers, DRAM (Dynamic Random Access Memory) producers, SSD (Solid State Drive) producers, HDD (Hard Disk Drive) producers, etc. We will focus on the manufacturers...
that produce SSDs, which are used as the cache memory part of computer systems. Also we have to identify the academic communities that deal with developing testing mechanisms for SRAM memories. There are a large number of academic communities that deal in memory testing, because each major university centre that has a computer engineering department has, within that department, a group that works on memory testing. So we are dealing with a large academic community, which means that we can apply the CC method.

3.2. Step 2: Linking the two or more parties into collaborative groups

In order to continue applying the CC method we need to go to step 2. In this step we will have to link the business part with the academic part. Mostly by looking at developing methods used by the manufacturers we can do these linking and grouping. This grouping will yield roughly a number of three to four academia research groups to each manufacturer of memory systems.

3.3. Step 3: Setting the basic rules and protocols for communication and collaboration

After completing this step we will focus on applying the next step, which will insure the increase in communication and collaboration that this field is lacking in. In order to do that the basic communication rules have to be established. First of all an initial discussion between each research group or representative from academia and the representative team from the business part have to occur. In this discussion the frequency of the technical e-mails and reports will be established, the usual case is that there will be one technical e-mail send per week, with the latest updates; and one technical report every two weeks in order to check for status updates. The most important part is that these e-mails and technical reports have to be generated by both parties. So the research groups from academia will send their research updates via e-mail and technical reports; and also the business representatives in charge with the project will have to send their production and implementation updates.

4. CONCLUSIONS

In this paper we presented a method called collaboration and communication (CC) that helps academia and business connect more efficiently. The efficiency comes from the fact that the two parties collaborate more closely without the fear of stolen ideas and unaccredited work, by the use of a third party infrastructure, provided by the CC method, that will ensure the correct accreditation of the intellectual work.

We have provided throughout this paper the methods and steps needed in order to apply our method to any research field. Our method consists of three steps that can be easily applied to any collaboration and communication need between different parties that work in similar fields.

We have also illustrated a case study where our method called collaboration and communication is applied in the field. The field where we have shown its applicability is the field of memory testing, where the delay between developing new testing methods and applying them in the production of new memory chips can extend over several decades.

5. ACKNOWLEDGEMENTS

This work was partially supported by the strategic grant POSDRU/88/1.5/S/50783, Project ID50783 (2009), co-financed by the European Social Fund – Investing in People, within the Sectoral Operational Programme Human Resources Development 2007-2013.

6. REFERENCES

ABSTRACT: Regarding the economic crises and the slow recovery that still continues, we believe that a solution can be improving the capacity to research and innovate in order to achieve sustainable development. Another key issue of the paper is about developing the cooperation between academia and business. The challenge of this development is how to increase the amount to finance research and innovation that can be implemented in the economy. As a global solution, to this problem we can recommend, for example, reducing tax evasion and by fiscal education. Also particular sources have to be found in order to develop innovation on SME level. It is essential for innovation to make quality research in order to be better prepared and increase adaptability to economic cycles. The aim of the paper is to find out how service innovation and cooperation between academia and business can enhance sustainable development indicators. The conclusions of the paper are structured in particular proposals and recommendations.

Key words: sustainable development, service innovation, cooperation academia-business

1. INTRODUCTION

A definition for sustainable development proposed by Interfaith Center on Corporate Responsibility (ICCR) “Sustainable development is the establishment of fair, effective and participatory structures in order to encourage development of communities and surrounding regions”. [11]

Sustainable development concept means a further elaboration of the close links between economic activity and the preservation of environmental resources. It implies a relationship between the environment and the economy, within which a key element is the consequence of environmental resources that are not “unduly” diminished. (OECD, 1990)

Careful economic analysis that will strengthen environmental protection lead to rising sustainable levels of welfare. (World Bank, 1992) [12]

There are several classifications of the existing sustainable development indicators: the OECD set includes 111 indicators, the set proposed by UE includes 123 indicators and the Canadian Index of Wellbeing includes 80 indicators. The disadvantage of such sets is the fact that they do not allow a global analysis of the situation in a country, and interstate comparisons, but only research on thematic areas, which does not provide the possibility to formulate conclusions. According to Sustainable Society foundation, which realises the index of Sustainable Society, and which in addition shows the range of the country from the sustainable development point of view, is based on 22 indicators divided into 5 categories as it follows:

- Personal Development (a healthy life, sufficient food, sufficient water, a safe sanitary system, opportunities in education, equality between sexes)
- A clean environment (the quality of the air, quality of the water, quality of the soil)
- Equilibrium in society (good governance, unemployment, population growth, allocation of funds, debt)
- Sustainable use of resources (recycling, use of renewable water, alternative energy)
- A sustainable planet (the forests dimension, biodiversity conservation, greenhouse gas emissions, ecological footprint, international cooperation [13].

Each indicator was expressed on a scale from 0 to 10 (where 0 shows lack of sustainability and 10 a maximum sustainability). The index presents the disadvantage of only using 22 indicators, and the power to each category of the 5 is not sustained by theoretical studies, but subjective up to the author.

Next, we present FDI in first 20 out of 151 countries analyzed in the year 2010, including Romania which is on the 19th place.
At the heart of business today lies a dilemma: Our economy is increasingly dependent on services, yet our innovation processes remain oriented toward products. Indeed, we have well-tested, scientific methods for developing and refining manufactured goods, but many of them don’t seem applicable to the world of services.\[3\]

The global crisis had worn the business world about the need to update its business models in order to survive. We strongly think that companies and states can be more competitive through research and innovation.

Now we must have the global view of what sustainable development means. As it is known there is a continuous shift between services, goods and agriculture. In 2050 services will have in developed countries like 80%, goods 15% and agriculture less than 5%. Although we need innovation in all sectors, it is essential that innovation in services to be at a high level.\[1\]

“\(\text{To be successful even as an employee in today’s global economy, one will need the drive, creativity, and innovative ideas more commonly found among entrepreneurs.}\)” When someone decide to be an entrepreneur, it is important to figure out some pieces of information like: begin with the end in mind, where to from here, take care not to win a game that it is not suitable for you.\[2\]

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2. SERVICE INNOVATION

Now we must have the global view of what sustainable development means. As it is known there is a continuous shift between services, goods and agriculture. In 2050 services will have in developed countries like 80%, goods 15% and agriculture less than 5%. Although we need innovation in all sectors, it is essential that innovation in services to be at a high level.\[1\]

We must take into consideration Romania’s rise from 49 place in 2006 to 19 place in 2010. We must observe the countries that joined the EU in 2004 (with Bold in the tabel) and that engage better places in this top, specifically: Latvia 6 place, Slovenia 8 place, Estonia 11 place, Hungary 14 place, Czech Republic, Lithuania and Slovakia are on the 16, 17, 18 places.

Table 1. The first 20 countries out of 151 at the level of 2010

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Source: Sustainable Society Index, available online at: http://www.ssfindex.com

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Figure 1. – Innovation waves [14]

Growth and competitive advantage within a company can be obtained through services. Innovation in services will became a easy and reliable way to develop companies that fight off the pressures of expenditures and product standardization with stress on lowering the prices. Now internet is playing a key role and new technologies like Web 2.0 and Web 3.0 will make the difference. The paradigm is changing due to the help of new technologies and rich internet applications and will facilitate innovation in service sector. Being a decision making factor we have to consider associating a service with the products we sell. [14, 4]

Now we summarize some fundamental aspects regarding emerging economies and innovation in services:

- touching the customer more quickly and encourage them cocreate with your business in order to find out the needs
- going outline de borders from consumer help to innovation
- think of your business as a service business where customers have different needs and are willing to pay more for variety and convenience.\[5\]

Nowadays, it is a tendance that companies outsource a lot of activities to cut expenditures, but this practice cannot make from the company a better one having innovative product and services. Core activities should not be outsourced but improved so that to became much more effective.

Companies can combine economies of scale with economies of scope. Economies of scope are different from economies of scale and describe „to the efficiencies that result from offering several items from a single source. In banking, economies of scope are referring to cross-selling.”\[6\]

Service innovation can be done both in large and small companies with higher speed implementation in the last category. Large companies need to consider investing in a platform in order to provide more products and services all together. When possible, small firms should do the same. Also, collaboration between academic world and enterprises need to be a successful one.
In the future, time will become more and more valuable for clients. „They will not take only products, but also services connected with the products. They will need experiences, not just stuff. To get the most out of services innovation the company has to transform the business model into a platform, that can sustain profitability and make it harder for competitors to expel your organization” [7].

“The cited study regarding the creation of an organizational innovation model, concludes that the weights of critical dimensions in measuring organizational innovation area are: technical innovation (0.416), administrative innovation (0.584), external relational innovation (0.318), internal organizational innovation (0.266), product/service innovation (0.262), and process innovation (0.154).“[8]

In order to obtain satisfactory results in innovation, the company has to make a strong research and later use the results found. In big companies, employees must take part in the entire innovation process in order to produce valuable added value to the entire chain of production management. They have to be stimulated when achieving outstanding results.

3. THE NEED OF COOPERATION BETWEEN ACADEMIA AND BUSINESS

Cooperation between academia and business has to be successful in order to generate innovation. Furthermore, both universities and enterprises have to follow state policies to obtain good results. As we already stated, service sector will develop more and more and in turn society will become more and more knowledge-based. The role of future universities will be shifting from academic development, also needed but not enough, to economic development tied with intellectual property. Even if, there are voices that do not agree adding a new purpose to universities, the entrepreneurial university is gaining ground in states like US, Asia, Latin America and Europe. [9] Our opinion is that Romania has to adapt its strategies in order to motivate universities to become entrepreneurial. In this respect, more actions have to be done. Knowledge gaps between Romania and other European countries must be reduced in a short period of time. Research and innovation have to became of great importance for universities because the business world is changing, so academic world must change too.

4. SOURCES TO FUND INNOVATION AND RESEARCH

Companies need to allocate funds for these activities and maintain a strong connection with entrepreneurial universities. In order to achieve progress, the government should also act in this way. The problem nowadays, is that stats are facing massive public debts, so funds for research and innovation are smaller.

A solution can be, for example, through lowering the amount of tax evasion and teaching payer to have a responsible attitude towards paying taxes. These efforts have to be done on one side by the tax payers and on the other side by the government. The government has to describe in detail and with clarity how are the funds used for the benefit of the society (better conditions in hospitals, more money for research and development in strategic areas, and so on). Tax morale are directly related to how citizens are treated by tax authorities, by their trust in government institutions and by extent of popular right. [10]

5. CONCLUSIONS

The paper starts from the definitions of sustainable development and ranks Romania considering the Index of Sustainable Development.

We recommend developing innovation, especially in service sector in order to reach sustainable development. Research and innovation are two key functions that middle management and top management have to consider. Past business models need to update in order to survive in a more and more complex business world.

Academic world has a key role in acquiring good results in research and innovation. Entrepreneurial universities have to develop more and more in a changed business world which has adapted its business models. If a company is just selling goods, it has to consider also adding a service to the products sold in order to became different from the competitors. Governments can obtain the funds to finance these two important sectors by diminishing tax evasion and through fiscal education.

On the other hand, governments should be trusted by citizens and respect citizens rights.

6. ACKNOWLEDGEMENTS

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PUBLIC-PRIVATE PARTNERSHIP: SYNERGY BETWEEN HIGHER EDUCATION INSTITUTIONS AND BUSINESS OR INDUSTRIAL ORGANIZATIONS

Eva-Nicoleta, Burdusel\textsuperscript{1} Liviu, Balan\textsuperscript{2} and Anca, Plohod\textsuperscript{2}

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\textbf{ABSTRACT:} Based on existing studies on the necessity and significance of public-private partnership, the present paper focuses on the most recent perspectives and outcomes of connecting higher education to the business community: industrial organizations development and labour market demand. It is a commonplace statement that anticipative thinking, visionary leadership and strategic management are key factors of all organizations – industrial and non-industrial – for gaining advantage on a highly competitive, unpredictable and challenging market. This holds true for both HEIs and industrial organizations which should place value on a permanent interaction among: universities (as knowledge creators and disseminators and focused on fundamental research), industry (as promoters of innovation and applied research); and society (in view of an educated and skilled citizenry). The present study highlights the benefits and outcomes of the public-private partnership and illustrating best practices in the field.

\textbf{Key words:} public-private partnership, labour market, higher education, business community.

\section{1. RATIONALE:}

Based on existing studies on the necessity and significance of public-private partnership the present paper focuses on the most recent perspectives and outcomes of connecting higher education to the business community: industrial organizations development and labour market demand. It is a commonplace statement that anticipative thinking, visionary leadership and strategic management are key factors of all organizations – industrial and non-industrial – for gaining advantage on a highly competitive, unpredictable and challenging market. This holds true for both higher education institutions and industrial organizations which should place value on a permanent interaction among: universities (as knowledge creators and disseminators and focused on fundamental research), industry (as promoters of innovation and applied research); and society (in view of an educated and skilled citizenry).

\section{2. CONTEXT}

The 21st century’s knowledge-driven economy requires a synergy between educators and business people and, in this context, the public-private partnership represents a means for attaining competitiveness by universities as well as facilitating the acquisition of new skills – both specialized and transversal – required by the rapidly changing labour market.

According to Agenda 21, “training is one of the most important tools to develop human resources and facilitate the transition to a more sustainable world; it should have a job-specific focus, aimed at filling gaps in knowledge and skill that would help individuals find employment and be involved in environmental and developmental work; training programs should promote a greater awareness of environment and development issues as a two-way learning process.” [1]

Therefore, in view of implementing and carrying out these objectives, Romania’s new Education Law, which entered into force in 2011, strongly recommends and emphasizes the
necessity of partnerships / consortia with research-development centres [art. 129(2) and art. 155(3)] or other economic entities, professional associations and/or public institutions in view of developing study programs able to meet the labour market demands.

Romania’s new law on education has reinforced and made official the idea rolled out in the Presidential Strategy on Education and Research for the Knowledge Society which urgently recommended the collaboration between universities and business, industry or professional associations in view of quality assurance for graduate and doctoral study programs [2]

Moreover, a significant stipulation of the Romanian Education Law no. 1/2011 recommends and highlights the need for a correlation of curriculum and qualifications in view of quality assurance of the main academic processes: teaching and research.

The same idea had been previously outlined by the Presidential Strategy on Education and Research for the Knowledge Society which stipulated the setting up of a National Qualifications Framework for Higher Education in view of a more coherent connection between study programs and qualifications in terms of competences and learning results [2]

Mention should also be made of the Europe 2020 Strategy for Smart, Sustainable and Inclusive Growth whose aim is to: develop an economy based on knowledge and innovation – smart growth; promote a more resource efficient, greener and more competitive economy – sustainable growth; as well as foster a high-employment economy delivering social and territorial cohesion – inclusive growth. [3]

These threefold goal may be achieved by means of the following flagship initiatives, where four initiatives address education and research in particular: [4]

- Innovation Union (leading to smart growth);
- Youth on the move (leading to smart growth);
- A digital agenda for Europe (leading to smart growth);
- Resource efficient Europe (leading to sustainable growth);
- An industrial policy for the globalization era (leading to sustainable growth);
- An agenda for new skills and jobs (leading to inclusive growth);
- European platform against poverty (leading to inclusive growth).

The “Innovation Union” initiative aims to: “promote knowledge partnerships and strengthen links between education, business, research and innovation and to promote entrepreneurship” by means of “reinforcing cooperation between universities, research and business and prioritising knowledge expenditure”. [4]

The “Youth on the move” initiative aims to: “enhance the performance and international attractiveness of Europe’s higher education institutions and raise the overall quality of all levels of education and training in the EU, combining both excellence and equity, by promoting student mobility and trainees’ mobility, and improve the employment situation of young people.” [4]

The “Digital Agenda for Europe” initiative aims to: “provide a stable legal framework that stimulate investments in an open and competitive high speed internet infrastructure and in related services; facilitate the use of the EU’s structural funds; as well as to reform the research and innovation funds and increase support in the field of ICTs so as to reinforce Europe’s technology strength in key strategic fields and create the conditions for high growth SMEs to lead emerging markets and to stimulate ICT innovation across all business sectors.” [4]

The “Agenda for New Skills and Jobs” initiative aims to: “create conditions for modernising labour markets with a view to raising employment levels and ensuring the sustainability of our social models.

This means empowering people through the acquisition of new skills to enable our current and future workforce to adapt to new conditions and potential career shifts, reduce unemployment and raise labour productivity; as well as to ensure that the competences required to engage in further learning and the labour market are acquired and recognised throughout general, vocational, higher and adult education, including non formal and informal learning.” [4]

3. BENEFITS OF THE PUBLIC-PRIVATE PARTNERSHIP

The most significant outcomes of the collaboration between academia and business may be briefly summed up as:

- Promoting, encouraging and actively supporting excellence in research and generating innovation, design and creativity
- Bringing the processes of education, training, research and labour in closer interaction and thus enabling a more immediate and informed response to any occurring challenges
- Help develop a critical mass in the field of fundamental and applied research in view of rolling out innovative and cooperative research projects
- More effective dissemination of research results and consequently, adapting the Humboldtian university model – advocating the close connection between research and teaching – to the present requirements so that the new university pattern be able to extend its scope to society and community outreach

The objectives outlined in the previous chapters will enable the academia to gap the bridge between theory and practice in view of fostering sustainable economic growth by means of: informed awareness of educators and employers – both performing the roles of investors and stakeholders in the education process – about the ability of universities to prepare graduates for the future by empowering them with the required skills and competencies for a knowledge-based society as well as strengthening the interaction between university and industry for improving university-industry technology transfer.

According to the ARACIS Report on The State of Quality in Romanian Higher Education – Quality Barometer 2010, there is “an ambiguity related to the social functions of the university.

We still find ourselves in a society where the university is regarded as a provider of general academic training whose services should be accessed only by the best … and whose main purpose is to prepare elites.

These two types of actors – employers and academics – entertain opposing views of the university, with the academics’ image being much more positive.” (p. 11) This contrasting view is triggered by the fact that employers perceive an important gap between the required and the actual competencies acquired by graduates, hence such a public-private partnership will enable the higher education system to react more promptly and adequately to the labour market and the social changes. [5]
Furthermore, according to the ARACIS Report on Statistical Distribution, interpretations and options on The State of Quality in Romanian Higher Education – Quality Barometer 2009, one of the main aspects valued by employers in the selection and employment of graduates is “the reputation of the university they graduated from (which acts as an indicator of the potential knowledge of the graduate)”; furthermore, “employers perceive the graduates as better trained in theory than in practice”; p. 14 hence most employers “believe that the academic knowledge of the newly employed graduates must be supplemented. p. 15 [6]

In this respect, Lucian Blaga University of Sibiu has recently launched the initiative called LBUS Dialogues – under this aegis the university organized the first event focusing on the topic “University as knowledge broker and competencies trainer”. The main goal of such an endeavour is to redesign the evolution of LBUS in view of becoming more open and responsive to the external context, and providing increasing competitiveness and welfare for its community by means of the high quality educational services.

The exchange of ideas, knowledge and competencies is a two-way process and it should therefore engage all stakeholders: representatives of the business community, local administration and cultural institutions.

An initial outcome of this event is the setting up of several focus groups, made up of teaching staff and specialists, in order to receive and analyse accurate feedback from employers and adapt study programs and curricula accordingly. [7]

4. BEST PRACTICE SAMPLE: CONTINENTAL AUTOMOTIVE SYSTEMS – LUCIAN BLAGA UNIVERSITY OF SIBIU PARTNERSHIP

The present study highlights the benefits and outcomes of a win-win public-private partnership and illustrates best practices in the field by means of the successful collaboration between Continental Automotive Systems and Lucian Blaga University of Sibiu. Mention should be made that the present study relies on the previous researches undertaken by the authors therefore the added value of this paper stems from the continuity of analysis and the authors’ focus on improving the existing partnership in view of achieving excellence in teaching and research as well as promoting innovation and creativity as main vectors of competitiveness.

Here is a selective overview of the collaborative activities jointly initiated and developed by Continental Automotive Systems and Lucian Blaga University of Sibiu as well as their significant outcomes for the academia and business alike:

1. Company presentations – meant to strengthen students technical know-how; promote company opportunities and recruit qualified students for the summer practice program; such an activity represents an alternative to traditional methods of recruitment, thus giving the employer the chance to train future job applicants during a brief period of internship;
2. Job shops – promoting employment opportunities and recruiting suitable candidates for available jobs or internships;
3. Open door activities – LBUS students visit the Conti location;
4. Student summer practice – organizing a 3-month internship for students during the summer holiday;
5. Graduation projects – LBUS students may undertake research for completion of their graduation projects and they are employed at Continental for 5-6 months;
6. Curriculum design and development:
   a) Applied Electronics – BA study program designed to meet the needs and requirements of Continental Automotive Systems (graduating its first class in 2011);
   b) Courses – included in the compulsory curriculum - delivered by Continental Sibiu specialists:
      • Communication techniques and public relations;
      • Embedded systems;
      • Technologies and equipment used in electronics;
      • Digital electronics;
      • Analog integrated circuits;
   c) Courses delivered by LBUS professors to Continental employees:
      • Image processing;
   d) Optional/extra-curricular courses included in the additional Continental curriculum:
      • Microprocessors in automotive (30 graduates in 2010);
      • Embedded software (12 graduates in 2010);
      • Electronic hardware in automotive (50 graduates in 2010);
   7. Conti info centre – a permanent info stand in universities;
   8. Conferences – participation at a number of international conferences by scientific presentations;
   9. Sponsorship – sponsor different events (e.g. academic competitions, conferences);
   10. Conti scholarship – award scholarship to best performing students;
   11. Supporting Conti employees in continuing education – MA study programmes at LBUS;
   12. Academic competitions – Continental as main partner in organizing different academic competitions:
      • Implement a road recognition vehicle: 12 teams of 40 students from 4 universities (Sibiu, Brasov, Cluj, Craiova) designed and implemented an embedded application to control a car on a predefined route;
      • Conti mechanical design contest: teams of students from 3 universities designed an embedded application to control a car on a predefined route, evaluating CATIA competences;
      • Hardware and software engineering: Computer Science students present their SW- and HW-related projects to a technical committee; the first prize is awarded by Continental as main partner of the competition;
      • Student competition organized by the Technical University of Civil Engineering of Bucharest: Continental sponsored 2 teams from LBUS which ranked 1st and 2nd in the national competition and 13th 23rd in the European competition;
   13. Conti day – recruitment event organized by Conti Sibiu in the main lobby of the Hermann Oberth Faculty of Engineering including stand, company presentations and
other student-related activities; the main goals are: promoting the company as a major partner of LBUS as well as promoting company opportunities and recruiting the best qualified students for internship programs;

14. Conti lab;
15. Conti-funded teaching loads: 1 professorship and 1 assistantship.

5. REFERENCES


5. ARACIS Report on The State of Quality in Romanian Higher Education – Quality Barometer 2010


DEVELOPMENT OF FOOD ENGINEERING GRADUATES’ PROFESSIONAL INSERTION ON THE LABOR MARKET

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ABSTRACT: The improvement of the food engineering graduates insertion on labour market it’s an important target even during the educational training. The paper provides the four complementary levels followed in steps of the development reach: level 1 - connections with top food companies on industry processes (dairy, cereals, meat, additives, starch); level 2 – development of a systematically training and increment of the business customer faith; level 3 – food engineering’s graduates employment; level 4 – development of necessary projects to social and economic adjustments to communion acquires.

Key words: graduates’ professional insertion, food engineering labour market

1. INTRODUCTION

“Lucian Blaga” University, in Food Engineering (as Food Engineering, Food Control and Expertise, Food Biotechnologies, Public Nourishment & Agrotourism Engineering and Management) or our master programs (as Food Quality and Safety Assurance, Modern Food Process Management), we always are lose ourselves in as teaching action to be adapted with the new requirements on food labour market.

The interest for a high insertion rate of our food engineer graduates on the actual labour market begins even in the qualification stage of the future experts in food field. This interest finds again in the mission of the studies programs, submitted to the national evaluation in order to accredit or temporary license. The food engineering graduates professional insertion on the labour market becomes in the present context a real index of the professional qualification university efficiency for the future specialists.

Even the major document of “Lucian Blaga” University, the Charta ULBS [1] has concrete stipulated in its mission the target “to promote the Excellency in specialists’ formation and scientific research as they could have real chances on the free labour market; all this by their active involvement in the choice of their professional trajectory, in the technological, economical and social cultural advance in the contemporary Romanian and world society.” A dynamic and flexible education is desired in order to adjust the graduates to the competitive business market demands.

At once the university is a major piece in the educational system with a significant function in professional specialty formation and also in the opening of new offspring. So a balanced society development is ensured. Therefore the “Lucian Blaga” University of Sibiu “has a hard root in society life, being a centre of sciences, culture and humanism” [2]. In this way the development in our university means a first-class education, good students and teachers mobilities and also European harmonization of the studies programs, adapted with the new requirements on labour market; and not at last this development covers the market evolution anticipation and an authentic chance for the shaped specialists, in order to have a high inserting on the business market [2].

An EU analysis on the young people integration in the labour market, made in 2008 has shown four countries groups according to the youth labour market functioning and their major inconveniences [3]:

1. friendly labour markets which are characterized by high employment levels among young people (in Austria, Denmark, Sweden, Finland and England)
2. rigid labour market (in France, Belgium, Germany, Luxembourg and Slovenia)
3. split labour markets (in Greece, Italy, Portugal, Spain and Poland)
4. major dysfunction between the training and the labor market (in Czech Republic, Estonia, Hungary, Lithuania, Lithuania, Slovakia, Cyprus, Malta, Romania and Bulgaria).

On global scale, four models of transition from the university to a workplace have been in time developed [4]:

- the Japanese model: based on direct linear transition school education - labour, with training in the workplace. On the labour market, the Japanese companies beat up graduates, without a specific training on a specific job
- the German model: is a dual or alternative one, in which the theoretical training is combined with the practical training. It insures a continuous training, on high qualification levels, but the training is slow
- the French model: is based on a professional training within the school environment on a formal principle that corresponds to the hierarchical levels of employment with the level of training ”that best corresponds the needs”
- the American model: all students benefit of a common training (practical and theoretical) until the end of the secondary studies. The transition towards employment is made
within the high educational frame preceded by expensive courses [5].

In fact, the graduates’ insertion in food field on labour market is so dynamic and arises some problems, common with those pointed out to the other graduates from the Romanian public and private universities.

There are some relevant aspects needing solutions, as:

a) The graduates’ abilities have little demand on the business market; they have no information about the labour market evolution when they begin their academic studies. Geopolitical and geo-economical factors modify the labour market, in an random dynamics. Nowadays the professional insertion process is more difficult thanks to: new forms of employment, economic restructuring and evolutions, the increase of unemployment among young people, extension of the transition duration from school to a workplace, adjusting to the clients’ needs and increasing competition [6]. Uncertainty regarding the evolution of labour productivity slows down the process of graduates’ integrating into the labour market [7].

b) It’s missing a correlation between the education career and the acquired competences; the graduates have no social-biographic profiles.

c) The employers have no quite implication on education problems, that it needs an increasing responsibility and interest of the social partners/employers for higher education

d) Many performing graduates have no professional experience because of their interest only in their studies, without an employment during university qualification stages. In Romania only a low share of youths are employed during university studies.

e) Often the labour market proposals are so prosaic by activities or incomes for the good graduates. They expect interesting proposals in good agreement with their qualifications. There is often a great difference between graduates’ expectations having good academic results and the requirements of the labour market. So the graduates’ professional experience becomes an eliminatory demand from the employer companies.

f) The students’ practice during their studies is difficult achieved because the companies in field have a heavy feedback. Even so, the experience during this kind of training doesn’t matter too much in their employment

g) There is a limited labour market for many graduates: the employers can choice now from a great number of candidates also derived from the companies’ reorganization.

h) Graduates’ transition to a place work has become more complex, depending more on personal skills for negotiating [8].

i) The universities graduates leave Romania for the US or Western European Countries, in a brain migration and in this way the investment made from public education system doesn’t return into the labour market

At the institutional level these critical points of the graduates’ employment and also the necessity having a database concerning the graduates were good reasons on starting a far-reaching project [9].

Its major target was to design a reference map, wide following their professional trajectory on the labour market. That means a yearly recurrence of this study in each university, in order to have a real map of the graduates’ professional evolution. Periodically the higher education institutions could have such a methodology and instruments in order to achieve such studies and to consolidate and initially validate the database concerning the graduates, with national technical assistance. The project will also help universities to better evaluate the efficiency of the study programs offered, in order to improve their quality [10].

A first national project unrolled on this theme is “University Graduates and Labour Market” (APM) – Romanian Tracer Study”, financed from the European Social Fund through Sectorial Operational Program Human Resources Development and achieved by the Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI) and the National Council for Higher Education Funding (CNFIS).

The instruments and the applied methods in the study are close correlated with European those and are achieved with an important project partner: University of Kassel, Germany, The International Centre for Higher Education Research (INCHER).

Thus, starting with April 2012, a first survey was conducted on the 2005 and 2009 graduates and 55 public and private universities tracking their own graduates. The universities have made every effort for a good study implementation. The second survey was conducted on the 2006 and 2010 bachelor studies graduates. The research consisted in the application of a questionnaire that tracked the graduates’ background, starting with their university studies, continuing with their first job and then with other issues that were important on the professional development [11]. The questions are multiple, about the graduate studies, employment, wages, activity field, evaluation of their own abilities developed during their studies and not at last the manner in which the studies have contributed to obtain a job and to solve the job matters.

The major project customers were the universities and the policy makers. One hand, it has pointed out the importance of knowing the insertion mechanism on labour market and the other hand to know the differences between the “educational market” and the labour market [9].

In this way APM becomes a complementary way of cognition by research projects or performant doctoral schools. The project also pursues a good agreement with the European practices.

The APM project has two general specific objectives set for the academic education [9]:

1. “the amelioration of the systems for insuring the quality by supporting universities for improving the management and the capacity of supplying the qualifications relevant to the business environment in continuous change”.

2. “supporting the achievement of academic competent knowledge by young researchers, formed in the national network of doctorate schools, by extending opportunities for doctoral and post-doctoral studies”.

The APM project has found an entire opening and involvement in “Lucian Blaga” University, definitely in the Food Engineering programs. The requirement of project implementation is strongly built to the civil society necessities concerning the present labour market [2] as:

a) the improvement of the teaching process by a good agreement of the educational market with labour market
b) periodical monitoring on graduates’ professional insertion, in order to improve the educational proposal concerning an increasing of students’ training quality
c) the social partners having more responsibilities in education
d) more information about graduates’ professional evolution, from time to time, in agreement with different educational and socio-biographical profiles
e) national polity’s implementation in work force occupation.

2. CASE STUDY

The professional insertion on food field is a process that includes graduates, employers and trainers. The improvement of the food engineering graduates insertion on labour market it’s an important target even during the educational training [12].

We’ve just done in time, a local monitoring for the 13 graduates’ series of food engineers, concerning the insertion on the labor market. We are also involved in the APM national project. Complementary to the national monitoring by scientific instruments and European standards, we have proposed in food engineering education in “Lucian Blaga” University of Sibiu to make better the relationship with the economic environment in this field and also to develop a specific strategy in order to increase the food engineer’s graduates’ insertion on the labour market.

The present study provides our conceived levels and developed in time, followed step by step, in order to expand the graduates’ mass employed in food field. The SWOT analysis drawn up enabled us to focus on the critical points in relationship with the economic environment. Four levels are covered from the fist contacts with the food companies and the labor market feedback.

2.1. Level 1 - connections with the top food companies on industry processes

A data base was filled in by the professional relationship with about 40 food companies for all foodstuffs (figure 1), for dairy, cereals, milk, food additives, cooling drinks, starch, vegetal and animal oils, canned food, fish, milling and bakery, sugars, alcoholic drinks, meat and non alcoholic drinks. The accumulated data, permanently actualised, have included connection data, technological aspects, management trainee programs and bookings. The students making their summer technological practice and the graduates having a workplace in food field have also contributed; it was made a listing with all the relevant companies in food range on labor market.

2.2. Level 2 - development of systematically trainees and increment of the business customer faith, in two ways:

A) The companies standards required at the employment were presented by company’s human resources spokesmen at the workshops, in the faculty. The license and master students in food engineering found out about some requirements and challenges:

- their necessary skills and qualities that recommend them to start a career, their technical background
- importance of working as a team
- high degree of responsibilities in developed projects
- developing their professional personality
- one-year trainee programs in different production projects, under the direct supervision and coaching from experienced company managers
- potential and interest in self-development
- potential having leadership skills
- having excellent communication skills and fluency in English
- having a proactive and customer-oriented attitude
- having analytical and synthetic thinking
- being structured and organized
- could easily adapt to new environments
- having a proven affinity towards their chosen function in company

These professional meetings with the food companies have shown the algorithm of graduate’s success in his/her career development: 10% technical background, 20% feedback& coaching and 70% work experience. In this way through trainee programs in supply chain, some companies take guide the employed graduate throughout their traineeship and at the end of the program the graduate may be offered a final position in the company.

B) The students from the last study-year are evaluated in some professional technical interviews organized by food companies, which employ our graduates (cognition interview, mind and personality tests, technological interviews).

C) The graduates’ abilities were development by professional continuous formation in order to increase the food companies competitive on food quality and safety assurance [13]. Throughout the project POSDRU/39/3.2/G/26960 [14], finished in 2011, 250 food engineers graduates have obtained certificates in “Manager in food safety” and “ Auditor food safety”, all certificates recognized by Ministry of Labour, Family and Social Protection and Ministry of Education, Research, Youth and Sport.

2.3. Level 3 - food engineering’s graduate’s employment:

Further the contacts assignment with the managers from food labour market, the last year-students take yearly part in jobs workshops and jobs fairs. Jobs proposals are often received in the faculty and the students knowing the companies require can send their applications. In order to improve the connection with the industrial environment we set up at “Lucian Blaga” University of Sibiu a professional association subsidiary of ASIAR (Association of the Romanian Food Engineers for education, research and production). The subsidiary, in fact a networking, has in constitution food company’s managers, specialists, students, food engineer’s graduates, teachers and...
researches. In such case we have all the time the information about the news and necessities in food labour market and we can adapt the food engineering education to the business market. We are interesting to identify the necessary of graduates in food field both with the labour market requires in order to organize the specialists’ number/food profiles for employment.

2.4. Level 4-development of necessary projects to social and economic adjustments to communion acquts:

We have proposed the development of European project with mist teams from last-year students, master students, researchers, food managers and engineers.

3. CONCLUDING REMARKS

The rate of the academic graduates’ insertion on labour market (taken as the graduates who found a job in one year since the graduation/finish of studies) is real index of the professional qualification of the educational system efficiency. It offers an ensemble image over development of the labour force market and of the request for a certain level of training.

Simultaneously to the national monitoring by APM project (with scientific instruments after European standards), we have proposed in food engineering education in “Lucian Blaga” University of Sibiu to improve the relationship with the food economic environment and to develop a specific strategy in order to increase the food engineer’s graduates’ insertion on the labour market. The four strategy levels cover the road from information about the necessary of graduates in food field to the accommodation of educational instruments at the labour market requires. In the algorithm of graduates’ success in their career development the labour market reality shows than only 10% are from technical academic background.

4. REFERENCES

THE BUSINESS COMMUNITY TO SUPPORT THE TRAINING OF PROSPECTIVE STUDENTS/EMPLOYEES

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ABSTRACT: In the past years, theoretical high-school education in Romania has gone through much public criticism regarding both the quality and the effectiveness of the instruction offered to students. An excessive focus on theory for most subjects and the neglect of the practical aspects/applications of the themes studied are known to have had negative effects on students’ motivation and their ability to choose a career and to adapt to the labour market requirements. The authors of this article intend primarily to briefly analyse some of the curricular aspects underlying this problem and to suggest some opportunities to offset this situation – opportunities derived from the business community and within the reach of the theoretical high-schools’ managers. In support of the proposed solutions, the authors are going to examine two types of initiatives implemented at the “Gheorghe Lazăr” National College from Sibiu: “training placement” in EU-funded Leonardo da Vinci projects and a “work-experience” type of initiative leading to a successful programme run every school year in cooperation with firms, institutions, and companies from Sibiu.

Key words: training placement, work-experience, professional competences, business community.

1. DEFINING THE PROBLEM

The successive reforms of the education and training system in Romania have established the following educational lines for high-school (the term is used here as educational level) [14]:

- Theoretical
- “Vocational”
- Technological

Both “vocational” and technological educational lines combine theoretical education with practical training. More specifically, for both these fields of study the frame-curricula establish a balance between theoretical classes and practical activities. The practical activities usually take place within the high-school for the “vocational” line and in specialized school-workshops, and/or in training placement with appropriate firms and companies for the technological line. This type of combination is envisaged to ensure that the graduates of the “vocational” and of the technological high-schools respectively achieve appropriate professional competences that enable them to either continue their studies on a higher level in similar specializations or to enter the labour market [15].

Regarding the theoretical educational line, things are quite different, and the frame-curricula provide only for theoretical classes with very limited practical activities (e.g. experiments, programming, etc.) to be organized within these classes for certain subjects [15]. The question, “Why theoretical high-school is so… theoretical?” becomes legitimate when investigating the students’ motivation and their ability to choose a career and to adapt to the labour market requirements. There are at least three issues that need to be addressed in order to find an answer to this question [8], [13]:

- National Curriculum (frame-curricula, syllabi, textbooks);
- Teaching methods and teachers in general;
- Laboratory equipment and resources in general.

It is neither the place nor the time here to discuss teaching methods and resources, although their impact on the balance between theoretical and practical activities in the classroom might be very important in some cases. However, a brief analysis of the National Curriculum seems necessary due to the following reasons:

- It is the determining reason for the excessive theorizing
- It cannot be changed at the school level

First of all, within the theoretical line there are four so-called “specializations of study”, and when comparing the frame-curricula [15] across these specializations there are two major issues to be noticed:

1. A rather strong overall orientation towards general education subjects (we call this “general culture”), despite the idea of the “specialization” of the studies – as indicated in the statistical analysis presented in Figure 1.
2. A rather unbalanced distribution between the core-subjects (meaning here the subjects defining the specialization of study) and the “general culture” subjects across the different specializations, with somewhat a “disadvantage” for math and science oriented studies – as indicated in the statistical analysis presented in Figure 2.

Without going any deeper into this analysis, at least the following implications have to be mentioned:

- General culture increases the theorizing level of the studies
- Math and science specializations are less “specialized”

Secondly, the syllabi for the different subjects are built based on “general competences” and “specific competences” [15], where “competency” follows (to some degree) the definition agreed upon in the EU “Education and Training 2010 Programme.” We are not being critical toward the competences-based curriculum, which is a good idea, and it was fostered starting as early as the late ’90s in the National...
Curriculum policies, but more toward the problems residing in the understanding of the term, and moreover toward the balance of these “competences” when it comes to theoretical vs. practical aspects and applications. Analysing the “general/specific competences” in natural sciences – stated to be achieved by all the students by the end of the education cycle – and the content to be taught in order to develop these competences, it can be easily noticed that there is a strong focus on the theoretical approach [2], [9].

Finally, it is worth mentioning that the textbooks have to follow the curricula strictly, hence the same accent on theory more than on practical aspects and applications [2]. Furthermore, within a long-established paradigm of “a lot of theory” for the theoretical line of study, plus the other two issues earlier mentioned (teaching methods and resources), it is not surprising that a large part of the science textbooks, for example, focus on detailed and elaborate presentations of theoretical aspects rather than on practical aspects and/or applications in technology, industry, etc.

What are the possible effects on the students of such “excessive theorizing” in most of the subjects? First of all, studying a subject mostly at the theoretical level and with very little connection with the everyday applications is certainly one way to undermine students’ motivation. Secondly (and concurrently), it has a limiting effect on their choices regarding their further studies and/or career – mainly due to “warding” them off certain areas/domains, and as such actually reducing their options [1]. Finally, informal feedback from the graduates themselves, from higher education institutions and even from employers, indicate a range of training and/or work-related problems that are most likely determined by the “excessive theorizing” of the studies during high-school. These problems can be as simple (and possibly improvable) as a certain lack of adaptability to less theoretical requirements, or as complicated and challenging to correct as an actual bad career choice.

Within this context, it becomes obvious why there have been a serious number of public debates as well as public statements of various policy makers in the last years regarding the quality and the effectiveness of the theoretical line of study – all of them focusing on the “excessive theorizing” problem [16].

The question that naturally arises is if there is anything that can be done in order to address this situation. The first answer that comes to mind is to revise the curricula [10], and then to train the teachers, and finally to improve the resources of the schools. However, beside these types of major (and certainly very costly) actions that are the prerogatives of the educational policy makers, there certainly are other possibilities that are within the reach of high-schools’ managers. It is not about correcting what appears to be a systemic problem, but more about alleviating its possible negative effects – mostly in what concerns the ability of the students to make good/appropriate choices for their further studies and/or careers. This becomes even more important when taking into consideration the challenges of the school-to-work transition process in today society and economy [11]. The main idea is to “import” (to some extend) a method that is practiced for the technological high-school students and to adapt this method for the theoretical high-school students – and that is to place, for limited periods of time, the students of the theoretical high-schools in firms/companies for practical activities.

Transferring and adapting this method for theoretical high-school students has some limitations, as well as a number of feasibility issues that will be briefly addressed further on. What is important to outline at the end of this general discussion are the following ideas:

1. The problem of “excessive theorizing” in most of the subjects taught in theoretical high-schools is real and it can cause negative effects on the students.
2. It is possible to alleviate the effects of this problem by placing the students, for limited periods of time, in firms/companies for practical activities.
3. It is possible to implement this method in two different scenarios and the case study discussed further in this article will support this idea.

2. LOOKING FOR OPPORTUNITIES

The two scenarios of the method briefly described in the previous section are “training placement” and “work experience”. Both these terms refer to a period of time spent by a student within a firm/company. During this period, the student is required to perform a limited amount of work that is related to the activities of the firm/company. However, in order to better clarify the problem, we propose the following distinction between these two terms:

- During “training placement” the student is required to perform activities that are strictly related to his/her specialization of study.
- During a “work experience” programme the student is required to perform activities that are not necessarily/strictly related to his/her specialization of study, but more to his/her current options regarding his/her further studies and/or career.

Therefore, the “training placement” is an activity mainly oriented towards improving/developing the students’ professional competences. The “work experience” programme is an activity mainly oriented towards helping the students to assess (and eventually to correct) their options regarding their further studies and/or careers. It is obvious that this distinction is formal – as “training placement” can support students’ career guidance and the “work experience” programme often leads to the development/improvement of competences, etc. However, we will retain the idea that the “training placement” has to be strictly related to the students’ specialization of study, whilst “work experience” is a more general “immersion” of the students in the labour market that is not necessarily/strictly related to their specialization of study.

Considering the specializations of study for the theoretical educational line and the provisions of the National Curriculum we come to the conclusion that:

- The “training placement” method can be used only for the students of the Math-ICT (intensive ICT) specialization of study. This is due to the fact that these are the only students from the theoretical line that are supposed to develop professional competences during their studies and the fact that there are placement opportunities in ICT firms/companies.
- The “work experience” method can be used for the students of all specializations of study of the theoretical line.

The next question is where to look for opportunities for “training placement” and “work experience” for the students of the theoretical line?

Probably the most important opportunity for “training placement” is the Leonardo da Vinci Programme (LDV) financed by the European Commission as part of the Lifelong Learning Programme. The Leonardo da Vinci Programme funds several types of projects (“actions”) – that “range from those giving individuals work-related training abroad to large-scale cooperation efforts”. The action that interests us in this
analysis is the professional mobility action “People in Initial Vocational Training (IVT)”. Within this action, “the participants can do work-related training abroad while they still are at school or college or in alternative education and training schemes”. What we would like to outline here is that it is somehow uncommon for the theoretical high-schools to apply for the LdV-IVT action as compared to technological high-schools. The reasons behind this reluctance derive on one hand from the specificity of the organizational culture in theoretical high-schools and on the other hand from a certain lack of understanding of the objectives of the action and the eligibility conditions. Without going any deeper into this analysis here, what is important to mention is that the objectives of the LdV-IVT action are perfectly suitable for the students of the Math-ICT (intensive ICT) specialization of study from the theoretical line and that these students are eligible beneficiaries of the action. The case-study presented in this article provides the required practical demonstration of this assumption.

Regarding the “work experience” method, it’s all about finding appropriate firms/companies within the local business community to place the students according to their interests and their options for further studies/careers. This is not a simple endeavour due to a number of reasons that are related both to the school and the business community. The very first problem is the reluctance of the firms/companies to allow students to take part in their everyday operations – even for a limited period of time and with limited freedom for the students. This barrier is understandable from all points of view – but it can be surpassed mainly by enforcing all the aspects of the cooperation between the school and the firms/companies through detailed protocols. The second problem resides in the level of limitation that is imposed on the students’ activity during the “work experience.” If these limitations are too strong, then the “work experience” can turn into a “don’t-touch-anything-and-just-look-around” type of experience that certainly has very little benefit for the students. This type of situation is more difficult to overcome and the solution is either to try to reason with the firm/company’s management or to simply exclude the firm/company from the list of the potential collaborators. Thirdly, the high-school has to manage a number of internal problems – of which are worth mentioning: fitting the period of time dedicated to the “work experience” programme in the structure of the school year; selecting the target-group of the “work experience” programme; getting the teachers and the parents involved in the planning, implementing, monitoring, and evaluation activities related to the programme, etc. These types of problems are time and resource consuming and they require the full involvement of the high-school’s management and transparent cooperation with the students and their parents. This is why the “work experience” programme should be part of the strategic planning of the school and the parents’ community should be strongly involved in the entire programme [4]. The case study presented in this article indicates that the problems naturally arising from an activity that is not part of the regular activities of a theoretical high-school can be solved and the conditions to successfully implement a “work experience” programme in a theoretical high-school can be met.

3. CASE-STUDY

The “Gheorghe Lazăr” National College (GLNC) is a theoretical high-school from Sibiu, Romania, enrolling around 1000 students and having a strong and traditional orientation towards math, ICT, and natural sciences. Evidence from the school’s statistics as well as informal feedback from the students, their parents, and graduates have indicated that the “excessive theorizing” problem and its negative effects are likely to exist. Consequently, the management of the high-school decided to initiate an independent action in order to try to alleviate the effects of the “excessive theorizing” problem and to better support the students to choose appropriate further studies and careers. The action became part of the strategic planning of the high-school and enjoys the full support of the students and their parents. Initially conceived solely as a “work experience” programme, the action also included later on “training placement” – taking advantage of the opportunities presented by the Leonardo da Vinci Programme.

3.1. Training Placement

Analysing the objectives and the conditions of the LdV-IVT action, the management of the GLNC came to the conclusion that the students of the Math-ICT (intensive ICT) specialization of study meet the eligibility criteria of the action and that the school can apply for funding. This conclusion was supported mainly by the fact that, according to the provisions of the National Curriculum for the Math-ICT (intensive ICT) specialization, specifically for the ICT-subjects, the students should develop professional competences during their studies. Moreover, according to the current legislation, Math-ICT (intensive ICT) graduates can take an exam to attest their professional competences – which fully proves that the Math-ICT (intensive ICT) students meet the eligibility criteria set for the LdV-IVT action.

Consequently, the GLNC successfully applied for the LdV-IVT action and received the necessary funds to implement two professional mobility projects: the first one in 2005-2006, and the second one in 2010-2011. For both projects, the beneficiaries were 15 students from the Math-ICT (intensive ICT) specialization of study, age 17-18. For the first project, the students were placed for 5 weeks in companies in Plymouth, UK, whilst for the second project the students were placed for 4 weeks in a company from Leipzig, Germany.

