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FOREWORD

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

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

The coverage of this special issue includes but is not limited to the following subjects:
1. Entrepreneurship education and research
2. Innovative new methods for engineering and business education
3. Collaboration in engineering and business education
4. Knowledge management in engineering and business education
5. New curricula development
6. Quality management in engineering and business education
7. Multimedia in engineering and business education
8. Social and philosophical aspects of engineering and business education
9. Management of engineering and business institutions
10. HCI (Human Computer Interaction) applications for educational purposes
11. LifeLearn and the European Qualification Framework

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

Constantin Oprean
General Chairman of the Conference
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NEW CURRICULA DEVELOPMENT
**GROUND RULES AND BENCHMARKS FOR ENVIRONMENT PROTECTION INTEGRATION IN UNIVERSITY EDUCATION**

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**ABSTRACT:** The magnitude of ecological problems and social activities aimed at the protection and quality of the environment both at national level and at international level impose the need for rapid and different changes in the educational systems of many countries. Modern educational theory, practice and recommendations of the international organizations are leading to the ecological system at the high education level. In order to understand the need and the importance of ecological factors and laws in the occupational field, the connection between ecological and professional aspects of student's future professional activities, it is necessary to understand the environment protection as the necessary content and principle of educational work at the university. The paper has as goal to synthesize the educational needs of the academic population and to highlight the educational program orientation in the environment protection field for different segments of the high level education system.

1. **INTRODUCTION**

Taking into consideration the origins, historical development, foundation, many centuries of existence and tradition of the university, as well as the fact that the education for the environment protection represents a new concept, a new philosophy of education is needed. This should provide an answer to numerous difficulties and problems that occurred in the second half of the XX century. That also caused the need for the introduction of this „innovation” into the system of high level education. While the problems of the environment became that serious, that was impossible to ignore them, they provoked the reaction of many universities which concentrated their attention on some questions and problems of environment. New departments and faculties were founded within the universities, which were engaged in problems of engineering and the protection of the environment or, on the other hand, the whole university dealt with the problems of the environment protection. Whatever was done, there is no doubt that the universities urged further developing of education for the environment protection at the high level education in many parts of the world.

Valuable contribution to the development of education for the environment protection at the high level education was offered by many international organizations (UN, OECD, IUCN etc.). At the scientific events hosted by these organizations some important documents and recommendations were adopted otherwise related to the goals and tasks of education for the environment protection, curriculum, methods, organizational and other problems of high level education [3].

2. **GENERAL KNOWLEDGE AND SKILL DEVELOPMENT**

Even though we live in countries with different universities, different students’ population attending those universities and supporting the social and economic system of their countries, with different problems of environment, still we can say that there is a lot of common characteristics among universities from different places when we talk about the education for the environment protection.

Achievement of education for the environment protection at the high education level must begin by defining the goals and tasks of this education, in fact, answering questions, such as:

- Which is the target?
- What shall we accomplish in the future?
- Which are the potential envisaged results?

The basic target of education for the environment protection is what should be in common to all universities, namely, the formation of opinions, views and models of behavior by the future experts which will enable versatile, precious and efficient taking into consideration the ecological ideas, aspects, factors and laws in their professional activities.

One of the most current tasks of modern high education is related to the transfer from an informational-communicative teaching to a modeling-based one. That kind of transfer brings changes in understanding the essence of high education as well as its basic determinants, goals and contents of teaching, in fact, it means consolidation and breaking-in of proper models that are significant for high education teaching.

Nowadays, in the practice of most Romanian universities the goal of teaching is formation of certain systems of knowledge and skills. It is considered that the certain amount of ecological humanitarian knowledge is satisfactory, and that this knowledge is automatically „involved” with professional knowledge, leading to necessary integral effects. It does not only lie in the formation of curriculum but it also concerns what professors and lecturers call „knowledge giving”. Of course, you can „give”, but you firstly must create such conditions for students that allow them to adopt the knowledge and use it in a proper way.

Employers will not be interested in what the graduate knows, what is important to him is how well and how professional he will do certain assignments. From this point of view, it became extremely important that the expert, by accomplishing his tasks, should to realize the ecological aspects of his professional activity.
For the modern expert, the „rule” of knowledge is a necessary but not sufficient condition, but if he applies his knowledge efficiently he will then create the conditions that are needed for professional ecological activity in different living situations. One of the goals of curriculum and educational work at the high education level should consist of developing students' abilities to analyze environment problems, finding out causes and effects, and, in fact, explaining the conditions under which certain processes happen and what their consequences are regarding the quality of environment. The results of some research projects showed that a great number of students are interested in problems of the environment protection because they observe them as closely connected with political and social problems [2]. At this level of formal education, like in the previous ones, there is need for a holistic, universal approach to the environmental problems.

The mission of the university professor is to support the student analyzing and solving problems and adopting the knowledge to the level of the scientific analysis and scientific research. Scientific exploration leads to the new realizations and new facts, which have to find their way and practical application in everyday life. In this way it provides participation in solving practical problems of the environment which, unfortunately, is not present yet in curriculum at the university. On the other hand, participation, acting, engagement emphasizes the human skills of man and knowledge. The practical information which should be adopted by the students, during their curriculum, should be connected with carrying out certain actions because they are primary in this process (adopting information as knowledge is secondary).

So, we exceed the traditional determination and definition of goals („give knowledge”) and we are brought closer to the so-called objectives-results, objectives-effects, which reflect changes in our awareness. In other words, we are reflecting desirable changes in knowledge, abilities, ideas, habits, behavior and views toward nature and society. The overall goals of education for the environment protection are divided into four groups (historical-factual; personal-social; eco-social and eco-professional); each group includes not only content aspects, but also certain levels of adoption of the given contents [1]. Reaching the goals of the next level (group) is possible when the goals of the preceding group are reached [1].

The „output” in hierarchy is that group of eco-professional goals whose achievement provides respect for ecological factors and consideration of ecological laws in professional activities and acting. This requires the complete fulfillment of the previous group of objectives, namely:

- **historical-factual**: study of ecological development, ecological problems, ecological view of the world, etc.;
- **personal-social**: the development of ecological consciousness, moral, responsibility, values etc;
- **eco-social**: understanding the meaning and contents of interaction between ecological, spiritual, economical, political, legal and technological aspects in the development of the society. This also involves the development of ecological culture and proper perception of the role and place of ecological culture in system of forms and types of culture, etc.

Great accent must be put on adequate understanding the links and interactions between ecological, professional and organizational culture, on the ability to analyze reciprocal influences and conditions of ecological and professional aspects of the expert opinion. Specific methods are required for evaluation of results that influence professional activities in natural micro and macro environment, of the ability to diagnose, predict and foresee the environmental problems employing expert reasoning, etc.

In order to realize the importance of ecological factors and legislation in professional activities, links and interaction between ecology and professional aspects of their future professional activity and job, it is necessary to integrate the content related to ecology and environment protection in all the subjects approached at the high education level.

Obviously, the contents of education for the environment protection must become a compulsory component of education at the high education level. The environmental protection must be considered as a principle of curriculum and educational work at the university. This way, the conditions are created, for example, for the students who study chemistry to realize that their responsibility does not end when they release wastewater into the sewage system. The students will have to learn about the importance and characteristics of wastewater in technological process, its production, its release, and its influence to the environment, what the possibilities for prevention and the environmental protection are. This is the same for the experts from other faculties, doctors, economists, lawyers, architects whose responsibility in their professional activities also influences the quality of environment.

If students are not interested enough in problems of environment, and the professor does not motivate them in a proper way, this way of bringing the education for the environment protection into the high education level will not be successful. Most of the teaching staff thinks that their subject is one of the most important ones for students. This attitude can be considered as reasonable, even necessary if we have in mind that the enthusiasm and value of what is taught is one of the basic prerequisites for an efficient activity. Difficulties are not just of psychological but also of intellectual nature because most of the teaching staff has classic education and they mostly lack proper ecological education.

There is no doubt that specialization is a necessary process in a developing career. But lately, what is more important is integration of different aspects of a problem, so it can be said that de-specialization becomes the process of scientific development. Consequently, future experts and researchers should be prepared for the education of environmental protection, especially the teaching staff at the high education level. During the studies students should have the opportunity to attend the introductory courses about the environmental protection and its problems.

Certain authors consider that these courses can be common for all students, including the contents related to biosphere, man and biosphere, environment and human society, politics and action methods [4]. Of course, the new ideas and conceptions that are connected with the problems of the environment are requiring continuous improvement of the contents of curriculum, maximum elasticity in their use. Quitting rigid and stereotype courses became also a basic requirement.

### 3. THE EXPERT PROFESSIONAL EDUCATION SYSTEM

In order to significantly improve general and special knowledge and abilities for the environment protection and to develop the existing capabilities for professional and specific actions in everyday living situations, the education of the expert who will work on general and special jobs and problems for the environmental protection is of great importance.
Presently, two basic trends and conceptions for education of these experts at the high level education do exist:

- advanced study and specialization of experts of different profiles for certain problems of environmental protection by postgraduate studies and by scientific research work. The postgraduate degree involves adequate courses building upon the previous specialized academic profile in which an interdisciplinary aspect should dominate.
- education for special profile, by graduate studies according to the special integral curriculum of education leading to the title of an expert.

Despite the fact that the above-mentioned conceptions are interpreted in different ways or they involve opposite attitudes and determinations, they do not exclude each other in the pedagogical sense. On the contrary, they are complementary and they should develop simultaneously.

The basic argument that the appeal to autonomous education is based on several specific problems requires a complex and integral approach, rather than a partial one. Successful mitigation of hazards in the environment means to develop the professional knowledge which maximally responds to the principles and standards of effective management of the ecological security; it also involves minimum compensation level of the ecological damage, in every phase of the industrial production.

Efficiency of this knowledge should be assessed from the position of possible prevention of ecological damages which would occur if there were no guarantees for ecological security of projects, technology or production that would lean on adequate methodology and knowledge base.

Environmental risk factors acting initially in a certain phase of production are in correlation with the phase and they increase with geometric progression. It practically means that efficiency of prevention of any final ecological damage is bigger if prevention measures for ecological security are undertaken in an earlier phase of production. This principle is built into the foundation of methodology and professional strategy for the environmental protection.

While ecological security represents a complex as well as an inter- and multi-disciplinary area, the experts have to perform various activities in their professional actions, namely those that are analytical organizational practical jobs and problems in the field of environmental protection. They also have to deal with scientific-research work and tasks to solve complex problems of the environmental protection and to spread knowledge and experience from this scientific area through education forms existing at this very moment.

Consequently, the universities should focus their education on the environment protection as well as on the complex nature of all occurrences that are connected with it. Furthermore, this means that the program conception of these institutions must include aspects which are in relation with natural and chemical, as well as with social sciences. An inter- and multi-disciplinary training for the environment protection must develop knowledge and abilities of students in the following order:

- recognition of general situation and changes in the environment influenced by different factors; discovering and recognition of potential risks in the environment;
- discovering and recognition of basic sources and causes of danger in the environment by carrying out building, production process, economic activity, the introduction of evaluation method and prognoses of ecological damage;
- carrying out the methodology for the design technology protecting nature and resources as well as the measures for dangers and damages mitigation, restoration of ecological balance in ecosystems of different type in different countries;
- applying the standards on the natural environment by carrying out building and other activities, technical ecological expertise, quality control of environment, ecological monitoring etc;
- realizing the conception of complex engineering security of production and other economy activities, modern mechanical modeling methods and measures for protection;
- adopting the necessary pedagogy and didactic-methodic foundations for successful realization of educational and informative activities in this area, etc.
- Emphasizing the economic aspects for performing the activities for the environmental protection and rational use of natural resources will be another feature of the training program. This should be linked with the realization of legal aspects for the environment protection at national and international level.

Another specific skill which is required is related to the development of the methods and measures that will solve or decrease the problem of waste materials generated from different sources, problems of noise and radiations and other progressive methods for the protection of nature and environment.

Further professional education improvement of this category of specialists involves the development of the scientific-methodological base in this field of concern, through working out of local, regional and general ecological scales according to processes of acting; research, identification and working out of methods, technology and means for prevention, prognoses, planning and carrying out of preventive measures for the environment protection; research and working out of methods, technology and means for prevention, prognoses, planning and carrying out of preventive measures for the environmental protection.

The reconstruction of affected ecosystems and the processing of exact ecological information about the dynamics of changes in particular ecosystem are representing, also, basic specialized abilities required.

The experts will be required to perform detailed analysis and evaluation of retrievable processes in natural and technical systems and studies regarding the ecological equipments, the safe and clean technology and production etc.

In the case of experts who professionally are dealing with problems related to the environment protection, it can be stated that they have the basic responsibility in this field of concern. These experts should provide other necessary conditions (educational and informative) for other people’s activities in the field of environmental protection and in the area of material production in everyday life activity. This kind of education, as any other, involves permanent education. Besides necessary coordination inter-department, inter-faculty, in fact, inter-university cooperation, each university can organize special conferences, congresses, meetings etc., in order to stimulate necessary contacts for permanent education of experts in this area.
4. TEACHING STAFF EDUCATION SYSTEM IN THE ENVIRONMENT PROTECTION FIELD

Professional and didactic-methodic education and improvement of teaching in the area of environmental protection represent an important segment of education for the environmental protection at the high education level. Its importance is completely understandable if it is known that the success of any educational process depends on the carriers of that process, namely, the teaching staff.

In recent years numerous projects and researches have been dedicated to education of teaching staff in the area of the environment protection. Many authors consider that this education should provide knowledge of ecological facts and conceptions, proper foundation in sociology connected with human ecological, development of abilities for critical analyses and grasping of problems in the environment and development of responsibilities for the environmental protection. Conceiving adequate curriculum implies taking into consideration the following aspects:

- ecology as science which studies the interactions between living creatures and the environment, including man and his environment, as well as in urban and rural regions and ecological principles connected with components of the environment and the disturbances that make changes in ecosystems;
- economic problems of rational use of natural sources as well as planning sources, application of adequate technology, exact politics in the production-consumption relation;
- sociological aspects which include:
  - proper individual and social responsibility regarding environmental issues;
  - processes of creating awareness as well as a legal and administrative system and other measures that are related to the environmental protection;
  - integration of regional planning with ecology and economic demands etc.

In addition to these aspects that are related to professional foundations of education for the environmental protection, another component of educational program should be related to the development of pedagogy and didactic-methodic abilities for realization of this education in this area.

The program conception of the teacher’s education for the environmental protection means an interdisciplinary approach. Education for the environmental protection should become an obligatory component in other subjects of natural and social sciences according to their goals and tasks, and in accordance with the problems they are dealing with.

The professional and didactic-methodic education in the area of the environmental protection should help integrate all future teachers of different disciplines and specialization from teacher’s training faculties as well as non-teachers’ training ones. This means introduction of proper contents in the area of the environmental protection not just at the level of regular studies but also at the level of postgraduate studies.

At the same time, there is a need for organization of certain educational forms for additional education and improvement of teaching staff who work in the area of primary, secondary and high education. In order to achieve the desired results in education and improvement of teaching staff in the area of environmental protection it is necessary to develop more intensive inter-faculty and inter-university cooperation and exchange of experience in the national and international frames.

5. CONCLUSIONS

As many theorists have already stressed, the 21st century is going to be the century of computer science and ecology. That is why it is logical for the environmental protection to take the key place in structure of high level education just as it is necessary for the contents and the principles of educational work to become some of the main factors for the development of modern high education. A comparative analysis of educational theory, practice and recommendations of different international organizations all point out to the trends of the ecological educational system.

The main component for ecology, as a new direction of improvement and development of educational system is education for the environmental protection. The difference between ecology and education for the environmental protection is that ecology represents the tendency of bringing in ecological ideas, principles, ecological approaches into other disciplines, but education for the environmental protection represents adopting of knowledge of different character and level in this discipline.

From the perspective of high level education, educational needs of different groups and categories of educational population can be identified. Within this context, a major role comes to the problems related to professional education of experts for the environmental protection, education of teaching staff, and education of experts of different profiles in the area of the environmental protection.

What is also important, are program and didactic-methodic problems that are related to choice and didactic transformation of ecological contents and methods, their penetration, integration and didactic-methodic distribution in a system of high education level. Regardless of educational population, program-organizational, didactic-methodic and other problems and difficulties, there is no doubt that the implementation of the environmental protection as content and a principle of educational work in all segments of high education is compulsatory.

In this way, the basic prerequisites will be fulfilled to create and develop a high education system, which will be in evolution, which will suit modern demands, ecological intentions and the needs for sustainable development of our society.

6. REFERENCES

DIFFERENTIATED CURRICULUM FOR DEVELOPING RESEARCH COMPETENCE

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ABSTRACT: The aim of our study is to identify key elements concerning attitudes, skills, values and knowledge of researcher as a start point for designing a research competence differentiated curriculum. Pre-service education and continuous education for researcher are issues with high interest in knowledge society, researcher being those who create and manage knowledge. In these conditions, our first objective is to verify if there are differences determined by experience work in researcher perception about traits, skills, values and knowledge needed in research work. The second objective is to make a framework for a differentiated curriculum. The study was developed between May and October last year and was investigated 300 subjects. For achieving the first objective we used a check-list validated into a previous study. Our data prove that there are differences determinate by experience and domain in researches view concerning attitudes, skills, values, knowledge. These differences define some psychological and behavioural models who conduct as to the first lines in designing a differentiated curriculum.

1. INTRODUCTION

The concept of competence has been increasingly used in organizations, be they learning or production institutions (enterprises, companies, etc.). Despite the popularity of the concept, there is no unanimously definition and we do not consider that this is important, given the variety of the situations when competence is the topic of discussion.

The studies interested in this phenomenon review the definitions given throughout time for the concept of competence [2], [5], [10]. In the definitions gathered by Brugman, 1999, the understanding of the concept of competence is correlated with performance. The two concepts – competence and performance – are related due to the connection between a person’s characteristics (knowledge, objectivity, skills, attitudes) and the behavioral outcomes of using these features in different contexts, that are nothing else but every person’s performances. Basically, this relation can be understood as a manifestation (performance) of a skill (competence). The definitions collected by Hyland, 1994, are also correlated with performance, but this time, with the performance at the workplace. We can talk about competence with regard to a person’s professional expertise by using a binary scale, judging the respective person as being competent or incompetent, or a progressive scale, judging the analyzed person as being in a point on a continuous line from novice to expert [5].

Van Aken, 1992 and Stoot, A., 2005, observe that, in Anglophone literature, a distinction is made between “competency” and “competence”. The term “competency” is used with reference to concrete, behavioural manifestations of a person’s capacity, useful for performance in specific aspects of a field or profession, whereas the term “competence” is utilized for broader personal capacities, useful for performance in a specific field or profession [2]. Competency can be approached by underlining personal features – starting from the question: “what personal features lead to superior performance?” and competence can be seen from the perspective of putting an emphasis on the tasks that must be achieved – starting from the question: “which are the essential elements of a task, that must be achieved?” In other words, we are dealing, on one hand, with people who work, and, on the other hand, with work and work achievements [10]. If we apply these observations to the topic of this study, we can state that we will use “competency” when we approach the researcher’s competence as a person with certain traits that recommend him for research and “competence” when we deal with the competence of research in general, and with the main elements that constitute it.

Although competent researchers are formed implicitly via academic programs, an explicit curriculum for research competence is rarely described. Nevertheless, when there is a proposed curriculum for the acquisition of research skills, only the study objects or topics are described, the concept of curriculum being approached in its limited acceptance. This is why we would like the present study to be a starting point for the elaboration of a differentiated curriculum, where curriculum has a broader meaning, involving “a complex system of decision making, managerial or monitoring processes that precede, accompany and follow the design, elaboration, implementation, evaluation and permanent and dynamic review of the set of learning experiences offered in school” (A. Crişan, 1998, quoted in [2], p.59). This approach aims at identifying some guidelines for the initial and permanent formation of researchers, starting from their perception, structured according to their professional experience, in relation to the attitudes, skills, values and knowledge which constitute the research competence.

2. RESEARCH METHODOLOGY

According to the hypothesis selected for this article, we started from the supposition that there are significant differences between debutants and experts (in research) as concerns the importance conferred to the traits, skills, values and knowledge which define the researcher’s personality. Therefore, in our study, the personality traits grouped in the four dimensions – traits (T), skills (S), values (V) and knowledge (C) represent the dependent variable, whereas research experience is the independent variable.
The tool used for the elaboration of a psycho-behavioral profile of the researcher is a checklist especially created for this purpose, which contains 110 items belonging to the 4 above mentioned dimensions. The checklist was sent in paper-pencil and in electronic format to 300 persons, debutants as well as research specialists, with different specializations. Depending on the independent variable, the batch of subjects has the following distribution in 5 intervals of research experience: between 1 and 4 years – 47 subjects (group 1), between 5 and 10 years – 52 subjects (group 2), between 11 and 15 years – 28 subjects (group 5). 180 subjects filled in the checklist, of which only 173 answers (checklists) were valid.

The hypothesis was verified with the help of statistical processing in the SPSS 11 software, Independent Samples Tests-MannWhitney U, which calculates the significance of the rank difference of the characteristics grouped in the 4 dimensions depending on research experience, the independent variable.

3. DATA PROCESSING AND INTERPRETATION

From the results of statistical processing we selected only the data with a significance threshold $p<0.05$ (table 1), which indicate significant differences between the compared groups. The groups with considerable differences are on one hand group 1 (represented by the debutant subjects, with a level of research experience of 5 to 10 years) and on the other hand groups 4 and 5 (represented by experienced subjects, with over 16 years of research work).

<table>
<thead>
<tr>
<th>Personality traits</th>
<th>Compared group</th>
<th>Average of the ranks</th>
<th>Mann-Whitney U Scores</th>
<th>$Z$</th>
<th>Significance threshold p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orderly (T)</td>
<td>1 4</td>
<td>33,20 42,70</td>
<td>432,50</td>
<td>-2,10</td>
<td>0,03</td>
</tr>
<tr>
<td>Inductive reasoning (S)</td>
<td>1 4</td>
<td>33,15 42,80</td>
<td>330,0</td>
<td>-2,07</td>
<td>0,03</td>
</tr>
<tr>
<td>Administrative skills (S)</td>
<td>1 4</td>
<td>32,46 44,10</td>
<td>397,50</td>
<td>-2,43</td>
<td>0,01</td>
</tr>
<tr>
<td>Economic skills (S)</td>
<td>1 4</td>
<td>33,23 42,64</td>
<td>434,0</td>
<td>-1,99</td>
<td>0,04</td>
</tr>
<tr>
<td>Technical skills (S)</td>
<td>1 4</td>
<td>33,05 42,98</td>
<td>425,50</td>
<td>-2,15</td>
<td>0,03</td>
</tr>
<tr>
<td>Scientific truth (C)</td>
<td>1 4</td>
<td>34,00 41,20</td>
<td>470,00</td>
<td>-1,96</td>
<td>0,04</td>
</tr>
<tr>
<td>IT Use (C)</td>
<td>1 4</td>
<td>39,81 30,28</td>
<td>432,0</td>
<td>-2,11</td>
<td>0,03</td>
</tr>
<tr>
<td>Other foreign languages (C)</td>
<td>1 4</td>
<td>39,95 30,02</td>
<td>425,0</td>
<td>-2,20</td>
<td>0,02</td>
</tr>
<tr>
<td>Confident (T)</td>
<td>1 5</td>
<td>37,57 27,62</td>
<td>349,0</td>
<td>-2,15</td>
<td>0,03</td>
</tr>
<tr>
<td>Patient (T)</td>
<td>1 5</td>
<td>37,34 28,14</td>
<td>360,0</td>
<td>-1,98</td>
<td>0,04</td>
</tr>
<tr>
<td>Problem identification (S)</td>
<td>1 5</td>
<td>37,67 27,40</td>
<td>344,0</td>
<td>-2,33</td>
<td>0,02</td>
</tr>
<tr>
<td>Fluidity of expression (S)</td>
<td>1 5</td>
<td>37,50 27,79</td>
<td>352,5</td>
<td>-2,05</td>
<td>0,04</td>
</tr>
<tr>
<td>Spatial skills (S)</td>
<td>1 5</td>
<td>31,53 41,14</td>
<td>354,0</td>
<td>-2,03</td>
<td>0,04</td>
</tr>
<tr>
<td>Deductive reasoning (S)</td>
<td>1 5</td>
<td>30,53 43,38</td>
<td>307,0</td>
<td>-2,79</td>
<td>0,00</td>
</tr>
<tr>
<td>Emotional intelligence (S)</td>
<td>1 5</td>
<td>37,60 27,57</td>
<td>348,0</td>
<td>-2,10</td>
<td>0,03</td>
</tr>
<tr>
<td>Technical skills (S)</td>
<td>1 5</td>
<td>30,76 42,88</td>
<td>317,50</td>
<td>-2,60</td>
<td>0,00</td>
</tr>
</tbody>
</table>

We may notice the fact that the dependent variables accountable for the significant differences for debutants and experienced researchers have different ratios. Thus, skills seem to be the most important in the researcher’s personality structure, with 63%. They are followed by knowledge and traits, with 18.5% each. As concerns values, research professors share the same opinion. There were not any values that constituted the object of considerable differences.