The evaluations of the projects were accomplished through questionnaires filled out by the students upon returning from the training placement and through the final reports of the project-teams. According to these evaluations, the following positive conclusions can be drawn:

1. The knowledge, skills, and improved attitude gained by the students during the training placement were appreciated as a beneficial “supplement” to the rather theoretical approach in their ICT studies at school.
2. The first-hand experience in a work-place in a foreign company, the cultural activities included in their programme, as well as the everyday living for a rather long period of time in a foreign country were appreciated to have significantly improved their communication skills and their understanding of a different European culture.
3. The training placement helped the students to better decide on their further studies and careers – as confirmed 5 years after the mobility by the beneficiaries of the first project.

It should be mentioned that the 15 beneficiaries of each of the LdV-IVT projects represented roughly 25% of the total number of eligible students in the school in each of the given years (17-18 years old and enrolled in Math-ICT, intensive ICT, classes). This is considered a fair percentage given the inherent challenges to implement such a project. Also, the time-span between the two projects is rather large and it is mainly explained by the reluctance of the teachers towards the significantly increased responsibilities involved by the projects.
Regarding the management of the projects, probably the most difficult problems encountered were the ones related to some compatibility issues between the LdV-IVT administrative and financial procedures and the current legislation regarding financial management of the public institutions. These problems led to a number of bureaucratic challenges that meant overtime work for the accounting officer of the school, etc.

3.2. Work Experience

The “work experience” programme was initiated by the GLNC more than 10 years ago as a programme targeting 17-18-year-old students from all the specializations of study provided by the school. The programme aims to offer the students a 1-week “work experience” period in a local firm/company in order to give them a better understanding of the requirements of a job and to support them in their decisions regarding their further studies and careers. It is important to mention that, unlike the “training placement” case, the “work experience” programme cannot significantly help the students in a 1-week period to develop/improve their professional competences. However, the 1-week “immersion” in a workplace can increase the awareness of the students regarding what is expected from them in the future, and furthermore can improve their motivation. Finally, the “work experience” programme can provide some of the much-needed practical support for the highly theoretical studies of the students in the school.

Since its initiation, the “work experience” programme has had ups and downs, and was even suspended for 2 years – due to both internal and external reasons. For example, one of the serious problems that had to be faced every year was to set-up the 1-week period dedicated to the programme within the given structure of the school year. Indeed, the “work experience” programme is considered an extracurricular activity and hence it had to be planned outside the regular school-time. Until the school-year 2011-2012, the only solution to this problem was to plan the 1-week period of the programme during vacations – and the coordinating team of the programme had to face all the difficulties and the consequences of such a decision. However, starting with the school-year 2011-2012, the Ministry of Education, Research, Youth and Sport has decided to provide within the structure of the school year a 1-week period entirely dedicated to extracurricular activities. This decision is perfect for the “work experience” programme of the GLNC and helped revive and reinforce the programme.

According to the data provided by the GLNC, the “work experience” programme involved every year around 80-90 students, age 17-18 (roughly 50% of the total number of students of this age enrolled in the school). The students spent the 1-week period of the programme in one of the 12-18 local partner-firms/companies covering a wide range of fields: ICT, industry, medical care, pharmacy, banking, insurance, commerce, etc. The partnership between the GLNC and the local firms/companies is enforced through protocols detailing all the aspects of the activities of the students during the “work experience” programme, as well as the mutual responsibilities of the partners, etc. The evaluation of the programme is accomplished every year through questionnaires and/or focus-group discussions with the students (and more rarely with the representatives of the firms/companies) as well as through the annual activity report of the school.

As an example, to reinforce the overall conclusions of our case-study, we will discuss the results of the questionnaire applied to the 76 of the 84 students involved in the GLNC “work experience” programme in the school year 2011-2012. The questions were grouped in 10 different categories as detailed below. Except for the questions in groups 9 and 10 asking to describe the problems encountered during the programme and to provide personal opinions and recommendations, for the rest of the questions, the students were asked to answer using a scale from 1 to 5 – with 1 meaning “strongly disagree/highly negative/very bad” and 5 meaning “strongly agree/highly positive/very good”. The questionnaire yielded the following results (also see Figure 3: “0” means no answer; % refers to the proportion of the students giving a certain rating; job-related questions based on [5]):

1. Level of understanding of the activity of the firm/company and of the work and work relations in the firm/company:

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2. Level of satisfaction regarding the “job” performed (diversity, completeness, impact on the department/firm, liberty of decision, possibility to self-evaluate the results):

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3. Team-activity and team-building (mutual trust, common objectives, decision-making process, level of motivation):

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4. Self-assessment regarding the effects of the programme on the motivation level (confidence, human contacts and relations, personal image, school results):

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5. Self-assessment regarding the benefits of the programme (support for career guidance, practice and development of general/specific skills, improvement of communication skills in various contexts, gain in general/specific knowledge, respect for work and property):

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6. Organizational matters (information received at school and in the firm/company, safety, compliance to the work-schedule, planned/accomplished activities, initiative):

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7. Relationships with the other students and the personnel at the working place (respect, correctness, understanding):

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Regarding the 8th group of questions, the students were asked if they would recommend the programme to their colleagues in the lower classes (86% answered in the mid to high range), if they would recommend the school’s management to keep the programme within the regular activities of the school (89% answered in the mid to high range), and finally if they would recommend the school’s management to keep collaborating with the firm where they were placed during the programme (79% answered in the mid to high range).

For the questions in groups 9 and 10, the students were given the possibility to elaborate on their expectations and the problems encountered during the programme, and to provide recommendations and personal opinions, etc. It should be noted that some of the answers given by the students to these questions indicated a very high level of commitment.

The results of the questionnaire indicate an overall positive impact of the programme – with most of the students rating the benefits, the experience, etc. in the mid to high range. The most
important problems reported were related to (1) the limitations imposed to their activities (“on-the-job-shadowing” was reported for some of the firms/companies involved in the programme); (2) the deviations from the initially agreed upon work-schedule; and (3) the rather short period of time dedicated to the programme leading to “learning too little about the job I’m looking for” as one of the students put it.

4. CONCLUSIONS AND FURTHER STEPS

The “training placement” and the “work experience” programme are two methods that can be used by theoretical high-schools in order to alleviate the possible negative effects of the “excessive theorizing” problem – a problem that is mainly determined by the current provisions of the National Curriculum for the theoretical educational line.

In order to put in practice these methods, the managers of the theoretical high-schools have to resort to the business community. This may mean the European business community – taking advantage of the Leonardo da Vinci Programme financed by the European Commission – or the local business community – taking advantage of the support of the parents and the local community in general. The opportunities clearly exist and it is mainly a matter of reaching out and transforming them into actual activities of the school. This requires the dedicated involvement of the schools’ managers, of the teachers, and of the students and their parents.

There are a number of limitations and conditions in order to put in practice any of the two analysed methods. Attentive management and a good understanding of the legal provisions as well as a strong and transparent relation with the business community can provide sufficient support to negotiate the successful implementation of any of the two methods. However, it should be accepted from the very beginning that very likely, there will never be enough places to satisfy all the needs of all the students in the target-group.

The experience of a high-school like the one we discussed in our case-study should be better promoted as a “good-practice example.” This could encourage other theoretical high-schools to include in their regular activities “training placement” and “work experience” for their students.

The reluctance of the local firms/companies to take part in “work experience” programmes is a matter that needs further investigation. First of all, this investigation should seek for possible methods to increase the awareness of the local business community of the problems that theoretical high-schools encounter. Secondly, there is a need to further explore the legal provisions (both in the public and the private sector) in order to find stronger and better ways to enforce the cooperation between schools and firms/companies. Finally, it should be better understood what the expectations of the firms/companies are and, based on this understanding, to look for possible methods to encourage their participation in “work experience” programmes.

5. ACKNOWLEDGEMENTS

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WHAT DETERMINES THE MIGRATION INTENTIONS OF UNIVERSITY STUDENTS?

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ABSTRACT: The paper aims at exploring determinants of the university students’ intentions to stay within their university region. At this, we presume that students’ career choice motivations are related to their professional intentions, which again, along with demographic characteristics, affect their migration decision. Our analysis is based on a cross-sectional study of 2,353 students from three different higher education institutions, two of them located in Germany and one in Namibia. Results indicate that in Germany migration matters because a considerable proportion of students intend to leave the university region after graduation. At this, we found that the students’ geographical provenance exerts the most significant effect on the intention to stay. Moreover, certain professional intentions were directly and some career choice motivations were indirectly linked with the intention to remain at the university location. We present several conclusions and implications.

Key words: Graduate Migration; Professional Intentions; Career Choice Motivations; Universities; Germany, Namibia

1. INTRODUCTION

In today’s world, higher education institutions play an ever-increasing role. Besides their traditional functions of teaching and research, they are now challenged to contribute to society’s economic and social development, which is often articulated as relevance or the ‘third mission’ of universities (Etzkowitz et al., 2000; Gibb, 1996). In that, transferring qualified people to the economy is an important task. Particularly at the regional level, they have become important drivers of economic development and growth (Bleaney et al., 1992; Drucker and Goldstein, 2007; Etzkowitz, 2001). How universities can contribute to economic progress and structural change, especially in their immediate proximity, is illustrated by some outstanding examples (Bramwell and Wolfe, 2008; Chrisman et al., 1995; Feldman and Desrochers, 2004; Hsu et al., 2007).

Nevertheless, it seems that migration of well-educated and highly skilled workers can severely inhibit or retard a region’s economic development. This is particularly serious for regions with changing or medium-sized economic structures or in economically depressed regions as for example in the case of East Germany (Schneider, 2005). However, assuming that graduates with professional intentions in line with local economic requirements tend to migrate, the function of the university as a source of human capital for the regional economy appears to be questionable. From these reflections, our central research question arises: Which factors determine the university students’ intentions to stay within their university region? Our paper addresses this research caveat, as to our knowledge there is almost no research yet available to answer this question. Only some research was conducted to scrutinise migration of university students or graduates. These works can be classified into discussions on how universities could attract students from other regions to successfully compete (e.g. Baryla and Dotterweich, 2001) as well as into surveys on international (e.g. Aidis et al., 2005) and interprovincial migration (e.g. Bond, 2008; Busch and Weigert, 2008; Faggian et al., 2007; Gottlieb and Joseph, 2006; Kodrzycki, 2001; Venhorst et al., 2010; Yousefi and Rives, 1987). The last focus is relevant for this paper, and it seems that a certain upsurge in recent years is taking place in this regard, which underpins the growing importance of the subject.

The research presented here provides a step further in examining migration intentions concerning university students’ prospective career paths. Our analysis aims at an interregional comparison and is based on data from a cross-sectional study carried out in Eastern and Western Germany as well as in Namibia, the latter being completely omitted from research on graduate migration. The regions we analyse are mainly dominated by small and medium-sized firms and changing industry structures. However, they are also embedded in different economic and cultural realities, but have a particular historic relationship. Since Namibia was a protectorate of the German Empire from 1884 to 1915, the culture, language, architecture, work ethic and will of the German population living there are still relatively strong and vibrant. In general, our paper contributes to a better understanding of the universities’ role for the regional economy and the effects that migration exerts in this context. Knowledge on the determinants of migration is essential for the development of forecasting models of students’ decisions on place of work. Furthermore, as migration in the developing countries is only scarcely explored, our study is the first international comparative survey including Namibia.

The remainder of the paper is structured as follows: Section 2 outlines the theoretical framework of our research. In Section 3 we present the methodology, i.e., data, sample, variables, measurement and statistical methods. Section 4 offers a descriptive and explorative data analysis to determine contingency factors on students’ migration. In Section 5, the paper finishes with a conclusion, implications and limitations.

2. THEORY AND RESEARCH CONTEXT

Labour force migration is an outcome of a range of factors, and there is no single migrational model that encompasses all of...
The most frequently cited one is the human capital approach, by which migrants move because they perceive the economic benefits of moving to be greater than those of staying do (Williams et al., 2004). In fact, the regional economic climate and culture seem to be important driving forces for migration. For example, Kodrzycki (2001) analysed the migration of recent college graduates in the United States and found that the majority of moves are made to regions with stronger economies or more attractive characteristics, as measured by such factors as higher employment growth, lower unemployment, higher pay, lower housing costs or better amenities.

Furthermore, migration is strongly linked with professional intentions. It is, in this way, a function of the career choice, covering the preferred type of employment and the aspired size of the firm. To analyse students’ and graduates’ professional intentions, a number of empirical researches have been carried out in recent years (Chlosta et al., 2006; Greene and Saridakis, 2008; Josten et al., 2008; Tackey and Perryman, 1999). For example, Fueglistaller et al. (2006) asked students from 14 countries and found on average that students intend to enter the job market after graduation as follows: entry into a large company (17.8%), a medium-sized company (16.8%), a small company (11.8%) or as an entrepreneur (12.1%). However, these preferences can vary considerably according to the particular country. Whatever these preferences are, if they do not coincide with the regional economic structure and adequate job offers, migration is likely to occur. In fact, Bond (2008) investigated graduate migration in Scotland and concluded that the opportunity of an employment is the most significant driver.

Nevertheless, the decision of an individual to stay within a region or to move from it is also a consequence of indirectly acting contingency factors on the professional intentions. Among the factors that influence the intended career path, there are cognitive as well as institutional factors. With regard to the first, several theories with a cognitive basis have been developed over time, appearing to be fruitful in gaining an understanding of the reasons underlying the decision for career choice. Among them, the Theory of Social Learning (Bandura, 1977) and the Theory of Planned Behaviour (Ajzen, 1991) have emerged as the most promising approaches. The central element of these theories is the individual’s intention to undertake and to put into practice a specific behaviour, influenced by motivational elements.

With regard to career choice motivations, the bulk of research was done to explore why individuals opt for the entrepreneurial path. In the developed countries, motives such as self-realisation (Carter et al., 2003; Kolvereid, 1996) and need of autonomy and independence (Van Auken et al., 2006; Carter et al., 2003; Douglas and Shepherd, 2002) seem to be the most important. In addition, economic motives are considered less important than others (Baumol, 1993). This is underpinned by a comprehensive study of more than 15,000 students at 37 German higher education institutions, exploring the weighting of the motives behind self-employment (Josten et al., 2008). These scholars found out that the most important drivers are working under one’s own initiative, making better use of one’s own capabilities, the freedom to determine one’s own working place and times, being one’s own boss and realising one’s business or product ideas. The opportunity of higher income was ranked less essential in their study. Interestingly, a survey of entrepreneurs in Kenya, Ghana and Nigeria revealed that the strongest motivator for starting a businesses in all three countries was the opportunity to increase earnings (Benzing and Chu, 2009).

On the other hand, the concept of ‘institutions’ within the New Institutional Economics presented by North (1990, 2005) offers another perspective for analysing factors that might impact professional intentions. It allows an understanding and examination of different forms of human interaction in a general framework of certain established rules and informal norms which can have a positive or negative influence on professional career choice. In this context, the ‘rules’ or ‘norms’ governing the several types of employment are worth to study. Considering for instance lower wages, job security as well as career and training opportunities, students may not be particularly attracted to working for a small firm (Kalleberg and Buren, 1996; Miller and Mulvev, 1996; Wagner, 1997). As a consequence, in the developed countries they are disproportionately employed in larger or established companies (Bannock and Daly, 1994; Belfield, 1999; Golla et al., 2006). Moreover, it is likely that demographic factors such as geographical provenance, qualification, age and gender determine the decision of an individual to stay within a region or to move from it. These factors act both directly on the migration decision and indirectly on the professional intentions. For the influence of individuals’ origin, Kodrzycki (2001) found that their past history of migration is relevant. For Germany, Busch and Weigert (2008) detected that non-resident students exhibit a significant higher migration propensity than resident students. This may be explained by social bonds with the home region. In fact, Bond (2008) stressed the importance of the connections people have to certain geographical places for the migration decision. For entrepreneurial activities, it was found that business founders tend to open create firms in regions where they have deep roots (Dahl and Sorensen, 2007).

Concerning the impact of qualification or course of study on the migration intention, certain empirical evidence exists. Aidis et al. (2005) surveyed students in Lithuania and found a higher mobility rate among courses such as economics and business administration compared to medicine, humanitarian and social sciences and natural sciences. Similar results are reported from graduate in the Netherlands (Venhorst et al., 2010), where students of agriculture and economics had higher migration intentions than those of other fields, and in Italy (Coniglio and Prota, 2008), where business graduates had a higher propensity to migrate to densely populated areas and engineers were more willing to stay in the university region.

Again, for age as another demographic factor, Aidis et al. (2005) found younger students with higher migration preferences compared to their older counterparts. These scholars also revealed an influence of gender, as in their study male students had stronger intentions to move than females. Interestingly, research is inconclusive in this regard, as other studies stated higher mobility intentions for women than for men (Faggian et al., 2007; Venhorst et al., 2010). This is presumably due to different gendered professional perspectives, so that female graduates leave the region in order to compensate disadvantages (Faggian et al., 2007).

Based on the hitherto research and the arguments discussed, we now present our research context. Figure 2 illustrates the dimensions to be explored, with arrows representing the supposed relationships between them.
3. METHODOLOGY

3.1. Data Collection and Sample

The data for our research is the result of a survey including students from the Polytechnic of Namibia (PoN) in Windhoek (Namibia), the University of Applied Sciences Jena (UASJ) and the University of Applied Sciences Worms (UASW). The latter stand for different regions, namely Eastern and Western Germany. PoN is the second biggest university in Namibia, representing almost half of all Namibian students.

The survey was conducted from May to August 2010. The questionnaires were firstly pre-tested with 20 students from the different localities. Thereafter, we personally contacted nearly the entire population of university students from all three universities by email, providing an anonymous personalised link to a standardised online questionnaire in German (for German students) and English (for Namibian students) language. In total, 16,690 individuals were approached by email. The questionnaire encompassed various groups of questions related to the respondent’s professional intentions, career choice motivations as well as demographic characteristics. The research was based on a prospective basis, i.e., we asked students to indicate their future professional intentions after completing their studies.

We received valid questionnaires from 2,353 university students, making up our sample. This corresponds to 12.1 per cent of the overall population of the three higher education institutions. The survey is representative for the three universities, as students of different course backgrounds and years of study are included in the sample. With regard to Namibia, it is worth mentioning that the total number of observations in our survey at the same time corresponds to approximately 5 per cent of the overall student population of the entire country.

3.2. Variables, Measurement and Data Analysis

In detail, we used the following set of variables for our statistical analysis:

Dependent variables: In migration research, some authors (M. Black, 1983; Yousefi and Rives, 1987) refer to geographical distance from the point of origin, i.e., the distance of potential moves. Likewise, we measured the students’ migration intentions through the distances of their preferred location for professional activities from the respective university location. At this, the intention to stay within the region after completing studies was captured by a dichotomous variable and assigned a value of ‘1’ when the students indicated the wish to stay within a 50 kilometres radius from their university location. We assigned a value of ‘0’ when the respondents stated the intention to move outside this radius. Professional intentions were gathered by two five-point scales: The preferred type of employment, ranging from ‘1’ with the statement ‘I want to become self-employed’ to ‘5’ with ‘I want to become an employee’. Likewise, the aspired size of the firm in which the students wish to work for was captured by ‘1’ being ‘I want to work for a small-sized firm’ and ‘5’ stating ‘I want to work for a large company’.

Independent variables: Career choice motivations used in our analysis are the reconciliation of work and family life, the pursuit of job security, the need of autonomy and independence, the quest for a high income, career opportunities, social recognition and status, the strive for influence and power, gaining new knowledge and experiences as well as aspiring for self-realisation. These items were assessed through five-point Likert-type scales, with ‘1’ being ‘very unimportant’ and ‘5’ corresponding to ‘very important’. Among the demographic characteristics within our independent variables, we asked for the students’ geographical provenance before entering the university, which we measured as a dichotomous variable. At this, we used a similar categorisation as we did with our dependent variable, with ‘1’ stemming from the region with a radius lower than 50 kilometres and ‘0’ coming from outside. Furthermore, we categorised the courses of study into engineering, IT, natural sciences (group 1), business administration and economics (group 2) as well as social sciences (group 3) and assessed them as dichotomous variables. Lastly, age was conceived as a numeric and gender as a dichotomous variable. Figure 2 summarises the dimensions and variables used in this study.

The three higher education institutions were analysed individually, because separate analysis allows us to identify differences and similarities between them. This is important as we believe that ‘local factors’ might explain differences in the migration intentions. For comparing the descriptive results of the different university subsets, we computed percentages, means and standard deviations. In order to ensure that our explanatory variables are independent, we undertook a multicollinearity analysis. To identify the role of influencing factors, we employed path analysis. This multivariate statistical technique is appropriate for analyses in which a series of regressions are being performed; the dependent variable for one regression analysis is also the independent variable for another (Hair et al., 2005). In doing so, we use standardised coefficients or beta coefficients. For the estimation process, we applied STATA software.
4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

Table 1 shows the composition of the sample in detail. The comparison between the geographical provenance of students surveyed and their preferred place of work reveals interesting insights. For all three universities, a considerable share of the respondents originate from the respective regions (42.5% for Windhoek, 42.8% for Worms and 39.2% for Jena). On the other hand, only a small share of students see their future professional activities in the regions of Worms and Jena (9.0 and 15.8%, respectively). However, there are a considerable number of undecided students. Hence, if we only consider those who explicitly declared their decisions to stay or to move, the percentages of students willing to stay are higher for Worms and Jena (16.2% and 27.9%, respectively). Nevertheless, there is a considerable net loss of students for the two regions in Germany, as fewer individuals are willing to remain in their university region compared to the share of those who had originated there. For Windhoek, the net loss is rather marginal, excluding the undecided students here leads actually to a slight moving in. Thus, the outcomes underpin that – at least for the two German regions – migration among future graduates is a serious phenomenon.

Furthermore, the students surveyed in all three locations strive more for a dependent employment rather than for self-employment, with the highest entrepreneurial intentions at the PoN. There is also a general tendency towards an employment in larger companies; however, with much stronger inclination at the PoN compared to the UASJ. As for the career choice motivations, the most frequently cited are striving for career opportunities and gaining new knowledge and experiences, which interestingly holds also for all three subsamples. As it turns out, students at the PoN are on average younger than their colleagues at the German universities surveyed. This might be due to the fact that a large share of Namibian students enter the university directly after completing high school.

4.2. Explorative Results

For starters, we checked for potential multicollinearity problems among the explanatory variables. The average variance inflation factor (VIF) is 1.74, whereas the highest VIF are 4.45 and 4.34 for the courses of studies. These values indicate a high statistical reliability of our multivariate statistical analyses (O’Brien, 2007). The outcomes of the path analysis, separated by the three subsamples, are shown by the Figures 3, 4 and 5. For the sake of clarity and readability, these figures only contain the standardised coefficients of those paths that are statistically significant at the 1% level.
The results reveal that the most important contingency factor on the students’ intention to stay within their university region is regional provenance. This is reflected by the relatively high values of the standardised coefficients, which in all three locations present values close to 0.4. In other words, being a resident student has the highest influence on the decision to stay. This holds for all three university locations, in both Germany and Namibia, and in line with the findings of Busch and Weigert (2008). In fact, social ties are likely to play a fundamental role in explaining graduate migration.

Another key finding is the direct influence of certain professional intentions and the indirect effect of two career choice motivations on the intention to stay. Firstly, for the UASJ we revealed a statistically significant relationship between the striving for an employment in a small firm and the wish to stay within the region. This situation can be explained by the fact that Jena has a firm size structure that corresponds to the professional intentions of a considerable share of students. In addition, for both German regions we found that seeking career opportunities is a crucial motivator for pursuing an employment in a large company. Combining the results for the UASJ, the aspiration for career opportunities has an indirect negative influence the intention to stay within the university region. Hence, students at this university seeking to climb the career ladder in a larger company tend rather to move from the region.

Secondly, for PoN students we detected a linkage between striving for a dependent employment and the intention to stay. Industry in Namibia is mainly concentrated in the capital Windhoek where the PoN is situated, which could be a justification for this outcome. Again, it also turned out that self-realisation as a frequently cited career choice motivation for entrepreneurs (Carter et al., 2003; Kolvereid, 1996) determines the intention to be self-employed of students at the PoN. With this, we can not only confirm that self-realisation is an important driver for self-employment among students in developing countries such as Namibia. In combination with the migration intention, we also conclude for PoN students that aspiring for self-realisation does rather not motivate them to stay in their university region.

As for the influence of other career choice motivations, the chance of a high income determines the quest for an employment in a large company for PoN and UASW students. In this way, we confirm the importance of high earnings as a job motivator for Namibian students, which was previously found for other African countries (Benzing and Chu, 2009). Contrary as would have been expected, neither in Namibia nor Germany there was an effect of the course of study on the intention to stay. We only found that students of business administration and economics at the UASJ are significantly more inclined towards self-employment. Nevertheless, no other influence could be detected of the course of study. This is in so far remarkable as in Namibia a degree in engineering sciences is supposed to offer students a lot of opportunities for entrepreneurship, whereas the current situation for engineering graduates in Germany is attractive for students wishing to obtain a position in a large company. However, none of such potential relationships turned out in our survey.

5. Conclusion and Implications

The objective of our paper was to explore factors that determine the university students’ intentions to stay within their university region. For this purpose, we identified potential contingency factors and examined their relevance in a cross-sectional study in three universities in Namibia and Germany. According to the findings obtained in our analyses, we conclude there are migration intentions among future graduates which might affect the universities’ third mission, in particular its role as a source of human capital for the regional economy. This holds in particular for the university population in Germany we surveyed. However, compared with other studies, it seems that the migration propensity of graduates is a particular regional phenomenon. Busch and Weigert (2008), analysing the migration of graduates between German federal states or abroad, uncovered that ten years after graduation slightly more than 70% of graduates still live in the state where they completed their studies. The presumably heterogenic distribution of graduate migration has implications for policymakers and academics, not only with respect to merely raising awareness of the potential dimensions and consequences of such regional brain drain, but also to developing an institutional setting as well as incentives to counteract migration in the affected locations.

In the light of our findings, it seems that students’ regional provenance is the key factor driving migration, i.e., originating from the university’s location makes future graduates stay in their home region. The social and cultural environment appears to be what determines the decision not to migrate or to return to the place of residence after spending some years in another region. In this sense, a possible reason for this situation can be social networks. Social relationships are to some extent locked into particular places (Allen et al., 1998). They imply access to specific resources, in particular to work possibilities, which individuals new to an area may not know or be familiar with. As migration appears to be mainly a function of students’ origin, higher education institutions are challenged to focus particularly on those individuals with no migrational intention and educate them according to the regional economic requirements. In this sense, academic curricula must be oriented more towards the needs of local industry, and universities must establish networks to promote local job opportunities.

Furthermore, we learnt that some career choice motivations such as a high income, career opportunities, influence and power as well as self-realisation may determine students’ professional intentions. These are, in turn, to a certain extent linked with the migration intention. The path analysis reveals that in particular the striving for self-realisation and career opportunities indirectly determines the propensity to move or to stay. Nonetheless, a number of presumably influencing factors we incorporated in our research were not statistically significant. Hence, the explanatory variables we used might not be sufficient to explain the migration intentions of Namibian and German students. As we considered only a limited set of contingency factors, we deduct that other aspects could be relevant for this. We explicitly encourage further research in the field to uncover other underlying reasons for graduate migration. For this purpose, we believe that the inclusion of social or institutional factors (e.g. socioeconomic, personal and geographical characteristics) could certainly enrich the knowledge base. In particular, we point at the sparse availability of research on graduate migration in developing countries. More research will allow policy makers in these countries to design effective strategies and methods to convert universities into institutions with strong impact on the regional development.
The present study has some limitations. The first concerns the fact that only data from three universities have been analysed. For this reason, the outcomes are not representative for the general situation in the two countries and findings should be generalised with caution. As migrational flows shape and are shaped by specific economic spaces (Williams et al., 2004), we suggest that further empirical studies in this field should also gather data from other regions to compare findings in order to detect regional and national differences. The second limitation has to do with the prospective basis of the statements given by the respondents. We asked students about their professional intentions in some cases years before their occupational choices will be made. According to their actual career path and subsequent experiences, their perception may alter in the future. Longitudinal studies over several years could compensate for this restriction. Nevertheless, we hope the findings of our study will inspire other scholars, and the combination of this and future work will surely allow valuable comparisons and insights.

6. REFERENCES
BUILDING PARTNERSHIPS BETWEEN BUSINESSES AND ROMANIAN UNIVERSITIES: A NEW STRATEGIC APPROACH

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ABSTRACT: The development of viable partnerships with the business community is crucial for a sustainable development of universities in the current economic framework. The dialogue between academia and businesses may take place in different areas, like competences and skills needed to be developed for graduates, internships in companies, common research projects, trainings, funding a.s.o. The paper aims to present the experience of different universities across the world in developing successful partnerships and some of the success stories that can be identified in Romania, with the goal of proposing a framework for good practices within Romanian universities that will allow them to benefit from an appropriate dialogue with the business community in accordance with the European Union policies and that will foster their expansion.

Key words: partnership academia-business, sustainable development, good practices

1. INTRODUCTION

Enhancing competitiveness is essential in a global setting. In this respect, governments and companies have to find the appropriate strategies to generate innovation. The partnership between universities and companies can play a key role in enhancing competitiveness by providing an appropriate way to channel the knowledge from the academia - where knowledge is created -, to the businesses - where it is transformed in innovative activities (Audretsch et al., 2012). This way, competitiveness can be enhanced at the level of the firm, industry and country.

But the university-industry collaboration is only one alternative for businesses to obtain the access to the source of knowledge. According to the results obtained in the International Innovation Benchmarking Project developed by Cambridge-MIT Institute, in both UK and USA, the knowledge sources are dominated by industrial sources, like customers, suppliers, competitors, and the internal pool of knowledge of the company itself, universities being ranked far down in terms of frequency of use (Cosh et al., 2006).

The cooperation between universities and businesses should benefit to both parties, as they depend on each other for what concerns the fostering of human capital abilities: on one hand, universities have the role of preparing the human capital for the work in businesses and, on the other hand, businesses need qualified and, more recently, highly qualified human capital in order to efficiently operate in a strongly competitive environment. In this context, the programs developed jointly by universities and businesses are supposed to take into account both parties’ needs so that the “university-industry engagement” (Othman, 2011) be a sustainable one.

The concept of university-business engagement may be understood as covering different categories, according to Vigdor et al. (2000): teaching and research activities in the form of consultancy offered by universities to their industry partners, curriculum development with the support of

businesses, invited teaching activities, reciprocal visits, joint meetings, joint publications, jointly organized conferences and seminars, joint attendance to conferences and seminars etc.

Therefore the interaction between universities and industry may take a variety of forms. Cosh et al. (2006) proposed the following types of interaction:

- Educating people (training skilled graduates to be hired by the industry)
- Problem solving (through research contracts, joint research, technology licensing, consultancy, access to specialized equipment)
- Increasing the stock of knowledge (publications, patents, prototypes)
- Public space functions (forming and accessing networks, stimulating social interactions, meetings and conferences, Alumni networks, internships, faculty exchanges, curriculum development, etc.

While the extent of such partnerships in the developed world is rather high, the developing and emerging countries are left behind. The first university-industry collaboration in the United States and, most likely, in the world, is the now renowned Massachusetts Institute of Technology (Hatakenaka, 2004).

Still, the experience of universities in the developed world is far from being homogeneous in terms of such partnerships: Hatakenaka (2004) describes the university-industry relationships developed by the University of Cambridge as being fuzzy, the ones by the University of Tokyo as impermeable, and the ones of MIT as porous. The author identifies three parameters that delineate the nature of the university-industry interactions: information inflow, scale and scope. In her view, MIT permits high information inflow and relationships with the industry that are broad-scoped, while Cambridge tends to favor smaller and narrower in scope relationships, and University of Tokyo has only low information inflow and narrow relationships promoted mainly
by some individuals and not necessarily visible within the entire organization.

According to the research of Abreu et al. (2008) on knowledge exchange as perceived by British businesses, “developing trust and understanding between individuals is a key component of university-business relationships”. Most of the successful models of cooperation seem to be initiated at individual level and it is based on trust. Loo et al. (2011) consider that the models of cooperation range from “direct partnership of an individual at a university with a specific division of a company, to a relationship that stems from a chance meeting of academic and industrial researchers at a professional conference”.

At the World Economic Forum’s Summer Davos held in Tianjin, China in 2010, young scientists concluded that the cooperation university-business is an important platform for transferring technologies from the laboratories to the marketplace. But the development of such partnerships is hindered by cultural, technological, and intellectual challenges that both universities and businesses are facing. There are certainly differences between the two partners, for instance in terms of time horizons: while universities look for projects that require several years of commitment as needed by a PhD student, a company has to move faster and is expecting results sooner. There are differences in terms of goals and values also: while universities must commit to full academic freedom, open sharing of ideas and open for peer-based criticism, the company operates in a competitive environment and looks for the secrecy of R&D projects. (Loo et al., 2011)

Baker et al. (2005) advance the issue of the influence that beliefs about university-corporate partnerships influence customers’ attitude regarding the university brand. They see the university brand as a promise between the institution and its customers and suggest to university managers a more active approach of the university-business partnership so that it positively influences customers’ perception on the university brand. The implications for university managers are straightforward: “rather than waiting for customers to make inferences about corporate partnerships, administrators should understand what aspects of university-corporate partnerships would be perceived as a benefit to community members, and then communicate the actual benefits bestowed by corporate partners with some regularity or in some obvious manner” [Baker et al., 2005: 43]. Therefore, university administrators are in the position of transforming a presumably negative customers’ perception into a positive one.

2. UNIVERSITIES AS RESEARCH PARTNERS FOR BUSINESSES

One particularly interesting linkage between universities and businesses are research partnerships. Such relationships were encouraged by national and regional governments as part of their policies aimed at stimulating knowledge transfer (Cohen et al., 2002; Hall et al., 2000; Fritsch and Schwirten, 1999). But, as a direct consequence of increased competition and advancement in technology, the partnerships between universities and companies are changing nowadays. As universities understand the role of such partnerships for their own development, they have strived to adopt more commercially oriented managerial attitudes, able to better address businesses’ needs.

What motivates the engagement in an university-business research relationship? The literature on this topic is synthesized by Audretsch et al., 2012 from two points of view: the businesses point of view, the university point of view. There are three important industry motivations: access to complementary research activity and results (academic research augments the capacity of firms to solve the complex issues they are facing); access to key university personnel. On the other side, university motivation for such kind of partnership is more financially based. Audretsch et al., 2012, also identify the weaknesses of university-business partnerships, like: diversion of faculty time and effort from teaching, or the conflict between industrial secret and academic openness.

Philbin (2008) proposes a logical methodology for the collaboration between universities and businesses that improves the research co-operation between the parties and facilitates a better knowledge transfer. The process, which involves five stages - terrain mapping; proposition; initiation; delivery; evaluation - is supported by the technical mission and the business mission of the partnership, which are related to value creation both in the business and the universities (see Figure 1 below).

![Figure 1. Process-based model for collaboration](image)

Source: Philbin, 2008 (p.496)

When addressing the issue from the business side, it is expected that academic excellence is a powerful channel for businesses that are interested in carrying on joint research partnerships, particularly involving cutting-edge universities from a technological point of view.

The existing literature has shown, on the other hand, that geographical proximity between companies and universities plays an important role in the dynamics of technology transfer and that it provides an advantage for companies that are keen on keeping the pace with scientific developments (see, for example, Fritsch and Slavtchev, 2007, and Cooke, 2001). Consequently, one should expect universities that are closer to potential business partners to enjoy a higher number of research partnerships compared to universities that are more distantly located. Not surprisingly, Mansfield and Lee (1996) find in their study that universities that are considered by companies to be important contributors to their activities are the world leading education institutions in the scientific and technological field. Moreover, one expects a close link between the high quality of university research and the number of partnerships that universities are capable of developing.
3. CASE STUDY – A STRATEGIC APPROACH FOR COOPERATION AT LBUS

Lucian Blaga University of Sibiu (LBUS) has as strategic option to become a model of an open university towards the external environment. LBUS, as most of the universities, is a generator and a depository of knowledge. LBUS wishes to transfer the knowledge in order to increase the competitiveness and the well-being of the community in which it operates. The transfer of ideas, knowledge and competences should be made in both ways: from the university to the business community and vice versa.

LBUS understands the role it may play to become an active platform for the transfer of knowledge between academia, businesses, and local administration. In order to put in practice this strategic approach, LBUS initiated a series of events under the logo LBUS DIALOGUES in order to provide a message of openness towards the external environment and to generate the necessary debates for defining the common projects and activities that can be developed between the university and its faculties, on one hand and the business community, on the other hand.

For the first event in this series – “The University: a knowledge broker and a competence trainer”–, which took place in the spring of 2012, LBUS invited around one hundred representatives from the business community and local administration, the most important employers of its graduates. Participants at this event decided to continue the work in some focus groups in order to be able to debate concrete issues and to come up with ideas, projects that can be implemented. There were four focus groups formed (based on the major fields of specialization LBUS is providing): bio-medical studies, sciences, business administration, engineering and environmental studies.

The four focus groups took place, each being formed by approximately ten representatives from the business community and three to five representatives from the corresponding faculty. The debates were focused on two major directions: the feedback provided by the employers in what concerns the competences of LBUS graduates; collaboration alternatives between LBUS and its faculty and the external environment.

The most important result from the point of view of the top management team of the LBUS is the interest of the business community and local administration to get involved in common projects and activities with LBUS.

In the last two decades in both areas (business and higher education) there was a lot of room and opportunities to expand without an imperative of cooperation. Businesses expanded by hiring any kind of graduates and the willingness to get involved in the education process alongside the universities was insignificant. On the other side, there was high demand for higher education so many universities expanded too at a high rate and new universities were developed in the country. Many students were enrolled and, consequently, many graduates were provided for the marketplace.

The current global economic crisis that affected Romania brings both the academia and the business community to face new challenges. Both sides stringently feel the need to cooperate for different reasons. The university needs to receive the feedback from employers in order to adapt the programs delivered to the ever more sophisticated demands of the real environment. Also the faculty needs to be more connected and updated to the evolutions in the real setting. Companies understand that getting involved in the education process by offering internships, research projects for students and professors will reduce the period necessary for a graduate to be integrated in a company and thus will reduce costs and will boost efficiency for firms.

4. CASE STUDY – A PARTNERSHIP FOR MASTER PROGRAMS

During the summer of 2011, a team of professors from the Bucharest University of Economic Studies visited Politehnica University of Timisoara in the framework of a POS-DRU Project that addresses internationalized master programs (Contract POSDRU/861.2/S/59367 – Quality Assurance in Internationalized Master Education: Development of the national framework aiming at the compatibilization with the European Space for Higher Education). The goal of this visit was to observe the good practices employed by the Politehnica University of Timisoara concerning internationalized master programs and to propose the adoption of some of these practices for the universities that are part of the consortium that implements the project.

One of the success stories of Romanian universities’ partnerships with businesses is represented by the development of joint master programs between Continental S.A. and two public universities: University Lucian Blaga of Sibiu and Politehnica University of Timisoara. The Politehnica University of Timisoara hosts for more than ten years a Master Program in Automotive Embedded Software within the Faculty of Computer Science. The program prepares its students so that they are able to work after graduation in any of the countries where the company operates. The majority of students enrolled in the program are employed by the company during their studies, but the program is open to students that do not necessarily work for Continental. An interesting point to mention is that the company is willing to ease the students’ workload within the company in order to allow them to prepare for the courses and seminar in the program. Graduates’ prospects in the labor market are quite good, as the partner company typically employs program’s graduates or they may find jobs easily in similar companies – besides Continental, there are other five companies that have traditionally employed students graduating from the program. The number of students enrolled in the program is not high, given the fact that curriculum is structured so that it covers the competences and skills needed by the partner company and by a rather niche-type of specialization.

There are two features of the program that somehow distinguish it among master programs in Romania. On one hand, work in groups is by far the preferred manner of conducting classes for all disciplines in the curriculum; it is worth mentioning here that this is a request from the partner company. On the other hand, the program strongly promotes interdisciplinary approaches, which contributes to the development of transferable competencies such as communication abilities, teamwork and the finding of innovative solutions to interdisciplinary issues. This interdisciplinary approach is based on the program’s link with the labor market and in turn it provides an applied quality for it, as well as contributes to the development of general competencies for the graduates, beyond the technical ones.

Professors that teach in the program consider that extending the collaboration with other companies would contribute to the
program further development and consolidation, as the link with the labor market and businesses are critical aspects for the overwhelming majority of technical master programs, due to the practical skills that these programs should provide to their students and graduates. Moreover, the existence of such links motivates candidates to apply for the program. In terms of a SWOT analysis, the link between the program and the labor market is a feature that indicates a solid program, but it may transform into a threat in cases where the partner company withdraws its support and the program cannot find other partners with similar interests. Thus, strengthening and diversifying such university-business partnerships is a solution that is able to ensure a sustainable existence of the program in the long-run. At the same time one should point out the fact that the program is also preoccupied by the reinforcement of graduates’ general managerial competencies, which is another strong feature.

Foreign visiting lecturers, particularly from United States and Canada, are part of the program – they offer elective courses in an intensive courses format of two weeks. The students’ level of English proficiency is certificated during the admission process either through a linguistic certificate that is internationally recognized (such as Cambridge Certificate) or through a test prepared by the Department of Modern Languages of the University. Moreover, professors that teach in the program are examined every year for their proficiency in English. Thus, the program fosters the communication capability in a foreign language both for professors and students.

5. CONCLUSIONS

There is a transformation in the last decades for what concerns the concept of University: from a distant institution, to a place of research and innovation; an institution open to transfer the knowledge in the benefit of the society. In the European Higher Education system universities are complex organizations whose final purposes have to be correlated to the interest of the society.

If in developed countries the experience is already significant and the cooperation between universities and industry is solid and takes a variety of forms, in developing, emerging countries like Romania, this process is in an incipient phase.

Still we can identify already more formal interest in building real partnerships on both sides - universities and businesses. Good practices can be seen in Romanian universities, like the two examples we described in this paper: Lucian Blaga University of Sibiu and Politehnica University of Timisoara.

6. REFERENCES

ABSTRACT: The paper discusses the importance and relevance of corporate education as a social responsibility of universities. The research findings are intended to provide a starting-point for understanding the nature of the working relationship between universities and corporations in order to successfully develop and deliver corporate education programs in engineering and business. The role of universities has been evolving over the last 20 years, from a focus on teaching and research towards a partnership with industry, government and communities. Nowadays the mission of higher education comprises also the necessity to contribute to the sustainable development and improvement of society as a whole. The ability of the universities to organize the traditional disciplines differently to suit the needs of the society is the key to success of corporate education. Beyond the crisis, the strategic importance of the corporate education is driven by technological changes, the global economic liberalization, the rise of the service economy, the cosmopolitanism, etc.

Key words: corporate education, social responsibility, relationship universities-corporations, globalization

1. GLOBALISATION, CRISIS AND HIGHER EDUCATION

Globalization is a highly dynamic process. It is not purely an economic process - it has deep social, cultural and environmental consequences. It has produced tremendous benefits, poverty levels have fallen in many countries and increased trade has been transformative. What the financial crisis shows is that we were ill-prepared to manage this global economy.

According to many theorists (Foster (2009), Krugmann (2009), Wolf (2008), James (2009)) neoliberal globalization has come to an end, capitalism is in a long-term crisis and we are faced with „depression economics” as a general case. As Immanuel Wallerstein, a world-system theorist, has suggested for some time, what was called “globalization” in the last couple of decades was really at the global level an “age of transition” away from the current capitalist world-system towards something else. What is this “something else” we do not know yet.

Because of technology, globalization, crisis and other competitive forces companies have radically restructured how work gets done.

To meet the challenges of this rapidly changing environment, it is necessary to prepare individuals for a workplace where duties are permanently changing, where cross-cultural and language skills must be developed, where flexibility, lifelong learning, flat hierarchies and an increase of social competence are required, where information technology becomes of paramount importance, where initiative-taking is more important than obedience, and where strategies are especially complex because of expansion of markets beyond national borders. The workplace will have less hierarchy and supervision, more autonomy and responsibility, more collaboration, less predictability and stability.

Therefore, education must help individuals to perform tasks for which they were not originally trained (Tullao, T.S., 2003), to improve their team skills, to lay the basis of complex thinking linked to the realities of this new world. To memorize any information or learn how to follow directions will be insufficient for success in the job market of the 21st century.

According to Anthony Salcito, the Vice President of Microsoft Worldwide Education (cited in Schiller and Arena, 2012), the education system no longer meets the needs of the population it serves. The public schools were designed for 19th-century industrialism not an era of globalization and interconnectivity. Because students remain largely uninspired due to the outdated standards and textbooks corporations are pressed to recruit new talents. “We have to acknowledge that learning is shifting away from content memorization to a more relevant, personalized, skill-based foundation. We have to dig deeper, think harder and get more engaged to determine what change is needed and then push the pieces forward. We also have to bring a culture of sustainability to the process of transforming education,” said Salcito.

Globalization is affecting the types of knowledge and skills students will need to thrive. Since they will be collaborating with people around the world, they will need to have greater “global literacy”—knowledge about the people and cultures.

With the advancement in information technology and a move towards knowledge-based industries, the role of educational services will become more important in the future.

Five major lessons emerge from the expert research and opinion (Jerald, 2009) on what kinds of knowledge and skills will most benefit students in the future:
• More education, some postsecondary education or technical training are essential;
• More advanced courses in traditional knowledge and skills in school subjects like math, language arts, and science;
• Students must better learn how to apply what they learn in those subjects to deal with real world challenges, rather than simply “reproduce” the information on tests.
• Developing the ability to think critically about information, solve novel problems, communicate and collaborate, create new products and processes, and adapt to change;
• Applied skills and competencies can best be taught in the context of the academic curriculum, not as a replacement for it; critical thinking and problem solving are highly dependent on deep content knowledge and cannot be taught in isolation.

Education has the potential to provide solutions to the major problems that we are currently facing. The German government plans (The Bildungsrepublik Deutschland), for instance, have identified investment into education as a strategic and tactical key area for the recovery from the current financial crisis and economic recession. However, we argue that education can realize this potential only if it comprises ethical and social responsibility aspects. In this respect, we agree with Mullerat (Mullerat, 2010), who argued that the world cannot survive without a “global ethic” which respects human rights but also conveys the idea that rights go hand in hand with duties. Universities have their duties regarding this new environment of learning.

2. THE STRATEGIC IMPORTANCE OF CORPORATE EDUCATION

Corporate education is a system of professional development activities provided to educate the workforce. It may consist of formal university training or informal training provided by non-collegiate institutions.

The simplest form of corporate education is represented by training programs on specific aspects of the job processes or responsibilities. Corporate training can be provided through contracts or relationships with educational institutions that may award diplomas, certificates, credits (also possible through a system of Continuing Education Units). Corporate education can be used as part of a holistic human resources effort to determine the performance of the employee and as part of their review systems. Also, the organization can use corporate education and training as a win-win-arrangement with managers and key employees.

The literature is full of examples of partnerships that created mutually beneficial education programs. When partnering goes, corporations gain educated workers and higher education fulfill its mission and maintains academic integrity. Universities can provide to the corporate partners education, research partnerships, and connections to world class faculty and students.

The standards in corporate education focus on the acquisition of skills that are expected to bring changes in an employee's performance and to have an impact on the organization.

Therefore, according to Kessels (1991) in corporate education, curriculum is defined as: “the course of action open to an organization for influencing the necessary skills of employees that contribute to goal-oriented changes in their performance and in their work environment, thus striving for a desired impact on the organization by applying planned learning activities and the resulting learning processes”.

Companies need to bring education into their corporate DNA as a mean of innovation and marketplace survival and to embrace corporate education and training as an investment and not just a business expense.

According to Ryan (Ryan, 2010), a study in the United States on 3,100 workplaces by the National Centre on the Educational Quality of the Workforce (EQW) found that a 10% increase in workforce education/skills levels led to an 8.6% gain in total productivity, while a 10% increase in the value of equipment increased productivity by just 3.4%.

A study looking at Australia’s productivity levels considering the availability of skilled people in management, and the workforce generally, found the positive impact of skills on management practices to be significant, with 64% of managers in the highest performing organizations having a university degree or higher, along with 20% of their workforce. This compared with only 3% of managers in the lowest performing firms having university degrees and only 1% of their workforce (Management Matters in Australia: Just how productive are we?, Nov 2009, Dept of Innovation, Industry Science and Research).

Studies like 2009/2010 Trends in Executive Development: A Benchmark Report, highlighted some emerging trends in this area:

Professionals in executive development have learned to measure the success of development offerings and are adept at finding and creating relevant learning opportunities for the executives and for themselves.

The economic downturn means that there is more pressure now than before to prepare leaders (and the workforce) who can weather the storm and navigate their companies successfully through the turbulence.

The next generations of executive leaders are lacking necessary competencies. They highlighted weaknesses in the ability to think strategically, lead change, create a vision, and rally others around that vision.

We can say that corporate education is increasingly gaining much importance and attention in the knowledge based economy on the one hand and in a globalized world and in crisis, on the other hand, with the knowledge workers becoming key factors for the growth and development of organizations and societies.
3. THE WORKING RELATIONSHIP BETWEEN UNIVERSITIES AND CORPORATE EDUCATION

Universities served the public interest through education, research (creation of knowledge) and knowledge transfer. In the present day context the mission of higher education became more complex comprising also the necessity to contribute to the sustainable development and improvement of society as a whole.

According to the Association of Universities and Colleges of Canada (AUCC, 2001), “the mission of higher education is to contribute to the sustainable development and improvement of society as a whole by: educating highly qualified graduates able to meet the needs of all sectors of human activity; advancing, creating and disseminating knowledge through research; interpreting, preserving, and promoting cultures in the context of cultural pluralism and diversity; providing opportunities for higher learning throughout life; contributing to the development and improvement of education at all levels; and protecting and enhancing civil society by training young people in the values which form the basis of democratic citizenship and by providing critical detached perspectives in the discussion of strategic choices facing societies.”

Developing advanced knowledge and skills and converting these into useful products and services underpin the vitality of our societies. At the Spring European Council „Working together for growth and jobs” the European Commission stated that, in order to meet the Lisbon agenda and Barcelona objective, „Universities’ contribution to the creation and dissemination of knowledge throughout the Union must be reinforced”. One of the principal barriers has been the difficulty in aligning the university and industry interests, especially in the perspective of creating long-term partnerships. By establishing the foundations for successful research partnerships with industry and public bodies, responsible partnering reinforces the value of the university within society, creates new opportunities and enhances the prospect for continued top-quality research and education. But this is just one aspect of the problem.

According to McGee (McGee, 2006) traditional universities will become long-term partners to business by:

- Adapting materials to reflect learning needs spelled out in an organization’s annual operating plan;
- Matching the pace of change in business to serve as thought leaders and guides to the corporate work force;
- Developing a business-oriented approach to recruiting and retaining lifelong corporate learners.

Universities and corporations must identify learning solutions and their corresponding business results. The strategic alignment to business priorities requires close collaboration between those who develop and deliver learning (in our case the universities) and the company’s senior management who establish the business strategy (and the learning account manager) in order to prioritize learning requests against capacity and affordability and identify opportunities for learning investments to drive hard business outcomes. According to Meister (Morrison and Meister, 2000) „managing the corporate university according to “business impact measures” is really what separates a high-performing learning organization from one focusing on providing a catalog of courses “pushed” to businesses”.

Universities have also to drive innovation in learning design, development and delivery that meets strategic business priorities.

Universities foster a broad, integrated frame of reference that draws from a wide, multidisciplinary spectrum, but they must also provide practical business knowledge, managerial competence, and task-oriented education. Universities must not ignore the social, historical, and economic forces at work in today’s world. In the age of iTunes, open source software, and for-profit online universities, there are new rules for higher education (De Millo, 2011).

Corporations often want new degree programs or curricula for engineers, manufacturing people, or other business-related jobs, and they become frustrated when universities cannot create these programs quickly. As a partial response to company demands, MBA-accredited programs are adapting by delivering more leadership development, supplying the increased demand for flex- and blended- (a mix of online and face-to-face learning) MBA programs, and even projecting additional language requirements for the growing importance of the global market. But the university’s structure has to be realigned in order to bring greater value to their institution’s relationships with industry. To stay competitive and current, traditional business schools can continue to re-invent and emphasize their ability to supply these, negotiating special contracts with large corporations and promoting them to the market. The research of Ryan (2006) highlights the need for universities and corporate to take time to learn and understand the requirements and expectations of each other and, as in any good relationship, provide flexibility to accommodate these requirements and expectations.

According to Topal (Topal, 2009) “the socially responsible ethos of higher education has been subordinated to the forces of marketization and both society and the participants in such education are the poorer for it”. Therefore a new strategic aim for universities that adopted corporate education is social responsibility. Universities can serve as a bridge to the outside world, to move towards it and invite it to enter the organization. It can help the company to discover the stakeholders and cooperate with them. It can educate employees to respect people and the environment, to learn new competencies to help a company to be more rigorous and demanding for itself in the elaboration and implementation of its business strategies. For this purpose universities can deliver seminars on corporate responsibility culture, on protection of the natural environment, discouraging waste and pollution. They can organize leadership learning programs on Corporate Responsibility, Corporate Citizenship and Sustainable Development for top executives and middle management. They
can help employees who support NGOs through voluntary programs. They can develop cooperation with educational systems and other academics, building new curricula; they can deliver programs on the education of underprivileged people literacy, etc. Courses and learning assets can be effectively used to reach and influence the workforce, stakeholders, community, faculty and staff in regard to critical subjects that promote and educate corporate social responsibilities.

For expanding their values, goals and norms, the universities, especially in developing countries, should be able to combine good science with the complexities of business, intellectual property protection, social sciences and a regulatory environment in order to adopt different strategies for making the university education to suit the local communities and industries.

Sir Richard Lambert, Chancellor of the University and former Director-General of the CBI, argued that “universities themselves are going to have to show strong and purposeful leadership to navigate these times of change. They will need to work more closely with business in the interests both of their students and of their research activities – but not at the expense of their independence or their intellectual integrity. And there will be real opportunities ahead for those that get this balance right”.

4. THE SOCIAL RESPONSIBILITY OF UNIVERSITIES IN DEALING WITH CORPORATE EDUCATION

Higher education exists to serve the public interest and has to be socially responsible. It is globally recognized that an expanded higher education sector has become a necessary condition for a country’s growth in the present environment; it is important in promoting faster technological catch-up and in improving a country’s ability to maximize economic output (World Bank, 2002).

Sustainable development and social cohesion depend critically on the competencies of all the population – with competencies understood to cover knowledge, skills, attitudes and values. According to Rychen (Rychen and Salganik, 2003) there are three broad requirements in the context of organization or society: individual competencies, institutional competencies and application of individual competencies to contribute to collective goals. OECD identifies key competencies for personal, social and economic well-being.

De Haan (De Haan, 2006) identified eight key competencies for shaping competence: competence in foresighted thinking; competency in interdisciplinary work; competency in cosmopolitan perception, trans-cultural understanding and cooperation; participatory skills; competency in planning and implementation; capacity for empathy, compassion and solidarity; competency in self-motivation and motivating others; and competency in distanced reflection on individual and cultural models.

Corporate education should cover different competencies required while addressing other challenges faced by industries and individuals. Narasimharao (2010) argued that establishing a center for corporate education in universities not only help in acting as a coordination unit between industry and university but also help in integrating the activities and studies of various disciplines. The corporate education efforts of universities should evolve in this direction for utilizing the diverse expertise available at their disposal. “We need to ask what individuals need in order to function well in the organization or society, what competencies do they need to find and to hold down a job, and what kind of adaptive qualities are required to cope with changing technology”.

5. CONCLUSIONS

The role of corporate education and employee training and development is of tremendous importance and if the issue is not addressed strategically and effectively it will be one of the biggest impediment on any country’s growth, innovation, productivity and lifestyle into the future.

In the context of the corporate social responsibility the corporate education is challenged by not only personnel professional training but also by realizing in companies the programs of training the personnel of all levels aimed at forming the personal responsibility, analytical skills, emotional intelligence, aspiration for the result in the activity, educability.

The corporate education is becoming a factor of a country modernization in social and economic spheres. We can speak about the efficiency of corporate education, forming the employees’ active position via training, developing the corporation’s social capital.

It is necessary that the university takes the responsibility of not only fulfilling the objectives of corporations but also incorporate holistic education and training to prepare the employees for learning to think and act in a more integrated way in this changing and evolving world.

The European Commission published in September 2011 an agenda for modernisation of Europe's higher education systems and two of the main areas for reform identified in this agenda were: to improve the quality and relevance of teaching and researcher training, to equip graduates with the knowledge and core transferable competences they need to succeed in high-skill occupations and to strengthen the "knowledge triangle", linking education, research and business.

US universities are focused on entrepreneurship, strategic management, innovation and corporation accountability and we can see in the last years more top American universities breaking ground on similar programs in emerging markets, where, according to Marian Salzman (cited in Forbes, 2011) a whole new generation of would-be corporate raiders is ripe for picking.

The crisis has put the Education and Training systems to a test and we should see it as an opportunity to improve or change what is needed to be changed. The partnership between the business and the education sectors should be deepened to match the labour shortages and the future needs. Training should lead to the employment. To achieve that, the image of
corporate education has to be promoted and we can say that with the right corporate university management process the new era of management can be more profitable and exciting. This area is a major challenge but also an opportunity for many universities all over the world.

Around the world, there are 2.3bn Generation Y (the generation that was born between 1980 and 2000) and almost 50% of the world’s population is under the age of 27 (The Talent Management Summit 2012). This generation has a profound effect on how companies will manage, recruit and retain talent. Finding how to capitalize on this generation is one of the biggest challenges and opportunities facing global companies and the education system. Regarding the generations after the age of 27, they must ensure that they have the right experience and skills to be comfortable with rapid change and near-unprecedented complexity. To achieve these goals we need to transform the educational system to prepare all students to compete in a global economy by working with businesses and organizations to create a network of support for schools at the local, national and international levels.

Keeping pace with the changes in the labor market, with the needs of companies represents a major social responsibility, and universities should be a mainstay of this. Moreover, the Ministry of Education of Romania has initiated a process of change in the undergraduate curriculum in adapting to the demands of the labor market and universities should assume in turn this approach, both through consultation and by changing their own curriculum and through partnerships with corporations.

The economic currents are changing rapidly and we need to keep perspective on what works, inviting new ideas and new ways to create value, and involving and communicating with others.

6. REFERENCES

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DESIGNING FUTURISTIC EYEGLASSES WITH INNOVATIVE MARKETING STRATEGY USING PRODUCT LIFE CYCLE MANAGEMENT

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ABSTRACT: Glasses are becoming more and more important as part of our daily life. The product is an interesting and general. People's needs in this regards are different. In this research work a case study of product life cycle management of smart glasses for future use is presented. Research is thorough and quantitative. Basic objectives that were to establish are the reasons for wearing sunglasses, the most important characteristics that glasses must meet, setting the fashion trends for glasses and provides market strategy for selling glasses until recycling. On the basis of research done on sample of 30 people, different option were put in front of them the most important were chosen, which are, built-in speaker for playback, capacity to store memory, connectivity to external devices (PC) and Radio/MP3. Market strategy is also set for the glasses from factory to the recycling including customer feedback, environmental concerns. Conceptual design of the glasses using computer aided design is also presented. This multidimensional product is an achievement in innovation, entrepreneurship and gives good insight into the implementation of engineering education through product life cycle.

Key words: marketing strategy, product life cycle management, eyeglasses

1. INTRODUCTION

To achieve the life-cycle of a product improvement smart glasses have chosen as example. The product is interesting and general in use. Seneca the Younger, who was Emperor’s tutor Nero of Rome, wrote: "Letters, however small and indistinct, are seen enlarged and more clearly through a globe or glass filled with water."[1] Nero also said to have watched the gladiatorial games using an emerald as a corrective lens.[2] In 1946, Vasco Ronchi of Florence stated "when it is all summed up, the fact remains that this world has found lenses on its nose without knowing whom to thank.”[3]. Sunglasses, in the form of flat panes of smoky quartz, were used in China in the 12th century.[4] First spectacle frames were made of wood or animal bone. Lenses for myopia correction appeared in the mid-fifteenth century. By the sixteenth century the use of glasses for vision correction is done only in secret, in order not restricted environment suggests that the person has vision problems. Early glasses are shown in fig 1.

Figure 1. Ancient Glasses

During this time appeared wearing fashionable glasses with monocular and one vertical arm (used especially of women), they became a fashion accessory among elite society. In this way people do not recognize the existence of problems of vision. To the sixteenth century appears first fixation after lateral arms give ear glasses. Modern glasses are shown in figure 2.

Figure 2. Present Glasses

As science advanced along with advancing needs there is need for more versatile glasses.

This paper presents a thorough market study and quantitative results clearly stating the research objectives and complete product life cycle. For better understanding of the needs for the future smart glasses a questionnaire is composed and put in the general public. On the basis of respose from the questionnaire, objectives are chosen from wide set of options and their importance is categorized. Main features that are proposed at frist are flash light, camera, blood pressure measurement, pulse reader, Radio/MP3, hands free, data storage, and temperature sensor. On the basis of the results from the market research, the most important features those carry high percentage value were incorporated in conceptual design using CAD software. In designing process, part by part design and assembling of the product is proposed. Product is versatile and technological, electronics used is motherboard, batteries for charging mini USB, hands Free, jack, and loud speakers.

After designing process in this paper instruction to use is presented which explains data entry process and charging of batteries. Packing strategy is presented along with distribution in market, promotion and pricing of the product.

To complete the product life cycle maintains is describe for the durable and efficient use. Innovative strategies for widrwel
from the market, disassembling with user-friendly approach is design, recycling including destruction, disposal and environmental impact of the glasses is also discussed. For the continual improvement of the product, customer feedback is made a necessary part of the marketing strategy. A complete life cycle is discussed for the smart glasses.

2. RESEARCH METHODOLOGY

The research was conducted on a sample of 30 people aged between 15 and 65 years. Questionnaire composed of following questions is floated into the sample of 30 people:

- Are you carrying / bearing glasses?
- What is the main reason you wear glasses?
- How often do you wear glasses for the following activities?
- How important are the following aspects in your glasses look?
- Are you interested / accessory possibilities of glasses?
- How important to you as the eyeglasses would be accessorized with the following?
- An example of an adjustable single record, assume that you are in the following situation: you are under any medication and have taken several medications at different times. Are you interested in the possibility that your glasses voice alert when should you take a drug and what is it?
- What is your present occupation?
- Which of the following fits your monthly income?
- In what age range you belong?
- Gender

2.1. Research Findings

- Participants on the basis of gender?

![Figure 3. Participants](image)

Of the 30 respondents, 8 of them are men and 22 women.

- Are you carrying / bearing glasses?

![Figure 4. Participant using glasses](image)

- Why you wear glasses?

![Figure 5. Percentage of candidate using Glasses for different Purposes](image)

Of eyeglass wearers, 34.75% use them for protection, 59.88% to correct a defect of view and 5.42% is considered an accessory.

How often do you use your glasses for the following activities?

- Eye weakness short distance
- Eye weakness long distance
- To work on computer
- For sun Protection
- For other activities
- Use as Accessory

Research findings show that 74.23% use glasses to see for corrective purpose to look for close distance. 63.72% for far distance, 47.56% for working on the computer, 32.40% for protection against the sun, 17.35% use glasses for any activity they perform, and very little of them, namely 4.53% considered glasses as a simple accessory.

How important for you the glasses would be accessorized with the following?

- Flashlight
- Laser
- Camera audio-video
- Blood pressure
- Radio/MP3
- Pulse counter
- Hands free
- Data storage capacity
- Temperature sensor

Answers to this question considering only "important" and "very important" respondents responded as follows: 12.74% consider important and very important for glasses to be accessorized with flashlight, 2.70% would like laser, 24.56% would like to have room and audio-video built 37.50% would like to be able to measure voltage with something that is an accessory for spectacles, 56.35% would like a radio or MP3 built 3.75% would want to be able to count steps, 61.94% think the hands free accessory importantly, 46.20% considered advantageous for glasses to be able to play previously stored
words and phrases, and 29.64% would like be able to measure the temperature.

### Table 1. Categorization of Accessories

<table>
<thead>
<tr>
<th>Glasses Accessories</th>
<th>Very Important (%)</th>
<th>Important (%)</th>
<th>Medium (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Flash Light</td>
<td>5.40</td>
<td>12.686</td>
<td>12.74</td>
</tr>
<tr>
<td>2. Laser</td>
<td>1.45</td>
<td>1.25</td>
<td>2.7</td>
</tr>
<tr>
<td>3. Audio and video camera</td>
<td>14.48</td>
<td>10.08</td>
<td>24.56</td>
</tr>
<tr>
<td>4. Blood Pressure Measurement</td>
<td>17.41</td>
<td>20.09</td>
<td>37.5</td>
</tr>
<tr>
<td>5. Radio/MP3</td>
<td>38.4</td>
<td>17.95</td>
<td>56.35</td>
</tr>
<tr>
<td>6. Pulse Counter</td>
<td>1.5</td>
<td>2.25</td>
<td>3.75</td>
</tr>
<tr>
<td>7. Hands free</td>
<td>32.42</td>
<td>29.52</td>
<td>61.94</td>
</tr>
<tr>
<td>8. Data Storage Capacity</td>
<td>12.5</td>
<td>33.7</td>
<td>46.2</td>
</tr>
<tr>
<td>9. Temperature Sensor</td>
<td>15.24</td>
<td>14.4</td>
<td>29.64</td>
</tr>
</tbody>
</table>

The most important accessories are radio / MP3's with a percentage of 56.35% hands free software with 61.94% and playback of certain phrases or words previously stored with 46.2%.

2.2. Setting objective and their share

As a result of marketing research have been established as the needs of the respondents as follows:

- To fulfill the role
- Easy to use
- Have certain accessories.

These needs are transformed into functions with a weight of 4.3, 3 from a total of 10.

2.3. General design basis:

Glasses with radio, hands free and playback possibility of stored information.

### 3. INNOVATIVE PRODUCT DESIGN

To make design more optimize analysis is done on the basis of needs. This analysis is useful to transform customer priorities to guide the product design and out comes can be identified easily.

The clients and the correlations between customer needs and characteristics.

Qualiqa software is used to determine the characteristics of the product. Technique for determining the characteristics of the final product is a fast and unexpectedly gives good results in a relatively short time. With this method it was concluded that the glasses should have follows: glasses "pads", arms curved frame with speaker jack, mini USB, battery, microcontroller, hands-free and cord.

### 4. MODELLING PRODUCT DESIGN AND ASSEMBLY

Smart glasses are a new product on the market developed strongly in the last hundred years, a product designed to revolutionize glasses for use in reaction to user with new features:

- Built-in speaker for playback
- Memory capacity
- Connectibitute external devices (PC)
- Radio

Of course we do not deny the order principal that led to vision correction glasses namely. Smart way it can be equipped with both lenses for distance vision and for near vision (in a range of diopters). We offer customers the opportunity to use anti-glare lenses or / and Reflection.

4.1. Mechanical Component Glasses

SMART glasses are designed on the basis of recent fashion trends with versatile electronics and more ergonomic style. SMART glasses conceptuel design using CAD program shown in figure 9.

- Lenses
- Frame
- Ports for jack and USB
- Battery housing
- Speakers

4.2. Instructions for use

In terms of vision correction arranged function is not need any description, this being achieved as easy and natural as before:

- Place the glasses on.
- Ensure by ear hook and the rest miracle takes effect
- Correct order and continue daily activities.
- For the radio to start, jack connects to the glasses, which will act as buttons on support.
- Regarding storage and playback function, glasses are able to store some words and voice and have the capability to play back thought speakers.
- To connect the glasses to external media (PC) Use the supplied cables shown in figure 10.
5. ELECTRONIC COMPONENTS

SMART Glasses contains following electronic components

- Circuit board
- Microcontroller
- Li-Ion battery
- Mini USB
- Handsfree
- Jack
- Loud Speaker

6. PACKING

The product is packaged in an elegant and useful spectacle, used both for protection, storage and transport as shown in figure 11.

7. DISTRIBUTION, SALES STRATEGY, PROMOTION, PRICING STRATEGY.


Among the many products on the market we chose to create a new, revolutionary market strategy.

They have a number of modern features: - hands-free system, radio, player information and opportunity are very modern design practices and our product is for people regardless of age, social class, depending.

We propose the creation of this product attracting a large number of customers, satisfying them and also continuously improve product quality.

Our company's desire is to become market leaders in the field of smart optics.

To achieve the above objectives we start from the premise:

“Our client should be fully satisfied. “Then its satisfaction will increase company profits and also unconditional extension. Quality is the base word in the promotion of our product - "0 defects", "continuous improvement". Company strategy is shown in figure 12.

8. MAINTENANCE

Maintenance of these glasses is engineered like ordaniry glasses.
• For cleaning the lenses there will be a special soft plastic (Provided). Using any other material (eg garment) may cause scratches on the surface of lenses actually uncovered by the insurance policy;
• To avoid locking joints goggles is recommended when it is necessary to use a lubricant (eg oil fine mechanisms);
• For proper operation of the product, it is recommended to connect the power source every night or every 3 nights if used moderately.

Forgetting device connected to the power supply overnight there no risk, as it will automatically pause when batteries are fully charged.

Smart glasses are protected against moisture and condensation and droplets of rain and also avoid immersing them in liquid.

9. WITHDRAWAL, DISASSEMBLING, DISMANTLING, RECYCLING, DESTRUCTION, DISPOSAL, ENVIRONMENTAL IMPACT

9.1. Withdrawal from market
Withdrawal or recall of product from market is always last resort for the company and is also difficult to track the product. In case of smart glasses we have devised the batch and numbering system in such a way that it could be easy to track the location of product. In this case each product is numbered universally independent of the batch or lot of the product specifically for a designated dealer and in case of call for withdrawal each dealer in specific country and city would directly access to Central Control System for Product Regulation (CCSPR). A SMART glasses code is shown

Figure 15. Bar code with intended address

Bar code represents the “eu” represents product will sent to Europe and followed number indicates the number of the lot, “ro” represents the country code followed by the batch number in this country “sb” represent the city number followed by the packet number where final four digits represents the product identification and dealer data.

9.2. Disassembling/Dismantling
In spite of Hi tech circuitry, mechanism and delicate material smart glasses are made user friendly, and easy to disassemble. Disassembling process is defined in 3 steps as follows
• Power source Removal: In this category mechanically locked battery cap is removed and batteries are taken out.
• Primary Disassembling: In this category all mechanical components, like glasses and frame arms are removed
• Secondary Disassembling: Secondary disassembling is final and most crucial stage of disassembling in this part electronics along with microcontroller are removed

This type of disassembling strategy makes the smart glasses to be repaired easily and in case of component failure the component should be replaced without a lot a technical expertise and effort. Also this disassembling ensures the usage of these components in some other products in case of recycling.

9.3. Recycling
Recycling process works by mechanically separating the metals, plastics, and circuit s contained in the appliance. The process is described under disassembling heading. Smart glasses are made up of 95% recyclable material and are eco-friendly. Completely obeying the European recycling act which is as follows, Regulation (EC) No 1935/2004 of the European Parliament and of the Council of 27 October 2004 on materials and articles intended to come into contact with food and repealing Directives 80/590/EEC and 89/109/EEC[5]. Smart glasses completely comply with this act. This Regulation aims at guaranteeing a high level of protection of human health and the interests of consumers with regard to the placing on the Community market of materials and articles intended to come into contact with food either directly or indirectly.

9.4. Environmental impact of Smart Glasses
Smart Glasses major constituents are plastic, hi tech metal alloy, lithium ion batteries. Because 95% of the smart glasses are recyclable hence they have much less impact on the Environmental. Environmental impact of all these components assessed on the basis of following criteria’s to insure the environmental friendly product.
• High Power Efficiency: Smart Glasses run on very low power, such superior power efficiency of the smart glasses is found to be beneficial to the environment, in general
• Environmentally-harmful Production Processes: Production process is devised to run lowest energy consumption and waste production, which further reduction of the consumption of naturally occurring fossil fuels, hence putting this product one step further into the eco friendly products.
• Harmful Chemicals: The most harmful chemical that this product have are lithium ion and polymers, but because of advancement in the material and technology they all are 100% recyclable
• E-waste: Obsolete smart glasses eventually add to the e-waste, which gets dumped in environmentally-unsafe landfill sites if not recycled. Because of the low metallic contents this product offer environmental safety if dumped for a longer period into landfills.

9.5. Storage and Destruction
Smart Glasses should be stored at room temperature 25c and must not be exposed to high temperature like more than 45c for more than 48 hours. Integrated circuits and opto-isolators have an MSL rating typically 1 so this circuitry is properly sealed during manufacturing to avoid humidity effect, to reduce the pop corn effect. Shelf life of this product is declared as 2 years after 2 years packing must be rechecked again.

Figure 16. Destruction and Recycling Process
Physical destruction of product involves using a crusher. Other methods of destruction includes but is not limited to cutting, breaking, smashing, shredding and burning after removing glasses – to otherwise render the product “inoperable”. Destruction of this product does not require SCRs (Specific Control Rooms) and destruction can be done anywhere except populated areas.

10. FEEDBACK FOR A SUSTAINABLE REDESIGN

To succeed this product to resist as much as the market and actually have a life cycle as necessary as long as product purchase customers give us feedback needed to achieve our objectives and to resist all the glasses market.

Figure 17. PLM Feedback for Sustainable Redesign

This we achieve through its website where we have a section of opinions and ideas for improvement, we also have an e-mail clients opinions section, periodic surveys and questionnaires.

11. CONCLUSION

A complete and thorough product life cycle of SMART glasses is presented from conception to disposal and destruction. Product is new and revolutionary. Along with other uses of the product, SAMRT glasses can be used for more than just ordinary purpose, where they can be found helpful in assisting old people on special medical treatment and at the same time can be used for military purpose. Company’s market strategy is thorough which gives solution for critical steps like product promotion and pricing strategy. To avoid the decline of the product and increase continual improvement effective feedback system is introduced. Inside of the company policy of “0 defects” product trials, warranty for 3 years and free services including online client assistance are provided to the costumers for the customer satisfactions to make product and company a beacon of trust. Small details are also addressed in the PLM cycle like environmental issues, specifically engineered mechanism of the product for user friendly disassembling and maintenance, transportation and shelf life according to MSL rating, and a new call back system with unique bar code. This product is not intended for children under 3 years. Contains components that can be detached and there is risk of inhaling the components.

12. ACKNOWLEDGEMENT

SMART Glasses PLM team is thankful to Prof. Dan Brindasu for their technical and moral support in completing this product.

13. REFERENCES
MAKING AIR TRAVELLING MORE ECONOMICAL, AN INNOVATIVE DRAG REDUCTION APPROACH FOR A SUPERCRITICAL WING SECTION USING SHOCK CONTROL BUMPS

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ABSTRACT: Air travelling is the second largest travelling medium used by people. In future it is expected to be the first choice for the travellers. As increase in the price of oil cost of air travelling is getting higher. Engineers are forced to find the cheaper means of travelling by innovating new techniques. This paper presents the new idea to reduce air travelling cost by reducing drag, which is major driving factor of high fuel consumption. Two-dimensional and three-dimensional shock control contour bumps have been designed and analyzed for a supercritical wing section with the aim of transonic wave drag reduction. A supercritical airfoil (NACA SC (02)-0714) has been selected for this study considering the fact that most modern jet transport aircraft that operate in the transonic flow regime (cruise at transonic speeds) employ supercritical airfoil sections. It is to be noted that a decrease in the transonic wave drag without loss in lift would result in an increased lift to drag ratio, which being a key range parameter could potentially increase both the range and endurance of the aircraft. The major geometric bump parameters such as length, height, crest and span have been altered for both the two-dimensional and three-dimensional bumps in order to obtain the optimum location and shape of the bump. Once an optimum standalone three-dimensional bump has been acquired an array of bumps has been manually placed spanwise of an unswept supercritical wing and analyzed under fully turbulent flow conditions. Different configurations have been tested with varying three-dimensional bump spacing in order to determine the contribution of bump spacing on overall performance. The results show a 14 percent drag reduction and a consequent 16 percent lift to drag ratio rise at the design Mach number for the optimum arrangement of bumps along the wing span. This innovative technique proves to be a bridge between economical problems and engineering solutions and a milestone for aviation engineering.

Key words: Supercritical Wing, Air travelling, Economical, flow control, Drag reduction, Shock bumps, Transonic, Commercial

1. INTRODUCTION

Nomenclature:

- CL = Coefficient of lift
- CD = Coefficient of drag
- Cp = Pressure coefficient
- M = Mach number
- Re = Reynolds number
- A = Angle of attack (Degrees)
- L/D = Lift to drag ratio
- BWB = Blended wing body
- c = Chord length
- NLF = Natural laminar flow
- SC = Supercritical

Almost all the modern jet transports in operation today operate in the transonic flow regime, rather than supersonic, for a major portion of their mission (cruise) for the sole purpose of fuel economy. Invariably the transonic flow regime is associated with the formation of shock waves which give a drag rise called “wave drag”. This wave drag increases with shock strength and its fallout is flow separation. Consequently the performance of the aircraft is reduced significantly. Therefore it is of paramount importance for any designer to reduce this wave drag and many methodologies have been used previously for shock control. A review of previous research in the subject reveals the work of Qin et al. [1] who present a parametric study of the various shock controls using suction, blowing and shock control contour bumps. This study shows that a well design two-dimensional bump for the RAE 5243 Natural Laminar Flow (NLF) airfoil significantly increases the lift to drag ratio by reducing the shock strength and consequently the wave drag.

Konig et al. [2] demonstrated the advantages of using three-dimensional shock control bump on an unswept transonic wing. Experimental and numerical studies were carried out on an array bumps placed spanwise on a modern transonic airfoil. Close agreement was achieved between the wind tunnel test and CFD results which indicated an overall drag reduction of 10 percent.

Furthermore Ogawa et al. [3] developed three-dimensional bumps for a transonic wing for the purpose of drag reduction and buffet delay. By carrying out both experimental and numerical studies at Mach (M) 1.3 and by using an optimum spanwise distribution of bumps an overall drag reduction of 30 percent was achieved. Qin et al. [4] carried out the design and optimization of two and three-dimensional shock control bumps for the RAE 5243(NLF) airfoil using a discrete adjoint solver approach. The adjoint solver was a gradient based optimization technique which used a sequential quadratic programming optimizer to find an optimized design point considering sensitivity derives for a number of design variables. The optimized two-dimensional bumps resulted in...
a drag reduction of 18.1 percent while the optimized three-dimensional bump offered a 20.1 percent drag reduction. However the three-dimensional bumps were found to be very useful over a wide range of off-design operating conditions.

Sommerer et al. [5] carried out the numerical optimization of adaptive transonic airfoils with variable camber. Here the two-dimensional bumps were analyzed on the DAVA2 airfoil using the two-dimensional Navier-Stokes solver MUFLO. This analysis also showed encouraging results and the airfoils lift to drag characteristics were significantly improved with the addition of the shock control bump. Wong et al. [6] continued on their work and presented an adjoint-based optimization of a blended wing body shape with shock control bumps. In addition to the general geometric parameters the bump spacing was also optimized using and adjoint solver for three-dimensional bumps spanwise on a swept back wing. The result was an overall lift to drag ratio (L/D) gain of 12 percent.

Sobieczky et al. [7] developed a theory based shape modification concept analysis for transonic airfoils. The study boiled down to the design and study of the effects of an expansion shoulder bump for wave drag control. Here a leading edge bump was used to increase the aerodynamic efficiency of a supercritical airfoil and thus widening the region of optimum lift-over-drag ratio.

The supercritical airfoil has numerous advantages compared to the conventional airfoil [8] in the transonic flow regime and thus is the preferred choice of designers all over the world for use in transonic wings. This paper presents the design and analysis of both two-dimensional and three-dimensional shock control bumps for a supercritical airfoil. The design parameters are the various geometric parameters such as bump height, span, crest location, relative crest and bump spacing. The designed three-dimensional bumps are then placed in a spanwise array over an unswept transonic wing. However this idea has been developed with the concept of a variable geometry wing using smart materials wing technology in which the bumps would simply “pop-up” during the design Mach number phase of the mission. Therefore the computations have been done only at a design mach number and the effect of transition and performance at off-design conditions, Mach numbers and the coefficient of lift (CL), are beyond the scope of the present paper.

2. SIMULATION

2.1. The Flow Solver

All simulations have been carried out in a commercially available computational fluid dynamics (CFD) code. The turbulence models in this CFD code are based on Favre averaging the equations governing the flow. Favre averaging introduces additional terms known as Reynolds stresses which are modeled using the Boussinesq eddy viscosity concept. This eddy viscosity is modeled by the following equation:

$$\mu_t = \rho q l$$  \hspace{1cm} (1)

where q is the velocity scale and l is the length scale. The Baldwin Lomax turbulence model [9] has been used in all the simulations. This model is an algebraic turbulence model because the velocity and length scales are obtained from algebraic relations and is also commonly referred to as a mixing-length model because it employs Prandtl’s mixing-length hypothesis in modeling length and velocity scales. The reason for selecting this model is that it is robust and provides quicker solution as compared to one equation or two equation turbulence models. Although the accuracy of the Baldwin Lomax model in the transonic regime has already been validated by Moigne [10], using the CFD code MERLIN developed by the Cranfield University, for the purpose of this study the Baldwin Lomax model has been formally validated, for the CFD code used in this study, by comparison of computed surface pressure distributions with the classic ONERA M6 wing experimental results by Schmitt et al. [11].

A structured mesh was generated around the wing geometry and simulated at conditions identical to those of the wind tunnel test, angle of attack ($\alpha$)=3.060, M=0.84 and Reynolds Number (Re)= 1.2 x 106. Plotting the pressure coefficients on the upper and lower surfaces of the ONERA M6 wing at six different spanwise stations and comparing them with the experimental data reveals a fairly good agreement in the compared pressure coefficient (Cp) values. Fig. 1 presents the results of this exercise.

![Figure 1. Comparison between experimental and simulated pressure distribution using Baldwin Lomax turbulence model for the ONERA M6 wing](image-url)
3. PROBLEM DESCRIPTION

The placement of the bump manually is by no means a trivial issue therefore the shape of the bump is of utmost significance in achieving the desired results. For the two-dimensional bump four key characteristics, bump height, bump crest (or chord wise location of the bump), bump length and relative crest, were modified. However the bump height and crest played a pivotal role in the design procedure. For the three dimensional bump an additional parameter, bump span, was also considered. Fig. 2 shows the generalized key geometric parameters of the two-dimensional and three-dimensional bumps. It is important to note that all of the above mentioned geometric parameters have been quantified in terms of the airfoil/wing chord (c).

![Figure 2.](image)

3.1. Results

This section presents the results of the analysis of two-dimensional and three-dimensional bumps on the NACA SC (02)-0714 airfoil which is 14 percent thick phase two supercritical airfoil. All simulations have been carried out at M=0.78, Re=1.73 × 10^7 at α = 0°. It is pertinent to mention here that the phase two supercritical airfoils have an inherent finite trailing edge thickness. This thickness is not only beneficial for structural considerations but also contributes to a significant reduction of wave drag [8]. In this study the finite trailing edge thickness has been maintained not only for capturing real physics of the problem but also as an aid to structural mesh generation.

3.2. Two-Dimensional Bump

Fig. 3 shows the two-dimensional bump geometry and placement on the airfoil upper surface

![Figure 3.](image)

The results of the two-dimensional bump analysis are depicted in fig. 4. Fig. 4 (a) shows the development of a strong normal shock wave on the upper surface of the airfoil while fig. 4 (b) and (c) illustrate the effects that the two-dimensional bump has on the shock structure. The effect of shock dissipation by the development of a “λ-shock” structure is fairly evident. The series of oblique shocks of the λ-shock incurs the same pressure jump as the original normal shock but with reduced total pressure losses hence a lesser wave drag. This phenomenon is further explained by the comparison of the upper surface pressure coefficients in fig. 5. The dip and rise of the Cp in the region of the bump is characteristic of the λ-shock structure indicating a sudden deceleration followed by a re-acceleration of flow to reach the original minimum pressure of the baseline airfoil. The resulting changes in lift and drag coefficients are presented in table 1. These characteristics are in fact the performance parameters of the bump.

![Figure 4.](image)

![Figure 5.](image)

### Table 1. Performance parameters for two-dimensional bump

<table>
<thead>
<tr>
<th>Configuration</th>
<th>CL</th>
<th>Change (%)</th>
<th>CD</th>
<th>Change (%)</th>
<th>L/D</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.911</td>
<td>NA</td>
<td>0.0264</td>
<td>NA</td>
<td>34.66</td>
<td>NA</td>
</tr>
<tr>
<td>Two-Dimensional Bump</td>
<td>0.9202</td>
<td>+0.55</td>
<td>0.0246</td>
<td>-7.51</td>
<td>37.47</td>
<td>+8.10</td>
</tr>
</tbody>
</table>

The results presented above are encouraging and validate the effectiveness of the shock control bumps for the supercritical airfoil under study. Furthermore they are a great motivator for
the design and analysis of three-dimensional shock control bumps

3.3. Three-Dimensional Bump

Fig. 6 demonstrates the designed three-dimensional bump geometry. In addition to the key design parameters like those in the two-dimensional case mentioned earlier, an additional parameter of bump span has been used for the design of a three-dimensional bump.

![Figure 6. Three-dimensional bump geometry](image)

The simulation results are shown in fig. 7. Like the two-dimensional bump the three-dimensional bump also exhibits a $\lambda$-shock structure in comparison to the normal shock structure on the upper surface of the wing. However fig. 8 indicates an effect much more pronounced than that of the two-dimensional case at the bump centerline. The resulting surface pressure “bucket” can be accredited to the larger bump height in case of three-dimensional bumps (almost twice than that of two-dimensional bumps). This clear cut advantage of a three-dimensional shock control bump over the two-dimensional one presents itself in the form of better overall performance parameters as tabulated in table 2.

![Figure 7. (a) Local view of pressure contours on upper surface at bump centerline and (b) local view of Mach number contours on upper surface at two-dimensional bump centreline](image)

![Figure 8. Pressure distribution comparison of the baseline wing and three-dimensional bump at bump centreline](image)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>CL</th>
<th>Change (%)</th>
<th>CD</th>
<th>Change (%)</th>
<th>L/D</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.9368</td>
<td>NA</td>
<td>0.0276</td>
<td>NA</td>
<td>34.00</td>
<td>NA</td>
</tr>
<tr>
<td>Three-Dimensional Bump</td>
<td>0.9197</td>
<td>-1.81</td>
<td>0.0245</td>
<td>-11.18</td>
<td>37.95</td>
<td>+10.57</td>
</tr>
</tbody>
</table>

3.4. Supercritical Wing with Three-Dimensional Bumps

Based on the above mentioned results of the standalone three-dimensional bump a certain confidence is achieved to analyze an unswept wing with NACA SC (02)-0714 airfoil section. The dimensions of the wing are 1 meter × 1 meter and all simulations have been carried out at $M=0.78$, $Re = 1.73 \times 10^7$ at $\alpha = 00$. Fig. 9 illustrates the wing geometry with a full length array of three-dimensional bumps and the surface pressure contours. The only parameter that has still not been determined is the gap or spacing between the three-dimensional bumps therefore two arrangements with varying bump spacing was also analyzed. Similar sized grids were used to analyze all the three configurations in order to eliminate the error in the CL and CD values resulting from variations in grid size. Details of these configurations are provided in table 3. Optimum performance is achieved by wing 2, providing an overall drag reduction of 14.11 percent and consequently a lift to drag gain of 16.90 percent. However upon close inspection of the wing 3 results and comparing them with those of wing 2 interesting facts are revealed. Although the drag performance of wing 3 is depleted there is a significant rise in the lift. This occurrence is explained in fig. 10. The adverse pressure gradient behind the bump crest and the spanwise pressure gradients due to bump spacing create a pair of vortices at the rear surface of the bump which carries on downstream of the bumps. This “energized flow” creates boundary layer displacement effects in the spanwise direction and as a result this leads in general to variations of local lift distribution with the consequence of an additional induced drag component, hence the degraded drag performance coupled with a superior lift property. The surface pressure comparison of wing 3 and wing 1 is presented in fig. 11.

![Figure 9. (a) Wing with an array of full length three-dimensional shock contour bumps and (b) surface pressure contours on wing with full-length three-dimensional shock contour bumps](image)
In both the two-dimensional and three-dimensional bumps the event of $\lambda$-shock structure formation has been observed. The $\lambda$-shock structure transforms the original normal shock wave into a series of weaker oblique shock waves rendering the same pressure jump as the original normal shock with reduced total pressure losses.

Further investigation would look to explore the original “pop-up” bump aspect by means of analysis of a large swept back supercritical wing. The design of such a wing could be modeled on the wings planforms of large commercial jet airliners of the modern area. Also the bumps would be subjected to off-design conditions of Mach number and lift coefficients to determine the effects of transition process. A successful design and integration would ensure enhanced performance of the aircraft by means of an increased lift to drag ratio under cruise conditions and as the cruise constitutes a major portion of the mission a significant gain in range and endurance performances can be attained. This research ensures more economical commercial flights although it’s not limited to the commercial airlines. If implemented in commercial industry, this technique can save millions of dollars per day, which can affect the whole aviation industry.

5. REFERENCES


MANAGING UNIVERSITY THROUGH BUSINESS APPROACHES

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With the modern approaches embraced by the university management, it is becoming imperative that the concepts and instruments of business affairs management should be taken more closely into consideration, while designing the university’s strategy for sustainability. The challenges of globalisation affect university management, as they require an organisational mentality and policy changes. One approach in response to these challenges is to undertake proactive organisational changes and to adapt some of the management instruments and concepts of businesses ruling to the management of universities. Some of the world academia experiences have proven this approach to be right. Since universities should be paying more attention to their strategic management and shift toward a more business-like mentality management, partnering with all stakeholders is a must. Looking at all these facets will provide us with a fresh view to the capitalisation of the university - alumni relationship.

Key words: university management, business approaches, organizational mentality, entrepreneurial university

1. CHALLENGES UNIVERSITIES ARE FACING

Being recognised as an absolute societal necessity, education – including higher education – must be supported from the national budget in any part of the world, by virtue of the need to ensure everyone’s right to learn.

The private initiatives manifested in this area have introduced the concept of education supported by student fees. In countries accustomed to philanthropic channels, one encounters the practice of donations, sponsorships and financial contributions, which provide money for the educational systems. Nevertheless, this status of an allowance-dependent university is conditioning the existence, the quality and the performances of the act of teaching [1].

This status of dependence becomes critical especially when the country’s government and the respective community do not have too much funding available to allocate to education.

Relatively recent, large corporations have reached the point where they are creating universities that serve them directly, by providing training and qualifications for their staff and preparing the experts they need, as well as by developing research activities specific to their industry – the so-called corporate universities [2 and 3].

Although they are in operation, especially in the US, their status within the academic system is not exactly clear, nor is their viability too certain [4].

Globalisation and information technology, but also the economic crisis, have brought about new challenges to the existence of universities, as they have widened and deepened the pressure of competition between them, including that of competition for financial resources, but also for the attractiveness of a higher education institution in a society concerned with its survival, or domination or quick profit.

All this conditioning requires universities to change their attitude and mentalities, and to search for solutions that might secure their existence and their provision of competitive services.

It is well known that, although it is an optional stage in a person’s training, higher education has the role of creating professionals, while contributing to the definition of their personality – by transmitting knowledge to them, developing their skills and determining their attitudes.

The university’s mission is to preserve and transmit the human values in society, generation after generation, to contribute to the progress and welfare of society and even to determine them.

Beyond the act of teaching, it is in universities that the research activities which prefigure and influence the path of humankind are performed. For this reason, for representing a higher, but facultative level of training enabling the elite of university to act and to grow, universities – as actors responsible for the future of humanity – should be able to secure the highest extent of financial autonomy so that they might operate, perform and offer their services at the highest standards of quality and professionalism.

To accomplish their mission, universities must attract, motivate and convince the society with respect to their role and necessity. At the same time, the expertise and probity of their graduates allow the society to advance towards the targets and in the direction that universities themselves, after all, are prefiguring by the manner in which they plant knowledge, skills and values in the people they are shaping.

This is why it is the universities’ own responsibility – a major one – to tend towards an elitist society that understands, appreciates, supports and feeds the need for universities. In the same way that any company secures its place and role in society through the goods and services it provides, universities must come to the point of changing their mentality and operating mode, in order to self-support and promote themselves as necessary and useful (social) institutions.

This is how the so-called entrepreneurial universities have come into being [5 and 6].
For some universities, this means getting involved and investing in economic activities that are different from the act of teaching, but which generate income for its support, and also placing themselves at the service of certain business sectors [7].

For others, it means organising themselves as businesses [8] – especially private universities, even if they maintain their status of non-profit organisations.

But what is, at the present time, the most appropriate management formula for a university, the one that would enable it to both pursue its institutional mission in the best conditions, without compromise and while providing the greatest benefit to humanity, and to help the human society prosper due to its services?

The natural answer is that it should operate as a sustainable university [9] within a society that follows the path of sustainable development [10], thus contributing to the performances and positive evolution of that society [11] or even taking the initiative of creating it [12].

**2. CURRENT THEORIES AND IDEAS ON ENTREPRENEURIAL UNIVERSITY**

If the future of universities is that there have to exist into a global entrepreneurial society [13], as defined in 2009, these trends have immediately been envisioned and studied by experienced university scholars, since 2000 [14].

Thus, it has been admitted that, within the increasingly knowledge-based society and the highly marked oriented economies, the universities should undertake a more significant role in technological innovation.

At the same time, the universities are to align themselves to the new coordinates of organizational existence, which demands of self-sustaining strategies [15].

No matter the way of approaching this kind of academic management, the trend towards leading a university based on business concepts and tools, takes more and more substantiated vigour [16].

And, to no surprise, governments began to legally supporting and encouraging these new developments, too.

Most obviously, any reduction of the burden on national budgets to sustain education, compensated by the schools through undertake the initiative of self-financing, to the extent possible, while still keeping on the quality standards, is welcomed.

From here, for the university, to begin building on necessary institutional relations, networking and partnerships, it was just a naturally logical step [17].

**3. THE UNIVERSITY AS SOCIETAL LEADER**

At present, the human society is facing a multitude of global problems (poverty, increase in the population, damage to the environment, decrease of the resources, etc.) and a number of local cleavages and conflicts (for political, economical, social, unethical, cultural or religious reasons, etc).

Moreover, the financial crisis and the economic recession are determining rapid changes of mentalities, attitudes and values – institutionally, and in society.

Thus, it is becoming ever more obvious that the youth are turning to businesses and to making profit, while their interest in university or postgraduate specialisation is decreasing, at least in countries that are poor or that have been affected by the crisis, and especially in some of the former communist countries.

Nevertheless, among this confrontation with the frequent changes which take place on all the planes of the contemporary world (economic, social, political, financial, technological, environmental, in communications etc), the needs for specialists are becoming increasingly diverse and permanently require new expertise and new capabilities.

On the other hand, the current historical moment in the development of human society requires worldwide mobilisation to save the human civilisation [18], as it is threatened by self-destruction, as well as a concerted global commitment to sustainable development.

In this context, to slightly paraphrase Dan Candea’s statement about the relationship between the sustainable development of a community and the sustainability of organisations [19] – namely that sustainable companies stand at the basis of the human society’s path to sustainable development –, we may conclude that a sustainable institution is also based on dedicated members who are individually evolving towards sustainability and who, therefore, are contributing to orienting the human society toward sustainable development. This conditionality is compelling the universities to become sustainable institutions themselves.

At any level, however, the goal of strengthening the individual and/or institutional capacity for sustainable development, as well as developing this capacity within the community, can only be fulfilled by training and specialisation, by permanent education – and therefore through the services provided by universities along the lines of both education and research.

From this point of view, as universities are prefiguring the future of mankind through the experts and leaders they are providing to the current and the future society, they will have to undertake this role in a more and more conscious and responsible manner, to almost self-impose it as a mission defining their existence.