A second aspect becomes obvious if we take a look at the average of the ranks, and here the results present what the debutants perceive as important for the researcher’s profile, respectively what the experienced subjects consider relevant in relation to the same issue. The results are as follows:

- There are significant differences between debutant researchers (group 1) and the experienced subjects (groups 4 and 5) with regard to the importance granted to some traits and skills that define the personality of the researcher, in the sense that the first category gave confidence and patience, as well as skills such as: IT use, problem identification, fluidity of expression and emotional intelligence better rankings than the subjects in group two (chart 1 and table 1, the data in bold);
the data in italics).

- There are considerable differences between research experts and inexperienced subjects as concerns the personality traits, skills and value which define research competence in general, in the sense that the first category have significantly higher rankings for the following characteristics: orderly, inductive reasoning, deductive reasoning, administrative, economic, technical and spatial skills and scientific truth (chart 2 and table 1, the data in italics).

![Figure 1](image1.png)

**Figure 1.** The empirical personality profile of the researcher in the vision of the debutants (resulted from the comparison with experienced researchers)

An overall look at the differentiated perception of the two categories of subjects (debutants and experienced) with regard to what matters in the researcher’s personality structure indicates the fact that the debutants grant more importance to the instrumental aspects, whereas experienced researchers value the managerial skills more. Thus, at the beginning, the important aspects are: knowledge of several foreign languages, problem identification or fluidity of expression and emotional intelligence are important for the successful development of a researcher’s activity, these aspects must be taken into account when establishing the objectives and contents of their training program. In a previous study [1], we identified European universities which offer, via their programs, various opportunities for the development of self-confidence or for the preparation of the presentation of sequences from the PhD theses, by resorting to a series of strategies: discourse management courses, debates in limited circles regarding similar fields of interest, work meetings with the supervisors, participation to their peers’ public presentations. Moreover, patience or emotional intelligence could be developed by including them in research projects together with other peers and experienced researchers.

As concerns the objectives and contents of the continuous training programs for experienced researchers, they should focus on developing administrative, economic and technical skills. For this stage of professional development, the participants to our study, the researchers involved in the management of research programs and the management of research teams with different levels of experience, consider that management related skills are of utmost importance for defining the research competence of the skills related to management. Together with project and team management, information management is extremely important. This is why aptitudes such as inductive and deductive reasoning and values such as scientific truth are perceived as key elements for the research competence of expert researchers.

### 4. CONCLUSIONS

The performed study confirms the general hypothesis from which we started, according to which there is a nucleus of psycho-behavioural features that can be found in the
researchers’ personality and that define research competence in general, as well as the particular hypothesis that we chose to discuss on this occasion. The latter postulates the fact that there are significant differences between debutants and research experts with regard to the importance conferred to the traits, skills, values and knowledge which define the researcher’s personality.

The findings are very important to us because they show that there exists a set of traits, values, skills and knowledge that all researchers adhere to, regardless of their research experience. This is the source for the elaboration of a nucleus curriculum. Nevertheless, there are also traits, skills and knowledge that differentiate the debutants from experienced researchers, those with over 16 years of research activity, and here we can find the resources for the elaboration of a differentiated curriculum.

These data, corroborated with data describing common aspects and perception differences imposed by other independent variables, such as the field of activity and the type of research approached via the professions of those involved in the research or the subjects’ teaching expertise degree will represent the grounds for the elaboration of a curriculum model whose main focus will be the formation of research skills.

5. ACKNOWLEDGEMENTS

Our paper brings to the conference partial results of a study financed by CNCSIS and UEFISCSU, cod ID_303-361.8.10.2007, the study being interested in increasing the efficiency of researcher education and training.

6. REFERENCES

ABSTRACT: A marine engineer, educated to work mainly on seagoing ships, has an expected professional life of about 40 years, both at sea and on shore facilities. Therefore, the education he/she should have should address the expected innovations of the few decades to come. Present day technology related to ships and shipping, like all fields of engineering, is under a rapid progress. The classical marine engineering education of the late 20th century, as specified by International Maritime Organization’s Model Courses 7.02 and 7.04, has been prepared to attain a specialization on thermal power systems, machine elements, shop practice related to repair and maintenance of shipboard systems and basic electrical engineering. However, developing technology has also been dictating an additional level of knowledge and skills on both hardware and software of mechatronic control systems and power electronics, while concerns related to environment and higher costs of energy has been dictating orientation to more efficient operation of power plants. Another oncoming revolution shall be the introduction of fuel cell to marine power systems and integration of main propulsion and shipboard electrical power systems. Therefore, the education for marine engineers has to cover electrical engineering topics in addition to mechanical engineering and naval architecture disciplines. The purpose of this paper is to address those issues and propose a curriculum outline for marine engineering at Bachelor of Science level.

1. INTRODUCTION

Marine engineers are the members of a ship's crew that operate and maintain the main propulsion and electrical power plants and other systems on board a ship. Marine engineering staff also deals with the "hotel" facilities on board, notably the sewage, lighting, air conditioning and water systems. They deal with bulk fuel transfers, and like all seagoing personnel, require training in fire fighting and first aid, survival at sea skills, as well as in dealing with the ship's boats and other nautical tasks- especially with cargo loading/discharging gear and safety systems, though the specific cargo discharge function remains the responsibility of deck officers and deck workers.

The field is basically a sub-branch of mechanical engineering, although the modern marine engineering profession requires knowledge and skills related with electrical, electronic, pneumatic, hydraulic, chemistry, control engineering, naval architecture, process engineering, gas turbines and even nuclear technology on certain military and specialized vessels. Modern developments, as well as the impending changes and innovations related to the technologies used on board ships require changes in the knowledge and skills of the modern marine engineer. The purpose of this paper is to address those changes and underline the necessary modifications for the education of marine engineers. Therefore, an overview of the trends of marine propulsion technology is presented and then the requirements for an engineer responsible for operation and maintenance of this type of engineering system shall be discussed, finally proposing a curriculum at “Bachelor of Science” level.

2. INTERNATIONAL REGULATIONS RELATED TO THE KNOWLEDGE AND SKILLS OF MARINE ENGINEERS AND CURRENT MARINE ENGINEERING EDUCATION

Since the seas and oceans on which the ships operate are international areas, the level of knowledge and skills a seagoing officer should possess should meet certain international standards. Therefore, International Maritime Organization (IMO) has set a number of regulations related to the level of knowledge and skills of the shipboard personnel, the well-known “Standards of Training, Certification and Watchkeeping for Seafarers” (STCW Convention)[1]. This convention, issued in 1978 and has undergone a major revision in 1995, and hence is called STCW 95 convention. However, it is under constant supervision for the necessary revisions since then. An important part of the convention is related to the required level of training for the marine engineers. According to STCW 95 Convention, two levels of marine engineering officers have been specified:

- Officer in Charge of an Engineering Watch (Marine Engineering at Technical Level)
- Chief Engineer and Second Engineer Officer (Marine Engineering at Management Level)

Also, marine engineer officers are classified depending on the main propulsion machinery’s power: Those below 750 kW, between 750-3000 kW (including 750 kW) and at and above 3000 kW.

The purpose of this paper is to address both levels of engineering officers on ships at and above 3000 kW.
In order to provide a common basis for marine engineering training, as foreseen in the STCW 95 Convention, IMO has published “Model Courses”, one for the Engineer Officer in Charge of a Watch (Model Course 7.04) and one for Second and Chief Engineer level (Model Course 7.02) [2],[3]. These model courses provide the level of knowledge and skills required for a seagoing marine engineer, but however, do not explicitly specify the environment for education or the minimum entry level. The emphasis on the learning objectives asserted in both of those courses is on the mechanical science, with handskills related to fabrication, tool usage and maintenance practice. The professional development scheme for marine engineers as foreseen by STCW 95 convention is in Figure 1.

![Figure 1. Professional development scheme for marine engineers, as foreseen by IMO](image)

Many of the world countries interpret those requirements to be given at specialized colleges (Maritime Colleges) and at Associate of Science (Higher National Diploma for U.K.) level for Model Course 7.04, and an additional course for 7.02. However, the general trend is the provision of marine engineering education by an integrated course of four years at Bachelor of Science level, incorporating the learning objectives of both model courses. The sea training period of six months is generally offered by two-month summer terms at the end of the course of four year education and some as an additional (fifth) year.

### 3. Innovations of Last Few Decades and Trends in Ship Technology

It is obvious that sea-based transportation of commodities will also dominate the worldwide trade in the following decades, due to its obvious advantages: low cost, safety, and the ability of being transported in high amounts at a time. However, inevitable radical changes will occur in the maritime transportation in the following years. The main paths of those changes are mainly due to increased environmental concerns, quest for higher efficiencies due to dearth of fossil fuels, and increased automation onboard parallelism the advances in digital technology.

The digital revolution of the last few decades has also had impacts on marine engineering field- modern ships are fitted with digital control systems and instrumentation, unattended engineering spaces and remote controls for various systems, lowering the level of manning. Radical changes have also affected diesel engines- the increasing acceptance of digitally controlled common rail type injection systems, turbocharging equipment with improved performance and increased usage of waste heat recovery systems, all improving the fuel economy as an answer to the increasing cost of fuel prices. Requirements for cleaner exhaust emissions have dictated the use of dedicated systems for NOx gases reduction such as selective catalytic reduction systems and cycle modifications. Oncoming changes to diesel engines are the usage of new combustion technologies such as stratified charge, hypergolic and homogeneous charge-compression ignition (HCCI) engines, and modifications enabling the use of alternative fuels fuel on certain types of vessels both for increasing fuel efficiency and NOx emissions reduction. Increasing electrical loads for auxiliary systems and hotel requirements on certain types of vessels has forced shipbuilders to accept electrical propulsion: The same electrical power can be used both for auxiliary systems and for propulsion, also providing redundancy to improve system reliability. Another development in a different field of engineering is the development of podded propulsion systems. The combination of the advantages offered by podded propellers and electrical motors are suggestive that this mode of propulsion will be more widespread in the near future. Another concomitance to be expected in this field is due to the development of high-temperature superconductivity, which will enable even more efficient and more compact electric generators and motors.

In the field of high-speed marine propulsion, gas turbines, which were used for warship propulsion until recently, has found application on megayachts, passenger and car ferries, often using ventilated propellers or waterjets for their propulsion. High speed diesel engines are also experiencing higher supercharge pressures, cycle modifications such as Miller cycle and exhaust gas recirculation in order to provide cleaner exhaust gases.

Steam turbine propulsion systems are now limited for only a few specific applications. However, due to the escalation of both the monetary and environmental cost of energy, exhaust heat recovery systems involving steam turbines shall be more widely used in the near future.

Residual fuels used as bunkers will stay as the main power source of the ships in the near future, albeit being subject to lesser levels of sulphur content due to environmental restrictions. Natural gas, even used today as the partial fuel of LNG vessels, will be used in short sea transportation of passengers and goods in compressed form. As the coal gasification technology develops, coal gas will also be a
possible fuel of marine engines and therefore the revival of coal as a fuel on certain types of vessels will take place. However, the most revolutionizing fuel of the future shall be hydrogen to fuel the so-called fuel cells, in liquefied and compressed forms or stored as hydrides or in carbon nanotube material.

A foreseen development in this field is the introduction of magneto-hydrodynamic propulsors to replace conventional propellers [4]. Unfortunately, it appears that this potentially feasible system will probably find application only after several decades, only after the development of high-temperature superconductance technology.

Materials used in marine engineering technology are also undergoing a revolution- high performance, lightweight composite materials and advanced ceramic materials are finding usage in most engineering components. This trend is going to enter to a new era by the oncoming revolution of carbon nanotubes, which further the advantages of certain composite materials.

Nuclear propulsion, due to environmental concerns seem to be limited to surface and submarine naval propulsion in the near future. However, there is no doubt that the nuclear power plants of the future will incorporate many of the innovations of technology, providing a safe means of ship propulsion for high power ranges.

Changes in the world trade patterns and routes shall also have impacts on the ship types- the demand for faster cargo transportation will probably introduce surface effect ships- both in hovercraft and surface effect modes, and semi-aircraft, semi- ship “Wing in Ground Effect” vehicles. Compact high-speed diesel engines and gas turbines shall be the propulsors of those types of vessels. Another trend shall be the usage of Arctic Sea, the closest passage between the two dominant areas of the global free market. This route will require ice-class construction and outfitting on the vessels to be used on this route.

The extended use of inland waterways is also considered to be inevitable paralleling to the increase of world trade in areas where possible. The above-said developments shall also be applicable in fluvial shipping vessels, incorporating extra measures commensurating with increased environmental restrictions.

Usage of renewable energy in commercial marine field will be limited to small craft and low tonnage vessels, mainly due to the requirements for larger surface areas for solar energy and wind power.

Those imminent innovations shall reflect into marine engineering education as extra topics in advanced power cycles, electrical engineering and mechatronics, as well as main revisions to the curricula regarding materials science, engineering fundamental courses and technology.

4. UPCOMING REVOLUTION- FUEL CELLS

It will not be a prophecy to assert that the near future shall witness the development of a revolutionary power system- the fuel cell. In its simplest terms, the basis of fuel cell is the exact opposite of electrolysis process: Oxygen and hydrogen are combined together in a fuel-cell system by an exothermic reaction, providing a current of electrons. Since the unification of these two elements do not involve combustion, lower temperatures are possible. Fuel cells are not limited by the second law of thermodynamics and hence the thermal efficiencies are potentially higher. Also, since there are no moving parts in the fuel cells, they are mechanically more efficient, silent and more reliable, provided that the chemical and material composition of the fuel cells are not subject to deterioration. The concept is quite old, initially developed by Christian Schoenbein and William Grove in 1839. However, the first applications of fuel cells are relatively new- first in 1960’s for the energy source of the space craft. The concept is still in the development phase, although fuel cells ranging from a power rating of few watts to several megawatts have been put into service for various purposes[5]. The types of fuel cells potentially applicable for ship propulsion and/or ship service plants are the Solid Oxide, Molten Carbonate and Proton-Exchange Membrane types. The latter has already in application for the air-independent propulsion of submarines and for urban waterway transport [6].

The energy source of the fuel cell is ideally molecular hydrogen or a compound rich in hydrogen (methane or methyl alcohol, for example). Unfortunately, due to the obvious difficulties involved in obtaining and storage of those fuels, conventional hydrocarbon fuels are the present candidate fuels of fuel cells, after being reformed to release hydrogen. This shall require a chemical reactor “reformer” to be used, adding complexity to the system. The exhaust gas from the chemical reaction in the fuel cell shall normally be rich in water vapour. High-temperature exhaust gas for some types (especially solid oxide fuel cells) can be used in “reforming” the hydrocarbon fuel or can be used as an additional power source, improving the thermal efficiency of the system.

It is obvious that an engineer responsible for the operation and maintenance of a fuel cell power plant should have knowledge of chemistry, electrical engineering and heat transfer. Therefore, a special addition to the present day marine engineering curricula is deemed necessary to address this future challenge.

5. A PROPOSED MARINE ENGINEERING CURRICULUM

The proposed marine engineering curriculum should also fulfill the current requirements imposed by IMO, which initially leads to the Officer in Charge of an Engineering Watch certification, as well as the academic part of the Second and Chief Engineer Officer education while also satisfying the requirements for the Bachelor of Science degree. It should address the requirements of the developing and upcoming technologies of the few decades to come. Therefore, he should have a mechanical engineering core background with a strong insight to electrical power, digital control systems, information processing and fuel cell technology.

The proposed curriculum of the authors is given schematically in Table 1, indicating the classroom / application / laboratory hours per week. The logical sequence and prerequisites for the courses can be seen in Figure 2. While simultaneously fulfilling the learning objectives of Model Courses 7.04 and 7.02, they also include courses with the above-said contents. The professional development path of the proposed degree program is in Figure 3.

- Some possible technical elective courses are:
  - Advanced Thermal Power Cycles
  - Resistance and Propulsion of Ships
  - Heat Transfer for Combined Cycles
  - Heat Exchangers
  - Automation of Combined Cycles
  - Composite Materials
**Table 1.** Marine Engineering Sample Curriculum (Semester-hours are shown in class-application-laboratory hours per week format)

**FIRST YEAR**

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Semester II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics I (Calculus with Analytic Geometry)</td>
<td>Mathematics II (Calculus with Vector Analysis)</td>
</tr>
<tr>
<td>4+1+0</td>
<td>4+1+0</td>
</tr>
<tr>
<td>Physics I (Mechanics and Thermodynamics)</td>
<td>Physics II (Electrics and Modern Physics)</td>
</tr>
<tr>
<td>4+0+1</td>
<td>4+0+1</td>
</tr>
<tr>
<td>General Chemistry</td>
<td>Programming with MATLAB</td>
</tr>
<tr>
<td>2+0+1</td>
<td>1+2+0</td>
</tr>
<tr>
<td>Technical Drawing</td>
<td>Descriptive Marine Engineering I</td>
</tr>
<tr>
<td>1+2+0</td>
<td>3+1+0</td>
</tr>
<tr>
<td>Introduction to Computing (Operating Systems)</td>
<td>Maritime Safety I (Survival at Sea and Firefighting)</td>
</tr>
<tr>
<td>1+2+0</td>
<td>2+1+0</td>
</tr>
<tr>
<td>Basic Seamanship</td>
<td>Maritime English II</td>
</tr>
<tr>
<td>2+1+0</td>
<td>2+1+0</td>
</tr>
<tr>
<td>Maritime English I</td>
<td>16+6+1</td>
</tr>
<tr>
<td>16+7+2</td>
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</tr>
</tbody>
</table>

**SECOND YEAR**

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Semester II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics III (Linear Algebra with Differential Equations)</td>
<td>Production Methods I (Metalworking Workshop)</td>
</tr>
<tr>
<td>4+1+0</td>
<td>2+2+0</td>
</tr>
<tr>
<td>Statics</td>
<td>Dynamics</td>
</tr>
<tr>
<td>2+0+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Materials Science</td>
<td>Strength of Materials</td>
</tr>
<tr>
<td>3+0+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Thermodynamics I</td>
<td>Thermodynamics II</td>
</tr>
<tr>
<td>3+0+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Electric Circuit Analysis</td>
<td>Electromechanical Systems</td>
</tr>
<tr>
<td>3+0+1</td>
<td>3+0+1</td>
</tr>
<tr>
<td>Descriptive Marine Engineering II</td>
<td>Introduction to Electronics</td>
</tr>
<tr>
<td>2+1+0</td>
<td>3+0+1</td>
</tr>
<tr>
<td>Maritime Safety II (First Aid and Lifeboat Handling)</td>
<td>Maritime English IV (Maritime Correspondence)</td>
</tr>
<tr>
<td>1+1+0</td>
<td>2+1+0</td>
</tr>
<tr>
<td>Maritime English III</td>
<td>19+3+2</td>
</tr>
<tr>
<td>2+1+0</td>
<td></td>
</tr>
<tr>
<td>20+4+1</td>
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</tr>
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</table>

**THIRD YEAR**

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Semester II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Methods II (Welding and Cutting Workshop)</td>
<td>Engineering Economics for Ship Technology and Shipping</td>
</tr>
<tr>
<td>2+2+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>Heat Transfer</td>
</tr>
<tr>
<td>3+0+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Design of Machine Elements</td>
<td>Marine Diesel Engines II</td>
</tr>
<tr>
<td>3+1+0</td>
<td>3+1+0</td>
</tr>
<tr>
<td>Marine Diesel Engines I</td>
<td>Steam Turbine Installations</td>
</tr>
<tr>
<td>3+1+0</td>
<td>2+0+0</td>
</tr>
<tr>
<td>Steam Boilers</td>
<td>Hydraulics and Pneumatics</td>
</tr>
<tr>
<td>2+0+0</td>
<td>2+1+0</td>
</tr>
<tr>
<td>Automatic Control Systems</td>
<td>Maritime Law</td>
</tr>
<tr>
<td>3+1+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Ship Science I (Hydrostatics, Stability, Ship Structures)</td>
<td>Ship Science II (Hydrodynamics, Resistance and Propulsors)</td>
</tr>
<tr>
<td>3+0+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>19+5+0</td>
<td>Elective Course I</td>
</tr>
<tr>
<td></td>
<td>3+0+0</td>
</tr>
<tr>
<td></td>
<td>22+2+0</td>
</tr>
</tbody>
</table>

**FOURTH YEAR**

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Semester II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Machinery</td>
<td>Fuels and Lubricants</td>
</tr>
<tr>
<td>2+1+0</td>
<td>2+0+0</td>
</tr>
<tr>
<td>Marine Auxiliary Machinery</td>
<td>Corrosion and Fatigue</td>
</tr>
<tr>
<td>3+1+0</td>
<td>2+0+0</td>
</tr>
<tr>
<td>Management of Maintenance</td>
<td>Ship Surveying and Classification</td>
</tr>
<tr>
<td>3+0+0</td>
<td>2+0+0</td>
</tr>
<tr>
<td>Marine Gas Turbines</td>
<td>Hydraulics and Pneumatics</td>
</tr>
<tr>
<td>2+0+0</td>
<td>2+1+0</td>
</tr>
<tr>
<td>Fuel Cells</td>
<td>Elective Course III</td>
</tr>
<tr>
<td>3+1+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Power Electronics</td>
<td>Elective Course IV</td>
</tr>
<tr>
<td>2+1+0</td>
<td>3+0+0</td>
</tr>
<tr>
<td>Mechanical Vibrations</td>
<td>Final Year Project</td>
</tr>
<tr>
<td>3+0+0</td>
<td>N/A</td>
</tr>
<tr>
<td>Elective Course II</td>
<td>14+1+0</td>
</tr>
<tr>
<td>3+0+0</td>
<td></td>
</tr>
<tr>
<td>21+4+0</td>
<td></td>
</tr>
</tbody>
</table>
6. CONCLUSIONS

A review of present marine engineering education was made and of the technological challenges awaiting the future marine engineers was made. A curriculum fulfilling the current and future trends was proposed. Both the proposed curriculum and the contents of Model Courses 7.02 and 7.04, as well as provisions of STCW convention should be dynamically monitored by a team of competent specialists, taking feedbacks from the maritime industry into account and updated parallel to the requirements of technology and the trade.