Thus, the future of mankind, as well as that of higher education, is ultimately determined by how the universities will understand and undertake the role of leaders in the evolution of the human society, while learning that, to this end, they must organise and manage themselves as sustainable institutions.

**4. FUNCTIONAL CHARACTERISTICS OF THE SUSTAINABLE UNIVERSITY**

If a sustainable organisation means a structure that brings profit to its shareholders for an undetermined period of time, while complying with the social and environmental requirements [20], then a sustainable university must also be able to achieve all this within its specific context.

In order to maintain the health of the environment and the integrity of natural resources, the great majority of universities (which are non-polluting by nature) already have programmes and preoccupations regarding environmental protection and resource preservation [21 and 22] – an approach of living and acting as green universities.
Being institutions at the service of the community by definition [23], the universities’ social responsibility translates into ensuring the quality and ethics of the act of teaching, into preserving and transmitting moral values and into directing their research to the benefit of humanity. However, beyond their generic role, such activities also suppose preparing the young generation for the labour market, enabling it and the society at large to create and secure jobs, and teaching in the spirit of sustainable behaviour [24].

For the university, all this requires that it should remain anchored in reality and act in a flexible, proactive, adaptable and creative way. In essence, the university itself needs to be an organisation that learns [25] in order to constantly improve its performance [26], and not merely one that teaches and trains others (individuals, organisations or the community). This actually means that it must manage to internalise and apply, in its own institutional evolution, exactly the concepts and instruments it uses when teaching students about successful company management and business excellence, as well about the sustainable development of human society.

Implicitly, all this means that the university is satisfying its stakeholders [27]: the government (its shareholders), the society (its beneficiaries), the clients – who are both direct (its students) and indirect (their parents), the university’s own staff.

However, in order to achieve all this at a highly competitive level, continuously and within a certain time frame, the first requirement for a university to follow the path of sustainability is to secure the financial resources it needs in order to enjoy the comfort of operational institutional autonomy.

Since the university services include training, developing skills and enhancing research, and its “products” are the professionalism and personality of its graduates, who will have an impact on the evolution of humankind, how can it secure its path towards sustainability?

According to our viewpoint, regardless of the “ingredients” that might intervene in the “equation” of sustainability in the context of higher education, the managerial and strategic solution of the university is to anchor itself in the human community it serves and strives to satisfy, as well as to maintain permanent contact with the reality of the society’s evolution and of its needs for assistance which only universities can provide. In particular, this means creating partnerships that might enable the community to get involved in obtaining the necessary support for the university to properly function as an institution and to continuously deliver competitive outcomes.

In fact, this is the very path recommended to sustainable businesses: to have all the stakeholders involved in all the development and implementation processes of the organisation’s strategy and in the strategic management of the business as such.

5. UNIVERSITY’S STRATEGIC PARTNERSHIPS

What strategic partnerships could a university establish and how can they be achieved without compromise, so that the university might maintain its moral integrity, the autonomy of its actions as an institution, the probity and the quality of the services it provides?

It is obvious from the very beginning that, since they receive funds from the government and are subject to the legislative exercise thereof, universities are in a relationship with the government policy – even if indirectly. At the same time, both directly and indirectly, the government has certain expectations from the universities, as reflected in its imposition of requirements and in its management of university assessment and accreditation. Moreover, the national research plans and the access to the related funds are also controlled by the state. As a consequence, universities are – willingly or unwillingly – subordinated to the government, to various state bodies and institutions and to the local administration whose budget they depend on. We believe that a university can function properly and accomplish its mission with honour if its relationship with the government is a partnership. All this could lead to the harmonisation of the inter-institutional vision and interests, creating a congruent strategy. Of course, this depends on both parties involved, but the involvement and determination of universities in regulating this relationship is particularly important, especially with regard to finance themselves. The law allows for and encourages such determination.

A possible derivative of the connection between education and the public administration is the extension of the relationship between universities and the public institutions. By nurturing this connection, a university can adequately prepare public officers belonging to various categories and acting in various areas, while at the same time contributing to shaping the leaders who will regulate the functioning of the society. Thus, social existence substantially depends – once again – on the way in which universities shape those personalities who will represent and define the current human society and/ or those who will prefigure the society of the future.

At community level, the partnership between universities and the local administration can be extended to a relationship with the entire chain of the educational system [28], i.e. as a continuous connection from kindergarten to the 12th grade of high school. In this manner, the fluidity of individual training would encourage and prepare more and more high school students for pursuing higher education; on the other hand, the local budget would be correctly distributed so as to support all the stages of this process in a proper manner. In the same way that universities must have their stakeholders involved in their operating mode (from taking strategic decisions to assessing the results of the services provided), any management should take decisions based on consultations with the ones it represents and serves. Getting all the parties together may bring about all the data required to take informed, strategic and efficient decisions, as well as to obtain appropriate results.

Moreover, not only can the development of partnerships between a university and other universities make them all shift from a competitive environment to one that may also include collaboration, but the synergies thus created can also help all the parties evolve and win.

This is followed by the necessity to establish connections with the business sector. The university-business partnership has multiple valences and connotations, including ethical aspects and possible conflicts of interests due to the need for the act of teaching to be independent from any form of influence [29], while its beneficiaries may exercise such influence through financial conditioning.

It is certain that this partnership between the universities and the various industries/businesses, as well as the one established with the public authorities, supplies information from the reality of the specializations required on the labor market,
which leads to improving, updating and adapting the curricula
to the needs of that market, to diversifying and applying the
R&D activities and the overall university’s services, to shaping
the experts required in certain specific areas and, in general, to
ensuring a better integration of the graduates on the labor
market, or even job-specific training and qualification for
students according to the needs of those companies which
sponsor such training. It also means that the students perform
internships, get involved in research and write their bachelor’s,
master’s and doctoral dissertations with such academic
partners; it leads to the development of the technologies, as
required by a certain industry; it contributes to the creation of
new job opportunities; it adds value to certain production
processes [30], etc; it could open different other opportunities,
for both parties involved. When each of the partners involved
invests in this relationship, both parties are gaining benefits
[31].

A more comprehensive form of these relationships is the triple
partnership between the university – the government – the
industry/businesses. The interaction between the three sectors
is the “key to innovation in increasingly knowledge-based
societies” [32].

The further expansion of this relationship will also include the community. Starting from the partnership between
the university and the students’ parents, continuing with its
relationship with the alumni, including its relations with its
own staff, broadening the interaction to include professional
organizations and growing to involve the entire community –
this level will not only ensure the university’s integration in
society, but it will also secure the latter’s support [33].

Reaching this level of relational symbiosis would provide the
university with access to all the important resources
(informational, financial, human resources and social capital)
required for it to follow the path of sustainability, and also to
contribute to and support the sustainable development of the
society.

Thus, the university and the society would evolve together in
an environment of inter-conditionality. The Minnesota –
Mankato case [34], with its assistance program developed by
the (Harvard) university in order to help structure the regional
development strategy with the aid of clusters (the MOC –
Microeconomics of Competitiveness program) is an example
of governing efficiency: information-assisted decisions-
making, based on the advice provided by the academic
expertise, from which are benefiting the public interest and the
community’s evolution.

From all these partnerships, the university obtains benefits such
as: funding, research themes on request, a better curriculum,
the integration of the graduate students, diversified programs
and services, an increased number of students and new
“markets” penetration, community support, as well as strategic
institutional management that helps shape the society in co-
operation and consensus with the stakeholders involved.

Through this mechanism, sustainable universities can stand at
the foundation of human society and assume the role of leaders
in its sustainable development.

6. ALUMNI – THE UNIVERSITY STRATEGIC STAKEHOLDERS

The alumni are a category of special interest for the university
[35] – who can only benefit from its relationship with them
[36]. In the first place, as both graduates and former students,
the alumni have a double capacity: ex-internal and external
stakeholders of the university [37]. Moreover, they represent
all the leaders, managers, experts, professionals, public
officials, members of the civil society, parents, grandparents,
neighbours, political representatives, etc. that have been shaped
by the university. Thus, they are the university “representatives” in the society. Besides, they are known for
the capacity to provide for the university, from money to
knowledge, from innovation and creativity to community
support, from voluntary work to human resources, etc [38].
Thus, for the university, the alumni are strategic stakeholders;
for the society, they are the pillars of its existence and the
milestones defining the society of the future. And so, the
alumni could be the majority of the social representatives with
whom the university would build partnerships supporting its
institutional existence and helping the future society evolve.

From this perspective, the university management will have to
realize, in a deeper and more responsible way, that students are
not only the future professionals of the community, but also the
future supporters of their own institution, as well as messengers
and experts of the society. Therefore, the universities will have
to adapt their management solutions in order to invest in
students from this point of view too, in order to shape and
nurture their alumni from a new position – that of “authors” of
the evolution of human society.

In this context, beyond the need for university services in the
society and of the role of universities in the evolution and
becoming of humanity, they must also undertake the
responsibility of broadening their mission in the society to the
greatest possible extent. Only an elevated society can understand and appreciate the importance of the values which must
be kept and transmitted across generations. Only this type
of society can support and promote education and the role of
universities. Therefore, from this point of view it is also the
universities’ own responsibility to increase the degree of
elevation and the quality of the human society, so that to grow
together and further evolve.

7. CONCLUSIONS

The facts that we have wished to highlight in the above
paragraphs is that, in the context of the current challenges and of
the ones foreseeable in the nearby future of humanity, academic
management will have to take into account – ever more attentively – and to increasingly develop strategic
approaches that will ensure the financial comfort required to
support the academic activities at higher and higher quality
standards, as well as the universities’ role of leaders in the
development of the new society.

The ways and instruments required to accomplish these
desiderata must be found in the experience and management
practices of the business sector, which has been developing
such approaches by a range of valences, including by resorting
to the help and services of universities. The time has come for
universities to learn, in their turn, from their own lessons aimed
at training and strengthening the human and institutional
capacity within the society.

Moreover, universities must appropriate, develop, broaden and
strengthen the exercise of establishing efficient, relevant
partnerships on different planes, with and within all the areas
of society and with the whole community whose servants and
mentors they are. The examples provided throughout this paper, inspired from the practice of certain universities, are but a small hint that
such attempts are possible and prove useful. However, such examples are isolated initiatives. It is recommended that all these attempts at change and efficiency should become an instrument for integrated resource management (IRM), an instrument that universities might use comprehensively and synergistically as part of their efforts toward sustainability.

To this purpose, an important lever is exactly the human resource that universities are training: the students as future alumni, the students whose community can – the larger it becomes and the closer its relationship with the university – contribute both to the university’s sustainability and to the sustainable development of the human society at large.

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DEVELOPING A MODEL FOR ADVANCED PLANNING AND DESIGN OF THE PROCESSES IN AUTOMOTIVE INDUSTRY

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ABSTRACT: Increasingly, organisations are realising that the first step in almost any major project is to analyse and define their business processes, and then communicate those processes to those who need them. Process design is concerned with designing a business’ processes to ensure that they are optimised, effective, meet customer requirements, and support and sustain organisational development and growth. A well-designed process will improve efficiency and deliver greater productivity. In this paper the authors present a model for advanced planning for processes. In this paper is presented a conceptual model used in advanced planning of processes. The model was simulated in a private organization based in Sibiu, Romania - SC Compa SA - which produces mainly automotive components.

Key words: advanced planning, advanced design, processes, IDEF

1. INTRODUCTION

For a process to be considered ”good” it is necessary to perform a number of features such as: oriented to the customer, to add value (not cost;) is the responsibility, clearly defined a person to be understood by those working within it; to be well measured.; to be continually improved.

We can state that processes are at the base of management systems (quality, environment, safety and health, information security, etc.), and to implement such a system or integrated systems, effectively any organization must begin with: the identification of necessary processes; determining the sequence and interaction of these processes.

Process approach is one of the eight principles of quality management according to SR EN ISO 9001:2008 and refers to the fact that the desired result is achieved more efficiently when activities and related resources are directed to a process.

Processes design represents the activity of determining the workflow, equipment needs, and implementation requirements for a particular process. A number of input elements are necessary to design a process:

- knowing the objectives;
- knowing the performance conditions;
- knowing the processes capabilities [1].

Process design typically uses a number of tools including flowcharting, process simulation software, and scale models.

The stages of the processes design are:

- defining the process:
  - the name of the process
  - the scope of the process
  - the working team
- defining the process boundaries (where is the beginning and the end of the process)
- establishing the activities in the process
- planning the activities (including the resources and the responsibilities),

• elaborating the monitoring and controlling tools to permanently check the performance of the process

2. DEVELOPING A CONCEPTUAL MODEL USED IN PROCESSES PLANNING

The method used for the graphical representation of conceptual models is the method IDEF0 (Integrated Definition). The conceptual model for planning the process is presented in figure 1 and in the figure. 2.

![Figure 1. Advanced planning of processes](image)

The model is split on two detailed levels and is defined with purposes (advanced planning optimization process in preparation for series production); objective (ZERO non-conformances due to poor planning) and performance indicator (number of non-compliant activities / number of activities planned). Consequently also the stages of advanced planning and design processes were similarly decomposed as follows (Figures 3-7).

3. ANALYSIS OF NEW PRODUCTS WITH ADVANCED DESIGN AND PLANNING MODELS

Organization who conducted practical research simulation model it was SC Compa SA, private organization based in Sibiu, Romania, which produces mainly automotive components. This organization exports more than 80% of turnover in over 23 countries on three continents. Is a strong partner for some of the leading players in automotive industry,
which also updated constantly and its business relationships with other industries [2].

Types of products within this organization are presented in figure 9. The proper analysis involved centralization in table 2. The data are collected from the teams within the organization involved in design processes and advanced planning for processing.

To analyze new products presented before is required a representation project cost and time spent by engineering design patterns and advanced planning processes as shown in Table 1 below. By integrated simulation model for validation and by making comparative analysis with existing models resorted the concept called "triple constraint" used successfully in project management.

Figure 2. Advanced planning of process. Stages

Figure 3. Planning of process realization

Figure 4. Process design

Figure 5. Evaluation and validation of the purchasing process
Table 1. Designed cost and time allocated in case of advanced planning of processes

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Objective</th>
<th>Performance indicator</th>
<th>Time allocated (hours)</th>
<th>Designed cost (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designing technological process</td>
<td>Development of technological documentation</td>
<td>100% implementation in the technical documentation of input data</td>
<td>Transposed input data / data necessary</td>
<td>96</td>
<td>1920</td>
</tr>
<tr>
<td></td>
<td>Development of packaging technology</td>
<td>100% employment in resource planning</td>
<td>Resources used / Planned resources</td>
<td>16</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Development control plan</td>
<td>Identification of all elements necessary for compliance monitoring and control their activities planned</td>
<td>Monitoring and control elements developed / Monitoring and control elements necessary</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Development of matrix characteristics</td>
<td>Description of all characteristics that may affect safety or regulatory compliance, installation, operation, product performance or subsequent processing of the product</td>
<td>Features identified in the planning process / Features identified in complete the process</td>
<td>16</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>FMEA making process</td>
<td>The risk estimation process (criticility index C)</td>
<td>Real risk / Risk estimates</td>
<td>96</td>
<td>1920</td>
</tr>
<tr>
<td></td>
<td>Evaluation of environmental aspects (if applicable)</td>
<td>Identification of all environmental impacts associated</td>
<td>Environmental impacts identified / Anticipated environmental impacts</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Management analysis</td>
<td>Zero non-conformities identified in the analysis stage of development stage</td>
<td>Number of non-conformities identified in the analysis stage of development stage</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Documentation development for supply products, equipment and TDCD</td>
<td>1. 100% Compliance with the requirements of documentation for supply products, equipment and TDCD</td>
<td>Number of non-conformities identified in the analysis stage of development stage</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Development Plan equipment location</td>
<td>Optimal placement of all equipment</td>
<td>Planned equipment / equipment necessary</td>
<td>70</td>
<td>1400</td>
</tr>
<tr>
<td></td>
<td>Development Plan equipment location</td>
<td>2. Zero non-uniformed suppliers</td>
<td>Number of suppliers uniformed</td>
<td>28</td>
<td>560</td>
</tr>
<tr>
<td></td>
<td>Development flow for non-complying products</td>
<td>100% control of nonconforming product</td>
<td>Number of non-compliance identified associated with the control of nonconforming product</td>
<td>12</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>Supply and validation products supplied</td>
<td>100% supply products complying with documentation</td>
<td>Purchased product / product request</td>
<td>24</td>
<td>480</td>
</tr>
<tr>
<td></td>
<td>Insuring the equipment</td>
<td>Providing all necessary equipment as planned</td>
<td>Equipment provided / needed equipment</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Insurance TDCD</td>
<td>Providing all TDCD as planned</td>
<td>TDCD provided / required TDCD</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Infrastructure insurance</td>
<td>Ensuring the necessary infrastructure as planned</td>
<td>Infrastructure provided / Required infrastructure</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Reinforcing equipment</td>
<td>Location of all equipment necessary</td>
<td>Installed equipment / Equipment necessary</td>
<td>80</td>
<td>1600</td>
</tr>
<tr>
<td></td>
<td>HR insurance</td>
<td>Ensuring the necessary human resources as planned</td>
<td>Human resources provided / Human resources required</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Commissioning and implementing Zero series, the first sample</td>
<td>Compliance with all planned activities</td>
<td>Activities conducted / Planned activities</td>
<td>240</td>
<td>4800</td>
</tr>
<tr>
<td></td>
<td>Development Control documentation (ZERO series, the first sample)</td>
<td>Ensuring that all activities related process objectives</td>
<td>Met objectives / Targets planned</td>
<td>16</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Perform tests/blank ZERO series</td>
<td>100% compliance with the planning parameters</td>
<td>Test parameters / Parameters plan</td>
<td>32</td>
<td>640</td>
</tr>
<tr>
<td></td>
<td>Measurement systems analysis</td>
<td>100% validation of measurement systems</td>
<td>Measurement systems used / Validated measurement systems</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Perform process capability studies</td>
<td>Identification of all narrow places</td>
<td>Tight places identified / Planned tight places</td>
<td>96</td>
<td>1920</td>
</tr>
<tr>
<td></td>
<td>Validation technologies, equipment and TDCD</td>
<td>100% compliance requirements of product documentation</td>
<td>Requirements fulfilled / Planned requirements</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Management analysis</td>
<td>Zero non-conformities identified in the analysis stage of development stage</td>
<td>Number of non-conformities identified in the analysis stage of development stage</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Preparing Files for Approval Process for Production of parts</td>
<td>All parts for approval production</td>
<td>Approved parts / Components planned</td>
<td>16</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Preparing File for Advanced Product Quality Planning</td>
<td>Regulating all stages of product development to meet customer requirements</td>
<td>1. Steps used / Stage regulated 2. Regulated stages / Phases planned</td>
<td>16</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Validation series ZERO</td>
<td>100% compliance requirements of product documentation</td>
<td>Requirements fulfilled / Planned requirements</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Design documentation SERIES (product documentation, technology, control)</td>
<td>Prepare all necessary equipment for manufacture for mass production</td>
<td>Manufacturing equipment ready for mass production / Manufacturing equipment needed for mass production</td>
<td>64</td>
<td>1280</td>
</tr>
<tr>
<td></td>
<td>Management analysis</td>
<td>Zero non-conformities identified in the analysis stage of development stage</td>
<td>Number of non-conformities identified in the analysis stage of development stage</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>1648</td>
<td>29960</td>
</tr>
</tbody>
</table>

If the triple constraint model will consider the following three elements: cost or budget needed to conduct process modeling, duration or time spent carrying out these activities and performance or achievement modeling process. Put simply, taking into account the above mentioned to quality, triple constraint can be represented as a triangle whose sides represent the cost, duration and process performance (Fig. 8).

By integrated simulation model for validation and by making comparative analysis with existing models resorted the concept called "triple constraint" used successfully in project management. If the triple constraint model will consider the following three elements: cost or budget needed to conduct process modeling, duration or time spent carrying out these activities and performance or achievement modeling process.
In order to have a successful end process modeling activities must be taken into account all three elements mentioned above for the team coordinator concerned to balance these three competitive objectives. Moreover, the organizational framework from data collection on existing workflows has been a notable orientation to balance the three elements.

While the triple constraint (Fig. 10) describes how the basic elements of the project - the purpose, duration and cost - interrelate, there are other elements that may play important roles. For example, quality is often a key factor in projects, and beneficiary satisfaction and/or sponsor. A project team can reach the goal objectives, duration and cost, but not meet quality standards or the beneficiary and/or the investor [3]. If a higher level of performance will be required (Fig. 11), cost and/or duration will also increase. Similarly, if performance of the process reduces the cost (effort) and/or duration should decrease. If you have completed the process in less time with the same degree of performance, the third side of the triple constraints (cost) will increase to maintain equilibrium. Will therefore be necessary to increase effort, which increases the cost, perhaps by overtime or by bringing more resources in the project. (Fig. 12)

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Given this concept was developed following linear model:

\[ M_{ci} = \sum f(c, d, p) \]

\[ \sum f(c, d, p) = k_1 c + k_2 d + k_3 p \]

\[ a_i \leq c \leq b_i \]

\[ a_i \leq d \leq b_i \]

\[ a_i \leq p \leq b_i \]

\[ k_1 + k_2 + k_3 = 1 \]

Where:

- \( M_{ci} \) is the model;
- \( c \) is the cost;
- \( d \) is the duration;
- \( p \) is the performance;
- \( k1,2,3 \) are the weighting coefficients;
- \( a1,2,3 \) are the inferior limits;
- \( b1,2,3 \) are the superior limits.

This linear model is the based on the proposed model simulations. The actual simulation will be actually a sensitivity analysis which will vary from two of the parameters, namely cost and speed, performance remains constant as it is in fact to the model.

To use the linear model simulation cost and duration values will be expressed as a percentage.

Lower and upper limits of the variation is determined after considering all the measurements made on existing models and range between 92 and 106% percentage.

Therefore, given values for the analyzed integrated model improvement grades may be considered valid and can be implemented in the organizational framework.

Similarly applied to the integrated model simulations were performed designed a series of analyzes of sensitivity to the same ranges. The results obtained from simulation of the integrated model proposed for different ranges are shown in Table 3.

**Table 3. Centralizing of the integrated designed model simulations**

<table>
<thead>
<tr>
<th>The range of variation</th>
<th>The parameter</th>
<th>minimum</th>
<th>average</th>
<th>maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>[92-106]</td>
<td>Mci</td>
<td>0.9602</td>
<td>0.99069</td>
<td>1.02733</td>
</tr>
<tr>
<td></td>
<td>c [lei]</td>
<td>22635.6</td>
<td>24225.0984</td>
<td>26680.24</td>
</tr>
<tr>
<td></td>
<td>d [ore]</td>
<td>1122.4</td>
<td>1214.388</td>
<td>1293.2</td>
</tr>
<tr>
<td>[85-115]</td>
<td>Mci</td>
<td>0.93327</td>
<td>0.99975</td>
<td>1.08773</td>
</tr>
<tr>
<td></td>
<td>c [lei]</td>
<td>21159.44</td>
<td>24343.1976</td>
<td>28048.56</td>
</tr>
<tr>
<td></td>
<td>d [ore]</td>
<td>1049.2</td>
<td>1232.932</td>
<td>1390.8</td>
</tr>
<tr>
<td>[80-120]</td>
<td>Mci</td>
<td>0.918</td>
<td>1.00982</td>
<td>1.10133</td>
</tr>
<tr>
<td></td>
<td>c [lei]</td>
<td>19683.2</td>
<td>24687.6536</td>
<td>29524.8</td>
</tr>
<tr>
<td></td>
<td>d [ore]</td>
<td>976</td>
<td>1215.852</td>
<td>1464</td>
</tr>
<tr>
<td>[75-125]</td>
<td>Mci</td>
<td>0.8672</td>
<td>1.00487</td>
<td>1.12727</td>
</tr>
<tr>
<td></td>
<td>c [lei]</td>
<td>18699.04</td>
<td>24987.8224</td>
<td>30508.96</td>
</tr>
<tr>
<td></td>
<td>d [ore]</td>
<td>927.2</td>
<td>1209.68</td>
<td>1512.8</td>
</tr>
<tr>
<td>[70-130]</td>
<td>Mci</td>
<td>0.824</td>
<td>1.00182</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>c [lei]</td>
<td>17222.8</td>
<td>24077.4744</td>
<td>31985.2</td>
</tr>
<tr>
<td></td>
<td>d [ore]</td>
<td>854</td>
<td>1246.108</td>
<td>1586</td>
</tr>
</tbody>
</table>

Consequently, the degree of improvement (defined percentage) varies depending on values obtained by simulation and by the range thus:

- the degree of improvement costs for minimum values, regardless of the range and type of product is between 18 and 46%, and the average, in this case, hovering around 35%;
- the degree of improvement costs for the average values regardless of the range and type of product is between 8 and 25%, and the average, in this case, hovering around 19%;
- the degree of improvement costs for the maximum, regardless of the type in rotation interval [92-106] (this range was chosen because in other model ranges produced some improvement does not drinkable), is between 5 and 19%, and the average, in this case, hovering around 14%;
- the degree of improvement of life for minimum values, regardless of the range and type of product is between 18 and 47%, and the average, in this case, hovering around 35%;
- the degree of improvement of life for the average values regardless of the range and type of product is between 10 and 27%, and the average, in this case, hovering around 20%;
- the degree of improvement of life for the maximum, regardless of the type in rotation interval [92-106] (this range was chosen because in other model ranges produced some improvement does not bring improvements), is between 6 and 20%, and the average, in this case, hovering around 15%.

Overall looking at all the 250 trials (50 trials for each interval of variation) there can be seen that the degree of improvement for:

- cost is between 15% and 23% and has an average of 20%;
- duration is between 14% and 25% and has an average of 26%.

It should be noted that these values were obtained after removal of negative rates among values obtained by calculating the degree of improvement because they were not actually improvements.

The graphic variations in MCI, c, and d are shown in Figures 13-15.
4. CONCLUSIONS

A management system can provide the means necessary activities through ongoing consistent improvement of its processes. Thus it generates performance “good and bad”, ensuring the management processes.

Further improvement methodologies is a more intelligent management of a business by focusing attention on identifying and prioritizing customer needs and then making decisions supported by facts and data. In short, they aim to produce three main results: increased customer satisfaction, reducing defects, improving the life cycle of products / services, all provided to meet changing customer needs, market requirements and those imposed by technological progress and bring benefits to all employees, customers and other stakeholders.

The ideal of improving organization performance should improve in all priority issues for the stakeholders. For an organization to survive in the today's international competitive environment it must strive to improve learning, and innovation. Management should make decisions so that appropriate products are available when required, building the most efforts of all. There should be close cooperation between government, organizations, unions and universities. Everyone has to improve the products or services, as she is perceived by customers. This means that all departments in all organizations should use the most appropriate technology to improve efficiency, effectiveness and adaptability.

5. REFERENCES

KNOWLEDGE MANAGEMENT IN ENGINEERING AND BUSINESS EDUCATION
INNOVATION MANAGEMENT IN THE KNOWLEDGE-BASED SOCIETY

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ABSTRACT: The aim of this paper is to offer an insight into innovation management in the knowledge-based society. It sets off by explaining the concept of knowledge-based society and why it bears relevance for the modern world. Next, innovation and related concepts are introduced. Furthermore, a presentation of National Innovation Systems (NIS) is made, their history and role in the understanding of a systemic approach to research, development and innovation at both national and global level. Next, the OECD main guidelines for the elaboration of national innovation policies are presented. Last but not least, an analysis of the current situation of research and innovation in Romania is also included.

Key words: innovation management, knowledge-based society, National Innovation System

1. INTRODUCTION

It has become a widely acknowledged fact that modern economies are now being referred to as knowledge-based, due to the ever increasing relevance that knowledge is acquiring in everyday life. It is also true that institutions, companies and individuals progressively rely on knowledge as a key component for individual and collective growth.

However, knowledge in this context will be referred to as the one used by companies in the production process and, more importantly, in innovative activities. A company’s ability to innovate is mostly dependent on its ability to actually seize and foster human intellectual capital in an effective and efficient manner. This process is based on research and development (R&D), which represents a paramount activity for generating new knowledge for production and innovation. Nevertheless, the simultaneous ongoing processes of knowledge deepening and knowledge widening – which leads to a general expansion of the range of available technologies, as well as to a growing specialization of competencies – requires new, interactive patterns of learning.

Individual learning activities – as they are conceived in an R&D laboratory – are no longer sufficient to bring together all the necessary knowledge it takes to be competitive. Innovative firms require specialized knowledge, along with more types of knowledge, which increasingly are to be found outside the firm itself. Notwithstanding, because of its tacit component, knowledge, and particularly new knowledge, can be difficult to acquire in the market, so that companies turn to some form of collaboration with other companies and/or institutions that possess the required knowledge and, on a reciprocal basis, are ready to share it. Consequently, companies aim at creating links through which to access disparate and specialized resources of knowledge needed to innovate. The nascent configuration and reconfiguration of social networks of all types will by necessity reflect the shifting demand of the knowledge economy.

2. KNOWLEDGE-BASED SOCIETY

The debate on the emergence of the ‘knowledge society / economy’ first gained public attention when industrial societies started to be restructured and transformed into ones with a greater dependency upon “information” based areas of activity. Among the earliest authors to emphasise the importance of knowledge to society we could mention Machlup (1962). Economists such as Drucker (1959, 1969, 1994) and Bell (1973) regarded this as part of a move towards a “post-industrial” economy and society. The initial emphasis on “information” shifted in the 1970s to a greater focus on “knowledge”, which was reinforced by a re-emphasis on ‘human capital’ as an individual good, which increased the earning capacity of the individuals and recognised more strongly their contribution to overall wealth generation. This drew attention to innovators, entrepreneurs, and knowledge managers as the key to economic growth and change. Consequently, increased attention to the rights and capacities of the individual within society more generally, as part of a wider liberalization and deregulation of economic and social activities, also gained momentum during the latter decades of the 20th century (Giddens, 1991, 2001, Beck 1999). The correlations between the enhanced importance of knowledge as the reason for economic growth and wider social transformation became a theme in much of the writing that ensues.

What is then a knowledge-based economy (KBE)? The OECD define it as “… economies, which are directly based on the production, distribution and use of knowledge and information” [14]. The importance of the digital technologies, the Internet, computers, information and globalised networks that these technologies enable have also been stressed. It is now the “age of speed”. Time and space have been compressed (Harvey 1989, Virilio 2004). There is an increasing shift of activities to computers rather than these being carried out in specific locations. Testing of products can now be done through simulation on the computer. People can work from home (Felstead et al 2005, Leonard and Thorns, 2006). People can create virtual worlds in “my space” and live out their lives...
in cyberspace. Although not all are involved in these activities it does extend the range of possibilities and gives more prominence to ‘mental’ labour rather than physical labour carried out in discrete places. Knowledge is now seen as the primary source of competitiveness and the desire of governments is increasingly to create innovative and ‘smart citizens’. Extending what constitutes knowledge to the ‘cultural and creative’ sector is now incorporated into the discourse on the knowledge society as this sector has gained increased recognition as a potential contributor to economic growth.

It is however difficult to give one, all-encompassing definition to the knowledge economy/society. Smith [21], for example, asks himself the same question. “At the outset, it must be said that there is no coherent definition, let alone theoretical concept, of this term: it is at best a widely-used metaphor, rather than a clear concept.” The OECD has spoken of knowledge-based economies in very general terms, as meaning ‘those which are directly based on the production, distribution and use of knowledge and information’. This definition is a good example of the problems of the term, for it seems to cover everything and nothing: all economies are in some way based on knowledge, but it is hard to think that any are directly based on knowledge, if that means the production and distribution of knowledge and information products.” Furthermore, Foss (2002, p. 48) contends that, “[w]hatever we think of this journalistic concept [of the Knowledge Economy], it arguably does capture real tendencies and complementary changes.” What might these ‘new’ tendencies be? “We define the knowledge economy as production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence. The key component of a knowledge economy is a greater reliance on intellectual capabilities than on physical inputs or natural resources” [20]. In this case the ‘modern’ emphasis seems to be on ‘knowledge’ ‘accelerated technical and scientific advance’ and ‘greater reliance on intellectual capabilities than physical inputs or natural resources’.

3. INNOVATION AND RELATED CONCEPTS

3.1. Innovation

According to Nelson and Rosenberg (1993), innovation represents the process by which companies master and put into practice new product designs and manufacturing processes; at the same time it is a process in which ‘new knowledge or new combinations of old knowledge are embodied in products and production processes and possibly introduced into the economy’ [16]. Therefore, innovation essentially entails the use of existing knowledge, as well as the ability to generate and acquire new knowledge [6].

According to the Frascati Manual. Proposed standard practice for surveys on research and experimental development [13], R&D represents “creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications”. It comprises three broad activities: a) basic research (experimental or theoretical work carried out in order to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use); b) applied research (original investigation performed with a view to acquiring new knowledge, but unlike basic research, it has a specific practical aim or objective); c) experimental research (systematic work, using existing knowledge obtained from research and/or practical experience, which is aimed at producing new materials, products or devices, to installing new processes, systems and services, or to improving those already produced or in use). R&D encompasses both formal R&D in R&D units and informal or occasional R&D in other units.

According to The Oslo Manual. Guidelines for Collecting and Interpreting Innovation data [14], innovation represents the “implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” [14]. The same document lists four types of innovation:

- product innovation (the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses, including relevant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics);
- process innovation is the implementation of a new or greatly improved production or delivery method, including important changes in techniques, equipment and/or software);
- marketing innovation (the implementation of a new marketing method encompassing important changes in product design or packaging, product placement, product promotion or pricing) and
- organisational innovation (the implementation of a new organisational method in the company’s business practices, workplace organisation or external relations).

3.2. Lisbon strategy

In order to address the need for concerted efforts towards fostering innovation and developing a coherent research strategy at national and international level, the European Council gathered in Lisbon in March 2000 and set out the “Lisbon Strategy” - an action and development plan that had as aim to turn the European Union (EU) into the most competitive economy in the world and achieving full employment by 2010. This strategy, developed at subsequent meetings of the European Council, is based on three pillars:

- An economic pillar preparing the ground for the transition to a competitive, dynamic, knowledge-based economy. In this context, great importance is laid on the need to constantly adapt to changes in the information society and to encourage research and development.
- A social pillar designed to modernise the European social model by investing in human resources and combating social exclusion. To this end, the Member States have to invest in education and training, and to carry out an active policy for employment, thus facilitating the move to a knowledge economy.
- An environmental pillar, which was subsequently added at the Gothenburg European Council meeting in June 2001, draws attention to the fact that economic growth must be dissociated from the use of natural resources.

As a follow-up, a list of targets has been drawn up with a view to attaining the goals set in 2000. Considering that the above-mentioned actions fall almost exclusively within the sphere of competence of the Member States, an open method of coordination (OMC) necessitating the development of national action plans has been introduced. In the Conclusions of the Presidency, it was said that the European Union set as new
strategic goal “to become 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. Achieving this goal requires an overall strategy aimed at:

- preparing the transition to a knowledge-based economy and society by better policies for the information society and R&D, as well as by stepping up the process of structural reform for competitiveness and innovation and by completing the internal market;
- modernising the European social model, investing in people and combating social exclusion;
- sustaining the healthy economic outlook and favourable growth prospects by applying an appropriate macro-economic policy mix”.

As far as the strategy is concerned, it was stated that it was created to “enable the Union to regain the conditions for full employment, and to strengthen regional cohesion in the European Union.” The European Council saw the need “to set a goal for full employment in Europe in an emerging new society which is more adapted to the personal choices of women and men. If the measures set out below are implemented against a sound macro-economic background, an average economic growth rate of around 3% should be a realistic prospect for the coming years.” The means through which the strategy could be implemented were also taken into consideration – and here was the role of the OMC emphasised: “improving the existing processes, introducing a new open approach of Adam Smith (1776), where free trade was assumed up economist he was disapproving of the ‘cosmopolitan’ economic development rather than just to sit back and rely on allocation issues. From his position of a German catch -up economist he was disapproving of the ‘cosmopolitan’ approach of Adam Smith (1776), where free trade was assumed to be to the appanage of both Germany (the laggard) and England (the lead economy).

As far as the ‘national production system’ was concerned, List called attention to the necessity for the state to build national infrastructure and institutions with a view to promoting the accumulation of ‘mental capital’ and use it to stimulate economic development rather than just to sit back and rely on ‘the invisible hand’ to manage all problems. The next to address the issue of the ‘national system of innovation’ was Christopher Freeman in a paper he wrote in 1982 (but only published in 2004) for the Organisation for Economic Co-operation and Development (OECD) expert group on Science, Technology and Competitiveness, with the title “Technological infrastructure and international competitiveness”. Freeman (2004) too stressed the usefulness of government involvement in promoting the development of a technological infrastructure. He also underlined the limited relevance of short-term competitiveness strategies such as manipulating national wage and currency rates. One of the tenets of Freeman’s theory is that, if we want to understand why and how world economic supremacy moves from one
country to another, we need to look at how new technological systems come to the fore and how they fit in or clash with the existing national patterns of institutions. It may well be possible that some countries, prospering in the context of one technological system may fall prey to their own success since they will have great difficulties in adapting their institutional apparatus to the new technological system.

Starting with the ‘80’s, the necessity of a national system of innovations began to gain ground among several economists concerned with innovation research. Dick Nelson and other American scholars had compared technology policy and institutions in the high technology field in the US with similar patterns in Japan and Europe. The Science and Technology Policy Research at Sussex University carried out several studies comparing industrial development in Germany and the UK examining for instance differences in the management of innovation, work practices and engineering education.

The modern version of the full concept ‘national innovation system’ came to life in specialist literature in 1987, in Christopher Freeman’s book on innovation in Japan. In his work he made a thorough analysis of both ‘intra’ and ‘inter’ organizational characteristics of firms, corporate governance, the education system as well as the role of government [4]. Freeman’s cooperation with Nelson and Lundvall on a major International Federation of Institutes for Advanced Study project on technical change and economic theory resulted in a book with a section with chapters on ‘national systems of innovation’.

Another contribution that is worth mentioning in this context is the one made by Michael Porter (1990) on the competitive advantage of nations. Although there is no explicit reference to the concept of innovation system as such, there is nevertheless, significant interrelation with the ideas propounded in the above-mentioned works. His emphasis on feedback mechanisms from and interaction with domestic suppliers and users as a factor that gives competitive advantage is especially noteworthy.

As far as different approaches to delineate the constituent elements of an innovation system, we need to emphasise the fact that different scholars have different conceptions. The presentation of various definitions, as made by Lundvall in the above-mentioned paper, might nonetheless prove useful for the purpose of our study.

Lundvall [7] contends that one of the main common underlying premises is that national systems differ in terms of specialization in production, trade and knowledge. This is in fact not a new idea, since neoclassical trade theory starts from a similar assumption. Still, the difference lies in that among NIS-analysts it is assumed that there exists a dynamic co-evolution between what countries specialize in doing and what people and firms in these countries know how to do well. The implications are that, on the one hand, both the production structure and the knowledge structure will change only slowly and, on the other, that such change must involve learning. The fact that the trade specialisation does not imply a comparative advantage engenders a debate on what kind of specialisation might be most favourable to generate economic prosperity.

Secondly, Lundvall [7] maintains that elements of knowledge that bear relevance to economic performance tend to be localized and therefore cannot be easily transferred from one place/context to another. NIS are necessary exactly because we live in a society where knowledge does not equal information, and people do not all have unlimited access to information.

Thirdly, as a follow-up to the previous assumption, he upholds that knowledge, which represents something more than information, encompasses tacit elements as well. It may be contended that significant elements of knowledge are intertwined in the minds and bodies of agents or anchored in routines of companies and not least in relationships between people and organizations. This hypothesis is construed along the line of a similar contention that innovation system approaches transcend the precept of methodological individualism [7].

Fourthly, if we are to grasp the process of innovation, we have to concentrate on interaction and relationships, as companies, knowledge institutions and individuals very rarely innovate on their own, innovation being in fact a corollary of the multiplying processes of interactive learning and searching. Therefore, this entails that the system needs to be addressed concurrently from both the point of view of its constituent elements and that of the relationships established between the afore-mentioned elements. Consequently, it can safely be predicated that the innovation system approach is entirely ‘interactionist’ [7].

NIS have captured increased analytical consensus because they recognise the importance of knowledge flows; there is a increased usage of systems approaches and the knowledge institutions are greater than ever in number. The knowledge embodied in human beings, known as ‘human capital’ or ‘tacit knowledge’ is also being recognised as of key importance to economic growth. The remaining ‘codified knowledge’ resides in publications, patents and an increasing number of sources cultivated by the information technology diffusion. Innovation is considered as the result of the complex interaction between various stakeholders, including those within the system’s feedback loops.

An understanding of NIS helps identify leverage points and pinpoint mismatches that Government policies need to address so as to boost the overall innovation performance and competitiveness of a nation. The measurement and assessment of core knowledge flows is centred on:

- Industry Interactions e.g. joint research activities and technical collaborations, such as the Co-operative Agreements and Technology Indicators database of the Maastricht Economic Research Institute on Innovation and Technology.
- Public/Private Interactions among enterprises, academia and research institutes e.g. co-research, co-patenting, co-publications, citation analysis, exchange programs and firm surveys.
- Knowledge Distribution Power of and technology e.g. technology, use of advanced machinery and equipment adoption rates.
- Personnel mobility e.g. movements of skilled personnel to and fro various enterprises and institutions [15].

Countries tend to evolve along technological paths, known as ‘trajectories’, dependent of past, present and future patterns of knowledge accumulation that usually are country specific. Generally speaking some countries are not in a position to diffuse technology across a whole range of industries, but “in clusters of industries connected through vertical and horizontal relationships” (Porter, 1990). Different clusters have varying knowledge patterns dependent of the country specific context. A densely knitted knowledge network amongst forestry firms in Finland gave this specific cluster a strong national economic position and a competitive edge internationally.
3.4. Innovation strategies

It has been estimated that there is ever increasing awareness of the fact innovation play a major role in economic growth and development, as companies now invest as much in intangible assets related to innovation (R&D, software, skills, organisational know-how and branding) as they invest in traditional capital such as machinery, equipment and buildings. It is understandable therefore why governments too need to elaborate appropriate policies that foster innovation. According to [16], government policies aimed at fostering innovation have to pay heed to changes in the global economy and the transformation of innovation processes. In order to turn an invention into an innovation, several complementary activities are called forth, such as organisational changes, firm-level training, testing, marketing and design. Innovation nowadays is not only limited to research and development (R&D), though this remains an essential element.

The main priorities for innovation policy, supported by some underlying principles, as formulated by OECD (2010) are:

1. Empowering people to innovate;
2. Unleashing innovations;
3. Creating and applying knowledge;
4. Applying innovation to address global and social challenges;
5. Improving the governance and measurement of policies for innovation.

The actions that need to be taken with a view to unlocking innovations are [16]:

- Foster entrepreneurship;
- Enhance access to finance;
- Build the foundations for innovation in business with sound framework conditions;
- Foster markets for innovative goods, services and processes;
- Foster strong and effective public research;
- Invest in a knowledge-supporting infrastructure;
- Foster efficient knowledge flows, networks and markets;
- Unleash innovation in the public sector;
- Foster international co-operation;
- Tackle key challenges through innovation: climate change, health and food security;
- Bridge the gap in economic development through innovation.

3.5. Innovation. The case of Romania

We will present below the situation of our country as compared to other European countries, in terms of innovation, by five dimensions: *Innovation drivers* (which measure the structural conditions required for innovation potential), *Knowledge creation* measures the investments in R&D activities), *Innovation & entrepreneurship* (which measures the efforts towards innovation at the firm level), *Applications* (which measures the performance expressed in terms of labour and business activities and their value added in innovative sectors), and *Intellectual property* (which measures the achieved results in terms of successful know-how). Based on the Summary Innovation Index (SII), The European Innovation Scoreboard 2007 established the following classification of European countries:

- Sweden, Switzerland, Finland, Israel, Denmark, Japan, Germany, the UK and the USA are the *innovation leaders*, with SII scores well above that of the EU27 and most other countries. Sweden has the highest SII of all countries, but its leading position is mostly based on strong inputs.
- Luxembourg, Iceland, Ireland, Austria, the Netherlands, France, Belgium and Canada are the *innovation followers*, with SII scores below those of the innovation leaders but equal to or above that of the EU27.
- Estonia, Australia, Norway, Czech Republic, Slovenia, Italy, Cyprus and Spain are the *moderate innovators* with SII scores below that of the EU27.
- Malta, Lithuania, Hungary, Greece, Portugal, Slovakia, Poland, Croatia, Bulgaria, Latvia and Romania are the *catching-up countries*. Although their SII scores are significantly below the EU average, these scores are increasing towards the EU average over time with the exception of Croatia and Greece. Turkey is currently performing below the other countries included in the EIS (European Innovation Scoreboard).

As can be seen from the above figure, Romania is the worst performer, with the lowest score, out of all the catching-up countries, i.e. 0.18, followed by Latvia and Bulgaria. As for the catching-up countries, mention should be made of the fact that, although below EU average in all of the dimensions there are some noteworthy exceptions, such as on Applications where Malta has the highest ranking and where Slovakia ranks above some innovation leaders. In both cases these countries rank highly on sales of new to market products, which may be a reflection of the relatively small markets that companies in these countries operate within. In both cases the high score on Applications is also partly due to the structure of their economies, as Malta has high exports of high technology products and Slovakia a high share of employment in medium-high and high tech manufacturing. Although Turkey’s overall performance is below that of EU Member States, it has a stronger performance than some Member States on Knowledge creation.

![Figure 1. The 2007 Summary Innovation Index (SII). Source: The European Innovation Scoreboard 2007, p.07.](image1)

![Figure 2. Innovation drivers. Source: The European Innovation Scoreboard 2007, p.07.](image2)

![Figure 3. Knowledge creation. Source: The European Innovation Scoreboard 2007, p.07.](image3)
adapt to the changing nature of innovation from an early start. Makers should ensure that education systems assist learners to lay the foundations for developing human capital, and policy education is no longer to be ignored, as formal education lays paramount if we want to benefit from innovation locally, as specific assessments, tools and policies. Policy coherence is crucial importance for emerging from the crisis, even in countries with limited scope for public investment. It has been proved that in order to sustain innovation governments need to develop a strategic approach adapted to different contexts and settings. It calls for a combined effort to bridge disciplines, technologies and organisational structures through country-specific assessments, tools and policies. Policy coherence is paramount if we want to benefit from innovation locally, regionally and nationally, as well as at global level. The role of education is no longer to be ignored, as formal education lays the foundations for developing human capital, and policy makers should ensure that education systems assist learners to adapt to the changing nature of innovation from an early start.

4. CONCLUSIONS

Innovation is a driver of growth and is essential for addressing global and social challenges. Innovation can help in the process of recovery and put countries back on a track to sustainable growth and development. Innovation policies are therefore of crucial importance for emerging from the crisis, even in countries with limited scope for public investment. It has been proved that in order to sustain innovation governments need to develop a strategic approach adapted to different contexts and settings. It calls for a combined effort to bridge disciplines, technologies and organisational structures through country-specific assessments, tools and policies. Policy coherence is paramount if we want to benefit from innovation locally, regionally and nationally, as well as at global level. The role of education is no longer to be ignored, as formal education lays the foundations for developing human capital, and policy makers should ensure that education systems assist learners to adapt to the changing nature of innovation from an early start.

5. REFERENCES

BUSINESS INTELLIGENCE FOR EDUCATIONAL PURPOSE

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ABSTRACT: The paper follows three main directions: business intelligence – as a software tool, companies – as an application field and top management – as target of intelligent efforts. From this symbiosis does result an advantage, scientific and data based educational tool, having the goal to give the students a tool to explore data collections and analysis methods in order to improve the management of a company and forecast its evolution. The purpose of Business Intelligence (BI) software is to help the firms on acquiring knowledge about highlights and dangerous trends, to observe the connections and to forecast the future market evolutions. From this perspective, we consider that students need to learn theory and practical application about BI. After an overview of the BI main concepts, we choose to use the facilities of Jaspersoft BI software; to model the most frequently used analysis requirements, displaying the most relevant data and key indicators, following the steps of a BI system.