7. REFERENCES

1. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW 78), Published by International Maritime Organization (IMO), 2001.
2. Engineer Officer in Charge of a Watch (Model course 7.04), Published by International Maritime Organization (IMO), 1999.
3. Chief and Second Engineer Officer (Motor Ships) (Model course 7.02), Published by International Maritime Organization (IMO), 1999.
TOWARDS A NEW CURRICULAR DESIGN FOR FOREIGN LANGUAGE TEACHING IN ROMANIAN TECHNICAL UNIVERSITIES

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The present research aims at defining specific criteria underlying curricular design customized for foreign language teaching to engineering students in Romanian technical universities, in accordance with the recommendations of the Common European Framework of Reference for Languages: Learning, Teaching, Assessment (CEFR), enforced regulations in the field of national educational policies, European quality standards, the needs of the technically-oriented labour market, idiosyncrasies of the Romanian technical higher education. The authors regard such research as fully justifiable within an academic context lacking some specific curriculum-elaborating criteria adapted to engineering students’ specific needs, since the CERF stipulates general criteria applicable only to overall users. The authors conclude that defining a set of specific criteria is essential to establish a common framework of reference for curricular design customized for language teaching to engineering students, viewed as a successful complement to engineering education.

1. INTRODUCTION

The importance of foreign language teaching and learning is acknowledged by the Lisbon Strategy (2000) as a major objective of a knowledge-based society, constantly reinforced on occasions such as the initiation of the Education and Training 2010 Work Programme and Lifelong Learning Programme 2007-2013 by the European Commission or through the Council of Europe's actions regarding the elaboration of foreign language-related reference tools (the Common European Framework of Reference for Languages: Learning, Teaching, Assessment (CEFR), European Language Portfolio (ELP)). Developing linguistic competences in a foreign language is among the key competences recommended by the European Parliament and the Council of Europe in the field of education and lifelong learning (cf. 2006/962/CE: L394/14-5).

The current context of academic language teaching practice in Romanian technical universities is marked by a paradoxical state of affairs, in the sense that there is, at least theoretically, an increased amount of awareness of the importance of equipping engineering students with linguistic competences tailored for customized uses in order to cope with various engineering environments, whereas, in practical terms, a clear disuniformity is recognizable in the foreign language teaching and learning process caused by the absence of a set of specific criteria for curricular design customized for the engineering field.

The present article is meant as a first attempt to initiate the generation of some unanimously acknowledged guidelines in the elaboration of curricula for foreign language teaching in technical universities, with specific reference to the Romanian-language-taught degree programmes.

The paper is structured in three subsections, of which the first provides an overview of the general criteria for curricular design according to the recommendations of the Common European Framework of Reference for Languages, with specific reference to the Romanian-language-taught degree programmes.

2. AN OVERVIEW OF THE GENERAL CRITERIA FOR CURRICULAR DESIGN AS STIPULATED BY THE COMMON EUROPEAN FRAMEWORK OF REFERENCE FOR LANGUAGES (CEFR)

Despite its elusiveness, easily demonstrable by the multitude of definitions [1], the concept of curriculum, in latest research [2], [3], [4], is primarily focused on the development of competences viewed as vital assets that enable people to cope with personal, social and professional challenges. Narrowing down the range of competences and relating the discussion to learners’ linguistic competences, the Common European Framework of Reference for Languages gives primacy to the plurilingual and pluricultural competence which points to “the ability to use languages for the purposes of communication and to take part in intercultural interaction, where a person, viewed as a social agent has proficiency, of varying degrees, in several languages and experience of several cultures” [5].

Having as essential guidelines plurilingualism and pluriculturalism, the CEFR views curricular design in relation to three underlying principles, briefly described below:

a) the first principle entails that the teaching and learning of any foreign language should be carried out in relation to other foreign languages, subsequently furnished by the educational system, and in relation to the learners’ presumable lifelong learning trajectories deployed to further improve and develop their linguistic competences;

b) the second principle stresses that such linguistic diversification is to be performed in formal training systems considering efficiency criteria in terms of skill transfer and scale. Basically, this principle encourages the simultaneous or subsequent learning of several foreign
languages without setting identical objectives or progress types for each language, taken in isolation, but drawing on the transfer of skills from an initially-provided language onto a subsequently-introduced language so as to develop a multitude of language skills in the most economical manner:

c) the third principle rejects both the single language-oriented curriculum and the integrated curriculum for more languages and argues in favour of approaching curricular design in functional terms, i.e. taking into consideration its impact on the learner’s overall language education, acknowledging that linguistic knowledge (savoir), various skills (savoir-faire) and the ability to learn (savoir-apprendre) perform a dual function, namely they “play not only a specific role in a given language but also a transversal or transferable role across languages” [5].

In light of the above-mentioned principles, it follows that the first major general criterion for curricular design, as envisioned by the CEFR, is the importance of exploiting a specific targeted competence developed in the learning of a certain language as a transversal or transferable competence in the learning of other languages.

The second general criterion, according to the CEFR, points out the fact that curricular design is strictly related to the targeted objective (e.g., developing language awareness, result-oriented learning, acquiring written comprehension skills, etc.) or the combination of more targeted objectives viewed in tight correlation with factors such as context, group level and target group. Normally, variation of objectives showcases various dissimilar curricular scenarios whose global coherence and structure must be carefully contrived.

The third general criterion is viewed by the CEFR in terms of evaluation and progress/achievement tracking and emphasizes the importance of the multidimensional and modular constraints on curricular design so that it allows “synchronically (i.e. at a given moment in the learning path) or diachronically (i.e. through differentiated stages along this path), the development and recognition of plurilingual and pluricultural competences with ‘variable geometry’ (i.e. the components and structure of which vary from one individual to another and change over time for a given individual)” [5].

Conceived as a reference tool for foreign language teachers activating in the European Union, the CEFR remains a flexible tool as far as the design of learning and assessment programmes is concerned. The analysis of its utility and application in the teaching/learning of foreign languages for specific purposes (cf. Gajewsk et al. [6]) shows that the CEFR features certain limitations, that it is not “one single uniform system” [5], but an open one that can be adapted to specific learning and assessment situations, as the present case demonstrates.

3. THE CURRENT CONTEXT OF FOREIGN LANGUAGE TEACHING / LEARNING IN ROMANIAN TECHNICAL UNIVERSITIES

3.1. The status of the discipline Foreign Languages in the degree programmes of the fundamental field “Engineering sciences”

The study of foreign languages in Romanian technical universities is commonly stipulated in the Romanian-language-taught bachelor programmes; however, several universities already offer simultaneous programmes taught in a foreign language (i.e., English, French or German), in which case, a second foreign language, other than the vehicle-language, is stipulated.

According to the “Specific Standards for degree programmes in the fundamental field “Engineering sciences” [7], foreign languages are assigned the status of complementary disciplines in the engineering degree programmes and their study includes, at least, one of the following internationally acknowledged foreign languages: English, French, German, Spanish, Italian, Russian.

Commonly, foreign languages are scheduled in the first two years of instruction of the first cycle of studies (bachelor), yet their study may be extended to the entire cycle (e.g., the Faculty of Aerospace Engineering within the Technical University of Bucharest), depending on the interest manifested by the leadership of the institution. Occasionally, they are also included in the master programmes (e.g., the Faculty of Engineering and Management of Technological Systems within the Technical University of Bucharest).

The length of the foreign language study varies from one university to another or from one specialization to another and can spread over two, three or four semesters, depending on how important/less important the leadership of each faculty views the discipline.

Most commonly, two weekly hours of seminar, throughout the entire semester, are stipulated for foreign languages, amounting to 28 hours of instruction per semester. There are very few cases when a theoretical course is also stipulated. For instance, there are 14 hours of course and 28 hours of seminar along two semesters stipulated in the Applied Electronics programme from the Faculty of Electronics, Telecommunications and Information Technology of the Technical University of Cluj Napoca.

The forms of evaluation commonly include continuous assessment or colloqui, while the discipline is assigned one or two credits for each semester.

3.2. Some remarks on the foreign language curriculum for the engineering field

In higher education, the responsibility for designing and implementing curricula belongs to the higher education institutions which must ensure the quality of the degree programmes, within the legal framework of the university autonomy, and by observing internal evaluation-related documents as approved by the Senate’s decisions of each institution and, additionally, external evaluation-related documents stipulated by the Romanian Agency for Quality Assurance in Higher Education [8].

As far as the technical higher education is concerned, the foreign language curriculum design is the task of the foreign language departments functioning within technical universities, which adapt the content and objectives of the foreign language syllabi according to the specialization specificity and students’ professional learning needs.

The foreign language curricula available for the authors are designed according to the enforced regulations of each degree programme provider and contain the information from the discipline description model described by the National Agency for Qualifications in Higher Education and Partnership with the Social and Economic Environment [9]: discipline (title, status, number of hours/week, examination type, number of assigned credits); course instructor (name, scientific degree, affiliation);
objectives rendered in terms of professional competences; content, evaluation procedure, bibliography. Occasionally, curricula contain additional information regarded as relevant by the course designers such as principles of methodological approach, criteria for structuring the teaching of the discipline, international compatibility, etc., .

An additional remark is related to the course designers’ concern to render learning achievements in terms of competences, thus meeting the enforced requirements valid in the entire Romanian higher education and the professional needs of the future engineers with respect to the learning of a foreign language for specific purposes in accordance with the specialism specificity.

However, the description of the learning achievements in terms of specific competences does not reflect the latest trends manifested in the foreign language teaching didactics in which the stress is being shifted from the communicative approach, centred on the practice of communicative competences, to the action-oriented approach, focused on language users viewed as ‘‘social agents”, i.e. members of society who have tasks (not exclusively language-related) to accomplish in a given set of circumstances, in a specific environment and within a particular field of action.” [5].

Last but not least, the evaluation procedure does not make any reference to the proficiency levels established by the CEFR. The assessment of the proficiency level would enable language users to self-assess their proficiency in professional encounters such as CV writing or drawing up the European Language Portfolio (ELP). The CEFR and the ELP are included in Europass, a project of the European Union that facilitates mobilities offering transparency to various professional qualifications.

In light of the above-mentioned aspects, the authors regard as opportune and necessary the design of a new foreign language curriculum customized for the engineering field. The next section draws on the issues discussed in the previous sections to devise a set of specific curriculum-elaborating criteria adapted to engineering students’ professional learning needs.

4. DEFINING SPECIFIC CRITERIA FOR FOREIGN LANGUAGE CURRICULAR DESIGN CUSTOMIZED FOR THE ENGINEERING FIELD

Curricular design has an internal dimension, as well as an external one. The external dimension is derived from the educational policies currently enforced on a wider level, the European level, whereas the internal dimension is shaped by the quality standards enforced at the national level and the documents issued internally by the university decision makers, which enhances university autonomy and social responsibility.

In our view, the principles derived from the two dimensions are the following:

1. The quality orientation

The objectives set by the European Union in the Lisbon Strategy (2000) and the Bologna Declaration (1999) target at the reform of the higher education systems with a view to transforming them into systems more flexible, coherent and open to the society needs, able to cope with the challenges of globalization and the (re)training needs of the European work force. The curricular reform is part of this process.

2. The achievement-based orientation

The objectives of the discipline must be formulated “in terms of professional competences, abilities and attitude-values” [9] that a person has acquired and can demonstrate after successfully having passed the discipline.

3. The orientation towards the needs of the business environment and the technically-oriented labour market

This principle is simultaneously expressed in the national (Methodology for external evaluation, Romanian Agency for Quality Assurance in Higher Education [8]) and the European educational policies (London Communiqué towards the European Higher Education Area [10]) and its application entails the prospection of the social and business environment with a view to identifying the needs of the employers activating in an ever changing competitive market.

4. The assimilation of the new language teaching approaches

In the field of foreign languages, this principle involves, as already mentioned, the switching from the strictly communicative approach to the action-oriented approach based on the user’s social interaction.

This methodological paradigm “involves the creation or the modification of the learning tasks so far oriented towards communication” [11]. The action-oriented approach foregrounds a ground-breaking social objective linked to the progress of the European integration, aimed at increasing people’s employability inside or outside their native countries. This principle translates into approaching the foreign language teaching/learning process in terms of the triad learning (specific competences) – teaching (objectives: specific tasks in specific situations, appropriate methods, support) – assessment (proficiency levels).

The above-mentioned principles have guided us in shaping the following specific criteria for foreign language curricular design customized for the engineering field:

1. The modularity criterion

According to the CEFR, learning programmes and assessments may be: global, based on progression of knowledge in all the spheres of the communicative competence; modular, focused on the development of competences in a narrow area, achieving a well-defined goal; weighted, aimed at achieving a high level of proficiency in a specific language area; partial, focused on certain activities/skills and neglecting others.

In our view, the adoption of the modularity criterion in the design of the curriculum for the engineering field enables the structuring of the content according to the stages of linguistic training of the future engineers.

Three stages have been identified in the linguistic training of the future engineers:

- the stage of general training intended to homogenize the group level, with specific emphasis on general communication skills; this stage corresponds to the first semester of the first academic year considering the mixed-ability character of the foreign language groups at their constitution;
- the stage of specialised training having two components: a stage of initiation into specialised communication, based on the assimilation of the vocabulary and structures characteristic of the general scientific and technical discourse (this stage may correspond to the second semester); a stage of further extension /development of the technical vocabulary and specialized domain-related communication in close relation to the
Equally noteworthy is the fact that the rapid economic and significant contribute to transforming students into flexible when the primary/secondary education language is different and transferable competences applicable in the study of the permanently changing needs of the employers.

In the case of the four-semester study programmes, the linguistic training of the future engineers undergoes a full cycle covering all the above-mentioned stages, whereas the study of foreign languages for only two semesters is reduced to the stage of general communication and the stage of initiation into specialized communication, which is, unquestionably, insufficient.

2. The criterion of specificity of curricular objectives and related competences

The combined constraints of the second and third principles (achievement-based orientation, business environment/labour market needs) translate into an overriding prerequisite imposing a higher degree of specificity from the part of the course designers in the formulation of curricular objectives so that they are oriented to more specialized, job specificity-related competences and their actual, tangible acquisition.

For instance, the design of a foreign language programme focused on the development of communication techniques characteristic of company/business environment triggers the formulation of the following competences:

- professional competences:
  - cognitive competences (e.g., knowledge related to the business letter writing conventions);
  - functional and action-oriented competences (e.g., applying the protocol of telephone-based communication);
- transversal competences:
  - role-playing competences aimed at creating autonomy and social interaction (e.g., CV writing, presenting a project/report in a meeting);
  - personal and professional development-related competences (e.g., gaining new experiences in formal/informal environments).

3. The flexibility criterion

Equally noteworthy is the fact that the rapid economic and technological change characterizing today’s work environment requires high flexibility in employees and, more importantly, high flexibility of university learning programmes that must ensure that their output (i.e. university graduates) meets the permanently changing needs of the employers.

In our view, foreign language curricular design must be characterised by a twofold flexibility. It must be flexible enough to activate competences previously-developed in primary/secondary education and turn them into transversal and transferable competences applicable in the study of the language(s) provided by the university programme, especially when the primary/secondary education language is different from the higher education language. Furthermore, it must be flexible enough to allow intra-disciplinary competence transfer and to showcase integrated learning experiences which significantly contribute to transforming students into flexible social actors with enhanced employability and adaptability to an ever-changing social and economic environment.

5. CONCLUSION

The authors regard as opportune the design of a new foreign language curriculum customized for the engineering field on the basis of the above-mentioned specific criteria: the modularity criterion, the criterion of specificity of curricular objectives and related competences and the flexibility criterion. These criteria alongside other criteria, envisaged to be identified, may underline the design of some coherent curricular models that successfully meet the current expectations of the Romanian higher education and, in general, the needs of our contemporary society.

6. REFERENCES

A DECISION ALGORITHM FOR OPTIMIZING THE SPECIALTY CURRICULA IN MACHINE TOOLS AND PRODUCTION SYSTEMS ENGINEERING STUDIES

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ABSTRACT: The main goal of the paperwork is to present the process of building a set of mathematical models, based upon fuzzy logic, in order to assist the decision of including or eliminating a specialty discipline within engineering sciences curricula. The targeted engineering studies are at this time machine building domain, with a focus upon Machine Tools and Production Systems specialization within “Lucian Blaga” University of Sibiu, Romania, but the process should be the same for other specializations. The proposed method is a competency driven one, which will use the fuzzy logic techniques as decision system. The research presented here is still in progress at this time and it is a result of a joint effort of an international team from three universities from Germany and Romania.

1. INTRODUCTION

An important characteristic of the industrial branch and of university study programs in machines manufacturing is given by the evolution over time of the components towards a high degree of complexity and diversity. Initially, the studied disciplines were concerned exclusively with developing, conceiving, realizing, acquiring and repairing machines; along the economic, technological and social evolution, new work areas were added, connecting machines manufacturing with other disciplines from the domain of natural and of engineering sciences (mechatronics), of informatics and medicine but also with economics and sociology.

The result of this process is the appearance of an extremely diversified and specialized independent specialty culture in individual domains: design, production, manufacturing organization, automotive, energy, automation, etc. This differentiation determines high requirements for the interdisciplinary work. So, what requirements for available specialized knowledge are demanded by machines manufacturing companies from the graduates? How far do such knowledge need to be developed on the vertical and on the horizontal? The topic could be extended also to the question: how much do we need this knowledge in exercising the daily profession? Thus appears the fear that, together with the specialization, one could lose the initial opening for adjacent or general problem-setting.

To this comes also the remark that, in the companies’ opinion, the future professional activity will require more frequent changes within the disciplinary specialization or within the organizational responsibility, especially in the case of manufacturing small and medium-sized machines.

The non-updating during teaching at the university of this specialized knowledge represents another critical argument against their excessive deepening. Specialization makes sense only when it doesn’t serve predominantly for deepening knowledge but is subordinated to exercising transfer competence. This activity also makes sense if such an exercising of the transfer competence would not be scheduled at the end of studies, but already in parallel with the basic training.

Synthesizing, we can see that companies need both „generalists” whose base competences are the mastering of fundamental knowledge, and specialists who reflect a faculty’s specific profile.

It is a generally valid statement that first it is necessary to provide a solid basic training before letting the student get deeper into the specialization. Premature specialization is also unwelcome, because of the danger that in this manner the unilateral approach would be exercised excessively, thus losing the needed flexibility and neglecting the satisfactory forming of important competences such as the tangential competence, transfers competence etc. Also criticized are specialization combinations that are of no use in the current practice and that lead to a unilateral qualification profile. It is therefore recommended to pursue an „exemplary specialization” that serves for the proving and consolidation of the transfer competence. Thus, specialization will be in close connection with the applicative orientation. The applicative orientation should therefore be defined as a transfer ability, meaning the capability to use theoretical knowledge from fundamental disciplines in order to answer to concrete questions from hydraulics, energy techniques, production techniques, design techniques and to process them with the help of modern means such as CAD/CAM software, analysis and simulation software (CAE) etc. [3], [4], [6]

2. SPECIALTY DISCIPLINES PORTFOLIO

The objective of this research is to build a mathematical model for assisting the decision-making process upon the necessity of inclusion of a certain specialty discipline, selected from a specialty disciplines portfolio. The mathematical model is based upon the required competencies, which the graduate of the specialization should acquire.
The fuzzy logic approach was used for the construction of the model, which was implemented using Matlab & Simulink software package.

The specialty portfolio for the Machine Tools and Production Systems specialization from “Lucian Blaga” University of Sibiu is presented below (the disciplines are introduce in the chronological order in which they are studied):

1. Hydraulic systems for machines and equipments – EQ + DS
2. Driving systems for the machines within production systems – DS
3. Machines and production systems design) – EQ
4. Plastic deformation processing machines – EQ + TL
5. Automation systems for machines and production systems – AS
6. Numerically controlled machine tools – EQ + CAM
7. Flexible manufacturing systems and industrial robots – EQ + DS + AS
8. Machines and equipments manufacturing technology – TP
9. Machines and equipments computer assisted design – CAD + EQ
10. Machines and equipments modeling and optimization – CAE + CAD + EQ
11. Auxiliary devices for machine tools – TL + TP + EQ

Every discipline within the portfolio was associated with a marker or a combination of markers, corresponding to the types of competencies achieved by their study, as presented below:

- EQ – competencies linked with the equipments
- TP – competencies linked with the technological processes
- TL – competencies linked with the tools
- DS – competencies linked with the driving systems
- AS – competencies linked with the automation systems
- CAD – competencies linked with the computer aided design
- CAM – competencies linked with the computer aided manufacturing
- CAE – competencies linked with the computer aided engineering

A fuzzy based model for each of the disciplines within the portfolio was build in order to assist the decision making process of including the discipline within the curricula.

2.1. Gathering the data

The construction of the model involves the elaboration of some questionnaires, which will be distributed to everyone involved in the process of building a curricula, but mostly to the employers from the labor market, the enterprises.

A previous stage before realizing these questionnaires involves the building of a comprehensive list of competencies, which one supposes the engineer specialized in Machine tools and Production systems specialization should posses in a greater or smaller measure.

The elaboration of the list of competencies was done based upon the analysis of the curricula from a large number of universities, upon the demands from the labor market and upon other methods.

In the questionnaires, the receivers were asked to grade marks, between 1 and 10 for every competencies included in the list.

The list of the competencies taken into consideration in this research is presented in table 1.