Key words: business intelligence, educational tool, Jaspersoft

1. INTRODUCTION

The paper follows three main directions: business intelligence – as a software tool, companies – as an application field and top management – as target of intelligent efforts. From this symbiosis does result an advantage, scientific and data based educational tool, having the goal to give the students a tool to explore data collections and analysis methods in order to improve the management of a company and forecast its evolution.

The purpose of Business Intelligence (BI) software is to help the firms on acquiring knowledge about highlights and dangerous trends, to observe the connections and to forecast the future market evolutions. From this perspective, we consider that students need to learn theory and practical application about BI.

After an overview of the BI main concepts, we choose to use the facilities of Jaspersoft BI software; to model the most frequently used analysis requirements, displaying the most relevant data and key indicators, following the steps of a BI system lifecycle.

This paper presents the components, benefits, technology requirements, the design and implementation of business intelligence techniques. As for the experimental part, we choose to explore a data collection and analysis methods for an educational database using the BI software Jaspersoft.

2. SOME CONSIDERATIONS ABOUT A BI SYSTEM

The semantics of business intelligence is related to the expert information, knowledge and efficient methods for the top management of business. Firms have deep statistical knowledge about influence factors on decisions, such as the competition, partners, customers, economic environment, and internal operations to take a quality business decision [1].

According to the opinions of Forrester Research, the BI architecture is multi-level and it may be separated into at least two stacks. In order to realize a separation between the levels of the BI architecture, Forrester Research refers to data preparation and data usage as two separate, but closely linked segments of the business intelligence architectural stack [2]. The second approach describes business intelligence as the top layer of the architectural stack, such as reporting, analytics and dashboards [3].

Gartner’s 2012 Research [4] defines a BI platform as software that delivers a range of capabilities organized into three categories of functionality: integration, information delivery and analysis. The second category is presented as „information delivery is the core focus of most BI projects today, but also there is an increased interest in deployments of analysis to discover new insights and in integration to implement those insights”.

A BI system is built on a foundation consisting of large amounts of data, synthesized using new technologies such as data warehousing and data marts. The next step is the analysis of these data, finding patterns, relationships, and also structural, functional and causal types of connections.

In this manner, a BI system follows four stages [5]:

- Obtaining the data – collects and organizes data from different sources.
- Analyzing the data obtained through BI operations – is based on different types of management models for extraction, analysis, transformation and data processing.
- Identifying trends, changes that occur and errors – forecast by using predictive analysis. Identify opportunities within the business by using complex mathematical methods and algorithms.
- Simulations and gaining of new insights about business problems and opportunities.
Next paragraphs briefly describe these steps recommended for building a BI system and which have been applied to our study case.

2.1. Building a Data Warehouse from Databases

At first stage a data warehousing solution that collects and organizes large data quantities from internal and external sources is implemented.

A data warehouse (DWH) is a database containing statistical and current data, organized and optimized for the purpose of analysis. Data warehousing represents a centralization of data, a repository of all organizational data, in order to allow complex analysis and simple user access. In addition, data can be stored selectively in data marts, taking into account certain domains or activities or other criteria. Data marts can be defined as an access layer to the data warehouse, organized on purpose to obtain information for end users [6].

Data marts can be also used as an intermediate structure for collecting data from different sources and their content is replicated periodically in data warehouses. The concept of data marts is transparent for the BI system users. Data warehouses are periodically supplied with data from subsequent transactions without end user intervention.

The functional structure of a company should be able to extract useful information from large amounts of data, and use it for evaluating the results achieved, for planning and making business decisions. For this purpose it is necessary to ensure a quick and easy access to the data stored in complex structures.

When building data warehouses implementers find specific problems that do not appear in the construction of transaction information systems. Most of the problems are associated with the construction of data extraction systems. That is periodically automated data transfer from the source to the destination of the production data warehouse. Some of the problems that are encountered in the construction of the warehouse are:

• Gathering of different data from multiple sources (multiple production systems) implemented on different platforms;
• Late detection of changes occurred in the source system;
• Interactive work of the users with applications where the data source is the data warehouse.

Difficulties related to extraction of data represent the biggest challenge, making the process of building extraction system take between 70% and 90% of the total time required for the construction of the warehouses. When combined with problems that arise because of the iterative nature of building models and data extraction systems, accurately estimating the development time for the DWH system is becoming very difficult. This is one of the reasons why the projects which are building data warehouses, as shown in practice, are largely subject to the failure [7].

Typically, the data warehouse updated is completely automated and requires no action from the people. In case any mistakes do occur in the production system in the process of data refreshing, the administrators are automatically notified.

Tools for interactive viewing of the data warehouse (which is already implemented and running) are different from tools to build a data warehouse and are commercially available products or custom applications. These programs are modified to work with data warehouses and are intended as support for administrative decision-making, etc.

Jaspersoft includes both these types of tools, first level tools to build data warehouse starting from a relational database and the second level where tools for filtering, organizing and viewing data as graphics, dashboards are present. Also Jaspersoft contains OLAP component.

The second stage is a management model for extraction, transformation and processing data, based on different type of models for statistic interpretation, analysis and forecasting.

At this level reporting components (annual reports, analysis, dashboards, charts, etc.) are defined using technologies like OLAP (online analytical processing), data mining and analytical reporting.

The OLAP engine is a query generator having the ability to explore and analyze summary and detailed information from a multi-dimensional database. OLAP tools offer managers the ability to use data forecasting and “what-if” analysis. OLAP can only mark the trends and patterns within the data that was requested, but they are not capable to discover hidden relationships or patterns, which require other tools, like data mining [8].

The main characteristics of OLAP are:

• multidimensional view of data (data hypercube),
• ability to perform intensive calculations,
• time intelligence.

The multidimensional view refers to the enterprise activities viewed from different angles: time, location, products, benefits, human resources etc.

The third stage is represented by data visualization tools, which can help managers to examine data graphically and to identify inter-relationships. BI systems attempts to present data in a form that is relevant for strategic decisions.

At this level, one can find tools for reporting and presenting data in a friendly manner. A very efficient solution that can be used also to integrate data is to develop a business intelligence portal [3]. The main purpose of a BI portal is to integrate data and information from a wide range of applications and repositories, in order to allow visualization of many systems, either internal or external to the organization, through a simple Web interface. Therefore, a BI portal can be seen like a Web-based, secure interface, which can offer a unique integration point for the applications and services used by employees, partners, suppliers and clients of the organization. The main advantage of the information portal is that it can be easily offered as a service to the wide public.

At fourth stage, a BI system is capable to execute simulations and obtain insights about business problems. In this manner is possible to gain more knowledge, to forecast the future based on data obtained from different business context.

In figure 1 is represented the hierarchy of a BI system, from the level of transactional data until the top management that decides organizational strategy.

2.2. Choosing Jaspersoft as BI software

The scope of BI platforms expanded in 2011, the business users relying increasingly on decisions made by using these new tools. Some examples are significant in this respect:

• Hallmark Cards, one of the most recognized publishers of greeting cards, turned to business intelligence to determine the best means and methods for marketing;
• American Medical News has proven the benefits of using business intelligence for healthcare;

• BI technology influenced the banks in making better decisions when investing, the capability to quickly and efficiently determine risk factors. Bank of Montreal, US Federal Home Loan Bank, Garanti Bank of Turkey, Dallas Teachers Credit Union etc., all use BI software.

![BI Platform Diagram](image)

**Figure 1. BI Platform – support of enterprise management**

Gartner research analysts: John Hagerty, Rita L. Sallam and James Richardson, published in February 2012, the study "Magic Quadrant for Business Intelligence Platforms", built after a detailed examine of the strengths and weaknesses of most important BI software available on IT market. The main BI platform capabilities are organized into three categories of functionality: integration, information delivery and analysis. According to Gartner, we made a summary of these criteria [4]:

a. Integration – refers to the common BI infrastructure, metadata management and development tools.

For an application, all BI tools of the given platform use the same type of database, organized in respect of the object model and query engine according to acquired license. Also, the interfaces, and the entire portal should have the same aspect. By using metadata management, BI objects such as performance metrics and report layout objects are defined, offering a way to search, store and publish information.

Generally, BI software provides a set of development tools and a visual development environment, coupled with a software developer's kit for creating BI applications, integrating them into a business process.

The BI platform should also enable developers to build BI applications without coding by using wizard-like components for a graphical assembly process.

The development environment should also support Web services in performing common tasks such as scheduling, delivering, administering and managing. In addition, the BI application can assign and track events or tasks allotted to specific users, based on predefined business rules.

b. Information visualization – the most important category of BI classifications, refers to the end-user tools (reports, dashboards, ad-hoc queries), giving complex results without much efforts, but involving the necessary set of data and knowing what analysis techniques are the most efficient.

From this point of view, any BI platform should consider reports as an ordinary tool, that provides the ability to create formatted and interactive displays, with or without parameters, and their performance consists on the wide array of reporting styles (financial, operational and performance dashboards). Users should have access to the BI content and fully interaction with data, delivered across platforms including the Web, mobile devices and other portal environments.

Dashboards represent a subset of reporting includes the ability to publish formal (printed), Web-based or mobile reports with intuitive interactive displays of information, including charts, gauges, sliders, check boxes and traffic lights. These displays indicate the state of the performance metric compared with a goal or target value.

Ad hoc query represents the capability that enables users to ask their own questions about the data. Also, these tools must have a semantic layer to allow users to navigate through available data sources. These tools should include a disconnected analysis capability that offers the users access to BI content and analyze data remotely without being connected to a server-based BI application.

Microsoft Office integration – for some BI platforms Microsoft Office applications (a spreadsheet in Excel, for example) have a BI client behaviour. In these cases, it is important that the BI platform provides integration with MS Office applications, including presentation formulas, data refreshes, pivot tables and cell locking.

c. Analysis

Online analytical processing (OLAP) - the main characteristics of OLAP were already presented as tools placed at second stage of the BI system. This enables to analyze data using queries and performance calculation, establishing a style of analysis known as "slicing and dicing." End users are able to navigate multidimensional data and making "what if" analysis for modeling purposes.

Interactive visualization - this category of functionality is about the ability to display more efficiently aspects of the data by using interactive pictures and charts, instead of tables of numbers. Advanced visualization will go beyond just slicing and dicing data to include more process-driven BI projects, allowing all users to better understand the workflow through a visual representation.

Predictive modeling and data mining - this function allows users to classify variables into categories and to estimate continuous variables using advanced mathematical techniques.

According to their capabilities, Gartner institute placed BI software from different providers in the Magic Quadrant for Business Intelligence Platforms [4] – figure 2.

We choose Jaspersoft as BI platform taking into account the information published by Gartner institute on February 2012 about the market description and its advantages. The following paragraph will synthesize some of strengths and weakness of Jaspersoft BI software, according to the results of research studies in 2012 [12].

A. Strengths

• First of all, Jaspersoft is an open-source BI platform;

• Low price is the most compelling part of the Jaspersoft value proposition.

• Jaspersoft has the capacity to be embedded in the customer’s software, without being bound by the GNU General Public License terms and conditions. The study remarks that Jaspersoft has more than 400 OEMs and SaaS (Software as a
Service) providers that include Jaspersoft as the BI components in their software, offering the opportunity to integrate Jaspersoft into their internal applications.

Figure 2. Magic Quadrant for Business Intelligence Platforms
Source: Gartner (February 2012)[4]

- Jaspersoft also is partner into an important IT network that includes companies such as Red Hat, VMware, IBM and Tata.
- The compatibility with cloud deployments.
- To help both faculty and students assess for themselves the value of open source software solutions, Jaspersoft has provided a suite of BI solutions in educational purpose.

B. Weaknesses

- Gartner analyze underline that Jaspersoft is implemented in smaller companies with smaller volumes of data than the survey average, having as field of application departments rather than enterprises.
- Generally, Jaspersoft customers use BI platform for reporting, even they have a complex set of functions available. This weakness is consistent with Jaspersoft's roots as an open-source reporting tool; the customers have not yet begun implementing the entire set of BI functionality available as part of the Jaspersoft BI platform.
- Jaspersoft score was almost the lowest for the second year in a row, despite this being a key part of the company's business models.

Jaspersoft has an average score based on few criteria: ease of use for both, end users and developers, the integration of its BI platform components, its product quality and its performance.

3. BUILDING A BI APPLICATION IN EDUCATIONAL PURPOSE

We used the suite of BI solutions from Jaspersoft to create a demonstration with educational purposes.

This study adopted a quasi-experimental research method to evaluate the influence of the business intelligence in the learning process of managerial tools by the students. The experiment is at the beginning and it started during the practice stage (3 weeks, 6 hours each day) in two undergraduate classes of Departments: Computer-aided accountancy and Business administration from the Faculty of Economics, University of Pitesti, Romania.

Students must learn some theoretical concepts and in this purpose teachers have the mission to answer students’ questions about the relevance of BI to the business environment and management strategy [6][11]:

- What is new about business intelligence compared to previous informatics systems?

Business intelligence is a natural consequence of a series of previous systems designed to support decision making. The emergence of data warehouse as a repository, the advances in data cleansing, the continuous improvement of the hardware and software features, and the boom of Internet technologies that provided the user interface, all combine to create a richer business intelligence environment than was available previously.

- What types of information supply a business intelligence system?

Business Intelligence is used to obtain information and to combine all the capabilities available in the company in order to establish trends and future markets, technologies, features of the environment in which the company competes, the implications of the competitor actions.

- Who are the users of the BI systems?

Business intelligence is used by decision makers throughout the firm. At lower levels of management, it helps individuals to achieve their daily work, periodic reports and analyzes. At high managerial levels, it is the input to strategic and tactical decisions.

Practically, we simulated a virtual students’ practice vs. a traditional one and we tried to prove the advantages of this new method:

- The internship does not involve any extra-spaces
- Individual study and practical work take place after classes
- The study began on a demo-company
- Each student has its own company for practice
- All practical works are mandatory for the student
- Availability: 24 hours weekly

Virtual practice offers the students a possibility to work on the university network or on their personal computers. Students already have notions of design and implementation of databases from previous years of study, prerequisite for building a data warehouse for small and medium business. Well known DBMSs supported by Jaspersoft include PostgreSQL, Oracle, IBM DB2, Microsoft SQL Server, MySQL - all of them compliant with JDBC (Java Database Connectivity technology), as Jaspersoft is a Java-based server application. It can use any open-source (Tomcat) or commercial application server (JBoss, WebLogic, WebSphere).

This section shortly explains how to prepare the data to be used in reports, OLAP views, dashboards in Jaspersoft. A sample data source is organized in a data structure, using the fields (attributes) to define relationships between tables. We propose the following structure of an Access database, designated to store financial results for the example company presented (figure 3).
There are many free software tools to accomplish the migration from an Access database into a PostgreSQL database. Then, users must define a data source connection inside Jaspersoft. To connect to a data source it is important to configure the Data source and define a driver by setting the server path and database name in the JDBC Wizard. Students will define domains to join, filter and realize the processing of the data using either the Ad Hoc Editor or iReport.

Before using Business Intelligence software, students must analyze the information they need to collect, in order to facilitate decision-making, as well as the form in which information should be presented to the management (as a report, a chart, a dashboard etc).

A BI application could be designated to operational data use or to the strategic area. First area emphasizes the use of data for executing routine tasks of an organization. The flow of information between different hierarchical levels can be used for some operations of the company such as generating reports, providing processing and comparative data, analysis of different trends, influences, costing, determining the profit variable etc [10].

Second area concerns the impact of BI on strategic management. Business Intelligence can potentially influence the core of a firm’s activities such as choices pertaining to products, markets, and technologies (the corporate strategy level), as well as competitive methods within each of the product-market segments (the business strategy level) [12].

We focused in this paper on the first level, meaning learning to execute routine tasks of an organization. Students must define the Domain, which is a virtual view, created and stored on the server without modifying the data source. Through a Domain, users see columns that have been joined, filtered, and labeled for their business needs also they may create reports using either the Ad Hoc Editor or iReport. Users can save a report based on a Domain for others to run, and can also save the settings in a Domain Topic so others can design similar reports. The operations for defining a Domain are: selecting the tables, create the joins between table fields (as shown in figure 4), introducing filters and establish the visual fields.

Based on a domain, the students learn to create Reports, using Ad Hoc Editor or iReport Designer by dragging and dropping columns of data onto a table, chart, or crosstab. Users may then filter the data and save the report. A such a report for our virtual company is presented in figure 5, report that can either be run or re-opened for further data exploration.

A Dashboard is a collection of reports, input controls, graphics, labels, and web content displayed together. Users create dashboards interactively in the Dashboard Designer and save them in the repository. In figure 6, a dashboard combines the previous report filtered by expenses and restricted to year 2008, with the corresponding graphical display.

To have a bird’s eye view of the company’s operating fields, and to focus only on specific components, Jaspersoft offers end users the OLAP tool, a multidimensional view which refers to the enterprise activities viewed from different angles: time, location, products, benefits, human resources etc.
This approach will allow the young economists to develop their skills and exchange ideas, learn from each other and build a strong foundation for real-world applications that will follow after graduation. Also, teamwork and hands-on experimentation without the risk of involving real money can improve their abilities to make decisions and assess their efficiency before their position in a company will require it. The global economy is a highly-interconnected environment and a simulation could involve not just individual companies managed by each student, but also working in departments for a multi-national virtual enterprise, in order to accommodate with the requirements of such a challenge. This way, every student is a part of a great team, with common goals and deadlines. Each decision has an impact on all the others, and communication becomes essential.

5. REFERENCES

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Figure 6. A dashboard example for virtual company

The internship for the students was ended by a project which involved the stages presented above for each virtual company that they had to manage. Based on the lab results and the final tests, the teacher could evaluate the learning effect, built on reports, charts and OLAP analysis to survey the degree of the learning model and to assess the performance of classroom learning.

4. CONCLUSIONS

BI systems have a powerful impact on strategic decisions quality and are able to reduce the necessary time and thus these systems must have the ability to allow managers to view data in different perspective in order to discover new factors that affect business process and also to anticipate and forecast changes inside and outside the organization.

In this context, we seriously consider that students need to learn theory and practical application about BI technology. The highly regarded effectiveness of these practical applications lies in a powerful combination of theory, principles, and applied techniques using real-world tools. Data, collected from the firm and other sources, is stored and analyzed in a database that students themselves should design. We choose to use Jaspersoft, the free version of BI software which has an educational package, to use this technology on a virtual company, taking into account the most frequently used analysis requirements, displaying the relevant data and indicators used by the organizational management.

In the final section of this paper and based on the foregoing, we propose to continue those learning experiences in the following university year and internship stages, and repeat the experiment with a larger population of students and by using more BI instruments. As BI technology is evolving at a fast rate, and the number of students interested in developing real management abilities is increasing, we assume the use of a larger, distributed architecture to host student virtual companies as a future work.

Jaspersoft has integrated support for cloud services, and the migration of data processing from the desktop to the highly-available, easy scalable virtualized environments has established as a constant industry trend in the last years. Such an infrastructure is able to extend as necessary, based on user requirements, and is able to host a great number of students for long periods of time, as flexible storage capacity and communication channels are already built-in by the vendors.
ABSTRACT: Speech therapy can be viewed as a business in logopaedic area that aims to offer services for correcting language. A proper treatment of speech impairments ensures improved efficiency of therapy, so, in order to do that, a therapist must continuously learn how to adjust its therapy methods to patient’s characteristics. Using Information and Communication Technology in this area allowed collecting a lot of data regarding various aspects of treatment. These data can be used for a data mining process in order to find useful and usable patterns and models which help therapists to improve its specific education. Clustering, classification or association rules can provide unexpected information which help to complete therapist’s knowledge and to adapt the therapy to patient’s needs.

Key words: data mining, speech therapy, Information and Communication Technology (ICT), personalized treatment

1. INTRODUCTION

Language and speech impairments are affections which have negative impact on individuals’ life standard even they do not endanger their life. These problems occur frequently to children under school age and, if they are discovered and proper treated they can be often corrected. Logopaedic therapy is a complex process and it must be adapted to each patient.

During last years, the technological progress has a major influence on speech therapy. First, the communication among persons with various disorders was facilitated by computer or other communication tools. Second, the learning process was improved with help of various computer based speech therapy systems which increase the patients’ curiosity and their interest in therapy by stimulating strong feelings and affective states [1]. Last, but not least, the Information Technology used to assist the logopaedic therapy allowed to collect a considerable amount of data which may hide new, unexpected and potential useful information. This information can be extracted by a data mining process and may serve to improve the therapists’ knowledge in order to provide an efficient and high optimized personalized therapy.

This paper aims to investigate the potential of data mining to enhance the speech therapists’ knowledge, and finally to lead to an efficient personalized process of therapy.

The paper is organized as follows: Section 2 points out some challenges of speech therapy disorders and shows the complexity of the therapeutically process, Section 3 refers some aspects regarding the use of Information and Communication Technology in speech therapy area, Section 4 presents what is data mining and its methods that are useful in speech therapy, and Section 5 shows how can be used data mining as an educational tool for speech therapists. Finally, Section 6 presents some conclusions.

2. THE CHALLENGES OF SPEECH DISORDER THERAPY

Defined as problems of fluency, voice or how a person utters speech sounds, speech disorders may have different causes: organic, functional, neurological or psycho-social causes.

To prevent and to treat speech disorders is a complex process, which involve efforts of speech therapists and those of are asked to contribute to the children’s language education: parents and teachers.

If the proper treatment of these problems starts in due time, they can be corrected because psycholinguistic automatisms are not consolidated in young children [2].

An adequate diagnosis will decide the therapy for correcting speech problems. Each speech therapist must adapt its therapeutic program to each particular case, to the child’s learning rhythm and style and to the severity of its problem. Key problems in speech therapy are presented in Figure 1.
A first step is a complex examination, which starts with a personal and family anamnesis and continues with cognitive and personality examination. After that, a detailed speech investigation is made. This can reveal the existence of general speech problems regarding hearing, voice or vocabulary, articulation problems as poor coordinating or pronunciation problems. As a conclusion, complex examination provides data about social, cognitive and affective parameters and points out potential development problems allowing a diagnosis for the patient.

Then, more therapy phases must be followed in a specific order, according to each child’s characteristics. The therapy is built on stages, moments and concrete objectives materialized in a specific therapeutic techniques (exercises and procedures which the child has to perform) in order to achieve the final aim - a correct speech act [4]. From time to time one assesses the therapy results, and if it is necessary it is reconsidered and redesigned.

4. DATA MINING

4.1. Knowledge Discovery in Databases

Defined as “the process of identifying valid, novel, potential useful and understandable patterns in data” [5] knowledge discovery in databases (KDD) is a complex process consisting, accordingly to CRISP-DM model, of following six steps: business understanding, data understanding, data preparation, modelling, evaluation of the mode land deployment [6]. These steps are presented in Figure 2.

As one can see, one of these steps refers to data modelling. Defined as the semiautomatic extraction of knowledge from huge volumes of data, data mining correspond to the modelling step in the KDD process.

Data mining involves the analysis of large volumes of data using algorithms which produce a particular enumeration of patterns from such data. It aims to discover, from apparently unrelated data, relationships that can anticipate future problems or might solve the studied problems.

By appropriate methods, data mining is able to provide answers for two wide categories of problems: prediction and description, as shown in Figure 3.
Even prediction is the strongest goal, discovery, sometimes called knowledge discovery, is performed usually prior to prediction. For example, in speech therapy practice for a diagnosis suggestion, which belongs to predictive data mining, we have to explore the database for a set of characteristics that describes the diagnosis. Then the obtained information is used for the prediction of the disease for a new patient that comes in.

4.2. Data Mining Methods

Each of the two problems mentioned above may be solved by specific methods. If we intend to make a prediction we can use classification or regression. If our goal is knowledge discovery it is indicated to use clustering, association rules, database segmentation, visualization or deviation detection as shown in Figure 3.

Classification is a data mining task that aims to predict group membership for data cases using models that describes predetermined set of data classes. A model is built by analyzing data cases described by attributes. Such models, called classifiers, are constructed to predict categorical labels using a two acts process. In the first stage, called the learning step or the training phase, a classifier is build to describe a predetermined set of data classes, called training set. The class label of each training case is provided. This is the reason why this method is known as supervised learning. Once built, the model is tested on data that are also labeled in order to determine its accuracy. If it is validated, the model will be further used to predict classes of unlabeled cases.

Deviation detection allows detecting changes from the normal behaviour. It aims to discover the significant changes in data from previously collected values.

Clustering brings together sets of entities into groups based on their similarities. A cluster is a collection of objects that are similar to one another within the same cluster and are dissimilar to the objects in other clusters. The expression for similarity is often a distance function which can take different forms based on data types used in order to describe the objects. For example, for numerical data one may use the Euclidian distance, but for categorical data this distance is not appropriate. In this case, an algorithm which uses a new distance measure based on the total mismatches of the categorical attributes of two data records is proposed [7]. In data mining, clustering is an unsupervised learning method, because, unlike classification is not based on existence of predefined classes and class-labeled training.

Association rules try to find out relationships between different data which seem to have no semantic dependence. Association rules were applied initially to data sets consisting of variable length transactions, but in time, some algorithms has been adapted for data stored in relational databases. Mining association rules involve two steps: finding the frequent itemsets and rules construction. Frequent itemsets are those collections of attributes that frequently occur together within a transactional database. Inside of these frequent itemsets we seek the associations between various attributes.

5. DATA MINING AS TOOL FOR SPEECH THERAPIST’S CONTINUOUS EDUCATION

5.1. Data Mining for Speech Therapy

It is known that the logopaedic diagnosis is subjective and depends on the available data and on the experience of the logopaed. Therapy also must be adapted to each individual case, based on factors such as: the gravity of speech impairment, the child’s characteristics and lifestyle or the parent-child’s relationships.

In order to solve these problems some directions are already used. Statistic methods, queries or visualization models are useful to give to therapists a general view of speech disorders. More sophisticated information visualisation techniques can be used to generate representations for integrated patients’ data, which can be explored by therapists. These allow specialists to identify difficult cases and to pay more attention to their therapy.

The aim of data mining is to extract hidden patterns in data collected from speech therapist’s office and other potential data sources, using specific techniques. Hidden patterns can contain unexpected but very useful information.

If we refer logopaedic therapy, the useful actions performed by data mining can be grouped into the following categories [4]: classification, clustering and association rules mining.

Classification places the people with different speech impairments in predefined classes. Thus it is possible to track the size and structure of various groups. We use classification which is based on the information contained in many predictor variables, such as personal or familial anamnesis data or related to lifestyle, to join the patients with different segments [4].

Clustering aims to group peoples with speech disorders on the basis of similarity of different features. It is not based on the previous definition of groups. It is an important task because helps the therapists to understand who are they patients. Clustering aims to find subsets of a predetermined segment, with homogeneous behaviour towards various methods of therapy that can be effectively targeted by a specific therapy [4].

Since, the goal of association rules mining is to identify combinations of items that often occur together, in the personalized speech therapy area its task is to determine why a specific therapy program has been successful on a segment of patients with speech disorders and on the other was ineffective.

So, as a conclusion, we may say that data mining is a useful tool, which helps the therapists to design proper personalized schema for speech disorders therapy.

5.2. Data mining – educational tool for speech therapists

Data mining aims to find new patterns in large amount of data. Used mainly in business, data mining has some applications in education, medicine and healthcare. The process of tracking and mining patient’s data in order to improve therapists’ knowledge for enhanced personalized speech therapy is a new idea.

Knowledge extraction techniques applied in speech therapy area can be considered as formative evaluation techniques which aim to evaluate therapeutically programs while they are still in development with the purpose of continually improving these programs.
Data mining can discover useful information that can be used in formative evaluation to assist therapists to establish a proper basis for decisions when they design or adapt a therapeutically process.

The application of data mining in speech disorder therapy is an iterative process as is shown in Figure 4. Mined knowledge should enter the loop of the system and guide and enhance the whole process.

![Figure 4](image.png)

**Figure 4** The framework of applying data mining in speech therapy

Figure 4 shows the interactions that occur in a therapy system that include four functional blocks: speech therapist, a CBST system, the child with speech impairments and data mining module.

1. speech therapists collect data about their patients and store this data in databases that are part of the used CBST. Based on this data, a personalized therapy is designed;
2. the CBST system assist the therapy that is made in the therapists’ offices and provides the set of exercises that must be made as independent work. It allows also to track the child’s evolution during the various stages of therapy;
3. collected data are prepared for data mining algorithms, and transformed data are subject of data mining operations (classification, clustering or association rules).
4. resulted patterns are shown to speech therapist. They have to be in an understandable and easy to interpret form.
5. specialists interpret and evaluate the mined models. If they are found to be useful they become knowledge and contribute to continuous education of speech therapists.

This new information can also be used to improve CBST’s performances.

### 6. CONCLUSIONS

Data mining is an actual research direction with application in various domains. Originally designed to meet the needs of a highly competitive economy, one has proved that data mining can be a useful tool for lifelong learning of various category of specialists.

Speech therapy is a complex and difficult process because it addresses young children or adults with problems. In this case, the success of therapy is closely related to the ability of experts to design a personalized therapeutic path, as good as possible adapted to the features of the patient.

Data regarding therapy, patients or their status at different moments of therapy can be used in data mining operations to obtain new and useful information, often surprising even for experts. Starting with creating groups of patients with similar features by clustering, continuing with various types of predictions made by classification (diagnosis, the final state of the patient, the length and the cost of therapy), and ending with the association between different schemes of treatment and patients, which provides the best results, this information may be a solid foundation for speech therapists’ lifelong learning.

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### 8. REFERENCES

THE IMPACT OF TRANSFORMATIONAL LEADERSHIP ON UNIVERSITY PERFORMANCE THROUGH KNOWLEDGE AND INNOVATION

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ABSTRACT: This study investigated the range of potential performance implications of transformational leadership to improve the university performance by creativity, knowledge, and innovation. We examine the relationships among innovation orientation, transformational leadership, organizational learning, and university performance using hierarchical OLS regression technique. We found that transformational leadership influences the relationship between leaders’ performance (rectors, deans, and managers) and university’s outcomes (teaching, research, and service) to establish how leader behaviours affect the university performance. Results reveal that transformational leadership may motivate academic staff to work harder, exerting more effort and engaged in higher levels of task performance through inspirational motivation, intellectual stimulation, idealized influence, and individualized consideration. The current study shows that transformational leadership may facilitate higher levels of creativity and innovation through emphasized the knowledge integration mechanisms into university. The moderately positive relationships of transformational leadership with university performance suggest that universities should focus on selecting and promoting individuals for upper-level managerial positions with these characteristics.

Key words: transformational leadership, university performance, organizational learning, innovation, creativity

1. INTRODUCTION

Today, universities are the engines of economic growth and play an essential role in education the next generation of scientists and engineers [5]. The universities are repositories of new knowledge. The academic members generate new knowledge and use it in research activities and disseminate it through teaching activities. The university community also participates in many service activities. Thus, the missions of universities in general are in teaching, research and service. Quality of education service is linked to research and scholarship [7]. Universities face a constantly changing education market characterized by unpredictability and strong competition. They must identify the best solutions to improve their performance. Basically, university performance can be evaluated using three key dimensions such as teaching, research, and services. As a university register better performance, much more it enrol a larger number of students, it can attract more funds from research, and it can be more involved through its service in community. One way by which a university can meet this challenge is leadership, especially, transformational leadership. According to previous studies the transformational leadership has received a great deal of theoretical and empirical evidence [1]. Previous study has shown that transformational leadership is positively related to change, innovation, and performance aims [9]. There is comparatively little research on transformational leadership and university performance, although this leadership provides individualized support, consideration and appreciation which are essential for improvement the research, teaching, and service performance. The importance of transformational leadership has been widely discussed in the management literature, which suggests that understanding its four dimensions is crucial for organizations hoping to increase their competitive advantage. The present study attempts to address these issues and to provide a better understanding of the impact of transformational leadership on academic performance by examining the effects of organizational learning, and innovation orientation. This research reflects an effort to extend the literature on leadership by examining the impact of transformational leadership on university performance. It contributes to this literature in several ways. First, to our knowledge, this is one of the few empirical studies that analyze the influence of transformational leadership on academic performance. The research model is tested using a sample consist of academic members from different Romanian universities. Second, our findings offer some directions to action for academic management to meet current challenges. These guidelines are valuable for those seeking solutions to current problems facing. Third, we include some moderators in our model to understand the mechanism by which the main dimensions of transformation leadership affect the teaching, research, and services performance. Forth, the current study shows that transformational leadership may facilitate higher levels of creativity and innovation through emphasized the knowledge integration mechanisms into university. Finally, the results show that it is necessary to attract and promotion of transformational leaders in the top management positions of universities because they have knowledge worker that achieve tasks with greater intellectual content. Transformational leaders enable the search for new opportunity, creation of a common vision, and motivation and guidance of employees. Both creativity and innovation are major contributions to transform traditional universities. Skilled and flexible academic staffs are one of the key drivers of high education services. A skilled and flexible labour force can play important roles in knowledge transfer. The academic members contribute to stock of tacit knowledge. Human capital is a source of higher performance for universities and a critical factor for getting competitive advantage. The rest of the paper is organized as follows. First, we review the literature and provide a theoretical background to our research before proposing a set of formal hypotheses.
This is followed by a description of our study, research method, and results. Finally, we discuss our findings, examine managerial implications, and identify future research opportunities.

2. THEORETICAL BACKGROUND AND HYPOTHESES

From the beginning, it is important to clarify some concepts to understand the role of transformational leadership in a university. A mission is why an organization exists, and what it does. A vision is a statement which describes where an organization wants to be in the long term. A strategy states how the organization is going to achieve its vision, and implement its mission.

Universities are a training platform for the next generation of scientists and engineers. Universities need to adapt to the changing market through structural reform to respond actively to diverse demands of society and enhance their capacity. Basically, the missions of universities are teaching, research and service. Teaching refers to content of all programmes of courses through modernizing laboratories and other academic facilities. The teaching performance of university can be evaluated through the number of graduates, the faculty/student ratio, and the number of faculty member with PhDs.

The teaching university is based on education and seeks to increase the rate of enrolment. The research university alongside with teaching activities is engaged in knowledge creation by basic research projects. A professor can devote primary energy and creativity to teaching but he or she is penalized and often looked down upon by peers. It is well known that promotion at universities is greatly affected by a faculty member’s accomplishments in research. Thus, research grants become the driving forces for faculty recognition and promotion. The research performance of university is based on the number of PhDs, number of publications of different kinds, and the number of external research projects and grand obtained.

Service is third mission of university. This mission is based on the community engagement activities, creation of new business or spin-offs, participation in an editorial board member of journals or scientific committees of national and international conferences.

Today, in Romania, universities have a dual management system, one academic and the other administrative. The academic leading is realized by Senate. Rector and vice-rectors have administrative tasks and goals. This type of management system presents a major disadvantage, namely between the rector and the head of Senate is possible to arise a conflict. If a big conflict arises between the rector and head of Senate the management efficiency decrease dramatically as academic goals cannot be achieved.

Rector has a key role in managing and providing resources for teaching and research processes of the university. A rector does not have to be a scientist or a teacher remarkable scientific results but he must be a leader able to mobilize resources and have vision to act proactively to achieve the academic goals.

In this paper we attempt to show that a rector that applied transformational leadership will be able to achieve better results for his university. We know that transformational leadership refers to an ability of leaders to motivate, subordinates to achieve performance beyond expectations by transforming the subordinates attitudes, beliefs and values. Transformational leaders (rectors) becomes a key driver of explaining and enhancing competitive advantage, academic performance and opportunity growth by vision, inspiration, stimulation, coaching, and motivates of academic staff.

Bass (1985) conceptualized transformational leadership as comprising four core dimensions [3]. Inspirational motivation allows leaders to set a compelling vision of the future that leaders take initiatives in changing the organization. Basically, idealized influence characterizes leaders who represent a trustworthy role to follow. Intellectual stimulation enables leaders to encourage subordinates to take risk and look for new ways of doing things. Finally, through individualized consideration, leaders help followers on a one-on-one basis, focus on their individual strengths, and help them cope with stressful situations [3], [4]. Hence, we propose that a transformational leadership can improve the academic performance. Therefore, we hypothesize the following.

H1. Transformational leadership has a positive impact on academic performance (teaching, research, and service)

Innovation helps the university to deal with the turbulence of dynamic educational markets and, therefore, is one of the key drivers of economic growth and university success [2]. Transformational leaders can stimulate the innovation through encourage new different ways of thinking, seeking new opportunities or solutions to current problems and adapting the university at new challenges. Innovation orientation refers to all activities which support the teaching, research, and service. In a university is obviously the most important field of activity the research. By developing an innovative culture can be stimulated creativity and research. Innovation can attract additional funds useful to modernize laboratories and other facilities, to better motivate the academic staff and funding development of university through the establishment of new faculties, specializations or departments. The most important result of innovation lies in using new knowledge in teaching process. The transformational leadership enables university to integrate, share and use this new knowledge innovatively. By innovation processes, university can improve its internal dynamic capabilities to create, deploy, sharing and exploit knowledge.

H2: The innovation orientation has a positive impact on academic performance

Transformational leadership stimulate the organizational learning. The academic members are influenced positively to learn through creating a climate that support and enhance the learning processes. Transformational leaders encourage academic staff to transfer knowledge, good practices, and improve the teaching process by conferences, papers published in various journals and very good and active internal communication. A learning organization can acquire and use new and relevant knowledge better, develop critical capacities and skills. In this case, rector is a catalyst, mentor, and facilitator for organizational learning. The academic members learn through experimentation, communication, dialogue, and publishing [6]. Academic members are identified in this study through the control variable - academic status (1=professor, and 2= reader or lecturer). This leads us to the following hypotheses.

H3: The organization learning has a positive impact on academic performance

H4: The academic status has a positive impact on academic performance
3. RESEARCH METHODOLOGY

Our hypotheses were tested empirically using a field survey of academic members from different Romanian universities during the year 2012. The sample consists of 34 academic members. The present study employees a personal interview, using a structured questionnaire, to collect data.

The study’s dependent variable is university performance. We measured the academic performance as a multidimensional construct. We developed a scale with three items to measure and evaluate university performance. Our scale reflects academic staffs’ perceptions of teaching, research, and service outcomes of university. Respondents were asked: the university’s performance measured by teaching outcomes is high, the university’s performance measured by research outcomes is high, and the university’s performance measured by service outcomes is high. The scale was validated and presented high reliability.

Transformational leadership was measured by using a scale designed by Podsakoff, Mechenzie and Bommer (1996). We used the scales which has five items to determine transformational leadership [11]. Respondents were asked: the university’s management is always on the lookout for new opportunities for the university, the university’s management has a clear common view of its final aims, the university’s management succeeds in motivating the rest of the university, the university’s management always act as the university’s leading force, and the university has leaders who are capable of motivating and guiding their colleagues on their activities. The scale reflects academic staffs’ perceptions of transformational leadership in the university.

Organizational learning. Using scales established by Kale, Singh and Perlmutter (2000), we drew up a three items scale to reflect academic staffs’ perceptions of organizational learning in the university [8]. Respondents were asked: the university has acquired and used much new and relevant knowledge that provided competitive advantage over the last three years, the university’s members have acquired some critical capacities and skills that provided competitive advantage over the last three years, and the university was a learning organization.

Innovation orientation. We adapted our scale on Miller and Friesen’s work (1983). We drew up a two-item scale to reflect academic staffs’ perceptions of innovation orientation in the university [10]. Respondents were asked: the rate of introduction of new courses, laboratories in the university has grown rapidly, and the rate of introduction of new teaching methods, specializations, new service and attract the research projects in the organization has grown rapidly.

We used the academic status (professor, reader or lecturer) that control variable reflecting the characteristics of academic staff. Previous studies have indicated that this factor may affect the influence of transformational leadership on academic performance.

The questionnaire contained questions in the form of a 7-point Likert-type scale (1=strongly disagree, 2-disagree, 3-somewhat disagree, 4-neutral, 5-somewhat agree, 6-agree, and to 7= strongly agree) regarding the various aspects of transformational leadership, innovation performance, organizational learning, and university performance. The questionnaire provides the perception about academic performance of university, innovation orientation, and organizational learning.

4. ANALYSIS AND RESULTS

All measurements of the construct are based upon the respondent’s opinions. SPSS 20 for Windows was employed for determining relationships among the constructs. Our model examines whether the transformational leadership has an impact on university performance and the effects of innovation orientation and organizational learning on university performance.

Moderation multiple regression was used to test the hypothesized model. The predictor variable (transformational leadership) was regressed against the moderator variables (innovation orientation and organizational learning) and dependent variable (university performance) to establish whether there are effects on university performance. Linear regression is used to specify the nature of the relation between variables.

All these effects must be significant, with the significance of each association between the transformational leadership as predictor and university performance to indicate support for our hypotheses. The results of different hypothesis along with the value of the regression coefficient for our independent variables are presented in Table 1.

Table 1. Results of regression analysis

<table>
<thead>
<tr>
<th>Control variable:</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct effects:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic status</td>
<td>0.669***</td>
<td>0.191</td>
<td>.191</td>
</tr>
<tr>
<td>Transformational leadership</td>
<td>0.336*</td>
<td>0.336*</td>
<td></td>
</tr>
<tr>
<td>Innovation orientation</td>
<td>0.423*</td>
<td>0.423*</td>
<td></td>
</tr>
<tr>
<td>Organizational learning</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Indirect effects (interactions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transformational leadership x Innovation orientation</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transformational leadership x Organizational learning</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0.669</td>
<td>0.883</td>
<td>0.883</td>
</tr>
<tr>
<td>Overall R²</td>
<td>0.448</td>
<td>0.78</td>
<td>0.78</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.430</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Overall model F</td>
<td>25.92</td>
<td>25.72</td>
<td>25.72</td>
</tr>
<tr>
<td>ΔR</td>
<td>-</td>
<td>0.214</td>
<td>0</td>
</tr>
</tbody>
</table>

*p<.05; **p<.01, ***p<.001
The data were examined using moderated hierarchical OLS regression techniques. Control variable (academic status) is entered in Model 1, followed by the three independent variables (transformational leadership, innovation orientation, and organizational learning) in Model 2. The indirect effects were analysis through the interaction terms in Model 3. We predicted two interaction terms such as the transformational leadership x innovation orientations, and transformational leadership x organizational learning.

The inspection of the transformational leadership showed that it has a positive impact on university performance. The relationship between transformational leadership and university performance was positive and significant (b= 0.336; p<0.05). We used the standardized coefficients (beta), for example, b is the value of the regression coefficient associate the transformational leadership. Thus, Hypothesis 1 is supported.

Hypothesis 2 states that the innovation orientation has a positive impact on academic performance. The results indicate that innovation orientation is positively related to university performance (b=0.423, p<0.05), providing full support for Hypothesis 2.

Model 3 provides the results for Hypothesis 3. The organization learning was positively but no significant effect to academic performance (b=0.05, ns). Therefore, the Hypothesis 3 is not supported. Surprisingly, the results show that the organizational learning provide the capabilities as the transformational leaders encourage the academic staff to transfer knowledge create new knowledge and integrate them in teaching processes to develop critical capabilities and skills.

The results also indicate that academic status has no significant effect on university performance (Hypothesis 4). In addition, our research didn’t identify indirect effects of transformational leadership on university performance. That is, the interaction terms are not significant, indicating that university performance can be improved by the direct effects of transformational leadership.

As you can see in Table 1, the multiple regression coefficient, R, is amount of variation to the response that is explained by the three models. We can see that R square range from 0.448 to 0.780 (Model 3). The change in R square is a way to evaluate how much predictive power was added to the model by the addition of other variables.

5. CONCLUSION

This paper developed an integrative framework of transformational leadership and university performance. Our findings present a range of issues that reveal that transformational leadership may motivate rectors, deans, and managers to work harder, exerting more effort and engaged in higher levels of task performance.

We found support for three out of four hypotheses. These results suggest that transformational leadership and innovation orientation can improve the teaching, research, and service performance of university. The current study shows that transformational leadership may facilitate higher levels of creativity and innovation through emphasized the knowledge integration mechanisms into university.

The moderately positive relationships of transformational leadership with university performance suggest that universities should focus on selecting and promoting individuals for upper-level managerial positions with these characteristics (rectors, vice-rectors, deans, and managers).

This result is consistent with prior research that indicates that transformational leadership is associated with organizational performance. We did not find support for Hypothesis 3, that organizational learning has a direct effect on academic performance (possible a sampling error). Transformational leadership interaction ties did not indirectly influence the academic performance.

Our results suggest that universities if they want to cope with rapid changes to adapt to internal and external requests must promote into leadership position the transformational leaders. They have capabilities, vision and skills needed to produce the necessary changes to improve the performance university. Research activities have a critical role to support excellence and academic performance. Without research activity universities risk to fall behind and attract increasingly more difficult students.

Overall, the results of this study provide guidance for rectors and academic staff considering how to identify, design and apply the dimensions of transformational leadership to improve the academic performance.

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KNOWLEDGE CAPITAL – INFLUENCED BY RATIONALITY OR ANIMAL SPIRITS?

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ABSTRACT: It is already a well-accepted concept in expansion, the economy, organization and management based on knowledge. It is said that the owners of knowledge, respectively the individual, organization and the society, will hold the power in the future. Thus, the knowledge become the economic and personal basic resource and all the activities from the economic sphere are prevaingly concentrated on the treatment of information and producing of knowledge goods. However, it is still difficult to explain on a strict scientific basis why people behave non-rational when facing with money decisions. Classic finance foundation lays on strict rationality and optimization of financial decisions. We affirm that monetary and financial decisions are significantly influenced by psychological factors. Behavioural Finance adds to the equation the psychological and emotional facets of the human decision. This emerging discipline has challenged the Efficient Market Hypothesis, arguing that markets are not rational, but are driven by fear and greed instead. The paper proposes a critical analysis, based on consistency criteria, regarding the controversy current state of the informational efficiency theory of the capital market. In this sense, the critical approach is one that shows the weaknesses, the vulnerable aspects that characterize the classical form of EMH theory. Also, the paper highlights the most significant criticisms levelled against EMH by psychologists and behavioural economists.

Key words: knowledge capital, economy, organization and management based on knowledge

1. INTRODUCTION: THE IMPORTANCE OF KNOWLEDGE CAPITAL

In these times we often hear “economy, organization and management based on knowledge”. In fact, these concepts modify the importance of the organization’s capitals, from the tangible to intangible ones.

From the old times, the richness and the power were associated to possessing physical resources; so, the necessity of having knowledge was limited. Richness and power in the XXI-st century result prevalently from intellectual intangible resources, from the knowledge capital. The holders of knowledge become the most important value of a country or an organization: the people who own valuable ideas become an inestimable value, their maintenance in organizations using different methods becoming an acute necessity.

We have been the witnesses of quick globalization of economic activity, we have noticed the incredible growths of the results obtained from science and technology, and of the massive growth in importance of nets and connecting – all produced by knowledge and their utilization.

As a matter of fact, in this developing economy, the possession of knowledge has become the key of competition and economic success: it has added a different value of economic production through the growth of productivity, and through the utilization of new technologies and new ideas - both looked like inventions and, likewise, through new application of already existent knowledge – which produced revolutionary modifications in all sectors and markets.

Although we are in the first phases of the knowledge revolution, the impact of this process becomes already visible in the market volatility, in the uncertainties regarding the direction of the economic activities, in incertitude of careers and work places that people feel etc.

The intellectual capital is the term that represents the combined intangible assets, which permit the organization to function in an efficient way. It is very difficult to be identified, and even more difficult to be efficiently used. Once it is found and exploited, the performance will surely grow. It represents all the non-monetary resources and without any physical form that can add value to the performances and the potential of the company. In the new economy the intangible assets, like knowledge, become the new centre of competencies.

We are in a world that emphasizes the economic value of intangible assets. We have to deal with “cognitive domains” where ideas worth billions, while products cost less.