Table 1. Competencies ensured by the specialty disciplines

<table>
<thead>
<tr>
<th>No.</th>
<th>Competence</th>
<th>Symbol</th>
<th>Code</th>
<th>Grade (1 - 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Competence to understand the functioning of complex production equipments</td>
<td>CFSCPE</td>
<td>EQ01</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Competence to use and maintain complex production equipments</td>
<td>CUMCPES</td>
<td>EQ02</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Competence to design medium complexity production equipments</td>
<td>CDMCPE</td>
<td>EQ3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Competence to design complex production equipments</td>
<td>CDCPES</td>
<td>EQ4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Competence to optimize the designs of production equipments</td>
<td>CODPES</td>
<td>EQ5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Competence to design, realize, use and maintain integrated systems of production equipments</td>
<td>CPPE</td>
<td>EQ6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Competence to be acquainted with the technological processes</td>
<td>CATP</td>
<td>TP01</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Competence to design technological processes</td>
<td>CDTA</td>
<td>TP02</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Competence to optimize the designs of technological processes</td>
<td>CODTP</td>
<td>TP03</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Competence to organize and lead technological processes</td>
<td>COLTP</td>
<td>TP04</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Competence to provide the logistic of technological processes</td>
<td>CPLTP</td>
<td>TP05</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Competence to be acquainted with the constructive and functional characteristics of the tools</td>
<td>CACFET</td>
<td>TL01</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Competence to choose the proper tools for a technological process</td>
<td>CCPTP</td>
<td>TL02</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Competence to design the tools for a technological process</td>
<td>CDTTP</td>
<td>TL03</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Competence to be acquainted with the structure and functioning of the driving systems of the production equipments</td>
<td>CASFDSPE</td>
<td>DS01</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Competence to use and maintain the driving systems of the production equipments</td>
<td>CUMDSPE</td>
<td>DS02</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Competence to design medium complexity driving systems for production equipments</td>
<td>CDMDCSPE</td>
<td>DS03</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Competence to design complex driving systems for production equipments</td>
<td>CDCCDSPE</td>
<td>DS04</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Competence to optimize the designs of driving systems of technological equipments</td>
<td>CODODSPE</td>
<td>DS05</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Competence to be acquainted with the structure and functioning of the automation systems of the production equipments</td>
<td>CASFAPSE</td>
<td>AS01</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Competence to use and maintain the automation systems of the production equipments</td>
<td>CUMASPE</td>
<td>AS02</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Competence to design medium complexity automation systems for production equipments</td>
<td>CDMCASPE</td>
<td>AS03</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Competence to design complex automation systems for production equipments</td>
<td>CDCCASPE</td>
<td>AS04</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Competence to optimize the designs of automation systems of production equipments</td>
<td>CODASAPSE</td>
<td>AS05</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Competence to design the geometrical 3D models of complex parts and assemblies within the structure of integrated production systems using computer assisted design techniques</td>
<td>CDCA3D</td>
<td>CAD</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Competence to realize CNC technologies and programs using computer assisted manufacturing techniques</td>
<td>CRNCNCAM</td>
<td>CAM</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Competence to realize mathematical models of complex systems</td>
<td>CRMCMCS</td>
<td>CAM01</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Competence to use techniques and software of computer assisted engineering</td>
<td>CUMAE</td>
<td>CAM02</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Competence to use techniques and software of computer assisted simulation</td>
<td>CUMAS</td>
<td>CAM03</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Competence to realize applicative research activities in the machine building domain</td>
<td>CARMDB</td>
<td>RS01</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Competence to realize fundamental research activities in the machine building domain</td>
<td>CFRMBD</td>
<td>C31</td>
<td></td>
</tr>
</tbody>
</table>
3. EXAMPLE OF A FUZZY MODEL

In this paragraph the mathematical model for the discipline Machines and production systems design – EQ will be presented. The general structure of the fuzzy model is presented in figure 1.

![Figure 1. The general structure of multi criteria decision fuzzy model for a given speciality discipline](image1)

The inputs of the model are the competencies presented below:

- EQ01 - Competence to understand the functioning of complex production equipments
- EQ02 - Competence to use and maintain complex production equipments
- EQ03 - Competence to design medium complexity production equipments
- EQ04 - Competence to design complex production equipments
- EQ05 - Competence to optimize the designs of production equipments
- EQ06 - Competence to design, realize, use and maintain integrated systems of production equipments
- DS01 - Competence to be acquainted with the structure and functioning of the driving systems of the production equipments
- DS02 - Competence to use and maintain the driving systems of the production equipments
- AS01 - Competence to be acquainted with the structure and functioning of the automation systems of the production equipments
- AS02 - Competence to use and maintain the automation systems of the production equipments
- TP04 - Competence to organize and lead technological processes
- TP05 - Competence to provide the logistic of technological processes

The output variable of the fuzzy model is the “degree of inclusion of the discipline” and will fluctuate as a percentage between 0 and 100%. Only the disciplines which obtain a degree of inclusion equal or greater than 75% were be considered to be included in the curricula.

The fuzzyfication of the inputs was done by using the membership functions presented in figure 2 (for EQ01, EQ02, EQ03, DS01, DS02, AS01, AS02 and TP04) and 3 (for EQ04, EQ05, EQ06 and TP05).

![Figure 2. The membership function for fuzzyfication of the inputs EQ01, EQ02, EQ03, DS01, DS02, AS01, AS02 and TP04](image2)
The membership function for fuzzyfication of the inputs EQ04, EQ05, EQ06 and TP05 are:

- inefficient
- efficient

The linguistic variables used for the fuzzification of the inputs EQ01, EQ02, EQ03, DS01, DS02, AS01, AS02 and TP04 are:

- useless
- necessary
- mandatory

The set of rules associated with the fuzzy model is presented below:

- If (EQ01 is mandatory) then (Inclusion is HIGH)
- If (EQ02 is mandatory) then (Inclusion is HIGH)
- If (EQ01 is necessary) and (EQ02 is necessary) and (EQ03 is mandatory) then (Inclusion is HIGH)
- If (EQ01 is necessary) and (EQ02 is necessary) and (EQ03 is necessary) and (EQ04 is efficient) and (EQ05 is efficient) and (EQ06 is efficient) then (Inclusion is HIGH)
- If (DS01 is mandatory) and (AS01 is mandatory) and (TP04 is mandatory) and (TP05 is efficient) then (Inclusion is MEDIUM)
• If (DS02 is mandatory) and (AS02 is mandatory) and (TP04 is mandatory) and (TP05 is efficient) then (Inclusion is MEDIUM)
• If (EQ01 is useless) then (Inclusion is LOW)
• If (EQ02 is useless) then (Inclusion is LOW)

As a conclusion, the model allows the calculation of the degree of inclusion of a specialty discipline using the values of the grades given to the input variables, calculated as medium values, according to the questionnaires presented before.

In figure 5, a graphical representation of the fuzzy model, after running it is shown. From the figure it may be noticed that the final value of the output is 80.4%. According to the initial hypothesis, the analyzed specialty discipline should be included in the curricula.

A similar fuzzy model was built for every discipline within the specialist discipline portfolio and according to the results, a decision for inclusion /non-inclusion was taken.

4. CONCLUSIONS AND FUTURE RESEARCH

The main goal of this research was to build a set of mathematical models, based upon fuzzy logic in order to assist the decision of including or eliminating a specialty discipline within engineering sciences curricula.

The models presented in this paper will assist the specialist to choose from an imposed portfolio of disciplines. Usually, this portfolio is imposed by the national authorities for higher education in each country. Of course, the number of disciplines within it is much higher as the number of disciplines which can be included in the curricula, so the universities have to choose between them, a process which is often extremely difficult.

The targeted engineering studies were at this time machine building domain, with a focus upon Machine Tools and Production Systems specialization, but the process should be the same for other specializations.

A list of competences which a graduate student should possess after studying the disciplines from above-mentioned portfolio was built. The competences within the list were divided into equipments related, technological processes related, driving systems related, automations systems related, tools related and CAD/CAM/CAE related.

The list of competences was distributed to industrial companies in order to be assessed. The management of the companies, which are the main employer of the graduates were asked to grade every competence from the list with grades between 1 and 10.

Using this list and the grades, fuzzy models were built for each discipline within the portfolio. The inputs of each fuzzy model were a chosen set of competences selected from the list (different for each discipline) and the output was degree of inclusion in the curricula.

The fuzzyfication of the inputs was made according to a chosen set of membership functions and to the grades received by each competence. The chose of a proper set of membership functions is regarded as one of the major contributions of this research.

Finally, the models were used to assist the decision of including the discipline in the curricula by allowing the user to calculate the degree of inclusion, in percents.

A second phase of this research will analyze the stability of the proposed curricular area, also by means of fuzzy methods.

A new fuzzy model will be build, which will have as input variables stability conditions proposed by authors and as output variable the necessary degree of change of the curricula. An initial set of input variables may be chosen as: competition between universities, evolution of the number of students/year in the last five years, quality of research in the university, quality of management in the university, the ease of finding jobs for the graduates, the feedback from companies, etc. This new fuzzy model will allow a comprehensive stability analysis.
of the optimized curricular area, allowing the estimation of the influence of external factors upon it.

The model will also allow a “reverse-engineering” process, meaning that if some changes into the curricular area may be foreseen or imposed without running a stability analysis, one could easily estimate which changes are necessary in the input variables in order to achieve the imposed degree of change.

5. REFERENCES


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ABSTRACT: The present research-paper performs a critical analysis of the current Land Forces Academy (LFA) curriculum and suggests possible means to improve it. By using the seven steps of the Blitz QFD methodology we can define the qualities of a performing curriculum that is in conformity with customer expectations and then transpose these qualities into set-objectives. In this respect we submitted questionnaires focused on three fundamental elements: society needs, modern battlefield requirements and academic community needs. Interpreting the academic quality, the Essential Learning Standards and the post-compulsory frameworks we propose a military program that has a clear focus on what is to be learnt (WHATs) and how learning will occur (HOWs). When evaluating the impact of variations in the weights assigned to competences upon the relative importance of Academic Courses and Military training, consideration is given to constraints induced by the military environment and resources that take into account the diversity of students. We also attempt to identify known or expected sources of variability in the experimental units since one of our main aims is to reduce the effect of these sources’ variability on student performance. The research sets the context as a reaction to beneficiary requirement changes in order to develop new modules for the already existing curriculum, or to design, create and implement a new curriculum. It can be determined whether simple improvements are sufficient or new strategies are needed to increase the efficiency of the transformation process all military higher education institutions have undergone.

1. INTRODUCTION

The traditions of Romanian education and implementation of the European programs in training require that all the academic institutions reconsider and adjust their educational offer taking into account the new demands on the labour market of a knowledge-based society [1]. In the mean time, in order to be considered entirely satisfying, all approaches to the situation of human resources in organizations should by no means overlook people’s education and training process. [2]

This paper is a natural follow-up to our interests – already translated into a research project initiated by “Nicolae Balcescu” Land Forces Academy (LFA) in identifying the possible means of improving Romanian officer’s career so as he/she could rise to the requirements of the military organization in particular and to those of the labour market in general. (Figure 1)

Figure 1. Means of improving Romanian officer’s career

We provided situational knowledge, by collecting, analyzing, interpreting, and adapting information to the military academic environment and putting it in relation to the project objectives.

2. RESEARCH ARGUMENTS AND OBJECTIVES

Speaking in national and international terms the new educational policy has imposed a modern perspective on the teaching-learning-assessment act and the need to accomplish a new quality-based system in education. The new Curriculum is characterized by another didactic philosophy. “FORMING” refers to: the socialization process, the transformation of the student personality, the engaging of profound psychological mechanisms to conduct cadets to a new way of interaction. Forming is larger than the educational process. Curriculum is the basis of forming and the most common Knowledge Management process tool in learning organisations. The new model of teaching and trading from authors’ perspective is presented in Figure 2:

Figure 2. The model of teaching and trading

Some of the following events entailed the need to design a new curriculum:
Romania’s accession to NATO
The “signals from the beneficiary (military units)” which are contradictory
Advances in fundamental and applied sciences (effects based operations; network centric warfare; chaos theory, a.s.o.) [3]
Romania’s integration into the EU Romania’s integration into the EU requires that the military education be developed and modernized as an integrant part of the national education system, without losing its personality and identity. It also requires that the military education be compatible with the European education systems in terms of educational offer and aims.
Developments in Information and Communication Technology (ICT). Under conditions of uncertainty that characterize the new military environment, measurements of knowledge with reliability and precision are not possible. Knowledge needs must be understood as the potential for action [4] that doesn’t only depend upon the stored information but also on the individual interacting with it. Military organizations in dynamically changing environments need to behave experimentally: management systems need to encourage experimentation and be easy to re-arrange and adapt with changing the military environment. Such dynamically adaptive knowledge management processes and systems must include a process that continuously examines the military environment’s best practices (lesson learned). The dominant conception of IS-based organizational knowledge systems [5] is constrained by the very nature of the knowledge creation processes.

The need to build-up a clear and concise military curriculum, which is focused on the “added value” and “created value” and which is based on self-evaluation and institutional development, has become apparent. The objectives proposed to be realised by developing our project refer to:
- Correlating the officers’ and in the mean time managers’ building-up process with the labour market (client) requirements (projecting a new curriculum).
- Bringing trading at the place and time where clients need it.
- Optimising student’s learning process by implementing a Knowledge Management System.
- Intending to be a research–based conceptual framework for the optimization of curriculum in military academies (Figure 3).

![Diagram](image)

Figure 3. QFD-based theoretical framework for Curriculum optimization. Source: Adapted (James, 2004)

Which are the technical requirements of a performing curriculum? Some possible answers could be:
- The curriculum is a tool which helps teachers to manage knowledge and this will be the objective of the curriculum.
- The curriculum is a tool which shows the abilities, attitudes, habits, appreciations and forms of knowledge that students need, and this will be the objective of the curriculum.
- The curriculum is a tool which helps beneficiary to impose their interests and this will be the objective of the curriculum. Literature review showed differences among authors in perceiving the technical characteristics of a performing curriculum. In our opinion the beneficiaries’ interests are the most important. The curriculum must be the result of the customers’ (users’) work, because they must impose to LFA the essential minimum requirements necessary for the future system – the knowledge, design and implementation system. These requirements and knowledge must be separately established for the commander/military leader, staff, military specialist, fighter, instructor, educator, citizen etc., according to the specificity of the future graduates’ activity.

3. CURRICULUM ANALYSIS

Our research team included members from all departments of LFA and the target group can be characterised as follows:

![Table](image)

Figure 4.

The respondents were a sample set composed of 10 officers of each service, of different ages and ranks, including 12 woman officers and 10 students.
The main characteristics analysed, that define "Nicolae Bălcescu" Land Forces Academy were as follows [6]: Critical analyse of curriculum must take in account the main characteristics that define "Nicolae Bălcescu" Land Forces Academy. These are as follows [6]:

A. Goals

The university specialized studies focus on promoting the evolution of a future military career and on providing a basic support for a secondary career in the civilian life. Is the academic program correlated with the similar basic support for a secondary career in the civilian life. The respondents opinion on the issue analysed, in table 1. The respondents were a sample set composed of 10 officer s of each service, of different ages and ranks, including 12 woman officers and 10 students.

**Table 1.** Do specialities mach the services?

<table>
<thead>
<tr>
<th>Services</th>
<th>MACH</th>
<th>DO NOT MACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armour</td>
<td>23%</td>
<td>64%</td>
</tr>
<tr>
<td>Artillery</td>
<td>0%</td>
<td>85%</td>
</tr>
<tr>
<td>Engineering</td>
<td>15%</td>
<td>78%</td>
</tr>
<tr>
<td>Infantry</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td>Logistics</td>
<td>67%</td>
<td>12%</td>
</tr>
<tr>
<td>N.B.C.</td>
<td>11%</td>
<td>69%</td>
</tr>
<tr>
<td>Quartermaster</td>
<td>17%</td>
<td>62%</td>
</tr>
<tr>
<td>Railways</td>
<td>8%</td>
<td>89%</td>
</tr>
<tr>
<td>Signals</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Transportation</td>
<td>26%</td>
<td>57%</td>
</tr>
</tbody>
</table>

B. The structure of the educational system.

In relation with the objectives aimed at, the educational plan and the analytic syllabuses include disciplines of both military and university training, in order to achieve a balance between the professional and the intellectual building up. The disciplines are grouped as follows:

**Figure 5.**

![Figure 5](image)

**Figure 6.** The structure of educational system.

The basic military training (23.92%) unfolds modularly during the entire period of training, takes place in firing ranges and training camps and aims at improving the skills and proficiency of cadets, so as to form warriors. It encompasses the following disciplines: Tactics, Firing Training, Military Topography, and Military Law. Students believe Firing Training to be the most important; at the same time, officers believe Tactics or Military Law to be equally important.

b. The fundamental disciplines (20.28%) ensure the scientific foundation for the entire career and include the disciplines: Theory of Organizations, General Theory of Military Science, An Introduction to Management, Psychology, Sociology, Economics, Mathematics, Pedagogy, and so on. Management is considered the most important, Mathematics the most difficult, and Theory of Organizations was considered “not to be understood”.

c. The structural and specialized training (50.36%) ensures the theoretical basis for the initial specialization in the military branch (all officers considered specialization by training to be the most important), and the formation of cadets as managers and leaders.

d. Complementary disciplines (physical training, 5.44%) complete and homogenize the whole formation process of an officer.

(Some respondents considered physical training must not be included in the curriculum but be considered a daily activity, like eating or sleeping).

C. Objectives

- To build up the military, managerial and civic culture, an important dimension in the career of all officers.
- To obtain competence as warriors, military leaders, trainers, and citizens of the nation.
- To acquire the theoretical - practical basis for the specialization in the military branch.
- To achieve mastery of at least one foreign language of international use (especially English).
- To form skills in using the military specific technology.
- To strengthen the allegiance to the nation, to the Army and to democracy.

Developing knowledge soldiers [3] in anticipating the new dimension and challenges of modern warfare, is regarded by LFA officers (65%) as a key strategy for gaining competitive advantage. To be a multi-skilled-war-fighter (21%) or arm-specialist (14%) seems to become of lower importance.

4. CURRICULUM PLANNING

The dominant mode of managing education (setting objectives, drawing plans, then applying, and measuring the results) is described as the curriculum. This guides the educators in how to assess courses and training sessions. According to a way of thinking about education that grew in influence in the Anglo-Saxon specialized literature of the field, the central theory of curriculum is simple: human life consists of the performance of specific activities, and education that prepares one for life, prepares one for these specific activities definitely and adequately. We need to go out into the world and discover what our affairs consist of. This will show the abilities, attitudes, habits, appreciations and forms of knowledge that graduates need, and these will be the objective of our curriculum. Curriculum planning can be seen as the systematic attempt by educationalists and teachers to specify and study planned intervention into the educational enterprise. The theoretical model of curriculum planning includes the following phases:
Phase 1: Understanding the context
This phase involved an assessment of the current knowledge management system and included an analysis of all relevant information to build up an understanding of the learner profile. The main objectives of this phase were: to create an integrated view on the current state in the LFA from KM perspective; to identify its strengths and weaknesses in client’s opinion; to acquire the support of LF staff (SMFT) training centres and operational units and to assemble a work team.

Figure 7. The phases of curriculum planning

Phase 2: Planning and resourcing
This phase involved interpreting the academic quality, the essential learning standards and the post-compulsory frameworks to create a curriculum plan that has a clear focus on what is to be learnt, how learning will occur and how it will be assessed. The main objective of this phase is to create a knowledge strategy that will support LF strategy and identify particular knowledge activities, which will support the achievement of high educational and KM goals. Consideration was given to organisational structures and resourcing (Figure 7) that account for student diversity.

Figure 8. Development Framework
This (Figure 5) set the context for future curriculum planning that will best support student learning

Phase 3: Implementation
This phase involves the progressive implementation of the curriculum plan.

Figure 9. LFA resources

Phase 4: Continuous monitoring
This phase involves monitoring student learning on a continual basis as the curriculum plan is being implemented.

Figure 10.

Phase 5: Evaluation and review
This phase involves the evaluation of the curriculum plan and resulting student outcomes at key points in time.

5. METHOD
Quality function deployment (QFD) was developed in Japan during the 1960s by Akao (1972) [7] as a method for incorporating consumers’ demands into product development. Mazur and others defined QFD as a method for defining design qualities that are in keeping with customer expectations and then translating those customer expectations into design targets and critical quality assurance points that can be used throughout the production/service development phase [8].

Figure 11. The continuous monitoring process

The military organizations have a unique context in which Curriculum must be deployed and operate to play a valuable role in leveraging existing knowledge and converting new knowledge into action through the KM cycle. Both theory and practice have their place in curriculum planning. Theory helps managers to develop achievable goals for teaching. Practice is the implementation of these goals.

Figure 12. QFD Organizer of the Development Process
QFD provides criteria for determining the appropriateness of any decision. These criteria are derived directly from, or can be clearly traced to, customer needs.
6. RESULTS

Quality Function Deployment (QFD), was modified to provide a flexible and systematic approach to curriculum planning in military field. Can the actual curriculum of LFA help the graduates to successfully accomplish the civil and military job requirements? We analyzed operational requirements of students, teachers, and of officers from military operational units (Figure 13).

![Figure 13. Curriculum inputs](image)

Proposals for curriculum enhancements were examined and teaching methodologies carefully scrutinized to ensure that they are well suited to deliver the critical competencies and course content needed by students. Relevant analytical tools and techniques had to be identified and incorporated into the curriculum. All the analyses have been done based on the seven phases introduced by Blitz QFD [9]:

- " Went to gemba" - Gathered the voice of our customer (military mission abroad, applications, operational units etc.). Who is the customer?
- Analyzed the Verbatims (translate needed individual characteristics and skills into competences).
- Structured the military professionals’ needs to be educated. What is their structure? What do officers think about their needs?
- Identify the relevant knowledge, skills, tools and techniques for incorporation in the program and establish the relative importance of these tools and techniques - the WHATs: These tools and techniques were determined via faculty collaboration in the previous phase of the QFD process, the course design phase, and the derived weights reflected their relative importance.
- Analyzed the modern battlefield needs (only important needs in the context of the modern battlefield) (the sample size n=50 is optimal for $\sigma$ being the estimated standard deviation: $\sigma = 0,7$ and $\sigma_1 = 0,05$ ).

Experiment 1: Place: Operational unit (Bistrita)

Subject: Improving LFA curriculum.

The questions that the experiment intended to answer were:

- Which is the efficiency of present curriculum?
- Which are the competences to be developed by the officer building-up process?
- Which are the most important instruments to apply, process and create knowledge?

Results: Expectations from Military Curriculum:

- Help create innovative ideas and tools for the benefit of the army.
- Transfer best practices in near real-time.
- Decrease negative outcomes for first-time real-world contact experiences.

Consideration has also been given to the possibility that the respondents might not have been aware of, or could have misinterpreted their own as well as the organization’s needs. We have consequently formed a work group of military science, management of organization, decision theory, marketing and operational research specialists whose task was to draw up the model of the graduate from the education institutions concerned. We should also attempt to identify known or expected sources of variability in the experimental units since one of our main aims is to reduce the effect of these sources variability on student performances related to curriculum.

Experiment 2: Place: LFA

Subject: Information, contents and functions of Curriculum

Fifty experienced and junior practitioners were questioned on three elements of knowledge building (creation, processing, sharing). Questionnaires were designed to elicit general descriptions of the three concepts in the context of the interviewees’ work. “Which functions are required for Curriculum by a highly standardized educational environment?” Which are the technical critical requirements referring to curriculum quality?” “What instruments are helpful for lesson plan management, coordinating training, evaluation, accomplishing research projects goals, disseminating knowledge?”

Results: The conclusions revealed from questionnaires were systematised, and statistical procedures applied.

Experiment 3: Place: LFA

Subject: Attributes of curriculum in relation to technology.

This questionnaire consisted of 40 questions (adapted Moffet et al, 2003).
Results: Descriptive statistics were calculated for variables. Paired T-tests identified significant differences between the perceived and the actual success of Curriculum. The perceived success attributes ranged from 2.21 to 5.00 with a group mean rating of 3.20. The highest rated attribute of Curriculum was “teamwork”, with a mean rating of 4.5. The most important differences in means between the perception of our personnel and the usual perception revealed by literature were shown in attributes related to “information systems”. Our aim is to implement a Knowledge Management system in LFA in order to optimise the present Curriculum.