It is considered that this change in knowledge signification began two hundred fifty years ago, transforming the society and economy. Knowledge are seen as the economic and personal basic resource. As a matter of fact, knowledge is the only resource which matter today.

Regarding the traditional factors of production - the land, labour and the capital – they did not disappeared, but they reached a secondary level. They can be obtained, with the condition that the knowledge exists. In this new sense, knowledge mean knowledge as utility, knowledge as the middle of obtaining economic and social results.
Although the social process of changing from past based on progress in knowledge, too, what is new now is, on aside, the speed of renewing the knowledge, the fact that the quantity of knowledge that we have at our disposal is doubled every five years and on another side, the nature of that force which dynamisms the social, economic and cultural changes, that exceed the world informational technologies.

Among the observations Karl Marx made, it is the fact that capitals are mobile, as a distinctive feature against the other factors of production, as nature and labour. The capital has the property to be attracted in the zones where it is best remunerated, and the knowledge have become currently the true capital of a developed economy. The ones who own the knowledge, even if not very advanced, they have the freedom to move.

To the world level, the stock of knowledge grows much more as before. Concomitantly with his amplification, there is in progress a less dependency of classic resources, gradually the knowledge becoming the main capital of organizations. This current revolution of knowledge consists in fact in conditioning the procurement of economic performance, by the existence and utilization of knowledge capitals, of course appealing to the others forms of capital, too.

The value of organizations is determined mainly by the intangible actives value: the value is mainly represented by the employees who own the knowledge, the ideas and the information. They become the most important assets of one firm. With another words, there is a modification in the firms’ actives structure, being necessary both types of actives, tangible the intangible.

The maximum value is obtained through their combination in certain proportions, which vary depending on the size of the firms, the context in which act etc. There are many ways to increase the potential value of people in an organization. Modern ways of investment in education is specially recommended: training, professional and specialized qualifications, activities related to knowledge, as well as forming the competencies related to carrying out certain activities.

The levels where the authors consider that the knowledge can be found in firms are: to the labour force (the human capital), in the requirements and preferences of customers (the customer’s capital), in its products, processes, capabilities and its system (the structural capital). As it follows, the value of knowledge actives can exceed significantly the value of tangible actives.

Within organizations, this inexhaustible capital, the employee’s knowledge, is in a native form and it needs important effort to identify, gather and direct the knowledge to the final product or service that will be offered to the client.

Knowledge, in opposition to the traditional factors of production, represents an inexhaustible source because they are not consumed by their utilization, on the contrary, in this way they become more productive.

Or, how Peter Drucker said: “the power comes from the transmission of the information to make it productive, not from its concealment”.

Knowledge has always meant power: power to survive, power to adapt, power to thrive in a hard environment. Ever since the first human clan enjoyed the warmth of the first tame fire, it’s been true that knowledge shared is knowledge multiplied. The more a group knows of what its members know, the better it can perform in the world. But it’s also true that the more remote people feel from one another, the more risky knowledge sharing looks and the more tempting it is to hold knowledge for private advantage.

To keep up in today’s markets, people have to be able to think on the spot and get the information they need to make a decision. And it turns out that allowing them to proceed in this fashion does not sacrifice quality.

„An individual without information cannot take responsibility; an individual who is given information cannot help but take responsibility.” That maxim, from Jan Carlzon (former chairman of SAS Airlines), is what we have to use to govern the change of our new culture. We know that we need to move to a networked organization that is built around the flow of information and knowledge rather than geography, so we have to look for a new way to get people to assume responsibility. Getting people to assume responsibility for making things happen is what knowledge sharing is all about.

Knowledge management is a general term applied to almost any project that an organization undertakes which is designed to preserve, transfer or exploit knowledge from one part of the organization to another.

Knowledge is both and social and contextual. The person who holds the knowledge also knows what it means, what its limits are and how it can be used. This surrounding context of tacit knowledge is sometimes lost when the information is saved somewhere else.

Even transmitting the information to someone else is not the same as knowledge transfer. The receiver must actually pick up the information and learn how to use it in appropriate ways.

2. HUMAN BEHAVIOUR: RATIONALITY OR ANIMAL SPIRITS?

We saw that knowledge, information are very important for the development of a company or even an economy. But in light of the global financial crisis of 2008-09 and the subsequent international recession, we can affirm that it becomes more difficult to understand how economy works. It is still hard to explain on a scientific basis why people behave non-rational when dealing with money.

The classic finance assumes people rationalize and optimize their financial decisions. One of the most influential classical theories in the past fifty years, Efficient Market Hypothesis (EMH), has attracted a considerable number of studies in empirical finance, particularly in determining the market efficiency of a financial market.
EMH losses of significance and the hypothesis ofrationally fails to explain the excessive volatility of returns and trading volume observed in the major international markets in developed as well as in emerging countries [4].

The Efficient Markets Hypothesis is the idea that market prices incorporate all information rationally and instantaneously. As a synthesis of the most important premise of the informational efficiency concept concerning financial markets, these are:

- Investors are rational. Investors have risk aversion and only desire actives which have the highest yield for a certain degree of risk. Still, contrary to the general perception, EMH does not imply that all market participants are rational. Indeed, markets can become efficient if a group of investors have an irrational behaviour and are correlated in behaviour, as long as there are rational investors looking for arbitrary opportunities.
- Markets are efficient, meaning that current courses reflect all public and available information.
- Yields are independent. The exchange of courses can be determined only by new information. The yield in day t is not correlated with the yield in day t+1.
- Markets have a „random walk“. The probability of yield distribution is the same with the normal distribution (Gauss bell).

But, in reality, the prerequisites which lay at the basis of the theory of efficient markets are not real. The hypothesis that investors are fully rational agents which instantaneously process information in a correct manner in most unrealistic, and rationality is hard to define, human behaviour is often unpredictable.

The rationality of investors appears as a result of the fact that orthodox economic science still remains the prisoner of the mechanical paradigm, in which values, irrationality, lack of direct interest, intuition, are not considered valuables of the economic process [5].

Information can be difficult to interpret, technology and institutions are constantly changing, and also, the gathering and processing of information, as well as the realization of transactions require significant costs.

The new field of Behavioural Finance investigates the subtle and profound interactions within the human brain when faced with uncertainties of an economic decision. The most basic psychological traits of human being (fear, anger, greed and altruism) stamp an indelible mark on our decisions about money. The intellect (understanding a situation), reason (long-term consequences of the contemplated action) and emotion (the judge of the course of action) are all interrelated resorts behind human decision-making.

In their study, Akerlof and Shiller [1] enlarge the definition of animal spirits given by Keynes in his „General Theory” and introduce the optimism and the pessimism as well as the spontaneous reaction as components of animal spirits. More restrictively, Keynes defines the animal spirits as “a spontaneous urge to action rather than inaction”. This definition is more restrictive than that given more recently by Akerlof and Shiller [4].

Another author (Dhaoui A.), in his study [4] found that economy is driven by behavioural biases including especially animal spirits. He found that the excessive volatility is due to the presence of optimistic, pessimistic as well as investors with spontaneous reaction. the hypothesis according to which investors execute rational expectations failed to explain the way the economy works.

Information represents the set of public data, presented and available to everybody in an objective manner. The information can have a material impact on the price of the financial asset when the objective data is combined with the knowledge, practical experience and investors’ evaluation. The investors interpret data and significant events at two cognitive levels:

1. The intellectual level of ordination, process and analysis of real factors (economic data)
2. The logical and rational level of understanding how these objective identifiable factors will influence the perception of the other players in the market.

The term of information cannot be only defined by the data relevant at a specific moment of the market but has to be correlated with the volume of professional knowledge (human intellect) and the interpersonal dynamics of market players (their emotions and sentiments). More, due to uncertainty and continuous change, there is a strong interdependence between experiences (autobiographic memory) and rational expectations about the future.

Our experiences influence the way we interpret and select available data, based on relevance and salience. If we add to the decision equation (of which righteousness can be assessed only ex post) the time pressure, the decisional stress is the sum of uncertainty of interaction between rational and non-rational.

Estimation of psychological reasoning of other market participants behaviour - since other participants decisions and actions can have a decisive effect on own success or failure (Games Theory, J. Nash) [17]. In this case, formation of expectations is subjected to time pressure and omniscient uncertainty.

3. THE CRITICAL ANALYSIS OF EMH – A BEHAVIOURAL APPROACH

The concept of market efficiency refers to information: at a certain moment, prices reflect all available information. This involves the fact that no processing, no matter how deep, can predict future trends. The interest of every investor is to obtain information about the actions of the quoted companies.

This information will allow it to evaluate the perspective of each investment opportunity and to invest in the portfolio which has the best perspectives. All information channels are efficient if they spread intelligence quickly and if every new information becomes public very quickly.
Many practical observations concerning the reaction of investors to new intelligence, but also the mechanisms for their encompassing in the price of stocks, come to highlight the aspects of “market inefficiency” and refer, among others, to:

1. The appearance of time gaps in incorporating information – certain financial investors can present a defensive attitude concerning important public information, which they hesitate to use, so as not to “fall prey” to better informed agents;
2. There is a quickness of reaction which is not the same for all additional or unpredictable information;
3. Investors have a different perception, more or less profound, or selective, concerning information;
4. The appearance of action inertia – some investor imitates those who react first to intelligence. This phenomenon, of bringing new and new investors in the “professionals net” continues, until the first, considering the course is over-evaluated, retire from the market. The contrary movement carries the same inertia.

An important argument concerning the impossibility of the existence of a perfectly efficient informational market is that information has a price and it is not available to all investors in the market at a given moment [15]. So, the price reflected within the information of professional investors (the informed), by only partially; as these informed investors pay to obtain information, it is normal that the price does not fully reflect the information which they own, because on the contrary it would not be possible for them to cover the costs of obtaining the information in the first place. As a result, any model of capital market equilibrium must take information costs into account.

Investors will always have a risk aversion and also, they do not react to immediate information, but in most cases, they react late, guiding themselves to the trend (which implies past intelligence) in the reaction of present strategies.

We presented, in the above, several practical observations concerning the reaction of investors to the new information, but also mechanisms of incorporating them in the price of assets, which come to highlight aspects of market “inefficiency” and refers to: the occurrence of time gaps in incorporating information; the quickness of reaction is unequally distributed to any additional or unpredicted information; action inertia. One can distinguish between two categories of participants on the stock market, which obtain various portfolio investments, as they are either rational investors (“smart money”) which operate with relevant information, but also with regular participants (“noise traders”) which react to rumours and fashion.

People will not always behave in a linear way to new information, encompassing them immediately, as the EMH requires; people behave non-linear. Because of this, the prerequisite that investors are rational and thus, the modifications of courses is independent and that markets have a random sleep movement cannot be accepted. The irregular assimilation of information, as it happens in reality, could lead to a tendency of random movement – “biased random walk”, called a fractal time series.

But the most enduring critiques of the EMH revolve around the preferences and behaviour of market participants. Several strays have been identified from the classical paradigm of EMH bound by investor behaviour, of which we mention: over-confidence (supreme trust) (Gervais and Odean, 2001); overreaction (DeBondt and Thaler, 1986: they revealed that when assets are ordered by them rentability in the last 3 – 5 years, assets which during the past period had a high yield tend to have a low yield during the following time span and vice-versa. They attribute these anomalies to the over-reactions to information.

In the formation of expectations, investor grant a high importance on past performances of companies and a low importance to the fact that these performances can be inverted; loss aversion (which refers to the tendency of people to strongly avoid loss as they lack to seek gains), herding, regret (the theory of the late Bell, 1982). These critics of the EMH argument the fact that investors are often irrational. Speculative economic bubbles are an anomaly, because the market appears to be driven by buyers operating on irrational exuberance, who take little notice of underlying value.

In forming expectations, investors rely on their ability to gather process and understand a mosaic of different information. This ability is subjected to error, in a systematic manner. Access to correct information can lead, however, to inappropriate decisions (wrong informed decisions vs. uninformed decisions).

An inappropriate decision can lead to under or over reaction to materially relevant market information. Under (late) reaction is a direct consequence of an excess of self-confidence in the ability to process and understand new information. The individual is mentally anchored in past opinions and is mentally closed to new information that contradicts the old set of beliefs. An interesting example of mental anchoring is the price discount posting in a sales period.

People buy compulsively not because of apparently reduced prices but they are certain they just find an excellent deal. Overreaction (early) reaction is a direct consequence of mental generalization and representation.

Through generalization, people tend to extrapolate existing information, sometimes based on a single observation and consider it representative for a large population of event (provisional stereotomy).

The most recent event has the greatest impact on autobiographic memory. Recent losses or gains are more salient in their emotional and social impact. People tend to discount the eventual implications of low probability high negative impact events.

These events, due to their apparent low probability, seem to happen less often. Their expected outcome can have, however, disastrous effects on the value of investor portfolio. High emotional impact events, although rare, have a major, indelible impact on the emotional registry of a person. Any subsequent decision reflects the historical record of successes and failures.
4. CONCLUSIONS

Classic finance analysis is, in general, reflective and reactive. Adding the behavioural finance perspective into the equation can help in understating how other market participants will react. Human behaviour is, in general, reactive and not proactive, and consequently difficult to frame and predict in a narrow set of rules.

Behavioural Finance can explain with relative ease why the individual took a certain decision, but find it very difficult to explain what decision will take that individual in the future.

Akerlof and Shiller [1] substitute the investors’ behaviour bias to the hypothesis of rationality in order to explain the volatility in stock returns. They attribute the dysfunction of the economy especially to what they call the „animal spirits” bias as an extension to the General Theory developed by Keynes. In this sense they argue that „it is necessary to incorporate animal spirits into macroeconomic theory in order to know how the economy really works”. The „animal spirits” can be comprehended as a non-rational behaviour driven by investors [4].

Human brain has limited capacity to process, assimilate and understand the huge volume of information and stimuli that assault us every second. The decisions and judgments we undertake daily (hundreds) are constrained by personal circumstances, time pressure, psychological and emotional factors, and are at the crossfire of a rational and non-rational influences.

We often ignore a good decision for the simple fact that we are, in general, more interested by simple, reasonable and feasible solutions to our dilemmas. Our perception, especially when it comes to money, can be distorted and biased by our history, present circumstances and future expectations. Our attitudes and decisions in the financial area are a cocktail of rational and non-rational motives. We reach a certain conclusion and implement the subsequent decision based on what we know now, anchoring ourselves in information that we considered relevant, losing the larger perspective. Financial decisions are sometimes suboptimal due to our simplistic, heuristic and emotional logic.

Although there is a low correlation between professional abilities and investment success, investors have high confidence that somehow, someday they will succeed in beating the markets, in a systematic way. Beating the index by outsmart moves, ahead of competition, finding undervalued and overvalued securities and implementing the buying and selling decision at the right timing is difficult, if not impossible, in the long sustainable way.

Orthodox economic science considers three external methodological premises which are debatable: the rationality of the individual, the idea that the methodological anchor in economic science is globally efficient (minimization of opportunity costs), the idea that the economic process must be cast away, at least as a tendency, towards equilibrium [5]. But, in reality, the prerequisites which lay at the basis of the theory of efficient markets are not real.

The hypothesis that investors are completely rational and they always process instantaneously and correctly all the available information which is surely unrealistic, as rationality is hard to define and human behaviour is unpredictable at many times.

The more and more important influence of information factors, but also the acknowledgement – which became an axiom – is in general non-linear and even more so in human behaviour, economic processes and stock market activity have led to the non-linear approach of stock market processes.

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6. REFERENCES

COMMUNICATION PROCESS MODELING IN RESEARCH PROJECTS

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ABSTRACT: The communication process, a very important part in project management, is a subset of components that compete for their success. In this paper we present a model of the communication process for research projects through which we can obtain a work methodology in terms of communication efficiency. In the last part of the paper some test results are presented obtained by applying this model. Statistical representations, graphical views of data set analyses are made from machine learning methods for data mining. The aim is to obtain a relevant analysis of the communication process within research projects. The proposed model can also be the basis of future decisions made by project managers.

Key words: communication, project management, data mining, research project

1. INTRODUCTION

Project management research needs efficiency, usability, agility. The communication of research projects has an important role for their successful management. Communication process modelling in projects is the phenomena in a generalization that can provide a methodological framework of the project management process. The aim is to support those who choose project management as well as those directly involved in the development of projects. The proposed model is a conceptualization of communication projects and was implemented using the development environment for predictive analytics - WEKA. Output model provides adaptability to the requirements of research communication.

2. THE COMMUNICATION PROCESS WITHIN PROJECTS

Effective communication is a powerful tool that can change someone’s entire perspective on viewing an idea or other one’s point of view. Performs a communication process sending a message by a sender, message scroll is a channel, then this message will actually be received by a recipient. This process is modeled as a model represented in Figure 1.

Communication is considered to be the cornerstone of effective project management but most of it is done ad-hoc, driven mostly by individuals, personalities and preferences, rather than by needs, protocols or procedures. The main cause of the failure of a project is communication breakdown, either within the team or between the team and other beneficiaries of the project [2]. Therefore improving communication should be a priority for any manager indifferent of the level of power he holds and should be an extremely high priority especially for a project manager, one whose main job is dealing with people on most of his tasks.

The goal of communication in the project environment is to establish a common understanding to the required level of depth. How far should communication go for each stakeholder. Some may require to know what is being delivered and when, but many have no need to know how the work is being performed.

In general, the goal of communication should be to clarify information to the depth required by the receiver by minimizing barriers that might inhibit understanding. To use it, implies a broad understanding of audience, interest and environment. With the right practice, good communications can change the entire project experience for the better. Effective communications can and will build more lasting customer relationships, expedite activities and keep projects in control by ensuring that the parties are aware of what they need to be aware of. Consistency is the base for all good communications. Each communicator will have its own style and pattern of communicating, but there will be a certain expectation of consistency.

3. COMMUNICATION PROCESS APPROACHES RELATED TO ORGANIZATIONAL PROJECT MODELS

When talking about project development management and the communication process we need to consider the following terms in order to understand better this process that we are dealing with: model, modeling, methodology, family of methodologies or frame, sistem, project management process.
3.1. Approaches within project development management

In project management there are several approaches to developing artifacts which are achieved by processing resources. These approaches correspond to the project development strategies. Also these types of methodologies have corresponding models for project organizing. In figure 2 we present the categories of project development approaches based on methodological characteristics.

<table>
<thead>
<tr>
<th>Phased</th>
<th>Iterative</th>
<th>Incremental</th>
<th>Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td>A traditional planned approach identifies a sequence of steps. Typical development phases: initiation, planning and design, execution and construction, monitoring and controlling, completion. Some projects do not follow a structured process. A project will go through phases 2, 3 and 4 multiple times.</td>
<td>In a repeatable, practical and productive methodology that ensures project success while decreasing an organization's negative environmental impact. The methodology encompasses the management, control and organization of a project with coordination and emphasis beyond the project life cycle and on the five aspects of sustainability.</td>
<td>In a methodology of planning and managing project execution designed to deal with uncertainties inherent in managing projects, while taking into consideration limited availability of resources (physical, human skills, as well as management &amp; support capacity) needed to execute projects in multi-project environments. Resources should be performed across projects.</td>
<td>Agile project management approaches based on the principles of human interaction management are founded on a process view of human collaboration and a strong communication.</td>
</tr>
</tbody>
</table>

Figure 2. Categories of project development approaches based on methodological characteristics.

3.2. Approaches to process-based communication management

Traditionally, project management includes a number of elements: four to five process groups, and a control system [4]. Regardless of the methodology or terminology, the same basic project management processes are used. Major process groups generally include: initiation, planning or development, production or execution, monitoring and/or controlling and closing. In [4] the approach of project management consists of processes overlap and interact throughout a project or its various phases. Processes are described in terms of: inputs (documents, plans, designs, etc.); tools and techniques (mechanisms applied to inputs), outputs (documents, products, etc.).

The “Guide to the Project Management Body of Knowledge” (PMBOK) recognizes 42 processes that fall into five basic process groups and nine knowledge areas that are typical of almost all projects. The five process groups are: Initiating, Planning, Executing, Monitoring and Controlling, Closing. The nine knowledge areas are: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management. Each of the nine knowledge areas contains the processes that need to be accomplished within its discipline in order to achieve an effective project management program. Each of these processes also falls into one of the five basic process groups, creating a matrix structure so that every process can be related to one knowledge area and one process group. [4]

For example, the executing process group consists of the processes used to complete the work defined in the project plan used to accomplish the project's requirements. The execution process involves coordinating people and resources, as well as integrating and performing the activities of the project in accordance with the project management plan. The deliverables are produced as outputs from the processes performed as defined in the project management plan and other frameworks that might be applicable to the type of project at hand. (see fig. 3).

Figure 3. Executing process [4].

In the group processes from figure 3 there are two communication modules (Information/Distribution, Team development) where a strong communication process takes place.

Just as the entire management process of a project activity consists of groups of activities, specific tasks in turn are considered (sub)processes, so communication management in projects can be seen as a process that integrates in a project management system. This is how the communication management process can be presented in two different project management models (Fig. 4 Communication into an hierarchical model; Fig. 5 Communication into a „project-based” model)[10]:

Figure 4. Communication into an hierarchical model.

In this first model, communication takes place from member A to member B by following the red arrows flow, but the hierarchical model doesn’t always allow it because there are different procedures that need to be followed.

Figure 5. Communication within a „project-based” model.
In figure 5 where communication is used in a “project-based” model, communication between A and B takes place directly. This is why communication within team members depends on the way in which the project is organized. In the first model, communication takes place slowly because of the hierarchic flow, while in the second model, communication is direct and easy.[10]

3.3. Approaches to process-based communication management

Type Agile methodologies are based on project management principles set out in “Agile Manifesto”[6]. The purpose of these methodologies is to reduce project costs. Facilities received Agile methodologies such projects in areas such as construction, aviation, medicine, engineering software. Agile methodologies have been developed at management models such as Extreme Programming (XP), Scrum, and Feature-Driven Development, Evolutionary Project Management (Evo), Unified Process (UP), Crystal, Lean Development (LD), Adaptive Software Development (ASD), Dynamic System Development Method (DSDM), Feature Driven Development (FDD) and other.

Figure 6 shows comparative practices based on agile methodology development projects vs. non-agile.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Non-Agile Methodologies</th>
<th>Agile Methodologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>This phase deals with the modeling business modeling project work solution.</td>
<td>Project pre-planning, feasibility study would involve and establishing a vision project.</td>
</tr>
<tr>
<td>II</td>
<td>Greater focus on finishing performance requirements analysis and design to start.</td>
<td>This phase is the development team, the initial forecast requirements, forecasting and other original architecture.</td>
</tr>
<tr>
<td>III</td>
<td>In this phase, the real focus is on building software.</td>
<td>This phase refers iterations, where parts are being developed. This will include activities such as an analysis, design, development, and will be an ongoing process.</td>
</tr>
<tr>
<td>IV</td>
<td>At this stage it is testing to stabilize the solution found.</td>
<td>This phase involves final testing, some retouching software, implementation, and user documentation.</td>
</tr>
<tr>
<td>V</td>
<td>In this phase, the solution is moved into production.</td>
<td>This phase is the teaching of the solution to users.</td>
</tr>
<tr>
<td>VI</td>
<td>This is the stage of product life, which made maintenance support and other support activities. Finally, the product is withdrawn once the fire cycle.</td>
<td>Solution is withdrawal. This involves support functions necessary to support the application made.</td>
</tr>
</tbody>
</table>

Figure 6. Agile Methodologies vs. Non-Agile.

The agile process is show as an iterative process with a reiterative planning, increased communication, continuous review, adaptive teams and continuous feedback[7].

The agile project teams use open communication techniques and tools. These techniques and tools enables them to express their views and feedback openly and quickly. When agile teams talk about communications, they are usually talking about communication within the team. Agile puts a great deal of emphasis on the free flow of information between team members, team members and the product owner and even between the team and the direct customer.

Communication between team members and between the team and its customers is essential but it is not the only component of communication that must be planned. Sometimes there are other stakeholders that must be taken into consideration.

At the team level, team member communication deals with collocation, whiteboards, wikis and other collaborative workspaces. On a small team with a single customer, it might be sufficient to suggest that customers get all the information they need from attending planning meetings and iteration reviews.

When there is more than one stakeholder, or possibly a hierarchy of stakeholders, it is required to do more, meaning that written reports are needed in order to present the current situation.

The key to planning communications on an Agile project is to follow the principle of simplicity. Documentation shouldn’t be written just for the sake of it. The stakeholder’s needs must be take into consideration and provided for as soon as possible. Try to make things as simple, as clear and as accurate as possible[5].

4. A MODEL FOR REPRESENTING AND INTERPRETING THE COMMUNICATION PROCESS IN RESEARCH PROJECTS.

A model as an abstract representation of an object or phenomenon captures the essential elements of representative features of a system architecture, in our case the communication process.

Modeling the communication process involves conceptualizing structural components and establishing relationships between these components. This model adequately describes the process of communication projects and represent different visions by implementing input and the output data analysis and visualization.

Knowledge representation using WEKA development environment (from Waikato University, NZ) allowed the conceptualization of a model of communication which was conducted in several stages: a) a structure of input data, b) data pre-processing, c) testing different data classification and clustering algorithms, d) visualization of data interpretation e) statistical and decision-making analysis of the communication data set.
In the stage of creating an input data structure with the essential communication characteristics, we first had to establish the "attributes" of communication. Then, the input called "instances" were recorded in a spreadsheet (see Fig. 7).

Data preprocessing was created in an .ARFF relationship, where communication attributes are revealed by several statistical results such as: minimum, maximum, weighted mean, standard deviation. In Figure 8 are shown two attributes of relationship communication model and an example attribute selected "Frecventa" is illustrated by the number of instances each projects. In the lower right corner it is illustrated graphically the court appearance on frequence in relation to the project.

In stage three, different classification (Decision Tree CD4.5 - J4.8, Naive Bayes) and clustering algorithms (CobWeb, EM - Expectation Maximization) were applied on the instances. Figure 9 shows the result of instance classification through the J4.8 algorithm – decision tree.

Note that the classification tree is size 6 by classifying the "communication environment" attribute related to "communication frequency". The number of endings as a channell of communication is 5.

A graphical representation of this tree is shown in figure 10.
The communication model developed allows different views of the instances of communication analysis with the help of 1D, 2D or 3D graphics. Illustrated graphically in figure 11 is a clustering of the ways of communication related with the duration of communication occurrence.

With the model created we can have different interpretations of the results of communication in research projects (communication statistics attributes, views, graphs, diagrams, etc.).

5. CONCLUSIONS

The model created uses „instances of communication” as input data in research projects from universities or from research organisations. The model may be strong support for portfolio analysis from research projects, in terms of communication process.

This model was created to increase the effectiveness of communication in research projects. The model can help decision support for a research organization. It can increase the initiative of project managers and stakeholders in research projects.

Applying the model to analyze the communication process will hopefully lead to important conclusions for project managers and stakeholders involved in its development of research projects.

In the future we will continue to improve the model, but also to collect a representative data set of research projects at different universities or research organizations developing projects.

6. ACKNOWLEDGEMENTS

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7. REFERENCES


CONCEPTION AND FABRICATION IN AUTOMOTIVE INDUSTRY USING KNOWLEDGE MANAGEMENT PRINCIPLES

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ABSTRACT: Knowledge management is a reality nowadays, a powerful resource and one of the premises that provides efficiency and decisional support to any approach no matter of the specific domain were we apply the knowledge management principles. Knowledge models, the specific instruments of the knowledge management represent the start point of this paper, in which we present some aspects regarding the conception and fabrication using knowledge models in the automotive industry field. The approach starts with a short presentation of some knowledge models from the technical area and in the final part of the paper we present the guiding lines for a proposed knowledge model.

Key words: Knowledge management principle, straight axes, knowledge models, automotive

1. INTRODUCTION

The paper belongs to a series of papers concerning the designing the automotive industry from the educational point of view. The active use of knowledge management principles represents the acknowledgment of its benefits. The major benefit revealed in this paper consists in the capacity of knowledge models to offer pre-defined solutions for the systems they were designed. [16, 18] The complex nature of a design process demands structured knowledge delivery in order to increase the quality of the response and to decrease the reaction period of time “Knowledge is not a picture of reality; it is much more a map of those actions that reality permits. It is a repertoire of concepts, semantic relationships and actions or operations that have proven to be viable for the attainment of our goals” [3].

In this work we establish the fundaments on which the software solution proposed in the paper “Conception and fabrication of straight axes using knowledge management principles” is based.

In order to achieve this goals the paper follows the structure: after a short introduction in chapter two related knowledge based models - KBM are presented, the next chapter contains the methodology proposed in order to design a knowledge model. The first two stages of the methodology – interest areas identification and specific knowledge instruments are also presented. The paper ends with a conclusion part.

2. KNOWLEDGE MANAGEMENT MODELS IN ENGINEERING EDUCATION

2.1. Knowledge based engineering

In order to illustrate a part from the interests manifested in the knowledge based engineering - KBE area in the following table some works and the interest domain are presented.

| Nr. | Autor | Subject | Interest area
|-----|-------|---------|-----------------
| 1   | Abburi, Dixit [1] | KM for prediction of surface roughness in turning process | Fabrication, turning (2005) |
| 7   | Guerra, Young [8] | The design of a knowledge based model for decisional support in fabrication | Fabrication, technology, drilling process (2008) |
| 8   | Hunter at all [9] | MK for knowledge reuse for fixture design | CAD, Fixture design (2005) |
| 9   | Hunter at all [10] | MK for devices design | CAD, Fixture design (2010) |
2.2. Guerra –Young manufacturing knowledge model

An important knowledge model designed for fabrication – straight holes drilling – is the one proposed by Guerra-Young. The presented model it is a manufacturing model. By capturing information and knowledge Guerra and Young realised a MKM – manufacturing knowledge model concretised in a software solution, model which provides process planning support for machining holes.

In the figure 1 is presented the knowledge structure. The MKM refers to the drilling process and tool selection: which is the appropriated process to produce a round hole, which is the procedure, parameters for the process (diameter and positional tolerance, roundness and roughness).

3. RESEARCH METHODOLOGY FOR STRAIGHT AXES KBM

The different type of knowledge and their specific representation are used for structuring a KBM with educational purpose. The start point was the necessity of a KBM construction because of the complexity and the large amount of information and knowledge required in a design process. The KBM will be designed to support the users efforts in the technology design process, replacing the lack of experience with related theoretical aspects, methodology, examples.

In order to construct the KBM a specific methodology is established as seen in figure 2 –methodology for KBM construction.

3.1. Domain identification

Figure 1. Information and knowledge after Guerra and Young [7]
In order to identify the interest zone two types of results were analysed:

- analysing the questionnaires the conclusion was: a) 64.44% of the students prefers an electronic support for the information, 35.55% prefers the classic support; b) 52.33% of participants appreciate that they can use the information in the current presentation, the rest showed that supplementary explanation are needed; c) an increasing utilisation rate may be induced by the augmentation of the content with examples – 68.89%, detailed explanations 24.44%, bibliographic references 3.77% and 3% theoretical references; [19]

- analysing the year projects the conclusion was: a) KBM for different parts families are necessary for the design area activities; b) the model has to contain interest areas like: optimal semi finished part choosing, representation in conformity with the current standards, fixture representation, machine tool and their devices, tool selections, technical standardisation, economic calculation; c) is recommended that the organising and the structuring of the information regarding the interests area are made in a way which: provide a complete picture of the subject for a better understanding of it, it is desirable the alignment to the current requirements in companies regarding the norms and the methodology related to the topics.[18]

From the different types of parts families we choose the family of straight axes for our research. For this family the general manufacturing design case was detailed analysed thru dissemination of the specific activities and the identification of the informations that constitute the premises for each design stage. The system parameters was identified and followed in order to highlite the place they have in the system, their importance, the specific problem they cover and the way they affect the whole. For example in the first stage of the project activity Project theme documentation we find information, for example, about the required roughness, roughness that will affect also the second stage of the design activity Optimum semifinished product choosing, and the third stage of the design activity Design of optimum sequences of manufacturing operations and so on.

Figure 3 presents, a part of the general case analyse.

3.2. Solution construction

This is the step were all the informations and knowledge gathered on the precursory steps cristalised in concret, usefull formats. The appropriate format was found is the knowledge instrument - concept map - CM. CM was chosen because of its qualities:

- utilising CM the information is presented in a way wich underlines the conections between the central element presented and anoter elements related to it in an hierarchial, structured way;
- the knowledge appear under his diffrent forms, making the presented problem easier to understand: tacit knowledge, explicit knowledge thru the use of tables, procedures, standards, graphics, videos, sketches, patterns;
- the storage capacity is very good, diffrent tipes of folder may be added on a single CM like: .docx, .xml, .htm, .jpg and others;
- there are free programs wich may be utilised for CM construction for example CmapTools - http://cmap.ihmc.us/download/;
- the application is easy to use, CM may be shared.

The next step was to establish if CM are the appropiate instrument in the engineering educational field. An experiment mented to give answer to the questions presented in the following lines were conducted with the help of 90 students from the terminal year during the academic year 2010/2011:

- are concept maps appropriate to be use in a technical field for an educational purpose?
- are concept maps a solution for study groups - encourages the participants to work togeder and enriches their abilities as team workers?
- presented this way is the subject better understood?
- are concept maps an instrument to structure students knowledge and to realise the connections between the different subjects presented in their anterior activities?
The experiment is presented in the paper *Are concept maps a solution for the technical field?* [17], [19]. The conclusion of the experiment underlines the positive feedback when CM are used and confirms the choosing of CM for representing, structuring and storing information and knowledge.

<table>
<thead>
<tr>
<th>No.</th>
<th>Stage and dates and informations necessary to achieve it</th>
<th>Activities</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project theme documentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- drawings of the part to be designed</td>
<td>- observation</td>
<td>- parts number (1.1)</td>
</tr>
<tr>
<td></td>
<td>- assembly drawing for the part to be designed</td>
<td>- analysis</td>
<td>- semi-finished product shape (1.2)</td>
</tr>
<tr>
<td></td>
<td>- parts nomenclature</td>
<td>- identification</td>
<td>- surface roughnesses (1.3)</td>
</tr>
<tr>
<td></td>
<td>- project theme</td>
<td>- synthesis</td>
<td>- part material (1.4)</td>
</tr>
<tr>
<td>2</td>
<td>Setting the optimum semi-finished product</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- production types</td>
<td>- identifying relevant dates</td>
<td>- standardized</td>
</tr>
<tr>
<td></td>
<td>- processes for semi-finished product manufacturing</td>
<td>- correlation</td>
<td>- to be produced by</td>
</tr>
<tr>
<td></td>
<td>- (1.1), (1.2), (1.3), (1.4), (1.5), (1.6)</td>
<td>- analysis</td>
<td>- various manufacturing processes</td>
</tr>
<tr>
<td>3</td>
<td>Design of optimum sequences of manufacturing operations</td>
<td>- (1.1), (1.2), (1.3), (1.4), (1.5)</td>
<td>- optimum sequences of manufacturing operations</td>
</tr>
<tr>
<td></td>
<td>- standard technology</td>
<td>- correlation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- design of optimum sequences principles</td>
<td>- solving of a given issue</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- surfaces obtaining methods</td>
<td>- conception</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- heat treatments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Figure 3. Design stages structure[18]](image)

![Figure 4. Concept map realised by students](image)
The next step was to construct the knowledge structure appropriated for each interest zone. The theoretical base and applications on this subject are presented in the papers Knowledge models in Engineering technology and Manufacturing, Knowledge models in Engineering technology and Manufacturing. A specific example, [16, 18]. In figure 4 is presented a part from a concept map used for the tool selection in turning operations.

4. CONCLUSIONS

The paper presents the first stages belonging the straight axes knowledge model construction.

The knowledge model has an educational purpose and it is finalised with an experimental software solution presented in the paper Conception and fabrication of straight axes using knowledge management principles.

5. REFERENCES


CONCEPTION AND FABRICATION OF STRAIGHT AXES USING KNOWLEDGE MANAGEMENT PRINCIPLES

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² “Lucian Blaga” University of Sibiu, sorin.borza@ulbsibiu.ro

ABSTRACT: the paper continues the research started in the paper “Conception and fabrication using knowledge management principles”. The theoretical guidelines found in the mentioned paper crystallises at a practical level in an original product – a software solution. The proposed solution has as a central element notion concerning the design and manufacturing of straight axes in the automotive industry. The application field for the proposed example regards the educational area; the software guides the user by theoretical concepts, examples, problems through practical aspects concerning the design and manufacturing of a part belonging to the axes family specific to the automotive industry. The software was developed using the Access work environment.

Key words: Knowledge management principle, straight axes, automotive, software.

1. INTRODUCTION

The design activity in manufacturing technology and engineering represents a challenging activity for the students because of its nature: in order to design a technology the student has to follow a methodology using along the way his information and experience.

The information may be there (if the dates are structured and the connections between different concepts are made) but the experience must be gained, in this case by accessing a knowledge model, knowledge, as an intangible resource, being a strategic one, the knowledge creation being the dynamic capacity which permits the acquisition of sustainable and competitive advantages [1].

The solution presented in this paper represents the results of the researches conducted in order to find an appropriate methodology for knowledge model construction in engineering educational field. The methodology end the important stages as a) problem identification, b) detailed analyse of the general case, c) solution construction are presented in the paper Conception and fabrication in automotive industry using knowledge management principles.

The proposed solution consists in a software solution dedicated for the straight axes design which has as main pillars three concepts presented in the following lines knowledge management, critical mass and e-learning:

- **Knowledge management**: the principles of knowledge management are applied from the methodology of the software design to the instruments used – concept maps – and to the destination of the proposed solution: to represent a support, a decisional base in design activity;
- **Critical mass**: the use of the critical mass concept represents a recognition of the engineering design complexity; there are no independently issues, every concept must be connected to other related concepts in order to view the global picture and to highlight the correct domain which represents the subject of a given problem;
- **E-learning**: the interest showed for the electronic environment (a few numbers for 2011 are: 2,1 billion – internet users worldwide, 476,2 million – internet users in Europe, 555 million – numbers of websites in December 2011, 201.4 billion – number of videos viewed online per month in October 2011, 3.146 billion – number of e-mail accounts worldwide; the source of all the presented information is the rapport published by Royal Pingdom January 2011 on their web pages [6]) emphasises the necessity of the electronic environment presence.

2. SOFTWARE PROPOSAL

The application field for the proposed example regards the educational area; the software guides the user by theoretical concepts, examples, problems through practical aspects concerning the design and manufacturing of a part belonging to the axes family specific to the automotive industry. The software was developed using the Access work environment.

The proposed software is dedicated to who needs to test, to achieve and to consult knowledge related to the straight and hollow axes. Another possibility is concerning a subject specific for the educational area, the evaluation. Users or groups of users may be evaluated and the results can be stored.

2.1. Software structure

The structure is concentrated on two levels, the first one specific for the students and the second one dedicated for professors. At the log in moment the access level is establish accordingly to the type of user. Possible actions for the first level (students dedicated) are: database consulting, global/modular tests, knowledge achievement. Possible actions for the second level are: all the actions presented at the first level and furthermore evaluation for users/groups of users, analysis, objectives planning.

Once the activities are defined the objectives the software has to meet are now clear and the next step represents the
algorithms design. In the paper we will present an algorithm specific for the knowledge achievement in figure 1.

3. SOFTWARE DIRECTIONS

There are two main zones which characterises this knowledge model: the testing zone for global and modular tests and the knowledge achievement zone.

3.1. Testing direction

This zone is dedicated to knowledge testing and evaluation. Accordingly to the researches made the interests areas for the subject are:

- The analysis of micro- and macro-geometrical precision achieving;
- Semi-finished part material and semi-finished process choosing;
- machining additions choosing;
- technological process and operations sequence;
- technological regime;
- economical calculus.

Each test finishes with a result. When the answers are correct the user receives a positive feedback and when the answers are wrong the feedback sends the users to the areas that need improvement. An example concerning the analysis of micro- and macro-geometrical precision achieving is presented in figure 2.

The test results are registered in individual pages - Figure 3, respectively in the activities history – Figure 4. The results may be exported in Excel where further analyses can be made – Figure 5.
3.2. Knowledge achievement direction

The basic idea of this knowledge model consists in an unitary approach for the proposed subject. Thereby, along his approach for knowledge acquisition the user is accompanied by two constant presence: a proposed example - all the examples given along the knowledge model refers to the same part, which is a representative part for the axes family. That means that once the entire knowledge model is covered the sum of the given examples compose a complete technology designing example – related notions needed – and here we are referring to standards, tables for technological regim, theoretical aspects related to the subject. When needed the instruments used were concept maps “a hierarchical net centred on a focus question. The answer to the focus question is given by “reading” the concepts articulated with arrows which carry meaningfully relating words.”[3] They were choose for their capacity to present, structure and store information. Also an important reason represents their capacity of presenting the concepts as part of a whole. [3, 5]

The knowledge model has four modules: technical study, economical study, organization of technological process, graphic part – as presented in figure 6, and their corresponding sub modules, for example in figure 7 are presented the options for the technical study.

After choosing an option, the user has to decide what action he wants to perform in that area:

- **To consult the theoretical notions** (for example we present in figure 8 some theoretical notions concerning devices for semi-finished part fixture in a turning operation – from technical study module);
- **To consult the databases** (for example we present in figure 9 a part from a database, the table presents feeds for turning – from technical study module);
- **To consult a methodology** (in the figure 10 are presented some aspects from the optimum parts number – from the economical module);
- **To see an example** (figure 11 illustrated the correspondent example for the methodology presented in figure 10 - the example belongs to the economical module);
- **To exercise the notions** (we present another example from the economical module, the proposed problem concerns also the optimum parts numbers and represents a modality of testing the notions related to this subject).
4. PROPOSED SOLUTION VALIDATION

4.1. Validation of the knowledge model proposed paradigm

In order to validate the proposed knowledge paradigm 36 persons were tested. From 180 possible correct answers only 40 meet the demands, the percentage being 22.22%. After the application of the proposed knowledge acquisition methodology the answers who meet the demands were in number of 143, the percentage value being 79.44%, which represents an increase of 57.22%.

4.2. Application validation

The perception of the users on the finished product, the software solution for straight axes design, results from the applied questionnaires. The number of the respondents is of 26 persons and the questionnaire and the responses received are presented in capitol 7 annex. The general characteristics of the respondents were: age 8% 21 years, 69% 22 years, 23% 23 years, 38% women and 62% men, 50% profile TCM, 50% profile IE, terminal study year.

The conclusions are:

- the majority of the respondents appreciated the application as very useful 77%, 8% appreciated the application as useful and 15% indifferent;
- 71% considers that the application is useful for project activities, 17% for exams preparation, 9% for laboratory activities and 3% at courses preparation;
- The ease with which the work can be done is appreciated 73% of users considers is easily to work, 23% appreciate the level as medium and 4% as hard;
- The clarity of presentation was found as very good from 77%, 15% found it good and 8% found it week;
- The proposed tests difficulty level is seen as with a very high difficulty level, 17%, with a high level of difficulty 25%, 54% with a medium difficulty degree and 4% with a low difficulty level;
- The most appreciated module of the software was the one which permits knowledge practice 41%, followed by examples 28%, databases 25%, e-learning 4% and the evaluation area 2%. [2]

5. CONCLUSION

The software solution represent the result of a complex approach, characterized by six stages which are important in structured content: research methodology, identifying areas of interest (resulting from the analysis of a number of one hundred projects and the experience made during the years of project activities and laboratories), general case analysis and its synthesis, presentation databases necessary, identify and develop specific knowledge management tools using CmapTools software, application and validation of the concept. Taking advantage of the research results consisted in designing an original software solution with applications to acquire knowledge needed for design of straight axis.

6. REFERENCES

SOME ASPECTS REGARDING THE DEGREE OF KNOWLEDGE AND APPLICABILITY IN THE MANAGEMENT OF THE KANBAN SYSTEMS IMPLEMENTATION TO BE PURSUED BY STUDENTS IN ENGINEERING PRACTICE

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ABSTRACT: Kanban is often seen as a central element of Lean manufacturing and perhaps is the most used product application system. Kanban is the essence of the concept that a supplier or a products deposit must distribute the components in place and at the time the production needs them so that there are no stocks in the production area. The implementation of the Kanban concept must go through four different stages; each of these stages having more steps to be followed. The paper shows some analysis elements regarding the degree of knowledge and practicability in the study of the management of the Kanban systems implementation to be followed by students in technological practice.

Key words: Kanban system, engineering practice, applicability

1. INTRODUCTION
Kanban is a part of the Just-In-Time along with Kaizen and 5W. Kanban is a material-flow control method, based on the replenishment of only those quantities that have already been consumed; Kanban can also be defined as a requirements based production system because of the fact that the producer only produces what is required and when it is required – figure 1.

For the required part types to reach the desired place, at the desired time, in the necessary quantity – JIT - the communication of the process steps needs to be in place. As transmission medium for this information the use of the Kanban cards has been implemented. These cards were transmitted from the client to the supplier and the other way around.

The basic principle [1] is that the supplier produces and delivers to his client only products that were ordered by the clients through the Kanban structure. This significantly improves the information flow between the supplier and his client - figure 1.

The Kanban method suggests that a scientific approach is used to implement continuous, incremental and evolutionary changes. The method does not prescribe a specific scientific method to use.

2. WHAT KIND OF THEORETICAL KNOWLEDGE THE STUDENTS, IN TECHNOLOGICAL PRACTICE, MUST HAVE ABOUT THE IMPLEMENTATION OF THE PULL KANBAN SYSTEM
Pull Kanban system can be used to ensure that intermediate stocks held in the supply chain are better managed, usually smaller. Where the supply response cannot be quick enough to meet actual demand fluctuations, causing significant lost sales, then stock building may be deemed as appropriate which can be achieved by issuing more Kanban.

The “pull” system - figure 2 - reacts to the demand - it does not anticipate it - supplying the necessary quantity of a certain material at the right place at the right time. In the “pull” systems materials are “pulled” to the production line. When the material stock has dropped below a certain minimum limit (and only then) the supplier is being requested to bring material. The request is performed through placing an order based on a Kanban card which is being transported with each lot of part types.

Implementing this system means that once it is operational the production supervision is only performed at the final control phase as the system needs to operate on its own without any interventions from the outside.
• Kanban - operating principles:
  > the client obliges himself to transmit all his requirements towards the suppliers based on his consumption;
  > the supplier does not produce or deliver products to his client unless requested;
  > honouring the contract terms is assured through the Kanban structure.
• Kanban - operating routines:
  > labelling – in a Kanban control cycle all containers with parts will be labelled so that in each moment you can have a clear overview of the situation (quantity, part number; containers location from the production line);
  > production – nothing is produced or transported without an order;
  > priorities – the production orders are a clear reflection of the exact consumption of a certain line/department;
  > production lot size will be respected – this size will be calculated based on the optimum lot size.
• Benefits of the Kanban system:
  - inventory reduction; - reduction of total cost;
  - production flexibility; - production increase.
• Limits of the Kanban system:
  - vulnerable to demand fluctuations;
  - vulnerable to process changes and eventually to defections of the equipment;
  - inefficient in case of irregular orders or special, unforeseen orders;
  - vulnerable in case of stock shortages for raw materials and changes in their delivery dates.
After the decision to implement Kanban has been made the goals that need to be reached through this project need to be defined. These must be quantifiable and easy to measure [3]:
  - production time reduction – the reduction of the elapsed time from launching the product into production to the obtaining the final product (until maximum x days);
  - stock decrease (with x EUR per project);
  - decrease of faulty material level (with x%);
  - simplifying production planning (number of operating steps to be reduced to x)
  - increase in flexibility (obtaining the product in x days after launch).
The Kanban method encourages small continuous, incremental and evolutionary changes that stick. When teams have a shared understanding of theories about work, workflow, process and risk, they are more likely to be able to build a shared comprehension of a problem and suggest improvement actions which can be agreed by consensus.
On the assembly line [4] for shock absorbers the communication through a notification on the necessary part types and quantities.

3. WHAT KIND OF ELEMENTS, REGARDING THE PULL KANBAN SYSTEM IMPLEMENTATION ON THE SHOCK ABSORBERS ASSEMBLY LINE, MUST TO BE PURSUED BY STUDENTS IN ENGINEERING PRACTICE.