Estimating the degree of implementation of the educational policies was accomplished with the help of statistical multidimensional analyses using the SNIE indicator system. We followed the evaluation of the educational system and vocational training from different perspectives: the accomplishment of the objectives of the educational policies was be evaluated at global or local levels. The conceptual framework was defined by Internationally Comparative Education Statistics:

| Table 2. Internationally Comparative Education Statistics, Paris, OECD, 2004, p.21 |
|---|---|---|
| **FUNCTIONAL REQUIREMENTS** | **1. Results and products of education** | **2. Factors and context influencing the products of education** | **3. Context and constraints influencing the implementation of the educational policies** |
| FRA. Individual participants in the educational process | 1.A. Quality and distribution of the individual results of education | 2.A. Individual attitudes, participation and behaviours | 3.A. Learners’ previous characteristics |
| FRB. Training | 1.B Quality of the training process | 2.B. Learning / teaching practices, | 3.B. Students’ learning conditions and teachers’ working conditions |
| FRC. Providers of educational services | 1.C. Institutional performances | 2.C. University environment and organization | 3.C. Characteristics of the service providers and their communities |
| FRD. Educational system as a whole | 1.D. Global performances of the educational system | 2.D. Institutional offer, resources and policies | 3.D. National context |

In what follows we underlined the complex interactions and correlations between “customer needs” and the technical characteristics (Table 4).

| Table 3. Correlations between “customer needs” and technical characteristics |
|---|---|---|---|---|
| **Customer Needs** | **IMPROVEMENT** | **FRA** | **FRB** | **FRC** | **FRD** |
| **Functional Requirements** | | | | | |
| Academic disciplines | 0.184 | 2 | 1 | 2 | 3 |
|  |  | 0.012 | 0.048 | 0.092 | 0.012 |
| Military Training | 0.109 | 1 | 3 | 2 | 3 |
|  |  | 0.028 | 0.007 | 0.007 | 0.007 |
| Physical Training | 0.047 | 3 | 1 | 3 | 3 |
|  |  | 0.003 | 0.003 | 0.003 | 0.003 |
| Specialised courses | 0.026 | 3 | 3 | 3 | 2 |
|  |  | 0.002 | 0.002 | 0.002 | 0.002 |
| Absolute Weight | 0.366 |  | 0.046 | 0.060 | 0.105 | 0.025 |
| Functional Requirement weight | 0.195 |  | 0.255 | 0.445 | 0.105 |

The growth of “Providers of educational services” by the proposed optimisation is 44%.

Some of the QFD techniques and tools were

- GEMBA Visit Table:
  - A total of 50 officers were selected for the research sample among those that had already faced military operations in Iraq, Afghanistan, Somalia, Angola, Bosnia, and were asked to:[12]
  - (1) Assess the understanding ability and ease of use.
  - (2) Assess the probability that the use of the standard fighter would enhance the likelihood of success of an application.

![Figure 14. Guideline set for the use in the educational process (Cosma 2008)](image)

Based on officers’ answers we suggested a guideline set for use in the educational process (Figure 14). The mobilisation capacity, cooperation capacity, capacity to anticipate unpredictable situations, responsibility, self-control, tenacity and decisional promptness were the characteristics considered important for the design of the educational system.
the most important. The homogeneity of the analysed samples can be observed in the figure above.

- Affinity diagram
It was used to arrange customer needs. The “Graduate’s Model” is a means of expressing what are the competences due to be acquired (Figure 1).

**Figure 15. LFA Graduate’s Model**
- Customer Voice table
It was used to gather the customer’s verbatim relation to the competence, capabilities and abilities a graduate’s needs in order to fulfil the missions.
- Hierarchy diagram
It was used to make the process efficient. We reanalysed, quantified, classified and prioritized customer needs according to the following hierarchy.

**Figure 16.**
- Analytical Hierarchy Process
It was used to highlight the needs considered to be most important for the optimum achievement of customers’ missions. (Figure 17 and 18).

**Figure 17. Analytical Hierarchy Process 1**

![Diagram](image1.png)

**Figure 18. Analytical Hierarchy Process 2 (Cosma 2008)**
Military experts claimed that physical training is the second most important aspect in raising the fighting capacity, the first being the technical and tactical experience. As part of the military physical training in particular and of the fighting skills in general the physical training encompasses a complex of physical and motor abilities adequately combined to ensure the proper functioning of the fighter’s vital systems (see Figure 18). Physical preparedness is achieved mainly by training, which is supposed to ensure:

the correlation between physical efforts and the future missions, the completion of the exercises with the entire military gear and with extra weights in order to ensure the thorough learning and handling of the gear, the adaptation of training to harsh terrain and weather conditions changing situations and requirements;

![Diagram](image2.png)

**Figure 19. Analytical Hierarchy Process 3 (Cosma 2008)**
- The matrix of correlation
The matrix of correlation [13] configured the educational process that could meet customer needs

The absolute score was calculated by using

$$A_S = \sum_{i=1}^t p_i \cdot c_i$$  \hspace{1cm} (2)

$p_i$ = disciplines which have a strong team orientation.
$c_i$ = the coefficient of the competence’s importance

These received a weight of a five-point weighting scale.

The weights assigned to Physical Training from a low of 15.8% to a high of 46% approximated a symmetrical distribution with receiving the median weight of 3 on a five-point weighting scale. The results indicated that the greatest importance should be assigned to academic training.
The narrow rate suggested that fundamental or technical courses, which required considerable mathematical manipulation (Risk Analysis, Modelling and Simulation and Mathematical Programming, Decision Theory) were considered difficult to implement for the existing specialisations: Organisational Management, Economic and Financial Management, Public Administration but also for the proposed Economical Engineering (EE) speciality; this aggregating individual preferences during mapping process.

### Table 5. Client’s matrices

<table>
<thead>
<tr>
<th>Scenario #1</th>
<th>Scenario #2</th>
<th>Scenario #3</th>
<th>Scenario #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clients Point</td>
<td>LFA Point Priority</td>
<td>Operational Point Priority</td>
<td>Adjusted weight</td>
</tr>
<tr>
<td>Statistics</td>
<td>0.643</td>
<td>0.599</td>
<td>0.064</td>
</tr>
<tr>
<td>Risk Analysis</td>
<td>0.283</td>
<td>0.263</td>
<td>0.028</td>
</tr>
<tr>
<td>Decisional Theory</td>
<td>0.074</td>
<td>0.069</td>
<td>0.007</td>
</tr>
<tr>
<td>Dynamic Programming</td>
<td>0.074</td>
<td>0.069</td>
<td>0.007</td>
</tr>
</tbody>
</table>

This provided curriculum planners considerable flexibility in developing an integrated military curriculum.

#### Sensitivity tests

Tests conducted to ascertained the impact of variations in the weights assigned to the Military Tools and Techniques (the WHATS) and the rating scale used to map the HOWs into the What’s on the relative importance of the HOWs.

### Table 6. Sensitivity tests

<table>
<thead>
<tr>
<th>Scenario</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Avg</td>
<td>Rank</td>
<td>Avg</td>
<td>Rank</td>
</tr>
<tr>
<td>1</td>
<td>25.9</td>
<td>2</td>
<td>25.4</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>25.6</td>
<td>3</td>
<td>23.8</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>25.9</td>
<td>2</td>
<td>25.3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>22.7</td>
<td>4</td>
<td>25.3</td>
<td>1</td>
</tr>
</tbody>
</table>
Four scenarios were investigated. Scenario 1 used the weights obtained from the Course Design phase and a rating scale of 1-3-9 to map the HOWs into the WHATs. These showed the relative importance of each of the proposed courses in achieving the overall curricular objectives. These results suggest that the proposed planning framework is very robust. Significant changes in the input planning data have little impact on the relative scores of the HOWs. However, there is some minor shifting in the ranking of the HOWs.

7. CONCLUSION

The workplace has significantly changed, much remaining to be accomplished in the military education, although certain significant curriculum integration efforts are already taking place in various Romanian military universities. Increasing the emphasis on design abilities of military students provides better prepared students in what regards the military skills, in order to be productive members of the technical military workforce.

It is a common fact that the contemporary social, political and economic context determines the academic education to promptly and efficiently deal with changes that are very quick and difficult to manage. That’s why, in this new context, quality and its provision become key desiderata for the optimisation of the balance between projected requirements and final satisfaction.

In this perspective, our research contributes to the development of knowledge in this field, primarily by making available certain instruments within the decision assistance and optimisation of the capabilities used to ensure quality in the academic education. Romanian Military Academies must be willing to revaluate their approach and consider new theoretical approaches to the curriculum, QFD being a possible method to fundament the ensuring of the professional forming quality. The time necessary for the design of certain changes within the curriculum was also shortened.

In order for it to be successful, the QFD approach to the military curriculum planning had to place human needs above technology. At the same time, the benefits of this approach are greater than those of other alternatives available to the military organization.

Experienced researchers in the field of quality management education conducted in the following operations:
- checked and validated the research reports;
- analysed the research directions and methods and suggested corrections and alternatives of the approach;
- analysed the obtained results by comparing them with the international stage of research.

They concluded that unless the military educational institutions deal with the internal inconsistencies, confusion, and contradiction within the SMFT (Land Forces General Staff) theory and with ARACIS (Romanian Agency for Quality Assurance in Higher Education) standards, which have contributed to the problems encountered in the application of SMFT analysis, there is little hope that the QFD approach to military curriculum will become acceptable either to the military and civil personnel, or to managers in the near future.

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17. *** Power Analysis and Sample Size, http://www.ncss.com/pass.html,
EFFECT OF GLOBALISATION ON GENERIC COMPETENCIES FOR ENGINEERS

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ABSTRACT: Recent research relating to the need to consider generic competencies for engineering education in the context of global workplaces is reviewed and further developed within the context of a requirement for such competencies to be developed and practiced with due consideration given to a global social responsibility. A portfolio of generic competencies is developed and considered against factors such as ethnicity, culture, language, religion and ethics and detailed consideration is given to how best such competencies can be developed. It is concluded that the use of a range of novel learning environments can provide considerable advantage over the traditional on-campus education environment particularly in relation to delivering of the competencies within the context of a rapidly developing global information society. Particular difficulties relating to the achievement of such competencies are analysed and solutions suggested based on the use of a range of global based environments where aspects such as culture, ethics, and ethnicity can be effectively related to the evolution of generic competencies within a global context. It is concluded that a range of life-place environments are essential to the effective realisation of generic competencies within a global context for engineers at undergraduate, postgraduate and post-experience levels. It is further shown that globalisation of competencies provides for more effective career development with the establishment of a social responsibility mindset being considered as fundamental and mandatory.

1. INTRODUCTION

Chisholm and Burns [1] reported successful studies regarding the use of a range of off-campus learning environments where the learning does not necessarily have to be related to specific subject disciplines but where these trans-disciplinary environments support the integration of explicit and tacit learning involving competencies deriving from the study of a number of interacting disciplines.

Chisholm and Burns [1] proposed a new learning paradigm called life-place learning which involves a highly flexible, learner led system and operates in a person’s life places such as the non-paid workplace, the home, the community and leisure based environments.

Davis and Chisholm [2] continued this research and this has led to the establishment of life-place learning as a successful working concept which has at its core the recognition of all learning regardless of where it is achieved and as reported by Chisholm [3], supports the idea of negotiated explicit and tacit learning in a learner led system to deliver skills and competencies. The main factors relating to the accreditation of life-place learning were reported earlier by Davis and Chisholm [4]. It was further reported by Chisholm, and Blair [5] [6] that much of what has developed as theory and practice in relation to paid work-based learning has transferability to other life-place environments. Luegenbiel [7] reported that fundamental to the life-place learning model was the belief that the most effective learning in terms of the development of competencies is the recognition of the personal and professional autonomy of the individual learner. Earlier research studies by the authors showed the value of learners having personal autonomy in terms of underpinning their achievement of a range of competencies. Employability is about having the requisite profile of subject specific and generic competencies and knowledge to support graduates in finding a job of their choice. In our mass education system many engineering students complete a course without the focus of a planned career built around employment of their choice. At the core of employability is the need for the curriculum to provide for the profile of global competencies which will underpin engineering graduates achieving a job career in the global market-place. Employability is also concerned with developing competencies in the contexts of a global information society and social responsibility. Educators now have to recognise the key importance of taking a global perspective in relation to achieving generic competencies which can underpin engineers being successful in the global society. Generic competencies need to be developed through collaborative studies where national and cultural boundaries are transcended. Engineering graduates need to have competencies which support them working across world time zones in common projects with a number of different nationalities involved where factors such as ethnicity, culture, language, religion and ethics will need to be understood and put in context. So educators need to look at generic competencies in essentially a borderless world where increasingly the economies of countries and social structure are becoming increasingly interconnected. High value engineering is now developed around the world and so practice has to be taken forward within an overall global context thus leading to graduates working anywhere in the world on design, marketing, computing, manufacturing and having to interpret in terms of a rapidly developing global society. So generic competencies properly developed in the global context will support engineers working in cross cultural teams where cultural barriers are removed. Anecdotal evidence suggests that global experience and experiential development of generic competencies will complement specific technical expertise and thus provide the profile to ensure success for the next generation of engineering students in the global job markets. Despite evidence that global generic competencies are of key value for global employability, educators have been slow to address this need in engineering programmes. The modern
undergraduate curriculum is now often in overload with all the new developments so it is doubtful if it is realistic for example to ask for language competence to be taken forward by expecting engineers to study for a second degree in a required language. Placements abroad in another educational establishment or an industrial workplace are a possibility. The authors in this paper consider what are the key generic competencies and how these could be achieved using off-campus life-based learning environments.

2. DEVELOPMENT OF EMPLOYMENT RELATED GENERIC COMPETENCIES

As was mentioned earlier, programmes for engineering education are often now being taken forward with an overcrowded curriculum based on the growth of new subject matter considered to be essential to the formation of engineering graduates. The latest developments have seen employability and related skills and competencies compete for the limited time available on-campus. The key question which needs to be considered is as follows; can all the requirements relating to qualifying at a given level be effectively realised on-campus? The authors believe that many aspects of the curriculum associated with personal, professional and career planning and the associated competencies can be best established outside the traditional classroom environment. However it is doubtful if introducing personal development planning into the busy curriculum can by itself sustain the development of the learners’ long term capability and employability. Life-place learning as a model could without doubt contribute to the overall process by allowing learners to negotiate how to develop generic competencies using the range of extra-curricula activities combined with facilitating learners develop accredited recognition of competencies developed through unintentional learning through their life experiences off-campus. Typically competencies could be established during employment by the learner once on-campus studies have been completed for a given academic study year. By formalising the unintentional learning, under a life-place approach the learner could demonstrate through reflection, competencies achieved and be formally assessed as appropriate.

The Engineering Subject Centre, part of the Higher Education Academy Learning and Teaching Support Network (LTSN) published a useful Student Employability Profile in October 2004 [8]. An examination of the general competencies detailed and the Employers’ criteria for employability shows how effective the life-place model could be if integrated with the on-campus discipline based learning. Within this paper the illustration of delivery of employability skills and competencies is intended to be illustrative rather than exhaustive. The competencies are shown in Table 1 and the employers’ criteria in Table 2.

As can be seen from the tables many of the desired competencies could be developed through extra curricula activities involving all the life-places in which a person takes forward their everyday living. More recently Chisholm [9] reported on the need to develop competencies within the context of a global information society and typical examples of the generic competencies which were earlier reported as being relevant for engineers to move forward within the context of an expanding global information society are shown in Table 3.

Table 1. Illustrative example of competencies relevant to employability from the Student Employability Profiles – LTSN Engineering Subject Centre (2004)
Table 2. Qualities and attributes identified by employer members of the Policy Forum of the Council for Industry and Higher Education from the Student Employability Profiles – LTSN Subject Centre (2004)

- **Brainpower**: The ability to identify and solve problems, work with information and handle a mass of diverse data, assess risk and draw conclusions.
- **Generic Competencies**: High level and transferable key skills such as the ability to work with others in a team, communicate, persuade and have interpersonal sensitivity.
- **Personal Capabilities**: The ability and desire to learn from oneself and improve one’s self awareness and performance. To be a self starter (creativity, decisiveness, initiative) and to finish the job (flexibility, adaptability, tolerance to stress).
- **Subject Specific Knowledge**: Depending on the job, not most obvious and necessary in vocational areas.
- **Technical Ability**: For example, having the knowledge and experience of working with relevant modern laboratory equipment.

Table 3. Competencies within the context of a Global Information Society. Chisholm [9]

- Take forward and embrace a personal ethic of social responsibility and service within the community based environments which are racially, culturally ethnically and linguistically different from their.
- Practice culturally appropriate relationship centred involvement within the global environments in which they work.
- Use communication and information technology that can deliver information to communities of practice who are from diverse racial, ethnic, religious, cultural and linguistic backgrounds.
- Provide leadership that is totally inclusive of ethnic and cultural backgrounds and supports shared decision-making.
- Be able to work on as a team member within inter- and trans-disciplinary systems where diverse ways of thinking, being and doing are the basis of practice.
- Show ethical behaviour in all aspects of practice, both personal and professional which involves individuals from diverse global backgrounds.
- Show empathy with all diverse communities and individuals affected by engineering decisions taken in any given situation or environment.
- Consider for planning, development and generating engineering products and services the value and need to incorporate the determinants of global based views regardless of ethnicity, culture or race.
- Actively support and promote education and learning to improve the well being of a global society.
- Ensure that all interpersonal interactions in the job role and in other life-places are competent and effective within the context of linguistic, racial, ethnic and cultural differences.
- Incorporate fundamental consideration of relevant aspects of cross-cultural diversity into critical thinking, reflective analysis and problem solving in engineering.
- Support within their job role culturally aware developments and practices alongside ensuring inclusion and participation of communities of practice which reflect ethnic, racial and linguistic diversity.
- Continuously review and improve cultural competence at the personal and professional levels and within the organisational systems through the engineering job role.
- Within global working be prepared to deliver product development and engineering systems which are culturally appropriate and meet the needs of a diverse global community.
- In decisions and in delivering engineering practice ensure a balance of consideration at individual, professional, system and global societal needs.

Learner’s life-places are very much where the contexts of race, language, culture, ethnicity and religion are liable to be experienced such that competencies develop within the context of living and working in a global information society. A typical example could be global competencies achieved through a gap year at the undergraduate or postgraduate level. By using the life-place model approach the learner could complete a descriptor defining the desired competence outcomes, complete the gap year and on returning complete the assessment. This is illustrative of how the life-place environments provide a real world trans-disciplinary environment to facilitate this form of learning which is essentially experiential rather than academic subject based. The competencies shown in Table 1 can all be better delivered in real world life-place environments where the learners can draw on all their experiential living and formalise the outcomes using the life-place learning model as described earlier in the paper. The key aspect is the conversion of what is often informal or unintentional learning using the life-place approach which facilitates assessment and the award of credit if requisite. The workplace for example could support the delivery of many of the competencies and facilitate putting them in the context of a global information society. However this means access to unpaid work where the learner and the educators can negotiate what the learner will do in the workplace and what will be the desired skills and competence outcomes. It is also possible for learners to achieve outcomes in a paid workplace. However in this case the learner would be using this life-place to achieve unintentional learning as the employer would set the job outcomes to suit the organisation rather than the learner. However by prior agreement with the educators the learner could reflect on a continuous basis through a life-place learning approach involving the unintentional learning achieved while delivering the job role and thus be able to match up to some of the desired employability competencies. In such a situation, learners could
be in a position to achieve competencies such as listening, organisation understanding and sensitivity, process operation, questioning, teamwork, creativity and initiative. The authors, from their experience with the development of life-place learning believe that all the competencies listed could be effectively delivered using a combination of life-place environments. By combining the life-place learning approach with the on-campus delivery of the subject discipline this would take significant pressure of the educators in trying to deliver the range of competencies on-campus at the same time as delivering the subject discipline. However it should be remembered that educators will need to be involved as mentors and facilitators if life-place learning is to work effectively.

3. DISCUSSION AND CONCLUSIONS

As can be seen the creation of the global society that is now taking shape is both an enormous challenge and an unprecedented opportunity for the engineering profession and the engineering educators. Co-operative engineering product development, research and delivery of engineering systems increasingly requires a global network which is functionally dependant on co-operation across many cultures, disciplines and communities. This co-operation depends fundamentally on partners understanding each other’s competencies within a global societal context. Today global organisations can be successful if their engineering research departments can transform innovative ideas into new products more quickly and with less expense than their competitors. Global team building and working in global teams will facilitate achieving this, but global teams need their technical competence to be integrated with the global competencies discussed to achieve the contextual approach needed to survive in the global information society. Quite apart from this, globally networked research can create a potential global knowledge base where complex competencies can be made available at a rapid rate. Thus these competencies can nucleate co-operation and understanding across different cultures, disciplines, races and languages where the communities of practice are competent to deliver technically while exercising mutual respect and understanding of global diversity. This is the challenge facing engineering educators who need to develop approaches to achieving the next generation of sustainable global competences. So the educators need in depth skills to drive these global competencies into place in programmes.

The results show that global multicultural competency is a key direction which engineering educators must now take as engineering graduates increasingly have a career in the global information society. This means educators have to clearly understand what generic competencies students need to develop to work in an increasingly diverse world. Accepting that the engineering technology inputs are well understood in the engineering curriculum what are the generic competencies which are needed as inputs to create sustainable competencies which account for practice across the emerging global information society? Essential is a working knowledge of diverse ethnic groups and their associated cultures particularly in relation to inputs such as ethics, risk and safety. As was mentioned earlier another essential aspect is knowledge of social, political and economic issues and how these issues impact on race and ethnic relations across the global world. Above all it is clear that educators have a prime responsibility for teaching these diverse aspects to support personal and career development. What are the key aspects which educators need to develop? First and foremost engineers need to have flexibility to respond to and adapt to new and changing global environments to ensure global employability.

4. CONCLUSIONS

1. Multicultural competency development is now essential if future generations of engineering students are to be effective in the global information society.
2. Generic global based competencies can best be delivered through off-campus life-based learning environments.
3. A model is described for the approach to global generic competencies which takes account of race, ethnicity, culture, ethics and language.
4. A portfolio of generic competencies is proposed for development within the context of the developing global information society.
5. The establishment of a social responsibility mindset is considered fundamental and mandatory to the successful development of global competencies and a successful career with sustained employability.
6. Educators need to move forward by taking a case study problem solving approach to self development to become effective in taking forward generic competence development using off-campus environments.
7. Using a range of life-place environments could considerably enhance the effective realisation of generic competencies within a global context.
8. A profile of global generic competencies could significantly enhance engineering graduates’ career development and employability.

5. REFERENCES


FUNCTIONAL DIMENSION AND TECHNOLOGICAL DIMENSION
– SELF– DIRECTED E-LEARNING MODULE

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ABSTRACT: The main concept of this paper is: the critical mass. In this case, by critical volume, we understand the precursory knowledge someone should have in order to have the capacity to understand and assimilate a new concept. The actual paper is approaching this general concept from a particular perspective, the educational one. So, this general concept is used to find another approach for the study of a particular technical issue and is used to find a way to verify if the necessary notions are assimilated, an important instrument for those who want to remember a specific issue is represented by a module which implies a guided individual study and e-learning. To reach this we have to respond to some important questions: which is the “critical mass” in our case, what can we do if we have it and what is not possible if we do not have it.

1. INTRODUCTION

In this paper we are trying to particularise a general concept very often meet in our everyday life for the particular case of the educational area. To do this our approach should offer the answer to some important questions:

- Which is the particular area from the educational field where we want to apply the concept?
- Which is the particular subject?
- Which is the quantity of precursory notions needed related to the particular subject?
- What can you do if you reach the minimal mass of knowledge?
- What can’t you do if you do not have it?

To respond to all this question, we make a case study from our interest area, which is from the technology of machine fabrication field.

The start point of this paper is: the practice shows us that often, no matter how clearly and logical we present a new notion the feedback is not the expected one; the other side doesn’t understand the presented concept. Then it appears the question: which is the cause that generates this result? After the subjective causes are eliminated (lack of attention, tiredness and so on) it remains the lack of precursory information needed in order to understand the new concept. This is the problem we are focusing on in this paper: we try to analyze the needed steps we need in order to find out how to establish the minimum quantity of information someone have to know in order to understand a new concept. The problem will be solved by taking a classical technology issue, analyzing it and proposing a way to solve it.

2. PROPOSED EXAMPLE

2.1. Algorithm

![Figure 1. Critical mass general concept.](image)

![Figure 2. General algorithm.](image)

As we said before, the main purpose is to come with a solution, with a support or, in another words with an auxiliary
instrument for study. A possible way to supply this is presented in this paper and can be synthesised like in the algorithm presented in figure 2.

2.2. Case study analyses

The particular problem we want to present is: Functional measurements and technological measurement. In order to establish the ground abilities someone should have to understand the issue we will present a short example. The example will analyse a representative issue of the interest area: how to determine the deviation of element “x” from the figure below.

**Figure 3.** Technological quotation.

We see that the first technological measurement is equal with the functional measurement:

\[ X_{T1} = 15_{0}^{+0.1} \text{mm} \]  

(1)

To find out the value of the technological measurement \( X_{T2} \) we have to write the equation of the dimensions chain:

\[ 10^{0.05} = 25_{10}^{+0.1} - X_{T2} \]  

(2)

Because the tolerance of the resulting element, \( T_{10} \), is smaller than the tolerance of the component elements the equation is impossible:

\[ T_{10} (= 0.1 \text{mm}) < T_{25} (= 0.2 \text{mm}) \]  

(3)

To solve this we have three options:

1. To decrease the precision of the resultant element;
2. To enlarge the precision of the component element;
3. To change the orientation and fixation surfaces;

Because, generally, the designer establish the values of the functional measurements after a careful analyses the first option is not a valid one.

The second solution could be:

\[ 10^{0.05} = 25_{0}^{+0.05} - X_{T_2} \]  

(4)

\[ 10^{+0.05} = 25_{0}^{+0.05} - X_{T_2} + a_{X_{T_2}} \]  

(5)

\[ 10 = 25 - N_{T_2} \]  

(6)

So, the value of the technological measurement will be:

\[ X_{T_2} = 15_{0}^{+0.05} \text{mm} \]  

(10)

The third solution can resolve the coincidence between the orientation and functional measurements bases like in the next figure:

**Figure 4.** New bases.

Between the two possible solutions, we will choose the economical one as it will result after an economical analyse for the solutions in question.

2.3. Identification of precursory knowledge

Analysing the proposed example we see that the points which require precursory notions are the highlighted relations (2), (3) and (4):

- Relation (2):
- To understand and write this relation dimensional chain must be a familiar notion;
- Relation (3):
  - To understand and write this relation the second axiom of tolerances must be known;
- Relation (4):
  - To solve this relation the operations with tolerated dimensions must be known;

2.4. The problem

Someone incapacity of dealing with the presented tasks are illustrating an important reason for not understanding the example presented before.

Even if the presented problems appears to have nothing in common with the issue presented before, a strong connection exist, and this is the one which results from right the essence of the superior study itself: to become an engineer (for this particular case) a person should have strong notions from a group of disciplines and only a certain mass of knowledge and the capacity to operate with it makes a person an engineer.
3. MEASURES

3.1. Introduction

In this section we are trying to present a way to solve the problem represented of the absence of precursory information. Our proposition is an actual one: e-learning.

We propose this method because is characterised by: actuality, dynamism, efficiency, rapidity and beneficiary oriented. Another reason is the actuality and the dimension of this type of education.

The chosen e-learning model is the self-directed-E-learning.

3.2. Stages

The educational process is following the stages:
- Presentation;
- Orientation;
- Resolved examples;

A synthesis of the proposed model is presented in the algorithm presented in figure 5.

3.3. Presentation of the proposed module

The proposed module was realised in HTML and JavaScript language.

The opening page presents all the available subjects, subjects from the machine construction technology area – Figure 5. By selecting a subject we rich to the first decisional page where we have to decide what we want: information about the selected subject, we want some precursory information to help us understand the selected subject or we just want to test our capacity to deal with specific problems from the interest area as

Figure 5. The stages of the educational process.

Figure 6. The decisional page.

Figure 7. The opening page.
shown in the figure 6.

If we choose to approach the precursory notions subject a page with selected material from the interest area is opening. The page has the material structured in three chapters like shown in the Figure 7. In the first section there are a short list of references for the subject, the second section is presenting the actual theme from the “Dimensional and geometrical tolerances” lecture from the Engineering Faculty, a short paragraph is presented in figure 8.

The set of exercises presented in the test area help us to see if the preliminary notions are already known or if the preliminary notions are assimilated. After the exercises are solved the answer regarding their correctness is given. Taking in consideration this answer the precursory notions will be review if necessary. An example is presented in figure 9.

Six sections are allocated for the chosen subject “The calculation of the functional dimensions and technological dimensions”. A capture of the central page is presented in figure 10. All the material used in this presentation is part of the actual theme from the “Fabrication technologies” lecture from the Engineering Faculty “Herman Oberth” from Sibiu.

The first chapter is a short presentation of the two kinds of dimensions a presentation of the two central elements of the subject and the connection between them like presented in the figure 11, the opening page of this introductive section.

The approach continues with the point two: a presentation of the calculus methodology. Here is presented the general methodology step by step. The three and for section present two usual cases, very often meet in the practical situations and the way to approach them. A representative example completely treated, is the subject of the five sections. The example synthesise all the material presented in a logical way.

The preliminary information is now useful, the approach is now fluent – this is the part where the importance of the precursory information is shown: the instruments offered help us to operate with the new concept.

The last section of this part is represented by actual bibliographic sources.

At the return to the decisional page (figure 6), the last section of this page is completing the educational approach with a final evaluation. The object of this evaluation is the new concept presented.
4. CONCLUSIONS
The different parts of knowledge can be assimilated to the pieces of a puzzle: the final picture can be seen only with two conditions fulfilled: first condition is to have all the pieces and the second one is to operate them in the correct places.

Figure 13. The particularised concept.

5. REFERENCES
6. www.elearningpapers.eu
ABSTRACT: Successful delivery of competences to the socio-economical environment, by means of labour market oriented educational programmes, is one of the key missions of a university in general, and of a technical university in particular. Building on existing knowledge and experience with graduate level programmes, the authors propose an integrated approach to re-engineering of a graduate study programme into a Bologna type master programme in Quality Management and Engineering that meets the requirements of present stakeholders. The methodology developed by the authors advances a two phase approach to curriculum design, facilitating this way the transition to the new master programme. Each of these phases employs the use of structured instruments to ensure consistency and accuracy throughout the entire process. Including the key actors throughout the stages of curriculum development, along with their specific requirements, assures that the type of disciplines, their distribution and allocation in time during each semester will allow graduates to face the challenges of today’s economic environment.

### 1. INTRODUCTION

The new type of economy and society that is developing under our very eyes brings about great challenges for the universities which are one of the main actors in the “industry” of creating, transferring and sharing knowledge as the driver of development. In order to cope with the new demands, the education providers must themselves learn to think in terms of the life-cycle of their educational products and teaching-learning processes, aimed towards satisfying the requirements of the socio-economic environment [1]. The creation of new or the improvement of educational products is nowadays focused on developing competences [2], so that graduates can seamlessly move in and out from the external environment. The pinnacle of this process are highly qualified individuals capable of imparting knowledge by their contribution to the development of innovative products and services, who, at the same time, continue to grow their capacity to accumulate, use and generate knowledge.

### 2. GENERAL SETTING

The current work is focused on a study case pertaining to the transformation of an older-style study programme into a modern one, by responding to the requirements that higher education faces nowadays. The program under analysis deals with post-graduate education in the field of Quality Management and Engineering and the process is currently taking place within the framework of a development project financed by the Sectoral Operational Programme - Human Resources Development 2007-2013.

The main aim of this project, entitled “Design and implementation of a Bologna master study programme, with international outreach, in the field of Quality Management and Engineering, according to the needs of the labour market”, is to perform a reengineering process on the already successful graduate studies programme for “Quality Engineering” by increasing the focus on the needs of the socio-economic environment (labour market, relevant actors in the field of quality, research orientation).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Graduate studies</th>
<th>Bologna master</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Knowledge</td>
<td>Competences</td>
</tr>
<tr>
<td>Scope</td>
<td>Multidisciplinary</td>
<td>Interdisciplinary</td>
</tr>
<tr>
<td>Stakeholder definition</td>
<td>Vague</td>
<td>Economic &amp; Academic environment</td>
</tr>
<tr>
<td>Context</td>
<td>Beyond End-of-line Optional</td>
<td>End-of-line or mandatory for the next cycle</td>
</tr>
<tr>
<td>Participation</td>
<td>Sporadic</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Research orientation</td>
<td>Low intensity</td>
<td>Medium-high intensity</td>
</tr>
<tr>
<td>Duration</td>
<td>1 year (2 study semesters)</td>
<td>2 years (3 study semesters + 1 research semester)</td>
</tr>
</tbody>
</table>

For achieving this transformation, the following sequence of operations has been established:

- first, a fairly simple development process has been executed based on the Quality Function Deployment method that took into consideration both the lessons learned in the previous study programme and the requirements expressed by the identified external references;
- secondly, an improved iteration is performed within which significant result modifiers are introduced to every step of the first development, in order to produce valid results for the scope and purpose of the project.

This type of process, based on the spiral development model used in software and systems engineering (see [3]) allows for improvements or innovations to be gradually injected into the design process, ensuring a smooth transition between the two forms of programme.
3. THEORETICAL APPROACH

Both stages of the aforementioned approach can be identified in the algorithm shown in Figure 1. The first phase mostly consists of a trial-and-error approach, taking into consideration the lessons learned from previous experiences in running such programmes (prior curriculum).

After gathering the stakeholders’ requirements in the shape of desired competences for graduates, these are prioritized using the Analytical Hierarchy Process Technique (AHP). Further, by means of the QFD method, a correlation between the prioritized competences (requirements) and the disciplines proposed by the experts is performed. In this way, a deployment of the stakeholders’ requirements into the future curriculum is achieved by means of the correlations between these requirements and the proposed disciplines. By determining the number of credits for each discipline (thus the number of hours per semester) with respect to the importance of each discipline, according to the required competences of the labour market, the orientation of such a programme towards the economic environment is assured.

In order to perform this process with higher efficiency, the second stage of the development is proposed. This stage implies the upgrading of each key step of the algorithm. In Figure 1 the modifiers (tools, methods, constraints, etc.) introduced for this are highlighted in gray.

Figure 1. Algorithm for new curriculum development

The algorithm combines the advantages of using the experience gathered from previous curricula with the involvement of stakeholders’ requirements in the stages of development.

3.1. Improving the Requirements Determination Stage

For identifying the stakeholders’ requirements, some of the following instruments can be used. Feedback from the former graduates of the legacy Quality Engineering studies programme can be gathered by means of surveys which will focus on the competences that the graduates considered to be of most use in their jobs. Further, competences that other stakeholders, such as employers, managers, quality specialists, etc. require from a graduate of such a study programme are identified with the help of Focus Groups (or workshops).

The authors propose for this phase of the algorithm the use of Gemba observation charts. The following steps are necessary in order to determine these competences, based on the proposed method:

- Establishing the target group;
- Identification of possible occupations for future graduates of this programme;
- Selecting three occupations from the quality management field of activity and the corresponding competences according to the occupational standards;
- Elaborating Gemba observation charts by integrating the competences drawn from the occupational standards;
- Distributing the observation charts;
- Filling out of the Gemba observation charts by the employers;
“Gemba” is a Japanese word for “the place where the product becomes of value to the customer” [4], by that meaning the place where the product is being used and also the place where possible errors may occur. Unlike other questioning methods, Gemba observation charts do not consist in interviewing, but in recording, listening and observing customer’s reaction to a specific product/service. These charts were elaborated according to three occupational standards in the quality management field of activity.

In order to gather feedback from the employers regarding the importance, utility and frequency in use of each competence unit, a Gemba observation chart was conceived as follows: the three occupational standards analysed correspond to following occupations: manager of the quality system (according to SO-COD COSA: T-259), quality auditor (according to SO-COD COSA:T-261) and quality system specialist (according to SO-COD COSA: T-263). In conceiving one Gemba observation chart for all three occupations, common competences were filtered and only the specific competences for each occupation were integrated into the chart. Exceptions were made when dealing with competence units that support the other specific competences, for example: improving own professional training or teamwork.

Table 2 contains the structure of the Gemba observation chart: first column contains the number of the competence unit, second column the competence unit as it appears in the occupational standard, third column the detailed description of the competence unit, by that meaning the competence element. Employers of companies acting in the quality management field will be asked to fill out the fourth column by expressing their own opinion regarding the use of each competence unit considering the frequency in use, importance and utility.

### Table 2. A fragment from the Gemba observation chart

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>CONTACT PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GEMBA OBSERVATION CHART FOR THE OCCUPATIONS:</strong> Manager of the quality system, quality auditor, quality system specialist (ACCORDING TO THE OCCUPATIONAL STANDARDS: SO-COD COSA: T-259, SO-COD COSA:T-261, SO-COD COSA: T-263)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Competence unit</th>
<th>Competence element</th>
<th>Employer feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Educating, training and motivating the personnel into the concept of quality</td>
<td>Establishes the necessities of education and training of personnel, organizes and leads education and training, identifies motivating/non-motivating factors and applies motivation techniques</td>
<td>Feedback considering the importance, utility and frequency in use of the competence unit</td>
</tr>
<tr>
<td>2</td>
<td>Evaluating suppliers</td>
<td>Establishes criteria necessary in evaluating, quoting, ranking and selecting suppliers, identifies and evaluates suppliers.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Improving own professional training</td>
<td>Establishes necessities and ways of improvement, takes part at trainings</td>
<td></td>
</tr>
</tbody>
</table>

3.2. Improving the Discipline Analysis Stage

In the stage of identifying the proper disciplines to be included in the curriculum, several tools can be helpful. By using the experience gathered throughout the years in developing and running study programmes, a SWOT Analysis is performed on the prior curriculum. This analysis will highlight the disciplines that proved to be of high impact throughout years and which should also be included in the proposed curriculum. In performing this analysis, the feedback gathered from graduate students will be considered.

Another type of tools that can be used in this stage are the creativity tools such as Brainstorming, 6-3-5, Mind Map, LARC, etc. With the help of these tools, the experts in Quality can identify a set of disciplines that are compulsory for preparing specialists in this field, focusing on disciplines that are able to provide the proper competences required by the labour market.

3.3. Improving the Curriculum Structuring Stage

The final stage in the development of the curriculum is to determine the number of hours per discipline per semester, the type of each discipline and the type of evaluation for each of the disciplines analyzed within the algorithm. For each of these components, several result modifiers (highlighted in the algorithm) were used. For example, in the case of the number of hours for each discipline per semester a Calculus algorithm (detailed in the Case Study section of this paper) has been considered. Also, the Technical University of Cluj-Napoca has its own regulation regarding the curricula of the Master Study Programmes which must be followed. Some of the constraints that were considered in this case are as following: the number of credits for each semester of studies is 30 credits; the number of hours for each credit is 26 hours and there should be a balance between exams and colloquiums in a semester.

The type of each activity/discipline proposed in the early stages of the algorithm was determined with the aid of experts in the field. The expertise of such specialists in the designed curriculum was also considered for determining the evaluation type (along with the regulatory constraints). Having established these components, the curriculum is now determined.

### 4. CASE STUDY

In this section of the paper, an example of using the proposed algorithm will be presented. For reason of clarity and concision, in the following, there are presented only the results related to the reengineering of first semester curriculum. By using the tools shown in the algorithm (Gemba charts, surveys, workshop), the following competences required for a graduate of a master programme were identified:

- to design and implement quality management systems;
- to develop and implement strategies, policies and procedures regarding quality;
- to control and improve a quality management system and its processes;
- to use modern quality ITC instruments;
- to contribute to new product development;
- to plan and organize the measurement processes in production;
- to be able to organize metrology laboratories;
- to manage interactions between client requirements, technical characteristics and potential suppliers;
- to design and implement competitive development strategies for organizations, processes and products;
to support the achievement of long term competitive advantage on the market;
• to be familiar with the standards in the field and their application in the organization, with the certification procedures and to be able to complete audits;
• to be able to work with people, to communicate and motivate them in achieving the objectives.

Following, these competences were prioritized using the AHP method and then transferred to QFD for correlation with the determined disciplines: Quality Management, Strategic Management, Innovation Engineering and Management, Policies and Institutions in Quality Management and Research Activity. The results of applying the QFD method are presented in Figure 2.

![Figure 2. Deployment of stakeholders' requirements into the components of the first semester curriculum](image)

According to the perceived importance of each discipline for the labour market requirements, the number of credits was established (1).

\[
NC_i = Wi \cdot N
\]

where \(NC_i\) is the number of credits for one discipline per semester, \(Wi\) represents the importance of the discipline as given by the QFD method, \(N\) represents the total number of credits for one semester (in this case \(N=30\) credits). After applying (1) the results shown in Table 3 were obtained. Each credit is equivalent to a number of 26 hours. Taking this into consideration, the total number of hours for each discipline per semester is shown in Table 3.

The following step is to determine a proper distribution for the total amount of hours per discipline during each week of the semester.

\[
T = h \cdot NC_i
\]

\[
T = 14 \cdot (C + Ap + P + IS)
\]

where: \(T\) – total number of hours per discipline per semester, \(h\) – the number of hours per one credit (\(h=26\) in this case), \(C\) – number of hours for a course per week, \(Ap\) – number of hours for applications per week, \(P\) – number of hours for project per week, \(IS\) – number of hours for individual study per week. The last step in determining the curriculum was to establish the proper distribution of course, applications, project and individual study hours per discipline. This was made with respect to the constraints \((C + Ap + P \leq 5)\) and with the implication of experts. The following situations were considered. If the discipline is more a theoretical one than a practically applied one then a distribution of \(C = 2\) and \(Ap = 1\) or a distribution of \(C = 2\) and \(Ap = 2\) is chosen. Furthermore, if the discipline requires exercises then the \(C = 2\) and \(Ap = 2\) combination is chosen, otherwise the \(C = 2\) with \(Ap = 1\) combination is the chosen one. If the discipline is more practically applied then \(C = 1\) and \(Ap = 2\) or \(C = 2\) and \(Ap = 3\) combinations are possible. If the discipline requires a project work, then the \(C = 2\), \(Ap = 2\) and \(P = 1\) combination is chosen, otherwise the \(C = 1\) and \(Ap = 2\) is chosen. The calculus for the distribution of hours for Research Activity has been made with respect to regulatory constraints, considering a maximum of 12 hours per week for Applications and the rest up to the total number of hours per discipline dedicated to Individual Study.

### Table 3. Curriculum of the first semester of the master study programme

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Distribution</th>
<th>No. of hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Mgmt</td>
<td>C Ap P T</td>
<td>130 28 28 74</td>
<td>5</td>
</tr>
<tr>
<td>Strategic Mgmt</td>
<td>2 2 130 28 28 74</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Innovation Eng Mgmt</td>
<td>2 1 156 28 42 86</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Policies and Inst in QM</td>
<td>2 1 104 28 14 62</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
| Research Activity   | 1+12 IS=168hrs | 260 168 92 4 10

### 5. CONCLUSIONS

The undertaking of the authors proposes a different methodology for curricula development that could replace the trial-and-error type of approach with a more structured one. By adding significant result modifiers throughout the stages of the algorithm a better orientation of the programme towards the needs of the stakeholders is assured.

In the case study elaborated for this paper, the methodology has been applied for the re-engineering of the one semester curriculum for the master programme in Quality Management and Engineering. For future undertakings the applicability of the algorithm will be extended to every semester of the study programme, assuring this way the delivery of a better oriented “product” towards the needs of the relevant actors of the socio-economical environment.

### 6. REFERENCES

COURSE ON MEASUREMENT UNCERTAINTY DEVELOPED IN AN INTERNATIONAL CONSORTIUM

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ABSTRACT: The paper presents the development of an electronic course on the subject of measurement uncertainty by a consortium formed of partners at European level. The paper describes the steps followed by the consortium in the European Life Long Learning Erasmus project Statistical Analysis of Measurement Data for the Evaluation of Measurement Uncertainty (SAM-EMU). The premises are known as well as the design development and implementation stages of the project are presented. The consortium is formed by renowned European universities, accreditation bodies, foundations and industrial partners.

1. INTRODUCTION

One of the most important missions of universities and other education providers is to identify the areas of interest that are not covered by the curricula and to develop suitable learning material in that particular area. The evaluation of uncertainty of measurement is one of those areas of interest that is currently of great interest and comprehensive learning material has not been developed. Modern measuring processes are an important element of the manufacturing process and of quality management. The uncertainty of measurement is an important step in the quality control process. Experts in the range of measurement uncertainty evaluation are needed in the industry as a consequence of quality control requirements and the current lack of experts in the field is set to grow. Management systems require knowledge of the uncertainty to ensure a proper balance between the measurement uncertainty and dimensional tolerance. High accuracy measurements are more and more difficult to attain and it is difficult to document the measurement result. There are a lot of factors influencing measurement uncertainty. Correctly estimating and documenting the measurement uncertainty requires interdisciplinary knowledge about basic statistics, quality and metrology.

The current curriculum does not cover the subject of measurement uncertainty in a comprehensive way. Learning material regarding measurement uncertainty is available but for students to use the learning material effectively a good level of training and understanding is required. This is why comprehensive learning content has to be developed in order to meet the stakeholder’s expectations.

2. CURRICULUM DEVELOPMENT IN A CONSORTIUM

The easiest way to develop course content for a complex subject like the uncertainty of measurement is to assemble a consortium of experts in the field at European level. The advantages of forming a consortium are:

Faster course content development
In order to reduce the time required for the development of the course content, the consortium is the easiest way of bringing together experts in the specific area of interest. Because of the interdisciplinary requirement of measurement uncertainty experts on the subjects of quality, metrology and statistics are chosen. Another advantage of using a consortium is the possibility of sharing equipment and experience in order to speed up the process.

Joint curriculum development
The subject of measurement uncertainty is covered differently in particular EU countries and to different extent levels. The partners in the consortium have a good understanding regarding the current situation in their countries. Because the consortium is formed by partners from different EU countries a general overview regarding the subject can be determined and also compared to other countries in Europe, USA or Japan.

Developing a common curriculum on the subject of measurement uncertainty will provide the possibility to exploit knowledge of the course in a common manner by students and employees from the EU.

Creating comprehensive course material
Experts in the field that are recognized for their competences and knowledge ensure the development of a comprehensive course content at an international level that can be used as a reference is this field of study.

Easy to maintain and upgrade
Each member of the consortium is responsible for covering a part of the curriculum according to their specific competences so the required effort for course maintenance and upgrade is reduced.

3. PROJECT CONSORTIUM

A consortium comprised by renowned experts in the field of measurement uncertainty was formed by accessing a project in the Erasmus Lifelong Learning Programme and creating a network of excellence in the field. The title of the project is “Statistical Analysis of measurement data for the evaluation of Measurement Uncertainty” acronym SAM EMU. The members of the consortium are:

- University of Bielsko-Biała, Department of Manufacturing Technology and Automation and Academic Centre of Informatics, (Poland) as project coordinator;
• Friedrich-Alexander-University Erlangen-Nuremberg, Chair Quality Management and Manufacturing Metrology, (Germany);
• University of Huddersfield, Centre for Precision Technologies, (United Kingdom);
• Technical University of Cluj-Napoca, Department of Machine Tools and Industrial Robots, (Romania);
• University of Padova, Department of Innovation in Mechanics and Management, (Italy);
• Physikalisch-Technische Bundesanstalt, Division 3: Chemical Physics and Explosion Protection, (Germany);
• “ANGA” Mechanical Seals Ltd., (Poland);
• International Foundation for World Class Manufacturing (IFWCM), (Poland).