To make things simple they can think about a simple queue: units of work are input in one end, through many steps of the process, and the results yield from the other.

3.1. Levels of planning and control in case of pull Kanban system

In case of pull Kanban system, significant complications may arise from:
  - confusion of the roles of different levels of planning and control;
  - confusion with planning controls;
  - choosing a planning system and/or a planning process.
Planning and control process can be simplified by dividing on 3 levels:
Level 1: Business plan;
Level 2: Operational plan and sales - Production planning, The general outline of the production capacity, MRP (Material Requirement Planning), etc.;
Level 3: Control the landing - Input/Output Control, Kanban, etc.

2 - Level systems, such as MRP, planned "outputs". Kanban system is, according to many, the type of system that control plane. Is commonplace to have an agenda of indicators produced by a system of level 2 (MRP) and an redial Kanban, for specifying immediate requirements. The diagram in figure 4 illustrates this interaction. Here is the that customer sends an advisory agenda that is processed by MPS (Material Planning System) and MRP, to produce a company's agenda, for assembly and testing process. This command generates production planning (structure Kanban). The level of stocks in the warehouse is under control, the customer may withdraw the merchandise in stock, on the basis of daily planning using Kanban link. Dotted lines to the warehouse, making parts and suppliers are advisory planning, indicating the capacity requirements and due dates for deliveries, which will be drawn at the bottom of the assembly and testing flow by the Kanban bindings. In the event that is not a proper synchronization between MPS and the customer shall be generated conflicting requirements. In this case how to resolve these typical problems are MPS shortcuts which do not coincide with those set out in the planning of the customer

Figure 3. Business as usual versus Lean manufacturing

Only the desired materials/part types, in the desired quantities and at the desired moment in time (Just-in-Time principle) are pulled at the working station. The solution is a simplification of the communication through a notification on the necessary part types and quantities.

Figure 4. Planning and control process
3.2. Production Equilibrium

Production equilibrium and production flow, which anticipate and quantify the market demands, can be achieved by having the orders placed by clients as a starting point, through obtaining the optimal combination of products in an optimum time interval.

The students must pursue that the implementation of the Kanban concept must go through four different stages. Each of these stages having more steps to be followed: defining the project target and clients expectations - figure 5.

The Kanban systems are among the easier ones from an operational point of view however they ask for a change in the mentality of the operator. Performing an unscheduled inventory or abandoning their working station, unless absolutely necessary, is not desired. These simple rules are in reality quite difficult to implement. once their superiority is understood however, they can become a way of life [3].

For implementing the Kanban system the support of the employees and their motivation are crucial factors. They must be aware of the fact that the new system will make their work easier, will lead to a salary increase and one very important factor, they will not lose their jobs. In this regard the employees must be prepared, they must take part at a series of trainings where the Kanban concept will be explained to them, where they can find out how the Kanban system works, what is expected from them, how they can get involved and most of all what benefits they will have.

They must be informed about the company’s plans so that they will be sure not to lose their jobs because those of them that will no longer be working on these new lines will go to ones that are now in a project phase. If these terms and conditions will be taken into account the risk of workers sabotaging the implementation of the Kanban system on this line will be significantly diminished or even eliminated.

3.4. Increase production capacity

On the other hand, considering the fact that the demand for shock absorbers is increasing and that there already is a project on building a second montage line, the company seeks to increase the capacity of the “old” production line in parallel to obtaining new production space by reorganizing the available area to be able to fit the lines that are still in project phase.

The relocation of the line in parallel to the implementation of the Kanban system will lead to the optimization of the montage activities and to an increase of the produced shock absorber ordered by the client in the next years.

The proposal for the relocation is presented in figure 6.

By implementing the Kanban system these working stations will be optimized through increasing the ergonomics of the working stations and through a better supply with materials. Therefore the worker will not need to 5-6 times a shift to collect the necessary part types but the number of the parts at the working station will be enough to cover the demand for minimum a shift.

The major disadvantage of the relocation of the line is that the welding robots are closer to the montage, a fact that is not desired. However the welding is at distance between working stations is small the times for the part types. A worker will be made responsible for the part types. The proposal for the relocation is presented in figure 6.

3.3. The support of the employees

It is known that traditional systems consider quality as being expensive, faulty products/defects are caused by workers and the minimum quality level that can satisfy the customer is sufficient. Companies that have implemented Kanban consider that improving quality leads to decreasing costs that most errors are caused by systems and that quality can be improved inside the Kaizen system. Kanban is an organizational form of transition to decentralizing responsibility.

For optimizing the logistical process of rapidly transferring the products to the multiple working stations in the production line a clean and well organized working environment is necessary. This kind of work station will assure an increase in work safety (labour protection), in a “pleasant” state of mind of the employees and in productivity.

In addition to the tasks directly related to the production line, the team members should also be responsible for maintaining the work stations clean and orderly and for a good maintenance of the working tools and equipment.

The system must be built on a foundation that will permit the creation of the necessary lots, which may take a lot of time. For the system to be able to maintain its credibility it is not permitted to fail. Therefore a generous time period needs to be scheduled for the preparation of the systems and the safety lots.

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![Figure 5: The different stages of the implementation](image)

![Figure 6: The proposal for the relocation (Layout proposal)](image)
transport and handling of the material is decreasing making the reduction of the employee numbers possible.

Through the new layout of the production area another factor related to the motivation of the workers is accomplished – the workers operating the line can see the final product of their work because through the new layout each working station can see the packing of the shock absorbers. Also the workers will truly feel as a team without being divided between the two subgroups – welding and montage.

The workers need to be motivated to continuously come up with new ideas and proposals for improving the process. The proposals that will be afterwards implemented will need to be awarded to stimulate this process even more.

From quality perspective the implementation of a Kanban system will first of all lead to lower reaction times. From the part types that are included in a shock absorber to the finished product there is a very short way that is why if a noncompliance is appears this will lead to a very rapid reaction so that there will be a limited number of noncompliant shock absorbers on the way. The cause can be eliminated and just a limited/smaller number of pieces will be affected.

It must be stressed that continues improvement in the Kaizen system is an extremely important factor in a company that respects itself. Concepts like Kanban, Kaizen must be familiar to all employees of a company. The implementation of the Kanban system has also the Just in Time delivery as a prerequisite. It is absolutely crucial that these details are discussed with the suppliers. It must be clarified that the lot has to have as few as possible non-compliant part types for making the activities at the assembly line more efficient. Concerning the JIT deliveries an agreement needs to be made with suppliers regarding a very strict delivery schedules. For supporting the Kanban implementation the lot definition needs to be done by the supplier. On a contract base the frequency of the deliveries, to respect JIT, as well as the lot characteristics need to be defined. The deliveries from the customers will be stored in a PreKanban storage area from where they will be taken directly to the production line. In these areas the part types will be prepared to be taken to montage.

3.5. A single card Kanban

Also, the Kanban system that will be implemented will be the one with a single card. Therefore a clear lot definition will be made for each material type and it will also be decided in which containers they will be transported to the production line from the warehouse. It was decided that they will be brought to the line in boxes. There are part types that are big and need to be brought to the line on a daily basis (ex. tubes, cylinders, torques, a.s.o.) and there are other part types that can need to be supplied every two weeks, being smaller (e.g. sable).

For not needing to trigger an order, each box has a Kanban card attached. This card contains sufficient data for being able to recognize the part type, quantity, production line it belongs to, working station of destination a.s.o. The workers take the empty boxes to the warehouse and take the full ones to the production line.

For implementing the Kanban system an investment needs to be made by the company for purchasing equipment, pushcarts, baskets, boxes, Kanban shelves. Furthermore other expenditures concerning the relocation of the line, printing the Kanban cards, trainings will be made.

Through the line redeployment - figure 7 - is carried out a stream of material much better by subtracting intermediate times with transport and handling parts. For the supply of items on the line will be designated a worker will have to meet a well-established timetable. Will be complied with the principle of "bus", which is specific to the Kanban system relying on the "taxi" which is used currently.

![Figure 7. The line redeployment](image)

3.6. Periodic strategic reviews

Exceptional or fluctuating requirements may end up "kills" Kanban system, if they cannot be predicted. It is so well documented designed capacity so that the strategy could be revised if a fluctuating demand appears and that not only within the volume, but also in the mix. Even systems sales and operational planning must be so designed such that they can trigger this review.

4. CONCLUSION

Equilibrium and flow production, which anticipate and quantify the market demands, can be achieved by having the orders placed by clients as a starting point, through obtaining the optimal combination of products in an optimum time interval.

The paper presents some aspects regarding the degree of knowledge and applicability in the management of the Kanban systems implementation to be pursued by students in engineering practice for implementing the Kanban system on a shock absorbers assembly line at Bilstein SA Sibiu. The implementation of the concept is done through a process based on 13 phases (steps) that establish fundamental elements which make this line operational. This system detects problems that occur on the line and does not allow parts to "go" on line, where they can no longer be processed. Through the line redeployment is carried out a stream of material much better by subtracting intermediate times with transport and handling parts. Continues improvement in the Kanban system is an extremely important factor in a company that respects itself. Concepts like Kanban, Kaizen must be familiar to all employees of a company.

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SUSTAINABILITY IN ENGINEERING AND BUSINESS EDUCATION
INNOVATING FOR SUSTAINABLE UNIVERSITIES

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ABSTRACT: This paper presents an original approach to the changes required for the transformation of universities in sustainable universities. The focus is on the innovative approach of all activities and relationships of the university: teaching, scientific research and other services offered by the university, the relations of the university with the communities where it operates, inter-university relations, relations with business environment, etc. Based on the experience and information gathered by the authors in the strategic project “Improving University Management”, it is proposed a better, more efficient and more effective way of using the resources of universities, thus sharing the resources within the university and with others partners. Shared resources can belong not only to universities but also to their other collaborating organizations interested in the general progress of the society. This can become reality only if the universities will realize that by working together they can achieve higher performance rather than by simply competing with each other, approach which is not excluded but otherwise addressed.

Key words: sustainable universities, innovation, resources sharing

1. INTRODUCTION

Society can’t develop in any way. Sustainable development is, for now, the only rational way acceptable to its development. Such a society can’t be built anyway. Education is the only instrument for shaping such a society. School, in general and universities, in particular, have a decisive role in reaching the sustainable society. Universities can be a catalyst for transformation towards a sustainable society. For this, first of all universities have to become sustainable.

Universities need to allocate resources wisely to become sustainable and to give students life experience in a sustainable environment. They must be the catalyst for the necessary changes in the whole society and their students are tools that transform the whole society towards sustainable development.

Also, universities need to honor their role and importance held in the communities where they operate and serve. They should not be isolated but rather must integrate as harmoniously into society and contribute decisively to the progress. For that, universities must be adapted to the demands of society and to generate the vision, the desirable changes in the evolution of the entire university and society. Thus, from an educational point of view, public universities must comply with lifelong learning. On the other hand, considering the research plan, the university must be involved in the positive evolution of society. This means that the university should always be innovative.

Nowadays we are constantly confronted with problems that we need to resolve, new situations in which we want to overcome or projects that we want to achieve and we require in a greater or lesser extent our resourcefulness, creativity and ingenuity. But ultimately each of us manages to find original ideas and tricks which - not once - surprise us. These times correspond to the problems and the solution is based on a starting point barrier, an obstacle. The problem is given by a tension, a difference between "being" and "must be" between "real" and "ideal" and between "truth" and "imaginary desire" [2].

Innovation, trying to propose new elements, hitherto unknown and untried, destabilizes the current system. Even if the objective is to improve the system, destabilizing conflicts with the desire to have everything in place so that innovation will be adopted more often as a result of internal pressure. In almost all cases innovation capacities are overestimated by individuals, organizations and society. Innovative processes can be significantly delayed, sometimes stopped by the emergence of obstacles. An accurate analysis of possible barriers is essential for the success of innovation ideas.

The issue of sustainable development (sustainability) is increasingly present among the concerns of the international academic community. However, the depth of our unsustainable practices suggests that there was enough progress to move from unsustainable lifestyles to sustainable development. However, as in all relevant and visionary new actions where people are committed, there is always a boiling period required to develop and submit ideas to launch large-scale discussions to refine the concepts to correct and adjust.

This occurs in sustainable development in higher education. Many new educational approaches are tested. Some work in certain places, but have not yet been tested elsewhere, we do not know if they have wider applicability or if they must be adapted to each new cultural, geographical context, etc.

Innovation is the path that helps universities to adapt to the dynamics of the social changes and allows them to meet their important role that they have in assuring the progress of humanity.

There is difference between "is" and "should be" between "real" and "ideal". Innovation processes can be reduced essentially to solving problems. The road between the problem and the solution is based on a starting point barrier, an obstacle. The problem is given by a tension, a difference between "being" and "must be" between "real" and "ideal" and between "truth" and "imaginary desire" [2].

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Innovation requires firstly the identification of new techniques of creativity (individual or group), spontaneous inspiration or ability to make connections being useful in this regard. But creativity does not solve the problem. It only provides a solution to be translated into reality. This requires an entrepreneurial spirit and efforts, often large and difficult. Romanian academician Mihai Drăgănescu shows that while creativity is an almost permanent phenomenon of human nature, creation is rare. Because of this reason, the emergence of new things as results of creativity must be followed by their practical application to solve problems or to achieve progress.

Innovation is designed to introduce new social practice. The issue here is not only about economic or technological success but also industrial, commercial, social and cultural. The process is long, has an interactive and iterative process, involving many more actors with complementary knowledge and often suffers many adaptations before becoming a success [2]. Therefore, the purpose of innovation remains success, progress, the step taken forward, not backward.

2. INNOVATIVE APPROACH OF UNIVERSITIES’ ACTIVITIES AND RELATIONSHIPS

Higher education institutions must continually improve the impact they have on society, economy and environment. Current belief systems contend that nothing is isolated: student, teacher, institution, curriculum, pedagogy, policy, management system, community, media, culture, etc. Therefore, all intended changes must anticipate systemic effects at different levels and, where possible, to participate in sustainable development and to generate positive effects. Instead of fragmentation, integrative, holistic, approaches should be preferred, that lead to coherent learning experience for teachers, researchers, administrative staff, students and institutions themselves.

At least five main dimensions of any university can be observed: ethos (culturally university) curriculum, strategies and teaching styles, strategies and management styles, links with the community. All these should not be seen separately (this is non-systemic) but in relation to each other, especially when they are to make changes to improve processes, activities and relations.

It is useful to distinguish between a gradual change ("step by step"), where the system elements are changed without taking into account the full effects and systemic change, where the effects of all parties are taken into account from the start. The latter would require assessing over time how much the five dimensions of a university are in harmony or conflict. Gradual changes and systemic characteristics are summarized in Table 1 [3].

<table>
<thead>
<tr>
<th>Gradual changes</th>
<th>Systemic change</th>
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<tr>
<td>* involves changing parts of a system</td>
<td>* is done taking into account the effects on the entire system</td>
</tr>
<tr>
<td>* take little or nothing, into consideration the system seen as a whole</td>
<td>* recognizes and anticipates the necessary qualities</td>
</tr>
<tr>
<td>* are often imposed</td>
<td>* are made with a purpose, are based on collaboration and maximize participation</td>
</tr>
<tr>
<td>* involve less learning</td>
<td>* monitor and learn from the effects of change</td>
</tr>
<tr>
<td>* are often short</td>
<td>* are often lengthy</td>
</tr>
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Important areas for the implementation and institutionalization of sustainability in a university refers to [1, 3]: vision, mission and objectives, strategic plans and operational plans, budget, campus, student life and residents, policy construction and procurement policies; first year student experience, curriculum revision, partnerships with community, human resources development.

Differentiation between universities is provided rather by how they perform their core activities: education and research (education must be adapted to current needs and research must produce positive, visible outcomes). Dynamic transformation of society must determine universities to provide a different academic environment - to "produce" graduates who are at the same time, responsible people and professionals. This requires changes both in the organization and the people. Change requires clear objectives (clearly defined), time and resources. They have to be made both top-down (for providing resources, facilitating change, and motivating people) and bottom-up (involving everyone, including students). Bottom-up changes must prevail and turn as many into intrapreneurs (people who develop universities from the inside, through initiatives, proposals, commitment, dedication, cooperation, positive and proactive attitude).

Moreover, changes should be aimed at rethinking the role and place of universities in relation to local-regional environment and in relation to the entire society. This can be achieved only by making another type of relationship with all stakeholders. Universities must maintain good relations with the whole working environment (without neglecting the internal environment), taking account of local, regional, national and international aspects.

Strategies developed and implemented by universities must be realistic and address the issues previously mentioned. To be implemented, these changes must be accepted by the academic community. Their assumption can be made by calling the self-interest - everyone should understand that what is done is also in his/her interest.

3. REFLECTIONS AND SUGGESTIONS ON THE SUSTAINABILITY OF ROMANIAN UNIVERSITIES

In order to answer to the nowadays society needs and to create the conditions for “a relevant and responsive educational system to the specific needs of the economy”, the Romanian Executive Unit for Financing Higher Education and Scientific University Research, Development and Innovation (UEFISCDI) initiated the project “Improving University Management” (http://www.management-universitar.ro/), its goal is being to promote updated knowledge, modern techniques and actual management instruments for the higher education institutions across Romania.

The module "Resource Management and Sustainability" - within this project, developed and supported by members of the Centre of Competence in University Management - Sibiu, coordinated by "Lucian Blaga" University of Sibiu, aims to be a useful tool for the Romanian universities in their transitions to become strong and sustainable universities. Its content defines the concept of sustainability and shows how a university should evolve to become sustainable.

In training sessions held in the module, which were attended by officials with managerial competences from several Romanian universities, in addition to the plenary presentation of the concepts and issues specific to this module, participants (104 persons) were asked to take part in some group exercises for
analyzing their university, based on structured questionnaires. The analysis of the current situation of Romanian universities in terms of sustainability and identification of necessary changes were the main objectives of the research made in these exercises.

Results [1] showed that in only 22% of Romanian universities the concept of sustainability is understood correctly and in only 11% of cases it is included in the vision, mission and objectives of universities (and there are allocated funds for implementation of the concept). Regarding the inclusion of sustainability into the curriculum and research, 31% of those surveyed responded that their universities teach disciplines which deal (mention) the concept of sustainable development and in 18% of cases there are programs of study (in the fields of chemistry, economics, public administration, environmental engineering) that include disciplines that approach sustainable development. Only 12% said that their universities have also master programs dedicated to sustainability. 17% of respondents said that the universities from which they come there are contracts for research on sustainable development, while 22% said that departments or research centers on sustainable development already exist or are developing.

In the construction and procurement policies, the majority of respondents (47%) said they did not have enough information or refused to answer this question. In 29% of cases, university campus buildings were insulated with thermal-systems and 12% have alternative energy installations. Another 12% said that sustainability is an element to be taken into account when making purchases or builds something in the university, but did not mention anything concrete.

31% of respondents said that students are involved in the selective collection and recycling, 23% claimed that they come from universities that carry out educational projects, organize programs and workshops that include promotion and education for sustainable development. Student circles and research topics related to sustainability are other ways in which students come into contact with it. Also it is revealed that student organizations "timidly start to have concerns" towards sustainable development, or engage in voluntary actions to clean up the various green spaces. 9% of respondents said that nothing is done to integrate sustainability into student life.

The main barriers identified by respondents, regarding the implementation of sustainable development in higher education are (Fig. 1): lack of financial resources (23%), poor communication (19%), retrograde mentality (15%), resistance to change (15%); organizational culture of the university (12%), insufficient involvement (8%). Also, during the debates, the legislative instability in the field of education and the unfavorable or restrictive provisions contained in legal regulations aimed at education were severely criticized.

Asking participants to identify the main changes needed to transform their universities into sustainable universities, the participants identified the following:

- Defining a new vision, mission, strategy and objectives of the university;
- Introduce the concept of sustainable development in as many programs of study;
- Seminars organized by the university to local communities (public awareness), obviously it means a better cooperation between universities and municipalities / county councils (it is an issue that concerns us all);
- Increased transparency of information within the university;
- The emergence of a special department to develop the concept of sustainable development of the university;
- Allocation of specific resources for sustainable development - specific budget and trained personnel;
- Changing the organizational culture - the values and mentality of citizens;
- Taking the best practices, adapting them to their own situation and dissemination in the community;
- Treating the subject as a priority in all curricular subjects.

The results presented above suggest the essence of the required changes of all Romanian universities strategies [4] and highlight the need for adapting the legislation in this field to the current situation and to the trends outlined worldwide. It is expected from the political environment to understand the situation, to apply the necessary corrections and ensure legal stability to facilitate the transformation of the Romanian universities into sustainable universities.

As shown above (see fig. 1), the biggest issue of Romanian universities is underfunding of the educational system. Although the National Education Act, in force, provides for the allocation of at least 6% of the state and local government budgets to fund education and 1% of GDP on research, the reality is much different.

To this fact there are added other issues that reduce efficiency and effectiveness of processes and activities of universities. Most facilities (buildings, machinery, equipment, machinery, tools or other equipment) are obsolete and new ones are acquired almost exclusively as a result of the conduct of research projects (grants, research contracts), after completion, they remain in the university heritage. If during the course of projects the usefulness of new features is obvious, after the completion of the projects, in most cases, facilities are not sufficiently used.

In many cases the same equipment items are found in various university departments and financial resources are spent inefficiently and are insufficient anyway.

An overview of equipment needs and existing facilities is necessary for all universities. This involves improving internal communication and a higher dose of interdepartmental collaboration.
Simple steps can be very useful in this regard. An example is determining the load factor, LF, for each item of equipment, the relationship:

\[ LF = UT / RT \]  \hspace{1cm} (1)

where UT is the time of use and RT is the time reference.

LF calculation for each item of equipment (by type of equipment items), centralization of values and communicating them to all staff, together with encouraging interdepartmental collaboration (within faculties and between faculties of universities) ensure efficient use of facilities as certain as and efficiency of investments in equipment.

This approach is convincing and leads to sharing of material facilities. The same reasoning can be used to convince the entire academic community to switch to the sharing of all resources, with obvious benefits especially in the current context of lack of resources due to underfunding of education and scientific research.

Moreover, this trend may lead universities to work together more and to share at least the expensive equipment, which they can purchase and use together, based on well-defined partnerships. The collaboration also can extend the relationship with the external environment of universities (manufacturing companies, research centers, hospitals, cultural institutions, etc.), from local to international level.

Working with the external environment of universities, the community must take various forms, all aimed at mutual benefit and overall progress. An important area of cooperation is that of reducing the gap between labor market needs and the educational offer of universities. Zeroing of the gap is utopian, but its reduction and adaptation of supply and demand in this market is possible through the close collaborator of the stakeholders. In this respect, universities can adapt curricula and content of the taught disciplines to form experts demanded by the stakeholders. In this respect students' associations (local, national, international) must take various forms, all aimed at mutual benefit and overall progress. An important area of cooperation is that of reducing the gap between labor market needs and the educational offer of universities. 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To obtain transversal competences, to ensure better use of professional skills, universities can facilitate student involvement in a greater extent in university life and society. In this respect students' associations (local, national, international) and NGOs may have important contributions. Students can receive non-formal educational experiences that significantly improve their preparation and make them do better in the position of the employee or citizen.

Of course, there were presented just a few suggestions and examples, the range of possible activities is much wider as the university has a greater capacity to innovate.

4. CONCLUSIONS

The transformation of the society into a sustainable one can be achieved through the decisive contribution of universities. For this to happen, universities must first become sustainable. Then they would provide a good example to all and will offer students life experience for sustainable living. Upon graduation they will implement the learned not only at work but also in families and society.

The sustainable university does not appear instantly and without reason. It is the result of intentional changes made by allocating adequate resources in time, with dedication and consistency. Changes must be made through an innovative approach, mainly of the activities and university relations.

A sustainable university is using the most effective of all available resources. This practice encourages the sharing of resources, both within themselves and in external relations, redefining the relationship between collaboration and competition.

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6. REFERENCES

TEACHING SUSTAINABILITY THROUGH MOVIE MAKING ACTIVITIES

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ABSTRACT: The role of education in shaping the future is widely recognized. The world is becoming more complex, interdependent and unsustainable and this calls for a change in lifestyle. Thus, education for sustainable development is given increased attention in universities worldwide. Transformation of education into sustainability education implies systemic thinking and interdisciplinary approaches. At “Lucian Blaga” University of Sibiu there has been carried out an experimental, optional course which aimed to achieve an integrated approach to sustainability, fostering dialogue across multiple areas of knowledge. This paper presents an analysis of the activity of creating short video-clips related to sustainability and the impact that this teaching method has on the students.

Key words: sustainability education, optional course, interdisciplinarity, video-clips

1. INTRODUCTION

Numerous studies, reports and researches endorse education as a major vehicle for raising awareness and building a skills base for sustainability [5]. There are as well several documents that promote sustainability literacy as a core competency for graduates and professionals in the workplace, and encourage universities and colleges “to raise the profile of sustainability literacy in all curricula” [9].

Some authors view higher education as offering an unrivalled opportunity to provide leadership on sustainability: “Given what academics know about the current ecological condition of the planet, there is an obligation for universities to become leaders in the movement to prevent global ecological collapse” [14]. Viewed as an institution-wide issue, sustainability has the potential to become “a gateway to a different view of curriculum, of pedagogy, of organizational change, of policy and particularly of ethos” [18]. This shows a move from the Education for Sustainable Development (ESD) seen as embedded prescribed, pre-defined content into the curricula towards an understanding of sustainability as a different way of thinking and of teaching. Recent studies show that there is considerable support for utilizing innovative pedagogies to teach sustainability [6, 7].

Cotton and Winter [5] present that “there are a number of general principles regarding sustainability pedagogies including participatory and inclusive education processes, transdisciplinary cooperation, experiential learning and use of environment and community as learning resources.” All these principles of sustainability pedagogies involve student-centred and interactive enquiry-based approaches to teaching and learning [10, 15, 18]. The transition towards sustainability education implies shifts in thinking and practice.

2. WHAT KINDS OF TEACHING METHODS HAVE BEEN ADVOCATED TO SUSTAINABILITY?

In their chapter “It’s Not Just Bits of Paper and Light Bulbs”, Cotton and Winter [5] present a literature review of the wide range of suggestions for appropriate approaches to teaching about sustainability and also for specific teaching methods. Potential learning approaches are: participative inquiry/action research, where students investigate an issue which is of importance to them personally; transformative sustainability learning (TSL) or action competence, when students are encouraged to envisage alternatives and solutions to unsustainable practices [3].

Specific teaching strategies advocated for environmental education or ESD include those identified by Cotton and Winter [5]: role-plays and simulations; group discussions; stimulus activities (watching a video, looking at photos, poems or newspaper extracts to initiate reflection or discussion); debates; critical incidents; case studies; reflexive accounts; personal development planning; critical reading and writing; problem-based learning; fieldwork and modelling good practice – despite the teaching strategies, the importance of learning through the hidden curriculum and outside the classroom should not be underestimated [5].

Many of the approaches presented require a significant amount of prior preparation, as well as a reasonable time allocation. Sterling [17] advocates strongly for educational transformation to ‘sustainable education’ and argues for re-orientation of educational policies, programmes and practices using the synergy between ecological and systemic thought.

When promoting sustainable development, we should research and develop our work so that we become a part of the knowledge building community for sustainable development. In recent years, an increasing amount of universities have started organizing pedagogy courses for their teachers so as to specifically change the nature of teaching and learning [13].

3. THE EXPERIMENTAL COURSE AT “LUCIAN BLAGA” UNIVERSITY OF SIBIU

From March 2012 until June 2012 the students of the second year of studies at the Economic Engineering specialization, at the Faculty of Engineering from “Lucian Blaga” University of Sibiu, were offered the possibility to attend an optional course which approached issues of sustainability.
This means that the students who wanted to attend this course were not given grades, nor ECTS credits and they voluntarily participated in their free time.

All the students were informed about the opportunity to attend to this course and were told that there will be discussed issues regarding the environment, the society and also economic issues. They proposed to set up an on-line group to keep contact with the ones interested to participate and exchange information and organize meetings. The students created for this purpose a group on the social platform facebook.com. They argued that it is the best way to communicate, as they check their facebook accounts every day, it is free, easy to use and it’s also interactive. Thus, the facebook group entitled “The students change the world – experiment” was created. The group has 54 members, including the course lecturer, and the group activity will be described further in this paper.

The course was given by Valentin Grecu, PhD student and assistant professor at the Faculty of Engineering, preoccupied by Sustainability Management in Higher Education. The course utilizes expertise from a range of academic fields and aims to achieve an integrated approach to sustainability, fostering dialogue across multiple areas of knowledge.

As we have argued elsewhere [11], Romanian companies give increasing importance to the sustainability literacy of their employees and there is increasing pressure on Higher Education Institutions to approach sustainability education. In order to effectively contribute to driving environmental and sustainability improvements in their (future) workplaces, learners need to acquire knowledge, understanding skills and experience in identifying opportunities for improvements and designing effective strategies for realising them. They also need skills in effectively and persuasively presenting the proposed changes, requiring an awareness of both the ethical and business case for improvements [16].

During the course, the students explored definitions of sustainability; the impact of personal, technological and economic actions and decisions on the environment; the roles and responsibilities of world citizens, the food systems, some aspects of human psychology, and situations of endangered or extinct species. Learners were introduced to ‘real world’ examples and case studies, both global and local, utilised within the course, to illustrate the interconnectedness of the issues involved. Examples include climate change, food systems, energy, and conservation issues.

3.1 Course description

All course activities are designed to help students develop trans-disciplinary competencies, such as reflection, negotiation and dialogue-building. Some of the activities were inspired by the courses “Sustainability: Challenges and Opportunities” and “Body, Mind and Nature” taught at the University of Aberdeen, Scotland [8]. The course aimed to develop students’ self-awareness as having a role and responsibilities in relation to the everyday problems of sustaining our environment. It also tried to encourage students to recognise their own capacities and potential contribution to those problems’ resolution.

The meetings with the students were held once per week and lasted on average 2 hours. The number of students who participated at the course varied from one week to the other, with an average number of 18 participants per meeting. However, all the 54 members from the Facebook group were informed about the topics that will be discussed at the following meeting and some interesting debates were generated in that online environment.

The lecturer posted photos, videos and ideas that raised the interest of some students. The communication was very informal and the students were encouraged to express their opinions. Some posted photos and videos which were liked and commented by the others (figure 1).

In addition to the activity on Facebook, the weekly meetings were held at the Faculty of Engineering and when the weather was good, the meetings were held in the park, in the near of the Faculty, after the students finished their other classes. The meetings took place either on Thursdays, after 17:00 or on Fridays, after 14:00. The activities included movie watching, PowerPoint presentations, discussions, outdoor activities and games. In most of the cases the topics were proposed by the lecturer, but sometimes the students proposed themselves discussion topics related to the issues of sustainability and shared their experiences.

At the end of the course, 12 of the students who regularly participated to the meetings participated at the Student Scientific Communication Session and presented 4 papers about sustainability, sustainability education, and methods for raising awareness and disseminating knowledge regarding sustainability to other students. Through this activity, students could further develop important practical skills such as: locating and using research material, and selecting material from an extensive reading list; generating their own source material, assessing and analysing that material; making effective use of IT for information retrieval and written presentations; developing and presenting arguments; giving effective presentations making appropriate use of IT resources; analysing and commenting on the arguments of others; time and project management abilities and group participation. As a result of their implication, devotion and hard work, two of the presentations were awarded with the first prize and the fourth place.

4. MOVIE MAKING ACTIVITIES – AN EXPERIMENTAL APPROACH TO TEACHING SUSTAINABILITY

After acquiring knowledge and awareness about the issues that our society faces, the students acknowledged the importance of education for shaping the society into a more sustainable one. They were convinced that it is the responsibility of each citizen to act responsibly in order to change something.

For this purpose, in one of the meetings, a brainstorming activity was organized to identify methods for raising awareness and disseminating knowledge regarding sustainability to other students.
The students decided that short video clips would be an effective tool for reaching this objective. The video clips had to be funny, but also to have a message easy to understand, and should urge the viewers to research and learn more about sustainability issues. The students hoped that if the video clips were funny and informal, they would become viral on social networks such as YouTube or Facebook.

The ideas of the videos were generated also from brainstorming activities and some were inspired from commercials or similar clips. The students wrote 9 scenarios, but managed to film and edit only three video clips. The first clip tried to transmit the idea that people should care more about the nature and stop throwing garbage in the nature, as it has a negative impact on the environment. The second video tried to raise awareness about food systems, GMOs and chemicals contained in our food and the third video showed how much fun people can have in the nature, calling for reconnection with nature.

5. COURSE IMPACT

There is a growing number of educators and educationalists who agree that there is a need for us not to just promote an understanding of the sustainability problem, but also to promote the appropriate personal values that a population needs in order to behave in a socially and environmentally benign manner [4].

The optional course taught at the “Lucian Blaga” University of Sibiu aims to provide students with knowledge, skills and abilities for transforming the society into a sustainable one, using an interdisciplinary approach, as recommended by many scholars. A research has been carried out in order to assess the impact that this course had on the students.

5.1 Objectives

The main objective of the research is to assess the impact that the optional course had on the students. The research also sought to identify the profile of the students attending this course and the possible changes that can be made to improve this course.

5.2 Methodology

The research tools used for this study were: direct observation and course evaluation forms, filled in by the students. Many educational research methods are descriptive – they set out to describe and to interpret what is. According to Best [2], descriptive research is concerned with: “conditions or relationships that exist; practices that prevail; beliefs, points of view, or attitudes that are held; processes that are going on; effects that are being felt; or trends that are developing.”

Interviewing is widely used in educational research and is generally regarded as a powerful tool in extracting data, in particular qualitative in nature [1]. The course evaluation form was an online research tool tailored as a semi-structured interview consisting of 17 questions (See Appendix 4).

In other words, it was an online questionnaire, with opened questions and the students could fill in the form anonymously. This method was chosen because the interviewer was also the course lecturer, so in order to ensure the anonymity and avoid biased answers, the online form was preferred to classical interviews.

5.3. Results

The students were informed about the research and were invited to participate to the course assessment that aimed to identify their opinions about the course, about sustainability education and about the impact that the course had on them. The link to the online evaluation form was posted on the Facebook group, and all the 53 members were informed about the activity. There were 9 students (4 girls and 5 boys) who agreed to take part in this research and their answers are presented below, after being clustered into categories, using Weft QDA.

The categories have been created according to the questions of the interview. The answers of each question can be assigned to each of the 9 interviewees as they were numbered from 1 to 9 (i.e. the answers of the third interviewee are marked with number ‘3’). Figure 2 shows the answers of the interviews synthesized in a conceptual map, created using CMAP Tools.

6. DISCUSSION

Considering the feedback from the students, given during the courses, on Facebook and in the course evaluation forms, the optional course concerning sustainability issues, taught at “Lucian Blaga” University of Sibiu, was a success. This is also evident from the average grade that this course received from the students – 8.8 and from statements such as “it was a real pleasure and I was delighted to attend the optional course”. The aim of the course was to raise awareness on sustainability issues and experiment alternative teaching methods for sustainability in Romanian Higher Education.

The role of education is well understood by the students who appreciate that education “models young people to become responsible adults, who know their role in the society” (interviewee 8). The students also contend that education is good because it “opens our horizons and we know better what is happening around us”. They associated education with sustainability, showing that “all our actions have consequences that are reflected on the society and environment. If nobody would explain us some essential things about the link between us and the society it is likely that we would encounter certain events in life that instead of avoiding them, we create them ourselves” (interviewee 9).

The reasons for joining the course are questioned in question 4. Most of the respondents said that the topic seemed interesting and they wanted to learn as much, as they were aware of the issues that the Planet is confronting with. Another important reason, mentioned by more respondents is that “many of these extra activities are beneficial for all of us: we have the possibility to learn things that we do not know, to participate in certain activities that we would not ever think of. These activities ‘stir’ our imagination to come up with new ideas, and help us to better understand ourselves and the others” (interviewee 2).

Question 6 sought to identify what the students liked about this activity and the most appreciated was the teaching method and the atmosphere. Some of the other things appreciated by the students were: “the movies, the documentaries, the support materials, the initiative of [the] colleagues, the creativity, the freedom of expression, the open, interactive discussions, the fact that we can engage in various discussions or participate in planned activities”. They were not used to be listened to and therefore this was another thing that they liked about the course: “it was a pleasure to go to this course because of the freedom of expression and lack of binding (if I may say so), I came just for fun.”
The flexibility of the timetable (“we can make our program as we like”) and of the topics (“we can choose what we want to discuss during the course”) were also appreciated. Concerning communication, the students consider that “everybody understood what it was all about” and that “there was no barrier between the students and the professor”. “The professor was always enjoyable and didn’t think of himself to be superior to us and that encouraged us to speak and think without being afraid to make mistakes.” More students said that they “could discuss without holdbacks” as communication was “opened, not very formal” and “each of [them] could express a point of view”.

All the participants to the course evaluation activity considered that this course already had an impact on them. They claim that they are more responsible, in terms of environmental protection, they are more careful about what they eat and they try to waste less energy and recycle when possible. Most of the respondents argue that this course “certainly” made them think and reflect more “about what there is around us” and “about what effect [their] actions have on the environment”.

It is remarkable that all respondents are confident and optimistic, when asked if ordinary people like themselves can change the world. They argue that ambition and perseverance are key attributes for making the change possible. They also acknowledge that courage and patience are needed and that “if everybody does something for a change then […] that change will occur.”

Some are very straightforward, enthusiastic and confident that they can change the world: “Of course! If not us, then who?” Despite the enthusiasm, they recognize that “strong and logical arguments” are needed and they propose strategies for a successful implementation of the change: “it is enough to promote an idea in a group of people. That idea can attract more and more people and that can finally awaken the whole world to the reality that we live in.”

As mentioned before, the students particularly enjoyed the teaching methods. Their opinions regarding this aspect were questioned in the evaluation form, in question 9 – “What do you think about how the activities were conducted?” The students appreciated the diversity and the “relaxing, friendly and open atmosphere”. They pointed that since the course was given in an informal and “fun note” it “easily captured [their] attention” and the information was easy to understand.

Figure 2. Course evaluation – synthesis of students’ opinions.
Some of the advantages that the Facebook group brings are that “it made it possible that our activities to become known by those who were not so heavily involved in our work and kept us updated with any changes in program and with the upcoming activities”. This type of communication method seems to be effective for this type of activities. Moreover, the group on Facebook allowed each student to post images, videos or comments and it was host of several interesting debates. Also the students who didn’t actively participate to all the activities, showed their opinions regarding some topics. They commented or liked the posts and whenever they came upon photos, videos or links related to the activities on the group, they posted them on the wall, thus keeping everyone informed. The videos that were made by the students were also displayed in the group.

The video-making activities were appreciated by all the students who attended them. After being informed about the main issues of sustainability and their role in the society, the students were challenged to come up with ideas for informing other people and promoting a sustainable lifestyle. Brainstorming activities were organized and out of the many proposed methods, the group chose to use video-clips to raise awareness of the others. Then another brainstorming activity was organized in the park, to create scenarios for the video-clips. There were 9 scenarios selected, but only 3 video-clips were finally produced. The students expressed their regret that they didn’t produce more videos as they believe this is an effective method to spread a message: “I would have liked to make more video-clips for the most important issues of the Earth (Terra).

The ones that we made so far are very nice and transmit an important message. I hope that this message reaches everyone so they can understand the true value of the place we live in, the true value of what we are, as humans. We should take care of us and of our environment” (interviewee 1). Some are a little bit more sceptical towards the effectiveness of this method: “I don’t know if [the clips] will have the expected effects, but it is a beginning which, from my point of view, will not pass unnoticed by certain people” and others consider that the success of this method depends making a “big hassle about this topic in order to be considered.”

The idea of these video-clips was to make them somehow funny, with the message that can be extracted from the story, rather than being exposed obviously. The students believe that “Maybe at the beginning everybody will think about them as jokes, but because they are funny maybe they will watch them again and they will understand the message that we want to transmit.”

Besides the impact that these videos can have on other students, they have strongly impacted the ones who participated in the movie-making activities, as they consider this “a fun activity that had also a didactic and informative role”. Others said that “making the movies was fun, interesting and an excellent idea to transmit the messages related to sustainability” and that “the ones involved, learned a few things and […] tried then to show these things to the others”. These statements advocate the movie-making activities as an appropriate pedagogy for sustainability education.

When asked about dislikes or what would they change about the course, most of the respondents said that they wouldn’t change anything because they “like as it is”. Some want to see more people involved in such activities and they would change the timetable, so more students can attend this course.

Others would like to have more meetings and more topics to discuss about. Some students also suggested that this course to become mandatory because this type of education is “a very important one and should be implemented as soon as possible in the educational system.”

The benefits for attending the course are evident for all the respondents. Some see the benefits as the information that they gained for living a “green” life. Some mentioned that after this course they are more careful about what they eat and try to leave a smaller footprint in the nature. Others consider that this course helped them develop team-work abilities and encouraged them to think.

The students were also ask which do they consider to be the most suitable method to inform students about the problems that the planet is facing and to promote a sustainable lifestyle. They contend that “one method is not enough” and they suggest various methods such as:

- presentations,
- movies within the faculty,
- flyers and posters,
- theatre plays or short video-clips,
- projects within the faculty and actions such as “let’s do it Romania”,
- excursions to places where the effects of humans on the environment are visible,
- outdoor activities
- Facebook events
- TV spots

All the respondents answered that they will certainly recommend this course to other students because they can learn “interesting things about the environment” and because sustainability is a “topical issue and you only need a bit of logic to realize how important these activities are”. One student concluded: “I want to be more students willing to make a change. I want to do the things that others don’t care about and are indifferent to… I know WE CAN!!!” (interviewee 1).

7. CONCLUSION

Education is an essential tool for achieving sustainability. People around the world recognize that current economic development trends are not sustainable and that public awareness, education and training are key to moving society toward sustainability [12].

Stephen Sterling [19:77] argues that “if we want the chance of a sustainable future, we need to think relationally.” We are aware of the fact that the world is increasingly complex, interdependent and unsustainable and try to change the approach of education, from a fragmentary and limited one, to an integrating and multidisciplinary approach.

Teaching sustainability through movie-making activities is a new pedagogic approach that has proven to be very effective, as it is considered to be entertaining and challenging by the students. This is applicable for small groups of students and should be complemented by other teaching methods that have been experimented before.

The analysis of the feed-back forms filled in by the students seem to support that the chosen method was a successful one as it managed to develop an interdisciplinary understanding of complex issues in sustainability. Students gained knowledge, skills and competences for effectively and persuasively link knowledge and values in dealing with sustainability.
8. ACKNOWLEDGEMENTS
This research was conducted in the project POSDRU/88/1.5/S/60370 – “Integrating Romanian research in the context of European research – financed doctoral scholarships”.

9. REFERENCES
A DECISION SUPPORT SYSTEM FOR THE TRANSITION TOWARDS THE SUSTAINABLE UNIVERSITY

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ABSTRACT: In response to increasing concerns of society about environmental degradation and increasing demands for a transition to a more sustainable society, higher education institutions worldwide have begun to change their missions and educational practices and approaches to include sustainability. The role of higher education in the social context of an ongoing transition to greater sustainability has become a topic of significant scientific importance. Thus, universities worldwide are engaged into a process of transition to become sustainable universities. This paper proposes an algorithm for a decision support system which aims to help decision makers to fundament their approach to transforming the university into a sustainable one. Universities have different organizational cultures, values and resources, and the proposed algorithm helps to identify the most suitable solution for each university.

Key words: sustainable university, decision support system, university management

1. INTRODUCTION

Planet Earth has a limited capacity to meet the growing demand for natural resources made by socio-economic systems and to absorb the destructive effects of their use \([24]\). The impacts of overconsumption of resources have begun to have measurable negative effects both on socio-economic development and people’s quality of life in vast areas of the planet \([10]\).

Education is one of the most effective means available to society to shape the future \([30]\). However, according to Sterling \([26:12]\) “it is the change of mind on which change towards sustainability depends; the difference of thinking that stands between a sustainable or a chaotic future.” Otherwise, as David Orr \([20:5]\) pointed out, “without significant precautions, [education] can equip people merely to be more effective vandals of the Earth.”

Sustainability should not be just another issue to be added to a curriculum that is already overcrowded, but a “gateway to a different view of the curriculum, of pedagogy, of organizational change, of policy and particularly of ethos” \([27:50]\). The role of education in shaping the future is widely recognized. In a world that is becoming more complex, interdependent and unsustainable, education for sustainable development is given increased attention in universities worldwide. Transformation of education into sustainability education implies systemic thinking and interdisciplinary approaches to promote change of attitudes to learning and lifestyles.

2. WHAT KNOWLEDGE FOR SUSTAINABILITY?

One can generally say that in order to learn about sustainable development, one must be acquainted with several different branches of science. Paula Lindroos \([17:93]\) observed that “learning about sustainable development is guided by a principle of organizing science and at the same time focusing on the problem solving capabilities of the students. This means that both content and learning methods become important for the courses.”

Most notably however, issues of sustainability tell outside the realm of any specific discipline and even outside the realm of science. Hence teaching and learning on issues of sustainability requires the ability to bring together different realms of knowledge.

The role and importance of universities in transforming our society into a sustainable one has been highlighted by many scholars and institutions. In a position paper on global sustainability UNESCO \([31:4]\) states: “With respect to higher education, there will be emphasis on the role of universities in refining the concept and messages of education for sustainable development, integrating environmental, demographic, economic, social and a range of other concerns inherent in the notion of sustainability. In re-orienting their research programmes and curricula, key will be the universities’ capacity for flexible interdisciplinary cooperation and for collaboration with outside institutions… Universities will have to experiment by exercising more initiative and by risking new approaches.”

Tilbury \([29:98]\) argues that “Environmental Education for sustainability is an innovative and interdisciplinary process requiring participative and holistic approaches to the curriculum” and considers that there is a need for innovation, rather than integration of education-for-sustainability. Hart, Jickling and Kool \([15:109]\) also imply that environmental education should be “interdisciplinary, participatory, critical, community-based, values-based and inquiry-based.”

The Tbilisi report of 1977 states, among its many recommendations that “by adopting a holistic approach, rooted in a broad interdisciplinary base, [education for sustainability] recreates an overall perspective which acknowledges that the natural environment and man-made environment are profoundly interdependent…” \([32:2]\).
According to Tilbury [28:196] the developing, more holistic notion of education-for-sustainability is "reflected in the broadening nature and scope of environmental education, marked by moves towards an inter-disciplinary dimension and from a more local to global approach."

When promoting sustainable development, we should research and develop our work so that we become a part of the knowledge building community for sustainable development. In recent years, an increasing amount of universities have started organizing pedagogy courses for their teachers so as to specifically change the nature of teaching and learning [16].

3 SUSTAINABLE UNIVERSITY

An important attempt to define what "sustainable university" means was made in 1990, through the Talloires Declaration [22]. Jean Mayer, president of Tufts University in the U.S., convened 22 leading universities in Talloires, France, so that they can express their concerns about the state of the world and develop a document to identify the key actions that universities need to do in order to create a sustainable future. Identifying the scarcity of specialists in environmental management and its related fields, and lack of understanding of professionals in all areas of the consequences of their actions on the environment and public health, the meeting pre-defined the role of the university as synthetized in figure 1.

Figure 1. Sustainable University

The Talloires Declaration (1990) was signed by over 265 rectors and vice rectors of the universities in over 40 countries on five continents. This suggests a growing recognition that more academic research, education and university programs must lean on the challenge of sustainability. No doubt that signing the Talloires Declaration was, at that time, a symbolic act for some institutions. For others however, the document is still an incentive and a framework for sustained progress to achieve sustainability.

Promoting sustainability in higher education depends largely on the active engagement of those responsible of various disciplines with promoting attention environmental issues and sustainability as central objectives of practices and as a main mission in their areas of activity [11].

Fortunately, many of them have committed to review the subjects they teach, both nationally and locally. Members of various professional associations have established special interest groups, divisions or sectors focused on environmental issues and sustainability. There are emerging specialized journals such as Journal of Interdisciplinary Studies in Literature and Environment. Ante-mentioned publication provides a forum for debate and literary critical exposure stage built around environmental issues, including ecological theory, concepts about nature and capturing them in pictures, the dichotomy man - nature, and other such concerns [6].

3.1 The Transition to a Sustainable University

In response to increasing concerns about environmental degradation and the increasing demands for a transition to a more sustainable society, higher education institutions around the world have begun to change their educational missions and practices and include approaches to sustainability. Because this happened in the past decade, the role of higher education in the social context of a continuous transition to a more sustainable society became a subject of significant scientific importance [12, 21, 8].

Although this emerging literature on sustainability in higher education is diverse, is dominated by empirical and descriptive studies, specific approaches, strategies and initiatives to specific institutions, [18,1] but also includes prescriptive studies that often call to universities to play a more prominent role in education for sustainability [19, 7, 13, 4]. Much of the descriptive literature, so far, is focused on specific strategies or actions taken at specific institutions [2, 9].

The largely empirical focus of this emerging literature can be understood by taking into account the needs of short-term exchange of information in a fast changing environment and hybrid scientist-practitioner perspective of many people involved in, and evaluating sustainability initiatives in higher education. Given the early stage of this area of research, the emerging body of research seems to have a minimum of cohesion and a degree of repetition and redundancy. In addition, a strong base of theoretical research agenda has not been established.

4. A DECISION SUPPORT SYSTEM FOR THE TRANSITION TOWARDS THE SUSTAINABLE UNIVERSITY

Universities have different organizational cultures that value and promote learning and thus can play a vital role in the transformation of society that is based on educating new generations of citizens and leaders [25]. Higher education has always been responsive to social needs, and higher education history shows an evolution of the structure and goals of universities that directly reflect the dynamics of socio-technical systems of society [5].

Some of the literature on education for sustainable development seeks to identify best practices in one institution or set of institutions [33]. This approach can develop an ambitious vision of how an ideal sustainable university would look once it reaches the stage of "stabilization", but there is the risk of minimizing significant dynamics in the real world. For example, assuming that an ideal, stabilized state can actually be achieved, can be quite daunting for potential change agents, whose universities are far from the ‘ideal’ in a number of areas. What best practices analysis omits is precisely how these practices have been developed - and how these practices can have an impact in different contexts and cultures and can actually be considered "best" practices.

Thus, we propose a Decision Support System for university managers who seek to embark in this challenging transition towards the Sustainable University. Some recommendations might be efficient in certain cases, but we are aware that it is impossible to find a recipe for success that works in every situation. The Sustainability Decision Support System (SDSS)
is a tool that helps decision makers choose from more possible decision alternatives which suits best the University that they
manage, based on a set of decision criteria.

The algorithm that underlies the SDSS is an innovative
approach that combines two well-known algorithms: the
hierarchic-analytic process, used mainly in operations
management and the advanced multi-criteria analysis based on
FRISCO formula. The SDSS is applicable for an unlimited
number of decision alternatives and selection criteria. For
exemplification, we have chosen to present the situation with 5
selection criteria and 5 decision alternatives.

The system allows the decision maker to define his/her own
selection criteria and decision alternatives. In table 1 there are
presented the ones used for exemplification.

Table 1. Selection criteria and decision alternatives

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Code</th>
<th>Selection Alternatives</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
<td>C1</td>
<td>New degree program</td>
<td>A1</td>
</tr>
<tr>
<td>Number of Lecturers</td>
<td>C2</td>
<td>Mandatory Course</td>
<td>A2</td>
</tr>
<tr>
<td>Involved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Students</td>
<td>C3</td>
<td>Optional Course</td>
<td>A3</td>
</tr>
<tr>
<td>Involved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student implication</td>
<td>C4</td>
<td>Change existing courses</td>
<td>A4</td>
</tr>
<tr>
<td>Attractiveness to students</td>
<td>C5</td>
<td>Extracurricular activities</td>
<td>A5</td>
</tr>
</tbody>
</table>

After naming the criteria, the decider has to define the
relationships between every pair of two criteria. In other words,
every criterion is compared against the others and a quadratic
matrix that presents how these criteria relate to each other is
complete. The matrix that presents how these criteria relate to each other is
 supplied is given in table 2:

Table 2. Relationship matrix

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>Costs</th>
<th>Number of Lecturers Involved</th>
<th>Number of Students Involved</th>
<th>Student implication</th>
<th>Attractiveness to students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>0.5</td>
<td>0.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.5</td>
<td>0.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

It is important to remember that the scores presented above are
the choice of the decision maker. This choice can be based on
recommendations from the literature, vision, mission and
strategy of the university, market research, specific
particularities of the university etc.

After the relationship matrix is complete, the SDSS will apply
FRISCO formula (1) to rank the criteria and allocate an
importance coefficient or weight factor (γi) for each of them.
The FRISCO formula (an empiric formula given by a well-
known creation group in San Francisco - USA) was chosen as it is
recognized worldwide as being the best and most used
formula for this type of analysis [3:1933].

\[
\gamma_i = \frac{p + \Delta p + m + 0.5}{-\Delta p + \frac{N_{cr}}{2}}
\]

(1)

where:

- \( p \) – is the sum of the points (on a row) scored by
the analysed element;
- \( \Delta p \) – the difference between the score of the analysed
element and the score of the element on the last level;
if the regarded element is the element on the last level,
\( \Delta p \) will have the value 0;
- \( m \) – number of criteria outranked (standpoint of
the score) by the regarded criterion;
- \( N_{cr} \) – number of regarded criteria;
- \( \Delta p' \) – difference between the score of the regarded
criteria and the score of the first criteria (resulting in a
negative value); if the regarded criteria is the one
place on the first level, the result will be 0.

For the example given above, the weights for each criterion,
calculated using the FRISCO formula are given in table 3:

Table 3. The weights for each criterion, calculated with FRISCO formula

<table>
<thead>
<tr>
<th>Code</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>SCORE</th>
<th>RANK</th>
<th>Dp</th>
<th>Dp'</th>
<th>m</th>
<th>FRISCO</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.50</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
<td>3.00</td>
<td>2</td>
<td>2.00</td>
<td>-1.50</td>
<td>3</td>
<td>2.125</td>
</tr>
<tr>
<td>C2</td>
<td>0.50</td>
<td>0.50</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>5</td>
<td>0.00</td>
<td>-3.50</td>
<td>0</td>
<td>0.250</td>
</tr>
<tr>
<td>C3</td>
<td>1.00</td>
<td>1.00</td>
<td>0.50</td>
<td>1.00</td>
<td>1.00</td>
<td>4.50</td>
<td>1</td>
<td>3.50</td>
<td>0.00</td>
<td>4</td>
<td>5.000</td>
</tr>
<tr>
<td>C4</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.50</td>
<td>1.00</td>
<td>2.50</td>
<td>3</td>
<td>1.50</td>
<td>-2.00</td>
<td>2</td>
<td>1.444</td>
</tr>
<tr>
<td>C5</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.50</td>
<td>1.50</td>
<td>4</td>
<td>0.50</td>
<td>-3.00</td>
<td>1</td>
<td>0.636</td>
</tr>
</tbody>
</table>

Then, the decision alternatives are compared against each
other, based on the extent to which they satisfy each criterion.
Thus, in the example given, the alternatives have been
compared to each other five times – once for each criterion.
The same algorithm was applied when the quadratic matrix
was generated and the scores 0, 0.5 and 1 were allocated as
shown above.
In addition to the calculation of the weights based on FRISCO formula, which show how each alternative satisfies the criterion, there has been calculated the “array of importance”. The array of importance is calculated with the algorithm specific for the hierarchic-analytic process [23]:

- After the quadratic matrix has been generated, it is “normalized”, generating a new matrix, noted with A. Each value of each column is divided to the sum of the values of that column, using the formula (2):

$$b_j = \frac{a_{ij}}{\sum_{k=1}^{n} a_{kj}}$$  \hspace{1cm} (2)

- The array of importance, w, is calculated as the average of each line from the normalized matrix, using formula (3):

$$c_{ij} = \frac{\sum_{k=1}^{n} b_{ik}}{n}$$  \hspace{1cm} (3)

Given the fact that the quadratic matrix is filled in based on the algorithm presented above, it is consistent and thus the calculation of consistency is no longer required.

The final score for each decision alternative is calculated by adding the products generated by multiplying its score of the alternative for each criterion with the weight of the respective criterion. This is done both for the weights generated with FRISCO and the array of importance. Then the arithmetic average is calculated between these values, for each alternative and the one with the highest score is the optimal solution (see table 4).

<table>
<thead>
<tr>
<th>Decision Alternatives</th>
<th>Score W</th>
<th>Score FRS</th>
<th>Average</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>New degree program</td>
<td>A1</td>
<td>0.59</td>
<td>11.22</td>
<td>5.91</td>
</tr>
<tr>
<td>Mandatory Course</td>
<td>A2</td>
<td>1.43</td>
<td>16.49</td>
<td>8.96</td>
</tr>
<tr>
<td>Optional Course</td>
<td>A3</td>
<td>1.17</td>
<td>18.19</td>
<td>9.68</td>
</tr>
<tr>
<td>Change existing courses</td>
<td>A4</td>
<td>3.64</td>
<td>36.63</td>
<td>20.1</td>
</tr>
<tr>
<td>Extracurricular activities</td>
<td>A5</td>
<td>1.14</td>
<td>17.64</td>
<td>9.39</td>
</tr>
</tbody>
</table>

5. THE SUSTAINABILITY DECISION SUPPORT SYSTEM – ONLINE

The usefulness of the Sustainability Decision Support System for the transition towards a sustainable university is highlighted by the need to make decisions based on real facts and needs specific to each university. However, the algorithm presented is complicated and it requires good mathematic abilities for the decision maker, and this can therefore limit the usage of the proposed decision support system.

In order to ease the use of the SDSS and increase the number of potential users, the Sustainability Decision Support System was put online. The SDSS allows an indefinite number of criteria and decision alternatives in a user friendly interface. For this purpose an extension for the Content Management System Joomla! 1.5 has been developed. It can be easily integrated into any website created with Joomla! 1.5 (see figure 2) [14].

First, the user is requested to enter the number of criteria and the name (or label) for each criterion (figure 3). Then the quadratic matrix is generated and the user has to compare each alternative against the others, having the option to choose whether it is more important, equally important or less important than other criteria (see figure 4).

![Figure 2. The SDSS integrated in a website](image)

![Figure 3. Entering the criteria](image)

![Figure 4. Generating the quadratic matrix](image)

Then, the user is asked to enter the alternatives and then to compare each alternative based on each criterion (see figure 5).

![Figure 5. Comparing each alternative from the point of view of criterion “Costs”](image)

The software then uses the algorithm described in paragraph 4 and returns the optimal solution, as shown in figure 6.
6. CONCLUSIONS

Sustainable development is the biggest challenge to universities in the twenty-first century [34]. Since there are many different definitions and interpretations of the concept, the strategies of the universities that are beginning to strive for sustainability show some differences. Various universities have already become engaged in the process of integrating sustainable development in their activities [34]. The sustainable university is not easy to be achieved, but all the efforts, energy, resources and time invested in many universities around the world show progress [35]. The Sustainability Decision Support System, presented in this paper, is intended to help decision makers in their journey towards the sustainable university.

Universities have different approaches of the transformation process towards a sustainable university. Some incorporated sustainability in their visions and missions; others focus on sustainability education or research integration, while others have created environmental policies or campus strategies, but what is desirable is an approach that incorporates all the components of the model. A holistic approach can transform the university into a sustainable one, encouraging students, professors and other members of the academic community to commit themselves to help society make the transition towards sustainable life styles.

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ABSTRACT: The issue of Corporate Social Responsibility in economy has its roots in the 1950s of the 20th century. Due to further development of globalization or the financial crisis, the discussion of this issue is more current than ever before. Nevertheless, the arrangement within single enterprises as well the perception, acceptance and behavior of the customers varies very strongly internationally. The aim of the paper is to identify how the phenomenon Corporate Social Responsibility represents itself, how it has changed and furthermore, in how far it has affected different economies and countries. The main aspects of the paper are investigation of this phenomenon from a customer view in Germany, as well as the comparison to other European nations, the Asian countries and the USA. At first, the development of the term Corporate Social Responsibility is revealed and defined in general. Accordingly, the establishment of Corporate Social Responsibility in USA, European and Asia is presented. Following, there are investigations from these countries regarding the consumer perception and behavior in relation to Corporate Social Responsibility. Finally, a German research project is presented, which has analyzed consumer perception and behavior in Germany. The work ends with a short conclusion. At that stage final results are still under development. The author will present them at the 5th ICEBE.

Key words: corporate social responsibility, consumer behaviour, consumer expectations

1. INTRODUCTION

Due to ecological changes like climate change, the rapid progress of the information- and communication technologies, the financial crises, as well as the deterioration of the economic situation of public households, the state, the society and economy are confronted with new challenges in the 21st century [1]. Because of globalization, the possibility exists for enterprises to offer products at the global market [2]. At the same time, this also aggravates the economic situation by growing competition and the change of political circumstances for entrepreneurial actions [3]. Concerning all these changes the consciousness of public and consumers grows to a global extent for the need to protect the environment, to compensate waste of natural resources, to avoid injustice and to solve social problems. Consequently, citizens, consumers and investors demand high standards of enterprises and their products and require a social and ecological behavior of enterprises. Hence a new distribution of duties states concerning economy, state and society. [1]

The discussion and the characteristics of the takeover of social responsibility is led under the term Corporate Social Responsibility (CSR). Starting in the USA, the term has established over Australia, Western Europe, Central Europe, East Europe and, finally, in Asia. Nevertheless, considerable differences exist with the definition, the arrangement as well as the acceptance of the term. The main reasons for this are different historical, juridical, political and economic basic conditions of the single societies and countries. [4]

At first, the development of the term Corporate Social Responsibility is revealed and defined in general. Accordingly the establishment of Corporate Social Responsibility in USA, European and Asia is presented.

Following, there are investigations from these countries regarding the consumer perception and behavior in relation to Corporate Social Responsibility. Finally, a German research project is presented, which has analyzed consumer perception and behavior in Germany. The results of this research project will be showed up at the conference. The work ends with a short conclusion.

2. HISTORIC DEVELOPMENT AND DEFINITION OF CORPORATE SOCIAL RESPONSIBILITY

The term Corporate Social Responsibility is neither satisfyingly defined in literature nor in the enterprise practice. The beginning of the scientific discussion of the term has its roots in the 1950s of the 20th century in the USA. The decisive fact was the publication of the book “Social Responsibility of the Businessman” by Howard R. Bowen in 1953. Bowen creates a connection between economy and moral values, while managers must be responsible for their decisions not only in an economic way, but also compared with the society.

The term was extended by Joseph W. McGuire. He understands CSR as the legal and social minimum requirements and see the responsibility takeover not only by the manager but furthermore by the entire enterprise. [5] Clearence C. Walton stresses the aspect of the voluntariness concerning the responsibility takeover [6].

In the middle of the 1970s a change took place in the discussion about the term Corporate Social Responsibility. The strategically integration of CSR came to the fore instead of the prior ethical-moral discussion of the term. The Stakeholder approach from R. E. Freeman was considerably for the strategically integration. [6]
Therefore, an enterprise is confronted with a wide and diverse range of stakeholders and has the obligation to care about the relationships with the stakeholders, because the arrangement with the stakeholders leads directly to economic advantages and disadvantages for the enterprise. The entrepreneurial responsibility is personalized according to the stakeholders whereby concrete guidelines can be derived for the CSR activities. [5]

A further development stage can be seen in the operational implementation of the term Corporate Social Responsibility after the strategically integration. [6] Since the end of the 1970s different approaches have been developed to operationalize and measure social responsibility. Until today there has generated a wide range of most different management- and audit systems. [3][6] In that context, the work of Archie B. Carroll is considered as a conceptual model [6]. Carroll subdivides the social responsibility of the enterprises in four areas. Economic responsibility can be understood as the basis of Corporate Social Responsibility. Enterprises have an obligation towards the society to provide goods and services and to gain profit. At the next stage, the legal responsibility is thematized, which demands the compliance of the laws by the enterprises.

The ethical responsibility is located at the third level. This contains the voluntary observance of social values, norms and expectations which exceed the legal principals. The discretionary responsibility can be found at the top of the Corporate Social Responsibility and implicate that enterprises should behave like a “good citizen”. It embraces every voluntary engagement of the enterprise which benefits the welfare of the society and the environment. [7] Carroll shows through this, that both non-economic and economic aspects are important for Corporate Social Responsibility and is valuable for the society. [5]

In the course of the discussion Corporate Social Responsibility is just embraced by a social and economic dimension. In the 1990s it is complements by the ecological dimension to operationalize the construct comprehensive. In this time the term Triple-Bottom-Line arises through the enlargement of the economic dimension. It means that enterprises must pursue and consider economic, social and ecological aims. [5]

Beside the scientific and economic level the subject Corporate Social Responsibility was also taken up at the political level. First in 1987, there was an example for the sustainable development under the title "Our Common Future" published by the United Nations (UN). This was followed by the "United Nations Conference on Ecology and Development" in Rio de Janeiro in 1992 as well as the UN conference "Earth Summit+5" in New York in 1997. The UN established social and ecological minimum standards for enterprises under the Global Compact in 2000. In Europe, there followed the first edition of the EU Green Paper „Promoting a European framework for Corporate Social Responsibility“ by the European Commission in 2001 [1]. The European Commission adopted a new strategy for the social responsibility of enterprises in October 2011. Corporate Social Responsibility is there defined as “the responsibility of enterprises for their impacts on society”. [8]

To sum up, Corporate Social Responsibility can be defined as a “proactive takeover of ethical and discretionary responsibility by the enterprises, which ensure the conditions and compliance of legal obligations and the aspiration for economic goals”. It comprised social, ecological and economic aspects. [7]

3. CORPORATE SOCIAL RESPONSIBILITY ESTABLISHMENT IN THE USA, EUROPE AND ASIA

The beginning of the discussion with Corporate Social Responsibility has its roots in the USA. It arouses there because of the missing welfare state and the lacking social-state protection. [3] Therefore, it corresponds to the American national culture to deliver a high degree of economic, ecological and social responsibility to the society and the liberal economic system [1].

In Europe it is differently. There is the takeover of the responsibility obviously regulated through the presence of welfare states as well as high legal conditions. [9] Beyond, a form of Corporate Social Responsibility comparing to the USA could not be established through the inclusion of the enterprises in legal, political or economic guidelines in the European countries. However, a slow matching is to state through the Corporate Social Responsibility actions of multinational enterprises. [4] Through different historical, political and social circumstances the form and the comprehension of Corporate Social Responsibility differs in the European countries. [1]

The northern countries of Europe distinguish oneself by a distinctive welfare state system and a high trust of the population in the state institutions. The population is strongly interested in the behavior of the enterprises and a lot of enterprises have implemented this, although the term Corporate Social Responsibility is known as recently. Challenges are the reinforced communication of the theme in marketing and the profiling of it.

The West-European countries are strongly influenced by NGO’s, scientific institutions, the financial sector as well as the trade unions. Great Britain has integrated the term Corporate Social Responsibility into the British competition policy through the creation of a states secretary. It sees this issue as a voluntary obligation in the economic self-interest. The discussion develops in France contrary. From the fact that enterprises have high social security contributions, enterprises in France assume that the state is responsible for the issue. Consequently the enterprises are hard to motivate for implementing a coherent Corporate Social Responsibility strategy.

In Central Europe the social concern is often assigned to the state so that it seem to be that there is a smaller range for the economy concerning Corporate Social Responsibility as in other European countries. In Austria exists a voluntary cooperation of the economy with the government, which is set under a social partnership. [9] Similar to that, Germany develops political institutions to strength the relationship between government and economy.

Over that, Corporate Social Responsibility was first integrated in coalition agreement in 2005. The reticence of German enterprises can be led back on historical reasons, because a clear role allocation ruled in Germany between state, economy and society.

The relatively weak role of civil society initiatives leads to the fact that trade unions and organizations take up the theme hesitant. Nevertheless a change can be stated so that Corporate Social Responsibility is more integrated in the economy and the strategy of enterprises. [1]
The South-European countries distinguish oneself by a religious orientation and a strong family relation. It becomes apparent that the Corporate Social Responsibility is confronted with not adjusted political, legal and social structures, although there obtains a certain tradition of enterprise commitment in municipal affairs. Even if some initiatives exist, Corporate Social Responsibility is still seen as a matter of the enterprises which implement more in marketing than in management attempts.

In the East-European countries, there is no special implementing attempt to be ascertained. Reasons for this are the novelty of the concept and the missing discussion concerning social and economic responsibility. Nevertheless, an advanced development is to be seen in Czech and Poland. Moreover, it is to stress that in Estonia a wide consensus about the common good of social responsibility exists. [9]

The Asian countries are stragglers concerning the Corporate Social Responsibility discussion because of their cultural and historical development. The conversion of this issue is always dependent on the ruling government. Nevertheless, clear differences are still to be ascertained in the individual Asian countries. [1][4]

4. PERCEPTION AND INFLUENCE OF CSR ON CONSUMER BEHAVIOR IN THE USA, EUROPE AND ASIA

One of the most important issues by enterprises is how the Corporate Social Responsibility activities are perceived by the consumers and how it affects the consumer behavior. Because of the previous shown national differences, selected research projects are now presented from the USA, Europe and Asia, which examine the effect from Corporate Social Responsibility on the consumer.

4.1. Research in the USA

A study by Brown and Dacin can be understood as the basis study concerning this subject. In 1997 the authors found a positive effect of Corporate Social Responsibility information on the enterprise and product judgment by consumers. [10] Sen and Bhattachary proved that CSR information have a positive influence on enterprise judgment and purchase intention [11]. This could be confirmed by Moor and Webb. Besides, it appears in their research that information about a low enterprise engagement affects the evaluation more strongly and that CSR information has a greater impact on the purchase intention than the price. [12]

Becker-Olsen, Cudmore and Hill stated a high fit between engagement and enterprise, the perception of social-motivated reasons and a proactive CSR initiative as treats for the enterprise evaluation and purchase intention [13]. A positive influence of CSR awareness of consumers on attitudes toward the enterprise, identification with the enterprise and purchase intention is indicated by Sen, Bhattachary and Korschun [14]. Green and Peloza demonstrated in a qualitative study a change in consumer behavior to the effect that consumer think extended about purchase, shop less and budget their money [15]. At the end the enterprises act unethically, the consumer trust decreases [16].

4.2. Research in Europe

In a European survey, 70% of the sample stated that Corporate Social Responsibility is important to them if they select a product or service [17]. Rommelspacher reveals that a higher state of CSR information as well as brand knowledge leads to a superior judgment of CSR and a higher judgment of CSR leads on to a higher purchase intention concerning the brand in Germany. Nevertheless, corporate ability influenced the purchase intention toward brands stronger than CSR. [2] In addition, the acceptance for CSR rises for German consumers, the perception altruistic values is greater, the spatial proximity is greater, the consumer is more social, the education level is higher and the individual interest for CSR is higher. [18] An Austrian study shows that just few consumers perceive CSR or have an awareness of this.

Nevertheless, if consumers obtain CSR information it affects the purchase intention positively. But CSR is seen just as subordinated purchase criterion. [19] Furthermore, perceived ethnicity influences brand trust, brand emotions, product trust and brand loyalty positively. [17] A Greek study appears that the perception of profit-oriented CSR motives and high service quality affects patronage and recommendation intentions negatively. Independent of perceived service quality perceived positively motivated CSR has a positive influence on this.

An important moderating influence factor is trust. [20] Padapopolus et al. indicates that Greeks have a critical attitude toward their enterprises but that the perception of CSR influenced their attitude positively. [21] Concerning the East-European countries a Rumanian study with leaders of Rumanian enterprises shows that CSR is not well integrated because the meaning of CSR is not clear enough, low budget for this term, no existing society pressure and no acceptance in the society for this term. Besides, the profitability for the enterprises is unclear. [22] It shows differently in Croatia. There the implementing situation of CSR improves, because enterprises realize the importance of this issue. [23]

4.3. Research in Asia

A Chinese study states that many Chinese have not heard something about CSR. Married people show more interest in the subject than Singles. Also the subject has a bigger influence on women than on men. [24] Furthermore, a higher level of awareness of CSR comes to a higher purchase intension. Equally, a higher level of perceived CSR effects corporate evaluation, product association and purchase intention positively. Consumer’s trust of CSR moderates the effect between perceived CSR and corporate evaluation. [25] A Korean research detects the positive effect on consumer awareness of CSR on purchase intention [26]. Nevertheless, a Malaysia investigation shows that there exists just a weak connection between CSR and purchase intention so that there must be other more important purchase criteria [27].

4.4. Cross-national Studies

Singh et al. shows that CSR is less known in Spain than in United Kingdom and that consumers in United Kingdom are more interested in social and environmental concerns than Spanish consumers [28]. It appears that the influence of CSR on purchase behavior is stronger for German and French consumers than for American consumers. For American consumers, the economically responsibility is more important than the ethical or the discrete one. Different, however, Germans and French evaluate the legal, ethical and discretionary responsibility stronger than the economic responsibility. [29] A replication of this study in Hong Kong and Shanghai shows that the economic responsibility is perceived as most important.
The importance of the responsibility dimensions decreases
along legal, ethical and discretionary responsibility. Indeed, the
economic responsibility is different in Shanghai than in Hong
Kong and is not seen as part of CSR. [30] Bartikowski et al.
found in a comparative study between France, United Kingdom
and USA that culture has a moderating effect on the perception
of CSR concerning customer loyalty [31]. A study between
Australian students, Hong Kong students and Australian
members of Amnesty International demonstrates that buying
intentions changes if products are presented with different
social attributes. Thereby the evaluation of social criteria’s was
more important for the members of Amnesty International than
the students. Furthermore consumers are willing to pay more
for products with social responsible attributes if the
functionality does not suffer. [32]

Overall it seems as if CSR influences the consumer behavior in
the USA, European and Asia in a positive way. Additionally,
further influence and mediator factors are presented. Moreover,
already presented results, for example through a Rumanian
survey for East-European countries, could have been
confirmed. They show that there are differences reasoned in
different historical, cultural and political circumstances. Based
on these results and a German research gap concerning an
overall construct which is independent from brand behavior
and brand effects, a research project was conceived to research
the perception and their effects from CSR to consumer’s
behavior in Germany.

5. EMPIRICALLY STUDIE: CORPORATE SOCIAL RESPONSIBILITY IN GERMANY

5.1. Literature review, hypothesis generation and
study construction

The empirical research is divided in two parts. The first section
examines the influence of perceived CSR, trust of CSR and
awareness of CSR to corporate evaluation, product association
and purchase intension. This replicated a Chinese study from
Tian, Wang and Yang. [25] Theoretical foundation is the
Information Processing Theory, after what consumers perceive
CSR information’s, assess the truthfulness of the CSR actions,
aff ect from this inference about the enterprises or their
products and react to this in terms of purchase. This concept
agrees with the important variables consumers’ awareness of
CSR, their trust of CSR, their company evaluation, their
product association and finally their purchase intention in CSR
consumer research. The last three variables are generally
affected by the level of perceived CSR. [25] According to that:

H1: A higher level of consumers’ perceived CSR conducts a
higher level of consumer answers to CSR which are a) 
corporate evaluation, b) product association and c) 
purchase intention. [25]

Consumer awareness of CSR means the extent in which way
consumers are aware of CSR in their consumption. Even this
depends on country-specific political tradition, culture and
economic development and varies throughout the countries;
nevertheless consumers with a high level of CSR awareness
should better understand these activities and show a more
positive reaction to this than consumers with a lower awareness
of CSR. [25] According to that:

H2: A higher level of consumers’ awareness of CSR conducts
a higher level of more positive answers to CSR which are
a) corporate evaluation, b) product association and c) 
purchase intention. [25]

Consumer trust of CSR means consumer expectations that the
enterprise which implemented CSR will act in a sincere and
favorable way and fulfill the CSR actions and their
commitments without opportunistic motives. Research has
shown that trust of CSR affects attitudes responding to CSR.
[25] According to that:

H3: Consumers’ trust of CSR mediates the relationship
between consumers’ perceived CSR and their responses
to CSR which are a) corporate evaluation, b) product
association and c) purchase intention. [25]

The second part of the research work explored generally
perception, attitude and associations regard the term CSR of
the German participants. Because this section is an explorative
elevation, there were no hypotheses generated.

5.2. Method

5.2.1. Data Collection

An online survey was conceived and the link of the study was
put on the social media platforms Facebook and Xing with
request around forwarding. Beyond several e-mails were
sending to contacts, which are not available over the social
media. The elevation runs from 10th of August until the 31th of
August 2012 in Germany.

5.2.2. Measures

According to the Chinese study, in the first part of the study a
CSR report of a fictive enterprise is introduced to the study
participants. The CSR report was adapted to the German
situation and circumstances. After this the questions started
concerning the hypotheses and involve the perceived CSR,
trust of CSR, awareness of CSR, corporate evaluation, product
association and purchase intention. The single items were
used from the Chinese study and translated into German. The second
part of the study focuses on general questions: if the study
participants have ever heard from CSR before, how strong their
interest is in the issue, how important they see CSR in general,
what they associate with the issue, which elements of CSR are
important for them, which information they use to inform about
the issue and how important regional, national and
international CSR activities are to them. Answers were
measured about a seven-point Likert scale. The response
categories concerning association, importance of different CSR
elements and resource of information are developed referring a
German study about the acceptance of CSR in Germany [18]
and considering notes from a pretest. At the end of the study,
there are demographic questions like age, gender, education
achievement and income.

5.3. Results

The results will be presented on the conference and discussed
in accord with the results of the internationals studies.

6. CONCLUSION

State, society and economy are confronted with new
challenges. As a result of this, there is a growing consciousness
of public and consumers to social responsible behavior.
Moreover, they demand high standards of enterprises and their
products and require a social and ecological behavior of
enterprises. The discussion and the characteristics of the
takeover of social responsibility of enterprise is led under the
term Corporate Social Responsibility. The paper reveals that
CSR is a historical growing issue, which distributes around the
whole world.
Nevertheless, the discussion and the implementing from CSR varies across the countries because of different cultural, political and economical developments. One of the main issue for enterprises is the question how CSR affects consumer behavior. Because of country-specific differences this varies also across the countries. Nevertheless, empirical research shows that CSR has an influence on consumer behavior even if there are cross-national differences.

A German study was conceived to research the perception and influence of CSR on consumer. Results will be shown and discussed and compared to previous results at the conference. Independently, the prior empirical research from East-European countries shows that CSR is more and more perceived and important. Additionally, an Australian study reveals that there is not a huge difference between countries but also in the group membership. As a result, CSR was more important for Australian members of Amnesty International than for students from Australia and Hong Kong.

Summarizing, CSR is a global issue and contains a lot of possibilities for the state, the society and economy. Perhaps

7. REFERENCES


THE IMPORTANCE OF ENERGY SOLUTIONS FOR A SAFE AND RATIONAL DEVELOPMENT

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ABSTRACT: A new industrial revolution is on the verge in the energy domain considering the knowledge and skills acquired through the development of new energy technologies. Shale gas processing, unconventional oil exploitation, new exploring/drilling methods, mature renewable energy or in progress, all generated a wealth of knowledge in new technology. Therefore, this paper aims to analyse the positive and negative aspects of energy solutions, and to reveal the way to a world where a valid sustainable development, based on safe and rational premises, is actually considered. The paper also introduces suggestions for the energy system, which has a crucial importance in coping with the resource management of the future, where the economic, social, and environmental/climate needs of the post-crisis world should be suitably considered.

Key words: energy solutions, sustainable development, resource management.

1. INTRODUCTION

We live in a very complex world, which advanced remarkably in the development of new energy technologies throughout successive waves of energy substitutions of the past. From the intense use of coal in XVIII century and extensive use of oil in the XX century, to nuclear power and modern renewable energy sources (RES), all generated a wealth of knowledge in new technology. Over two centuries, by using exceptional skills and knowledge, fossil fuels have been converted into affordable heat and electricity that powered our modern society. After two industrial revolutions and major energy transformations, 1970s brought the anxiety about the scarcity of fossil fuels, combined with their effects on soil, air, water quality and also climate change concerns. Since then, major transformations have been noticed and considering the recent advances and new promising technologies, the XXI century will definitely bring a new industrial revolution based on new energy sources and systems, but supported by a legislative major transformation.

Energy is considered a crucial player within the sustainable context, as it has a key role in the global economic development, but also major effects on environment. Unfortunately, many of the current methods of energy supply and use are environmentally unfriendly, throughout the energy chain that links resource extraction to the provision of energy services [1]. Nevertheless, energy is a necessary, yet not sufficient, condition for economic growth, poverty alleviation, improving of human welfare and progress towards wellbeing, essentially shaping the living standards of the modern society. Diversifying the energy supply is a major challenge for any national economy and also is the consideration of the environment, therefore RES are seen as solutions to a low-carbon based economy. However, RES also came with their baggage of limitations, which will be further presented, and should be carefully tackled. Consequently, the green technology, perceived as a solution to the environmental problems, should not be used as a panacea to cope with the complex problems of economies and ecosystems, but instead carefully analyzed and solutions for specific locations found out.

Consequently, the present paper investigates the positive and negative aspects of energy solutions, and reveals the way to a world where a valid sustainable development, based on safe and rational premises, is actually taken into consideration.

2. ANALYSIS OF GLOBAL ENERGY LANDSCAPE

Since 1970, total primary energy consumption has grown by 142%, all the fuels being on an increasingly slope, fossil fuels on a steeper one, while hydro energy, nuclear power and RES on a milder one. Despite the torrent of information and anxiety over the extensive use of fossil fuels and their effects on environment, in 2010, about 87% of the primary energy use worldwide comes from fossil fuels [2]. In 2010 the world energy consumption was around 12,000 million tons oil equivalent (Mtoe), about 87% of this being represented by fossil fuels (10,407 Mtoe), while the RES accounted only for about 8% (945 Mtoe) [2] (see figure 1).

By analysing data over the last 40 years, RES have achieved a strong growth since 1970. From a value of the global energy consumption of RES of 270 Mtoe in 1970, to 653 Mtoe in 2000 it reached 945 Mtoe in 2010 [2], recording more than a triple increase in absolute values. Despite the increase in absolute values, as a percentage of total energy consumption, RES contribution to energy supply was rather modest during the 1970 - 2010 interval, in 2010 recording a value of 8% [2, 3]. These low figures are to be judged in contrast with the large subsidies granted for the green development. International Energy Agency estimated the global subsidies to renewable power to 66 billion USD in 2010, while the subsidies for fossil
fuels totalized an estimated 409 billion USD [4]. Based on these data, the estimated subsidy per consumed toe of renewable energy was significantly higher than for fossil fuels:

- 69.84 USD/toe of renewable energy
- 39.30 USD/toe of fossil fuel

![Figure 1. Mutations in the energy landscape over 1970-2010 interval.](image)

The European Union (EU) is a global leader in creating a new climate framework, therefore its energy policy has evolved through several stages since the 1970s. The current ambitious goals translate into the assuming of a triple quota by 2020: a 20% energy efficiency increase, 20% more RES utilization, and a 20% reduction of green house gases (GHG) [5]. However, all three priorities have weak points. The energy efficiency programs must be properly designed, as they may lead to increased consumption of resources meaning a higher overall energy use. “30% of the gains from energy efficiency are lost because the savings are put back into energy-consuming activities” [6]. The green revolution based on RES, an inspiring initiative, may be unfortunately another bubble and a way of profiting from climate change. Last, the 20% quota for GHG reduction should be accomplished by setting targets on industry and energy systems, or otherwise, the decrease in GHG may come solely from a slower economic activity than in the past. In such a way, unfortunately, the EU “is now learning that moving towards a world with more renewable generation not only may solve problems, but also may create new ones” [7]. Therefore, the answers must incorporate a rational view and the future energy solutions must be based on safe and rational premises.

### 3. ENERGY SOLUTIONS FOR SAFE AND RATIONAL DEVELOPMENT

#### 3.1. Energy solutions based on classical fuels

Presently, the energy cannot be at the same time stable, fully available, affordable and environmentally sound, therefore safe and rational solutions are to be considered in the road towards a valid sustainable world. We find ourselves in a transition time, when it is impossible to switch off coal stations, oil engines production or nuclear stations based on fission. Therefore, humanity should adapt to this transition period and instead of dismissing fossil fuels and former practices, better and improved technological solutions must be considered in the quest towards a low carbon future.

Fossil fuels are of key importance for economic growth, as non-fossil energy type cannot play the same role as fossil fuels in promoting global economic growth [8]. The rate of utilization of fossil fuels may be kept under control, whereas in the case of RES this is impossible, as they are mostly correlated with variable energy type. Moreover, in the case of the production of secondary energy, the fossil fuels cannot be easily replaced, like oil for transportation and petro-chemistry. Therefore, wise solutions must be thought that incorporate new solutions for fossil fuels, conventional or unconventional, in a quest to become more sustainable, with less impact on local (by releasing toxic spills on soil, water and air) and global environment (through the release of GHG gases).
Coal use should imply proper technologies and investment in cleaner processes and neutralization of emissions, and also the development of carbon capture and storage (CCS).

Oil utilization should involve more efficient engines. In addition, investments in innovative science and technology new exploring/drilling technologies to access the deep and more “expensive” fossil fuels equipped with cleaner safeguards are needed.

Natural gas use should be fostered as it represents the cleanest fossil fuel and it smooths the path towards achieving both economic and environmental targets of the future. Natural methane and liquefied natural gas (LNG), with important technologic improvements and regulations, should be considered the main actors for fuelling of a cleaner future.

Shale oil and gas are valuable resources with tremendous potential located on the subsurface (about 7,000 meters below ground level), or offshore [9]. However, the hydraulic fracturing that is commonly employed to release the liquid/gas from the sedimentary rocks is expensive and controversial, the problem relying on the economic and environmental effectiveness of the oil/gas retrieve. The ground water pollution may be overcome if the offshore locations are tackled first and the technology is allowed to advance.

Gas hydrates represent natural gas trapped inside crystals, and great resources are considered to be located under Arctic permafrost and offshore [10]. Their huge potential is not yet commercially available, but dedicated research is underway.

Nuclear power must be improved technologically and more investment is needed into safety issues, considering the recent evolutions from Japan and vulnerability towards natural catastrophes and human error.

Combined heat and power (CHP) represents an efficient solution with lower emissions than separate technologies for fossil fuels and biomass that aims the recovery and use of the heat resulted from electric power-generation.

3.2. Energy solutions based on RES

RES are very important for a diversified mix of energy sources that safeguards the global need of the security of supply, but also the environment [11]. However, they came with important limitations, depending on the type, and all of them should be reconsidered when speaking about green economy and their economic and environmental viability. Moreover, the green growth is not sufficient to support the actual consumption rate for energy resources [12] and, at the same time, RES are not sufficiently low-carbon in nature to regenerate the atmosphere. The 12 main weak points of RES sources are:

1. lower energy density per volume than fossil fuels;
2. intermittent supply and limited locations;
3. challenging harvesting, transport and distribution;
4. high initial capital costs;
5. higher transaction costs per KW than fossil fuels based power plants;
6. vulnerability to natural/terrorist hazards;
7. new green subsidies and incentives, feed-in tariffs;
8. increased prices for consumers;
9. lack of delivery infrastructure;
10. grid extensions and costly improvements;
11. indirect effects on environment and ecosystems;
12. controversial not-in-my-back-yard attitudes.

Therefore, RES must be placed under the magnifying glass of the safety dimension and analyzed accordingly with their impact from the production site to the delivery site.

Hydropower, the largest source of renewable electricity in EU, is only efficient when speaking about small size hydro-plants (up to 10 MW). Otherwise it has a large impact on ecosystems and human life leading to loss of land and habitat, displacement of communities and water-related diseases. Moreover, the dams are vulnerable to earthquakes and terrorist attacks, and also threaten the rivers’ wildlife.

Wind energy, the fastest growing RES from EU, is efficient especially when speaking about large-scale projects, but when it comes to small-turbines their production and shipping generates more CO₂ than save. Moreover, the turbines have an impact on the quality of life of different ecosystems, generating persistent noise, scenery and pristine nature beauty loss, and also rising ornithology concerns. At the same time, the best locations have already been used in several countries, so a potential development rests on the more expensive offshore.

Solar energy also leaves a mark when speaking about the production and disposal of polysilicon needed for photovoltaic energy. Regarding the production, aside the large amount of energy required, the byproduct of polysilicon is represented by a highly toxic substance, silicon tetrachloride, which has to be properly recycled and disposed, involving more energy consumption. Moreover, the lifespan of solar panels is estimated at 20-25 years, so they will have to be properly collected and disposed.

Biomass should be sustainable used, at a pace of consumption equal with the natural replacement rate [11]. Bioethanol production requires more land made available for ethanol producing crops this leading to a diminishing of forests and agricultural cultivations. Moreover, the process also implies fertilizers and pesticides that affect the soil on long term. Even with the second-generation of dedicated energy crops (like perennial tree, different grass species), there are several drawbacks including the massive consumption of fresh-water, threats for local biodiversity and it also generates air pollution. Biomass also incorporates less energy density than other fuels, and only those resources coming from wastes and residues from organic agriculture that are ecologically collected and not used for soil/animal activities are to be considered safe for utilization [13, 14].

Algae oil/algagal oil represents a promising replacer for traditional oil [15] and is extracted by different methods from algae or microalgae that are grown in open or closed photoreactors. However, the fresh water demand is high considering the stoichiometric demands, but also the cooling of reactors. The energy requirements are significant and the waste generated is very important, as 99.8% of the material is waste. Nevertheless, recent research [16] shows that the water management may be optimised and, by employing improved reactor designs, the energy demand may be also optimised.

Geothermal power comes with concerns regarding the safety of its production as it might be connected with the generation of local earthquakes [17]. Moreover, the development time for such a facility (permits, regulations, drillings, financing, etc) may take several years and also is accompanied by toxic discharges.

Ocean/waves energy is the energy produced offshore by ocean waves and accounted 250 MW in 2010 in EU [18]. However, it needs significant grid extension and improvements to reach land regions.
Tidal energy represents the energy generated by tides and the dams are generally built on rivers’ estuaries. However, they are characterized by high initial capital investments, also affect the marine life and are very vulnerable towards severe weather conditions.

The development of electrical vehicles is considered a solution to replace oil for transportation, as the automobile does not directly produce any emission. However, the charging of the battery involves consumption of electrical energy, which might be unsustainably obtained, leading to indirect emissions.

Hydrogen may not be yet considered as an important clean energy vector, as any new energy technology needs important time before reaching maturity and substantial market shares. It needs a proper development of technology and infrastructure, but it may contain the answer for the future.

A wealth of new technology, like blue energy, helioculture, piezoelectricity, ocean thermal energy conversion, etc is available and seems very promising, but is not yet commercially available.

The social and economic aspects of RES must be also taken into consideration by properly balancing the new and the suppressed jobs. The new green jobs created by RES are lower than expected [19] and we believe that they are a better solution when speaking about local development or in rural/isolated areas.

3.3. Solutions for a safe and rational energy management of the future

The technologic advances in exploring, drilling and producing energy made possible the present energy landscape, where unconventional fossil fuels, previously regarded as expensive and unattainable, should be reconsidered and sustainably used. From 4-D seismic, laser drilling, steel-cased wells, improvements of sub-sea installed water separators for oil [20], gas-to-liquid technology, based on Fisher-Tropsch process but with improved catalysts, to production management that incorporates fiber optics and robotics, all contributed to the new role of unconventional fossil fuels.

The quest towards RES must not be tackled emotionally and should not interfere with the wellbeing of the present generation, as the energy problem of tomorrow should not become a financial and economic problem of the present.

The energy problem has a tremendous effect on global wellbeing [21, 22]. The recent crisis and recent evolutions thought us that the economic effects of a crisis are interlinked with the dynamics of oil price [23]. We may assert that the majority of economic downturn registered after 1970 were preceded by a sudden increase of oil prices, as portrayed by figure 2a. Since 1970s, when the Stockholm Conference on the Human Environment (1972) acknowledged the importance of energy for a sane economic, social and environmental development, the global economy has passed to a vortex of oscillations, each decade from the interval 1970-2010 being characterised by one/two major crises. The primary energy consumption followed closely the economic slowdown/growth, as revealed by figure 2b. Since the 1970s, when the first oil crisis has hit the global economy, several deep crises have changed the world landscape.

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**Figure 2.** The interlinking effects of the crises of the last 40 years: a. correlations of GDP - oil price; b. correlations of GDP - primary energy consumption (OPEC – Organization of Petroleum Exporting Countries).

*Source: data processed from [2] and [24].*
The crises of 1970s (denoted 1), 1980s (denoted 2), 1990s (denoted 3), 2000s (denoted 4) and the current crisis that started in 2010 (denoted 5) brought high unemployment figures, fiscal insecurity and environmental degradation all over the world. The crises had tremendous effects on individuals over the years, in terms of exposure to poverty, vulnerability to a changing economic environment and even the security of their own lives. The present ongoing recession, the concerns about the resources scarcity and constant environmental damage should find a conclusion and the answer incorporates a safe and rational approach of energy sources.

The solution to all these problems is based on a smart mix of new energy policies and regulations, new energy sources and technology, involving also “clean” technology based on fossil fuels, safer nuclear energy and energy-efficiency programs. But above all, it must consist in a behavioural change, where the wastes should be kept to minim levels, both for individuals and companies. Fossil fuels subsidies must be responsibly phased out, while RES large subsidies must be rationally and should be granted only for the advancement of clean technology, but depending on their maturity degree. Market competitiveness should be the main driver of a specific mature technology. Recently, several countries of the EU considered phasing out the significant subsidies for wind and solar energy, as Spain and Germany, in a quest to achieve real market competitiveness, but also to reduce costs considering the ongoing crisis [25, 26]. Moreover, the green growth has to be safely and rationally tackled, as it may lead to another bubble, as that of the crisis of “dot.com” in 2000. The global new investments in RES reached 211 billion USD in 2010, recording a 32% increase in comparison with 2009 values [27].

The investments in new clean exploring, drilling, processing, waste disposal and transportation technologies of fossil and nuclear fuels should not be dismissed, but pursued with priority considering the energy and environmental needs of the present and the foreseen ones for the future.

Technology, traditional or modern, must be introduced considering their competitiveness in specific regions, as one might be unaffordable in certain regions, while in other proves to be the right answer. Another factor relies on the culture of a country and the behaviour of its inhabitants, consequently efficiency solutions are to be selected depending on region. Therefore, proactive measures that involve the collaboration of all stakeholders (companies, local and central authorities, research institutes and universities) are to be considered for each region, depending on their specificity.

4. CONCLUSIONS

The energy landscape is rapidly evolving and in the absence of a free/affordable energy source based on water/hydrogen or a stable nuclear fusion, the future will be shaped by the safe and rational use of fossil fuels, conventional and unconventional, and RES. Considering the increasing high oil prices, the unconventional deep and more “expensive” fossil fuels will become affordable and an economically feasible solution.

A new industrial revolution is on the verge in the energy domain considering the knowledge and skills acquired through the development of old and new energy technologies. Innovation and creativity are the main keys towards a smarter future and the present crisis may constitute the proper catalyst in achieving the desired wellbeing of the present and future generations by accelerating the transition to a cleaner and safer global economy.

In a quest towards energy self-sufficiency, the interests of the authorities should not interfere with the wellbeing of the present generation and the energy problem of tomorrow should not become a financial and economic problem of the present.

The energy solutions based on classical energy sources, conventional or unconventional, like oil, coal, gas, nuclear, have a strong potential as the possibilities of controlling the environmental risks have growth since the 1970s. The energy solutions based on RES should be pursued, but rationally and safely and must be introduced considering their competitiveness in specific regions. The hidden costs are to be identified for each energy source and energy efficiency plans, smart waste management solutions are to be pursued with responsibility considering the current and future needs and lifestyle.

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6. REFERENCES