The consortium members have a good knowledge on the subject of uncertainty of measurements thanks to the long established research record and to close cooperation with the industry.

The project consortium aims at developing and implementing an e-learning course that integrates contributions from different disciplines into a user-centred approach. Competences are presented in a way that is methodologically and didactically optimised for students and employees with a mostly work-based vocational qualification.

University of Bielsko-Biała deals with measurements and analysis of accuracy for complex machine parts. Coordinate measurements, the analysis of measurement uncertainty and surface roughness measurements are their main subject of interest. Their previous European experience includes projects concerned with e-learning, education and industry cooperation. University of Bielsko-Biała is the coordinating institution of the project and they will also prepare the content concerning the uncertainty of coordinate measurements.

University Erlangen-Nuremberg has participated in many projects and research networks – within the university as well as at national and international level. Thereby, the evaluation of measurement uncertainty has been an important research target. University Erlangen-Nuremberg has broad experience in the development of innovative learning content.

University of Huddersfield is one of the leaders in the assessment of surface roughness. They have participated in national and international projects dealing with surface roughness measurements.

The main research directions of the Technical University of Cluj-Napoca are in field of quality, measurement, e-Learning methods and platforms, simulation and optimization, quality in higher education, web technologies, developing training tools and methods in mixed learning environments.

University of Padova’s general aim is to perform research on methods and techniques for the full geometrical characterisation of manufactured parts. The areas of advanced coordinate metrology and surface characterisation have been defined as the main research areas.

Physikalisch-Technische Bundesanstalt deals with statistical analyses of measurement data and uncertainty evaluation. Its expertise results from long-lasting joint activities of PTB and University Erlangen-Nuremberg in implementing modern uncertainty analysis in industry.

ANGA is a supplier in area of mechanical seals and aircraft industry. The management system of ANGA meets the requirements of the standard: ISO 9001:2000 in area of designing, manufacturing, tests, sales and service of mechanical seals. ANGA’s role in the project will be testing the content of the whole course in industrial conditions. Their remarks should help authors to improve the quality of the course content and functionality.

International Foundation for World Class Manufacturing IFWCM utilizes the knowledge and experience of many experts coming from universities and industry. IFWCM has abilities to disseminate and exploit the project's results and organize the trainings after the project is finished.

4. AIMS AND METHODOLOGY

The project concerning the uncertainty of measurement encompasses the development and implementation of learning content which can be a supplement for existing curricula of engineering studies and higher-level vocational training. The courses are delivered by means of basic and specialised Learning Management Systems, offering on-demand e-learning modules, as well as assistance and systems that incorporate permanent participation in an e-learning community of experts. Being developed especially for the needs of distance learning, simulation software will facilitate virtual experiments necessary to gain the skills needed to carry out estimation of uncertainty.

The didactic materials will provide the possibility to gain or refresh the necessary knowledge from probability and statistics, quality and metrology. The contents will enable high level self-learning in the area of uncertainty. Many real-life examples explaining the methodology of evaluation of the uncertainty will be included. The errors and sources of uncertainty are presented in detail and illustrated using examples and case studies. Training and verification of knowledge gained have been developed in the form of simulations. Much attention will be paid to the uncertainty of coordinate measurements which are the key-technique in the mechanical parts manufacturing industry. Additional simulation software is used to explain the components of measurement uncertainty and the propagation of errors.

The systematic instructional design model chosen for this project was an adaptation of ADDIE model. This is one of the most common model for content creation [3]. The ADDIE Instructional Design Model consists of five phases: Analysis – Determining what is needed, Design – Defining how it should be provided, Development – Managing those who are creating it, Implementation – Providing access to those who will use it, Evaluation – Assessing if the materials and the project are on track.

The steps required according to the ADDIE development are:

1. Determining the target groups
2. Curriculum development
3. User needs analysis
4. Curriculum evaluation and redesign
5. Establishing the course layout
6. Defining the course distribution method
7. Developing the course content
8. Designing the test to assess the level of knowledge
9. Crosschecking the course material
10. Pilot implementation
11. Evaluating the content and implementing the improvements
Figure 1. The instructional design model used in the project

**Determining the target group**

The target groups are students of universities from the European Union who are interested in gaining additional knowledge on the subject of measurement uncertainty. Another group is industry employees working in quality and metrology laboratories of European enterprises. These groups have specific needs that have to be addressed in order to provide comprehensive course content.

**Curriculum development**

The initial curriculum was developed by experts of the consortium. The curriculum was compiled and divided into work packages according to the competences of each partner. The main topics of the course that have been agreed on are:

- Basic statistics – developed by the University Erlangen-Nuremberg;
- General methodology of uncertainty evaluation – prepared by University of Padova;
- Uncertainty of conventional measurements – developed by Technical University of Cluj-Napoca;
- Uncertainty in case of multivariate measurands – responsible for the topic is Physikalisch-Technische Bundesanstalt;
- Uncertainty of coordinate measurements – developed by University of Bielsko-Biala;
- Uncertainty in surface roughness measurement – prepared by the University of Huddersfield.

**User needs analysis**

In order to determine the needs of the different stakeholders they have been divided into three groups: students, employees from the industry and experts in the field of measurement uncertainty. The gap between the initial curriculum compiled by the experts of the consortium and the stakeholder needs has been determined by using questionnaires and interviews. Separate questionnaires were compiled for each group so as to identify the requirements regarding course distribution, the viability of using an e-learning platform, the costs related to attendance and certification. The prior level of knowledge of the target groups was also assessed. The questionnaire that was distributed to the experts contained questions related to the course objectives. After the questionnaires were analysed the identified requirements were grouped using the affinity diagram and then prioritized using the AHP method.

**Curriculum evaluation and redesign**

The inputs of this stage are the results of the user needs analysis. The initial curriculum of the course is improved by taking into consideration these results.

Aside from the requirements expressed by the stakeholders, the members of the consortium also added support instruments to aid the learning process and also to produce excitement and satisfaction for the user. The initial work packages were updated to the final curriculum.

**Establishing the course layout**

The layout of the course includes various parameters that must be agreed upon by all members of the consortium. The parameters include: the presentation method, text parameters size, colour, font and formatting, equations, tables, figures and images, animation etc. The format of the web page must be set in order to meet the requirement of the distribution platform. The layout of the course and the presentation method must be in accordance with the recommendations of W3C (World Wide Web Consortium) regarding HTML, CSS, XHTML and cross platform accessibility.

**Defining the course distribution method**

The course will be available in an electronic form on the Internet. The learning management system used to administrate the course is Moodle (the most widespread free solution for e-learning). The adopted learning system is asynchronous, supported by instruments of the Moodle platform [1]. The courses are delivered in an .html and .pdf format and the animations in .swf format. By choosing this distribution method the implementation cost to the user is reduced.

**Developing the course content**

Information presented in the course material contains theoretical material on each subject as well as exercises and case studied to facilitate the understanding of the knowledge by the user. The material of the course has been developed for web based implementation. Information is presented in such a way that people can readily understand and use. A set of guidelines has also been set to ease the development of the course content in a way that will be identical for all modules of the course.

**Designing the test to assess the level of knowledge**

Each course module will include a comprehension test at the end of the module to enable verification of the knowledge acquired by the user. The test is comprised by the following types of questions: open text, multiple choices, true/false, matching. For each question the answer includes comments so the user can understand why the answer selected is correct or incorrect. Apart from the final test the user can do a pre test to check the level of knowledge before the final test.

**Crosschecking the course material**

The course content is crosschecked by different members of the consortium to ensure the quality of the information that is provided as well as ensuring that no errors or mistakes remain. All modules have also been checked for English spelling and grammar by the UK representative of the consortium, to ensure the proper terms and expressions are used.
Pilot implementation

In the implementation phase of the learning content an evaluation will be conducted to check the quality of the didactic material and also the acceptance of the course as an alternative learning form by students and industry. Pilot courses will be conducted on short term target groups consisting of students and industry employees. Participants at the end of the course will be asked to take a poll. The poll results will be used to perform corrections and upgrades to the learning material, behaviour and functionality of learning platform and to enhance the user-friendliness of the course. The estimated number of users in the short term target group would be 25-30 participants. Industrial partner (ANGA) will test the course in industrial conditions with the help of its employees.

Evaluating the content and implementing the improvements

The last step of the process is to implement corrections and suggestions obtained from the pilot implementation data gathered. This data is to be compiled into three categories: technical aspects regarding the course platform, course material aspects and aspects regarding the design and ease of use of the course. These suggestions are implemented into the course before releasing the final version of the course.

5. OUTPUT OF THE PROJECT

The result of the project is an e-learning course on the subject of uncertainty evaluation in manufacturing metrology. The electronic course will be available over the internet and can be accessed at any time [4].

E-learning training courses are one of the favoured methods of study for vocational participants to encourage them towards a path to lifelong learning. The main target groups of the course are students of the European universities who are interested in gaining additional knowledge not fully covered in the study curriculum and industry employees working in quality and metrology labs in European enterprises.

Universities other than those of the project consortium can use this course in their curricula through the International Foundation for World Class Manufacturing which is a silent partner of the consortium and deals with organizing trainings on different subjects connected with world class manufacturing for industry. The consortium will continue to develop courses in this field of study and will promote this topic in order to attract other important partners to the consortium.

6. CONCLUSIONS

Taking into account that the project partners come from five European countries, the target groups that are used as a reference in the development of the course come from a wide geographic area. The different curricula of each university result in a different knowledge and competence for the target groups members.

Working in a consortium has enabled the design development and implementation of the course in twelve months. The number of active participants in the course development and implementation is around twenty members. Each partner participates in the project with no more than five people thus not all resources of one partner are focused entirely on this project. None of the partners would have been able to develop such a comprehensive learning material in such a short time span.

Creating a consortium has enabled the partners to access and share equipment and expertise at both a national and international level. The formed consortium can attract other important partners to the project in order to further develop the field.

The developed learning course will significantly ease the mastering of the philosophy and significance of measurement uncertainty evaluation.

7. DISCLAIMER

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

8. REFERENCES


ABSTRACT: Modern technical products have to fulfill complex sets of requirements. They have to meet higher and higher technical performance standards, satisfying in the same time cost-effective objectives and tight environmental issues. In this context, a paradigm shift occurs in engineering design. Engineering design education has to reflect this orientation into university curricula, too. Thus, the challenge for university educators is to formulate and implement reliable methods that make students feeling the value added of approaching engineering design from the competitiveness perspective. The experience of the Technical University of Cluj-Napoca (UTC-N) in bringing competitive engineering design in the study programs of several specializations is revealed in this paper. The UTC-N educational methodology in competitive engineering design under the scheme of semester projects is also introduced. A case study highlights the UTC-N methodology. The paper ends with some discussions around this experience, as it is seen from the students’ perspective.

1. INTRODUCTION

In order to meet today’s economic demands and to remain competitive in the global trade, companies have to direct their engineering design process towards elaboration of technical systems able to satisfy market requirements to high-volume production and at low-price or specific nano- and micro-scale production at affordable price, as well as social and environmental constraints in association to the industrial production processes [5]. As a consequence, engineering design has to follow a scientific approach that integrates multidisciplinary knowledge. Issues like synthesis thinking, functional optimisation, creative and innovative problem solving, value engineering, life-cycle and life-time multiple-objective optimisation, etc. mainly frame nowadays and forthcoming engineering design processes [3], [5], [6], [8], [9], [10], [11], [12], [13], [15].

Engineering design education should reflect this orientation into university curricula, too. The problem is not simple as long as its resolution requires solving, without compromises, the conflict between the time-horizon required to cover the wide spectrum of methods and methodologies characterizing the universe of competitive design and the limited study-time available in a university curricula (e.g. a semester course unit).

2. NEW ORIENTATIONS IN ENGINEERING DESIGN EDUCATION

In the context of European Higher Education Area (EHEA) the major objective of the Bologna process is to create more comparable, compatible and coherent systems of higher education in Europe [8], [13], [20]. Teaching engineering design requires innovative learning techniques, as well as interdisciplinary approaches [7], [9], [12], [14], [12], [14], [18]. Challenges in engineering design education move beyond this point, towards interdisciplinary integration in already overburdened engineering curricula [10]. To this, the need for engineering curriculum renewal with technology changes and knowledge growth should be also taken into consideration [13]. New assessment techniques are required because new skills are being taught, too [16], [17], [21].

According to many opinions, the education of future design engineers should include courses where students actually apply their design knowledge in order to solve real life problems from industry and to find new opportunities [6]. These promising learning approaches are called Problem Based Learning and Project Based Learning (PBL) [1], [19], [23]. PBL is a learning environment which includes research, case studies, guided design, and engineering design projects [23]. According to Barrows and Kelson [1], PBL is both a curriculum and a process. The curriculum consists of well selected case studies where students will have to acquire new knowledge, problem solving skills, self-learning strategies, and team working aptitudes [1], [22]. The process reproduces real life challenges. Students are immersed into pseudo-real scenarios, thus encouraging them to take more responsibility for their own learning and apply their knowledge with higher intensities [4], [9].

PBL is a cyclic process which comprises three phases [19]: (1) cooperative problem thinking and identification of the learning needs, (2) self-guided study to acquire the required knowledge for problem solving, and (3) application of the acquired knowledge to solve the problem under consideration, followed by a synthesis of the lessons learned.

As a result of PBL the roles of teacher and student are changed [1], [12]. Students assume more responsibility for their learning, this giving an increased motivation and deeper sense of achievement [23]. This also creates favourable premises for students towards a successful life-long learning attitude [4], [14]. Teachers in turn become resources, tutors, and evaluators, guiding students in their problem solving efforts [6], [8].

3. COMPETITIVE ENGINEERING DESIGN

The engineering design process is about the set of actions required to develop a system, a module or a part of a system for meeting expressed and implicit needs [2], [18], [21]. Various disciplines from fundamental sciences and engineering sciences provide means and tools to convert different resources in order to achieve stated objectives. Optimal use of resources is one of the goals in this conversion process.
In principle, the engineering design process comprises the following stages: needs identification, problem formulation, running of various researches (fundamental and/or applied), extraction of a narrower space of research for further exploration, analysis criteria formulation, elaboration of alternative solutions, analysis of the proposed solutions, decision-making and solution selection, solution development [2], [9], [15], [18], [21].

In mechanical engineering, solution development deals with generation of details for the technical product (e.g. execution drawings, assembly drawings, dimensioning, modelling, behaviour simulation, testing, optimization, etc.) [18], [21].

Practice has shown that engineering design process does not follow a unique path; it is not general for all design engineers [2], [21]. Personal and group knowledge and experiences, as well as accessibility to various resources define particular engineering design paths [2], [18], [21].

Competitive engineering design is an engineering design process which includes specific actions and related methods and tools in order to work out commercial successful technical solutions considering complex sets of qualitative and quantitative constrains and targets (e.g. multi-objective performance targets, cost targets, organizational constrains, time constrains, financial constrains, resource constrains, technology constrains, competition challenges) [2], [24].

In this framework, a clear distinction has to be done between design engineers and conception engineers. Design engineers are mainly focused on creating the drawings necessary for prototyping and producing the technical solution and the related calculations (e.g. dimensioning), whereas conception engineers are more concerned with designing the solution on a more system engineering level [18]. Thus, design engineers especially deal with product synthesis, while conception engineers are mainly focused on product analysis and conceptualization. Various CAD/CAC/CAR/CAPP/CAQ/CAE software tools are available today to make the work of both conception and design engineers more effective and efficient.

In conclusion, competitive engineering design requires integration of tasks related to both conception engineers and design engineers. Actually, competitive engineering design looks for engineers with complex skills of both product analysis and synthesis.

4. UTC-N EDUCATIONAL APPROACH IN COMPETITIVE ENGINEERING DESIGN

In engineering education, introduction of competitive design disciplines in the study programs is relatively new – starting with the last 10 years. However, surveying curricula in mechanical an industrial engineering, as well as industrial design and product design from universities worldwide, it could be observed this subject is still underrated in engineering education.

At the Technical University of Cluj-Napoca (UTC-N), the first course dealing with competitive engineering design was introduced as an optional course at the Robotics specialization in 1999. So far it progressed, being today included in the curricula of three BSc study programs and one MSc study program.

The major scope of the course in competitive engineering design was to reveal to students a deeper and broader perspective of the engineering design process, as an extension of the conventional engineering design courses, where the focus was mainly on functional synthesis, dimensional calculation, and graphical visualisation (e.g. 2D, 3D technical drawings; 3D modelling and animation).

The methodology applied within the project work of the discipline of Competitive Engineering Design at UTC-N, for the case of Robotics specialization, as well as the framework which based the methodology formulation are further introduced.

4.1. Framework for methodology formulation

The starting point in formulating an appropriate methodology to educate students in competitive engineering design was to identify the key elements that should be considered in the framework of the project work for providing to students a way to build competitiveness in the technical solutions they elaborate.

Based on authors’ personal experience of over 15 years in the field of competitive design, as well as on the guidelines revealed by specific literature, the following key elements have been selected for shaping the frame of the student’s project work at the discipline of competitive engineering design:

- [KE1]: The solution proposed by students must reach a set of performance objectives defined in the project specification sheet,
- [KE2]: The solution proposed by students should not exceed a cost objective, imposed by project specifications,
- [KE3]: The project has to be completed in a time-constrained period (e.g. the end of a study semester),
- [KE4]: Technical conflicts must be identified and solved without compromises,
- [KE5]: Students must be able to identify priorities for innovation,
- [KE6]: Students must understand the advantages of competitive engineering design, where and to which extend it makes sense to consider this approach in addition to the conventional engineering design process,
- [KE7]: Students must be able to assess from an economic perspective the value incorporated in each module and part constituting the technical solution,
- [KE8]: Student must be able to prove if the performance requirements of the technical solution are optimally deployed at functional level,
- [KE9]: Students must be able to identify priorities of intervention in design, considering various challenges (e.g. time, money, competition).

The second step in methodology foundation was to link the key elements to various tools that competitive engineering design uses for system analysis and synthesis. In this respect, a novel approach has been formulated and applied.

It consists of a combination of the FAST method [2] and the TRIZ method [2]. FAST is used for functional analysis of the system (here the methodology) and TRIZ is used for defining appropriate borders of the methodology (the set of necessary and sufficient tools and the way they should be integrated within the design process such as to meet the educational objective in the limited time allocated for the project work).

FAST-TRIZ integration is illustrated in Figure 1. Tools revealed in the FAST graphical representation are selected according to the guidelines suggested by the vectors of innovation emerged from TRIZ application with respect to a set of conflicting problems related to the educational process. Thus, the challenges in selecting the most appropriate tools for being integrated in the methodology are connected to two important issues that are further highlighted.
The first issue is related to the capability of completing the project in one semester. The second issue is about the way students can reach the critical mass of skills and experience for getting awareness about various edges of competitiveness in product design by using a limited set of specific tools.

TRIZ method has been considered to support the innovation process both in defining the roadmap and the set of methods that constitute the UTC-N methodology for educating students in competitive engineering design.

For horizontal innovation (see Figure 1), TRIZ recommends the following generic vectors of intervention to approach the first challenge (simplification of the roadmap without creating barriers for technical innovations): a) translate the problem from one dimension of a method to several dimensions of a method and use a multi-level assembly; b) make immobile methods movable; c) use mediator-methods to carry out some actions (see in reference [2] or [3] the pair “36-18” of TRIZ engineering parameters). For the second challenge related to the horizontal innovation (ensure the quality of results without using a complex roadmap), TRIZ recommends the following generic vectors of intervention: a) extract un-necessary parts from methods; b) use methods able to reveal the “resonance” characteristics of the system; c) replace a complex method with several simpler “copies” (see in reference [2] or [3] the pair “29-36” of TRIZ engineering parameters).

Figure 1 reveals the set of sufficient and necessary methods to be brought into the engineering design process in order to educate students in the spirit of competitive product design. For example, 4 Phase-QFD method [2] (see Figure 1) meets the inventive principles a, b and c. The FMEA method [2] meets the inventive principles c, a and c. Axiomatic design [18] meets the inventive principle c. Value engineering [2] comes in front of principle b. Pugh [2] is related to the principles c, b and c. IPDP [2] is convergent to principles a and c, etc.

According to the results of FAST application in Figure 1, the 4 Phase-QFD method plays a very important role in educating students in the spirit of competitive design. However, methods like AHP, FMEA, as well as TRIZ, Pugh, IPDP and value engineering cannot be omitted from the roadmap.

Applying a similar logic for the vertical innovation (see Figure 1), TRIZ leads to the following generic vectors of innovation in association to the challenge 1 (to make such as the limited time allocated to the project work not affecting the accumulation of the critical mass of knowledge in the field): a) activate the “resonance frequency” of students; b) use periodic actions (impulses) to motivate students; c) use approaches with “inflating” properties; d) use strong “oxidizers” (see in reference [2] or [3] the pair “9-26” of TRIZ engineering parameters). For the second challenge (transfer a relevant amount of experience without a huge effort from the student side), TRIZ leads to the following generic vectors of innovation: a) reject and regenerate parts; b) because it is difficult to obtain 100% of the desired effect try to achieve as much as possible – in some points use excessive actions (see in
Some of the solutions integrated in the roadmap of the UTC-N methodology for meeting the spirit of the vectors of innovation are further revealed: create conditions such as students can assess their professional progress (to compare initial capability and final capability); divide the work into several modules (e.g., three modules) and give marks to each module – students will pay attention in equal measure to all chapters of the project; the roadmap of competitive design should also include the steps of conventional design such as students are able to see that things are integrated, not separated; provide industrial examples and case studies about competitive design such as students will better visualize the relevance of the study-topic; the roadmap should give the possibility of comparing two design approaches – conventional and non-conventional (competitive); for students that want to learn more, give them opportunities in the project to do so and motivate them (e.g., prizes, bonuses to the final mark, etc.).

4.2. The UTC-N methodology

According to the set of recommendations highlighted in the previous section, the UTC-N methodology implemented at the Robotics specialization for teaching students in competitive engineering design is the following:

Step 1: Formulation of the project topic: design a robot gripper that must fulfill a set of requirements related to quality, operation, and environmental performances. The set of requirements is provided, together with suggestions about formulating the technical characteristics of the robot gripper and the related units of measurement.

Step 2: Product conception: three constructive variants of the gripping system have to be elaborated to the level of detailed kinematic chains. Students can use various sources of inspiration (e.g., books, patents, product catalogues, etc.). Students must further select one of the variants using empirical approaches (e.g., a qualitative appreciation with respect to the set of requirements introduced at step 1).

Step 3: Detailing the selected kinematic chain to the level of parts: based on their previous experience in preceding projects dealing with engineering design (e.g., projects at the disciplines of mechanisms & machine elements, robotics engineering, etc.), students must elaborate the detailed 2D drawing of the assembly (by hand or using a CAD software). They do not have to make any kind of calculations in relation to product parts and mechanisms. The focus at this step is only on functional issues and on how they are solved by means of part design and integration.

Step 4: Ranking requirements: the AHP method [2] is used in this respect, including consistency analysis.

Step 5: Solution selection based on a systematic algorithm: Pugh method [2] is applied on the three variants proposed at step 2. Students will be able to see how well they have selected the most appropriate solution from the three possibilities (step 2). If the selected solution was wrong, they have to jump back for reworking step 3. This is a first important lesson about cost and time implication in relation with an ineffective approach of the design process.

Step 6: Product planning: QFD-phase I [2] is applied for deploying requirements into technical characteristics. Students will be able to see the product from a different perspective. They will visualize the key technical characteristics (and their impact in design), the units of measurement (and the measuring procedures and means), the correlations between these characteristics and the optimization trends for each technical characteristic.

Step 7: Technical and economic targets formulation: for each key technical characteristic a target is established. The set of targets expresses the technical dimension of product’s competitiveness. Students are encouraged to select these targets considering both the ideal case (when ideality can be defined) and the real case (e.g., better or at least equal with the state-of-the-art case – applied to each technical characteristic). For example, for the technical characteristic “weight” – in association with “payload capacity”, students must select a target value which is 10% lower than the weight of a potential competing robot gripper commercialized onto the market (they use in this exercise reference product catalogues). The cost objective is also established at this stage.

Step 8: Qualitative analysis of the solution proposed at step 3: students use the information from steps 6 and 7 to roughly assess their initial solution. Lessons are learned and a set of recommendations for improvement are formulated.

Step 9: Identifying the vectors of innovation: TRIZ is applied with respect to the negative correlations between technical characteristics. Further, IPDP is applied to identify priorities of innovation with respect to the technical targets; then innovative problem solving is applied (TRIZ). Directions of intervention are formulated at the end of this process. Some of them would be related to concept design, some others would be related to modules/mechanisms design or parts design. Information will be transferred to the next stages of the design process.

Step 10: Functional analysis: FAST and Mind-Map [2] are applied to define a preliminary set of key functions (functions which are relevant in the equation of competitive design).

Step 11: Function deployment: QFD-phase II [2] is used to deploy technical characteristics into functions. Specific rules are considered to refine the set of key functions. Relative impact of each function is revealed.

Step 12: Develop the concept of the gripper: information from steps 3 and 8 correlated with guidelines from steps 6, 7, 9, 10 and 11 are used to improve the gripper’s concept and to formulate/reformulate the modules and interfaces of the gripper.

Step 13: Module analysis: QFD-phase III [2] is used to deploy functions into modules and interfaces. Impact of each module is revealed. Value engineering is considered, too. More details about modules and interfaces are identified.

Step 14: Detailing the concept at part level: information from steps 3 and 8 correlated with guidelines from steps 6, 7, 9, 10, 11, 12 and 13 are used to detail each module/mechanism and interface to the part level. Axiomatic design [18] is applied in this respect in connection to the most relevant functions (see step 11 and 80-20 rule [3]).

Step 15: Value analysis at part level: QFD-phase IV [2] is applied to deploy modules into parts. A value analysis is further performed. Potential directions of improvement from economic point of view are revealed. TRIZ is applied to redefine the solution (if necessary).

Step 16: Perform calculations: geometric dimensioning and optimization, kinematical calculation, strength calculation and optimization are further performed. This includes gripping force calculation, driving force calculation, main parts
dimensioning, driving system design, control system calculation and integration, sensors calculation, selection and integration. Optimization techniques like FEA [18] are encouraged at this stage, as well as virtual prototyping, modelling and simulation for analysis.

Step 17: Preventive failure analysis: FMEA method [2] is applied on the proposed solution. Deviations from economic and technical targets are estimated. Potential failure modes in terms of functionalities, reliability and safety are also identified. Improvements are conducted.

Step 18: Assembly drawing elaboration: CAD software is used to represent graphically the final solution (2D, 3D).

Step 19: Analysis of results and conclusions: students perform a comparative analysis of the initial solution (step 3) and the final solution (step 17). Further areas of development are identified and included in a strategic design plan.

Step 20: Technical report elaboration: the written report is elaborated, following good practice rules for work structuring and description.

In addition to the project work, students are also trained during laboratory sessions in using competitive engineering design tools. Some new tools to those met in the project work are added (e.g. Combinex, AIDA, ARIZ, Force-Field, 6-3-5 [2]).

5. EXEMPLIFICATION

The methodology cannot be entirely exemplified in the space allocated for this paper. However, a flavour about its application is further disclosed using an extract from a project work done by a student from the Robotics specialization, where a three-finger robot gripper had to be designed. The initial solution (worked out by following a conventional approach) and the final solution (worked out by following the UTC-N methodology) – for the mechanical unit of the robot gripper – are illustrated in Figure 2 and Figure 3, respectively.

As Figure 2 reveals, the initial solution looks immature, being founded on the limited experience of the student. It is the result at the end of step 3 in the methodology (see section 4). Here, student’s focus was on providing a functional solution, without having in view that a mature solution is related to many other aspects like manufacturability, assembling, reliability, serviceability, interchangeability in operation, maintenance, disposal, etc. as well as aspects related to cost-effectiveness and timeliness in the production phase.

The systematic tackling of the competitive design methodology presented in the section 4 of this paper effectively helped the student in the attempt of understanding project requirements, in setting up a deep-rooted planning of product’s performances, in analysing comprehensively intermediary and final technical solutions having in mind life-cycle and life-time perspectives, in understanding where, why and how to apply technical innovation, as well as in formulating a cost-effective solution. The result is illustrated in Figure 3.

A comparison between the solution from Figure 2 and the solution from Figure 3 shows that the same student, at a certain moment in time, is able to provide better results if he/she is guided by adequate methods and methodologies. Actually, the systematic design methodology and the related methods succeed to exploit with high efficiency the hidden potential of students.

6. ENDING REMARKS

A feedback at the end of each semester is asked from students. The benefits which students in the last five series of graduates see from this experience are highlighted below:

• In the first two-three sessions of the project, students have the feeling that the time they are going to spend for product planning would be too long and they are concerned about the chances of completing the design project in due time; however, as they progress with product planning and innovation, they start realizing the utility of the approach,
• The main idea students formulate around the project is that the non-conventional approach helps them very much in avoiding design mistakes (e.g. it stops them omitting important aspects in design, thus reducing significantly the introduction of drawbacks in the final solution),
• Students realize the major difference between empirical design approaches and systematic design approaches and agree with the conclusion that systematic design creates favourable premises for bringing superior results in product design,
• Students “feel” better the technical solutions they elaborate (both strengths and weaknesses) and they are able to argue any demarche they perform in the design project (both in the intermediary and final stages),
• Students understand how innovation can be systematically introduced and deployed into the technical solution,
• Students realize that a space of open communication is generated, offering them opportunities for discussions and debates around the design project.
• Students become also confident that a good initial planning of product design saves them from a lot of undesired situations (e.g. redesign, with supplementary costs of time and effort),
• Students understand they have to approach a design project from several perspectives if they like to increase their chances in formulating a mature solution,
• Students also understand that not only the kinematical and dimensioning calculations define the boundaries of the design process – they have to pay a major attention to the economic requirements and deadlines, too,
• Students realize how important is to fully satisfy the requirements formulated by stakeholders (client and producer) – actually their marks are given in tight connection with the level of achievement of requirements given to them during the step 1 of the methodology.

7. CONCLUSION
The experience from the Technical University of Cluj-Napoca of educating students in the field of competitive engineering design is introduced in this paper. The goal of this initiative was to provide to the students new perspectives in engineering design for better facing with the current and forthcoming challenges in product design and development.

A methodology in 20 steps is promoted for the achievement of this goal. It includes a set of advanced tools for product planning, analysis and innovation and a well-defined interconnection of these tools in the attempt to master the engineering design process and to upraise students’ intellectual potential and experience.

The methodology has been applied with very good results over the last 10 years, today benefiting of this experience three BSc study programs and one MSc study program.

8. ACKNOWLEDGEMENTS
Technical drawings in Figure 2 and Figure 3 are extracted from the project work of the student Adrian Blebea, which is acknowledged with gratitude.

9. REFERENCES
1. INTRODUCTION

The pilot project is aimed at reformulating the content of graphical communications courses for the first year engineering students. The need to address this issue was triggered by a number of problems which are in fact common in engineering education:

- Time constraints and as a consequence proper selection of a content that meets the learning outcomes for the introductory engineering design courses.
- Many first year students do not have any background in engineering graphics.
- The new curriculum design with this introductory Engineering and Design course has an important impact regarding graduate attributes in relation with the learning outcomes. The graduate will need to have not only the ability to demonstrate critical thinking and problem solving skills, but also graphical communication skills, creativity, ability and desire for continuous learning.
- The new model must align with both, the CEAB criteria and the teaching framework established by the European Space for Higher Education (ESHE)-The Bologna Process, 1999-which centres on learning, the active role of students, the importance of acquisition, application and integration of knowledge, critical thinking and problem solving skills, communication skills, creativity, ability and desire for continuous learning.

Traditionally, any engineering curriculum has included engineering design graphic subjects in which students received basic training in sketching, drawing, and CAD. Traditional teaching approach is basically oriented towards knowledge transfer. According to some authors [1], [2], engineering graphics subjects should cover topic regarding standardized technical drawing, sketching, design principles, basic training in a 3D computer aided design tool, and spatial abilities.

- The instructor’s role, if the intent is to use visuals to improve students’ spatial abilities, is to recognize meaningful visuals for the classroom presentations, in order to help engage today’s student in a visual world. Research shows that students learn better from integrated text and visuals than from either medium separately.

Specifically for this class, using visuals helped to enhance students’ learning. The results of the study show the importance of integrating rich visuals and media with text to direct students’ attention to important information, and the benefits of integrating the information into clear representations.

2. NEW DIRECTIONS FOR INTRODUCTORY GRAPHICS IN ENGINEERING EDUCATION

Responding to the demand for students’ early exposure to the engineering profession and for the development of their problem-solving and critical thinking skills, Faculty of Engineering from University of Windsor introduced the Engineering and Design course (ED) replacing the engineering graphics (EG) course, which is still offered at the “Herman Oberth” Faculty of Engineering from Sibiu. The differences in EG and ED courses are summarized in Table 1.

Whereas the material for EG is designed to enhance students technical and graphical communication skills, ED introduces the basic engineering concepts in a product design and engages students in designing appropriate project reports, enhancing in this manner their written and oral technical communication.

As seen from Table 1, both ED and EG students are introduced to the fundamentals of sketching, isometric and orthographic drawings, dimensioning and scales. Students who lack the basic drafting skills and visualization ability have a tremendous disadvantage. The study was designed to evaluate the

ABSTRACT: Rapid growth of electronic information technology has a major impact on the content, delivery, and role of engineering graphics. Changes in engineering education are inevitable, and require the incorporation of innovative activities. This paper presents an experiment of applying computer graphics, virtual reality, and Internet resources in the teaching of technical graphics in engineering and design courses at the University of Windsor, Canada, and Lucian Blaga University, Romania. Our motivation was the fact that most of the students have a lack of previous knowledge on the basis of drawings, resulting in difficulties in both understanding and visualizing technical drawings. As an experimental method, we have introduced software for enhancing visualisation, solid modelling, and design-build projects, in addition to regular pencil-and-paper drawings. To better support learning, we also provided a website with animations and virtual reality resources. This experiment is intended to improve the learning in a way that motivates the students. Classes and the course website were designed to take advantage of computers’ interactivity and animated resources.

REFORMING THE ENGINEERING AND DESIGN COURSE FOR THE FIRST YEAR ENGINEERING STUDENTS: WITH OR WITHOUT CAD

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implementation of a course content which will include CAD modelling and animation in order to improve spatial abilities of first year engineering students. In the process, the authors took:

- Learn the difference between orthographic and isometric projections
- Draw an isometric view
- Dimension
- Draw sections and details
- Recognize standard drafting symbols.
- Draw the principal views in an orthographic project

Table 1. The comparison of ED and EG course content.

<table>
<thead>
<tr>
<th>Engineering and Design (ED)</th>
<th>Engineering Graphics (EG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction: teaming of students; faculty and students working interactively on open-ended engineering design projects</td>
<td>Instruction: accent on lecturing followed by individual graphic assignments</td>
</tr>
<tr>
<td>Sketching, isometric and multi-view drawings with dimensioning An introduction to real world engineering problems</td>
<td>Sketching, isometric and orthographic drawings, dimensioning and scales</td>
</tr>
<tr>
<td>Accent on technical and communication skills; making oral presentation, writing technical report, and incorporating design solutions</td>
<td>Accent on technical skills</td>
</tr>
<tr>
<td>Accent on independent creative thinking</td>
<td>Accent on factual knowledge and development of specific technical skills</td>
</tr>
</tbody>
</table>

In this context, the development of spatial abilities has become an important learning outcome. It has become essential that faculty approaches and conceptions of teaching must shift from the traditional teaching approach which is basically oriented towards knowledge transfer, “teacher-focused” approach to a student-centred, “learner-focused” approach.

In this regard, the collaborations consisted of reflection and discussion about how educational principles can be applied in the context of these particular learning and teaching goals. Engineering faculty worked together to design learner-centered instructions, and to develop course materials that have a positive impact on enhancing the students’ spatial ability, and as a consequence affecting retention and achievement in engineering disciplines.

3. PROJECT GOALS: ENHANCE VISUAL AND SPATIAL THINKING ABILITIES

The pilot project is not intended as a completed work, but serves as sketches for the development of a teaching and learning method with the intent to improve spatial abilities in first year engineering students. Spatial ability has been defined as the ability to generate, retain, retrieve, and transform well-structured visual images [3]. According to other studies, spatial visualization is defined as the student’s ability to “manipulate an object in an imaginary 3-D space and create a representation of the object from a new viewpoint” [4]. The visual thinking into account the outcomes the students should gain in these courses, to include the understanding and ability to:

- skills are extremely important in engineering practice. One of the main aspects which has been taken into consideration was represented by time constraints which are in fact common in engineering, given the overall curriculum requirements. Since a semester long spatial visualisation course cannot be offered at this time, the short targeted training can be offered as part of ED respectively EG courses.

The results of the faculty efforts to develop a new strategy in order to enhance students’ spatial abilities has been investigated, and data analyses showed that, as a result of new teaching-learning approach, the pre-course poor results improved in both institutions.

4. INTO THE 21ST CENTURY IN THE ENGINEERING DESIGN PRACTICES

This paper presents an experiment of applying computer graphics, virtual reality and Internet resources in the teaching of technical graphics in EG and ED courses, in addition to regular pencil-and-paper drawings study and practice.

The intent was to develop students’ visual thinking and spatial reasoning skills through hands-on, interactive exercises. The interactive tools include:

- Learning modules and exercises on making drawings by hand
- Computational drawing environments that allow students to see relationships between two and three dimensional representations
- Explorations in the ‘virtual world’ of making things, taking them apart, and reasoning about the relationships among objects.
- To better support learning, we provided course websites with animations and virtual reality resources, in addition to CAD and regular pencil-and-paper drawings study and practice.
- Since the most difficult task for the instructor is to explain the spatial relationship among planes and objects by just drawing on the blackboard or even using a digital board, this task was accomplished by using software products to create instructional multimedia. For example, multimedia assisted in visualizing the geometric relationships involved in descriptive geometry. Fragments of an animated draft are presented in figure 1. It was also used to assist in visualizing the principles of orthogonal projection and sectioning. Results of the surveys indicate that this approach in regard with the teaching methods was extremely well received by the students, since it helped with the understanding of the course material. It appears to be more enjoyable than the traditional method of instruction, since it makes the lecture more dynamic.

In regard with the students’ learning methods, 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 anywhere and without tools or laptops. Different studies have shown that students who are not exposed to hand-drawn sketching do not gain maximum visualization skills. For this reason, both universities include freehand sketching in ED and EG courses. Hand-drawn sketching is a skill that is often under-evaluated by students who are eager to learn the latest graphic applications. For this reason, in the majority of the applications, only after the exercise of hand sketching with
analog material (paper), students will experiment with digital sketching in modelling software. The surveys’ findings show the suitability of integrating analog and digital methods.

5. PILOT STUDY IN IMPROVING SPATIAL ABILITIES

This experiment is intended to improve the learning in a way that motivates the students. Forty volunteer first year engineering students (20 from ED course and 20 from EG course) participated in this study. None had previously studied subjects related to engineering graphics, and all were full-time students who considered themselves as having difficulties with spatial abilities.

In regard with the software used for applications, the authors decided to use modeling programs which can be freely downloaded from the Internet, and which are very easy to learn. The idea was to choose software that combines a simple but robust tool set with an intelligent drawing system, enabling students to build and modify models quickly and easily. User-friendliness and simplification are qualities of software products to be used in this early stage of learning. These characteristics justify the selection presented in figure 2 as the modeling tools for the pilot study:

SmartDraw: it is easy to use, and very easy to adapt to; it automates the process of creating mechanical drawings. Unlike other programs that provide users with a blank screen and expect them to draw, with SmartDraw users select from a template that is specifically designed to create the type of illustration they need. It contains dozens of SmartTemplates for engineering.

Google SketchUp: it is a free, powerful, and intuitive 3D modeling program used for years by design professionals such as architects and engineers. It provides a solid base for thinking and designing in 3D.

• 3DVIA Shape: perfect for the beginner, allows the users to easily create their designs in 3D

LEGO Digital Designer, a free software tool, a CAD tool that uses LEGO bricks to perform the design.

• The students were able to experiment with all these CAD tools, since their use did not require extensive training. The pilot study involved a series of activities of increasing difficulty:

To build 3D models based on physical parts
To represent 3D models corresponding to parts given by their axonometric projection, selected from the textbook.

6. DATA ANALYSIS

As mentioned earlier, all participating students have common characteristics:

• None had previously studied subjects related to engineering graphics,
• All were full-time students
• All considered themselves as having difficulties with spatial abilities, as reflected by their performance in the pre-test, which was administered before the targeted training using CAD tools.

Table 2 shows a summary of the results as a consequence of this pilot study:

• The mean of the scores obtained for the pre-test and post-test

Figure 1. Fragments of the animated draft.

Figure 2. Modeling tools for the pilot study.

In every situation, the students were asked to make a pencil sketch before using the CAD tool.
The gain resulted as a consequence of the proposed method to improve spatial abilities using
In the majority of the applications, only after the exercise of hand sketching with analog material (paper), students experimented with digital sketching in modelling software.
The surveys’ findings show the suitability of integrating analog and digital methods, as shown by the gain values in Table 2 and Table 3.
The scores were assigned for paper and pencil pre-test and post-test. The results are shown separately for the students in ED and EG courses. Since the pilot study involved a series of activities of increasing difficulty, all these three levels were considered.

### Table 2. Average score for the students in ED class

<table>
<thead>
<tr>
<th>Test type</th>
<th>Pre-test score</th>
<th>Post-test score</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D models based on physical parts</td>
<td>72.3</td>
<td>88.7</td>
<td>16.4</td>
</tr>
<tr>
<td>3D models corresponding to parts given by their axonometric projection</td>
<td>65.8</td>
<td>76.2</td>
<td>10.4</td>
</tr>
<tr>
<td>3D models of parts represented by their orthographic views</td>
<td>48.6</td>
<td>59.7</td>
<td>11.1</td>
</tr>
</tbody>
</table>

### Table 3. Average score for the students in EG class

<table>
<thead>
<tr>
<th>Test type</th>
<th>Pre-test score</th>
<th>Post-test score</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D models based on physical parts</td>
<td>74.6</td>
<td>89.4</td>
<td>14.8</td>
</tr>
<tr>
<td>3D models corresponding to parts given by their axonometric projection</td>
<td>68.1</td>
<td>77.5</td>
<td>9.4</td>
</tr>
<tr>
<td>3D models of parts represented by their orthographic views</td>
<td>46.3</td>
<td>57.7</td>
<td>11.4</td>
</tr>
</tbody>
</table>

The average gain for the first test type is around 15 points, for the second 10 points, and for the third 11 points. These results demonstrate that with training and the use of above mentioned methods meant to improve the students’ visual and spatial thinking abilities, both groups of students gained equally in average for all three tests. The total average gain for the ED class is around 12 points, compared to the average gain of 11 for the EG class.
The value of gain being comparable for both categories of students and also for the three types of tests, is strong evidence that using both, pencil and paper and a suitable CAD tool, will enhance students’ learning and their spatial abilities.

### 7. CONCLUSIONS AND FUTURE WORK

From this study it can be concluded that the innovative methods of teaching and learning are the key to help first year students succeed in this type of class, and as a consequence affecting achievement in engineering disciplines.

Results of the surveys indicate that this approach in regard with the teaching methods was extremely well received by the students, since it helped with the understanding of the course material. It appears to be more enjoyable than the traditional method of instruction, since it makes the lecture more dynamic.

It should be noted that user-friendliness and simplification are qualities of software products to be used in this early stage of learning. Time constraints do not allow the use of more complicated CAD tools like AutoCAD or CATIA. From this perspective, one of the challenges of technology innovation is that software programs often come with too many features that the product becomes overwhelming to learn. If the software engineers and academia will work together to improve collaboration and software redesign for simplicity of use, this will help to shape creative and technically competent engineers.

The newer model proposed, concerning the implementation of innovative methods of teaching and learning, will be further analyzed and developed. In this regard, the faculty team is discussing the possibility of introducing other innovative ideas in order to enhance students learning. The findings will make the object of a future study.

### 8. REFERENCES

THE RELATIONSHIP BETWEEN MOTIVATION, ANXIETY, LEARNING STRATEGIES AND ENGLISH LANGUAGE LEARNING: A STUDY ON THE CADETS OF THE LAND FORCES ACADEMY OF SIBIU

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ABSTRACT: Our study examines the relationship between the linguistic level of competence of the cadets of the Land Forces Academy and variables like: the general level of academic anxiety, the utilized learning strategies, the motivation for the learning of English and the anxiety caused by it. The following instruments were used: Oxford Placement Test 2, Academic Anxiety Test (AAT), R. Oxford’s Strategy Inventory for Language Learning (SILL) and Gardner’s Attitude / Motivation Test Battery (AMTB). 121 students were included in our study. The results indicate that the significant differences between the categories of English proficiency are produced by the different degree of utilization of the cognitive, metacognitive and compensatory strategies by the investigated subjects. Furthermore, we have found that the higher the level of proficiency, the higher the level of anxiety that facilitates the knowledge acquisition. The proficient subjects also obtained significantly higher scores in the tests that measure the intensity of motivation and of the desire to learn English.

1. INTRODUCTION

For the Romanian military the importance of knowing English at an advanced level has grown immensely, particularly in the last decade, due to causes like the modifications in defense relations and the shifting roles and tasks of officers and NCOs. More and more forces participate in various international military operations, often under the command of N.A.T.O. or U.N., and the main means of communication is the English language, which has become a real “lingua franca”.

Being aware of the changes taking place in the contemporary military environment, especially as far as the missions being carried out in the multinational theatres of operations are concerned, the English teachers of the Land Forces Academy of Sibiu have reorganized the courses and seminars. They have introduced into the syllabus themes and topics meant to sensitize the future officers about the importance of intercultural issues and now they are trying to find out the learning strategies the cadets employ most frequently in order to adjust and improve their teaching style.

The fundamental objective of the process of learning foreign languages is the forming and developing of appropriate competences adequate for the job, for the professional militaries and for the civilian personnel whose professional activity requires these skills.

The programs of study are designed according to the changes produced in the national education system as a result of the implementation of the principles, objectives and commitments assumed by our country in The Bologna Declaration and the need to observe the NATO work procedures and performance standards.

The strategies needed in acquiring and improving foreign languages by the Land Forces Academy’s cadets are outlined in a number of MOD orders ranging from entrance exam standards, outlooks at the study of foreign languages to standards for foreign languages assessment.

The foreign languages program is part of the military academic program and is achieved through intensive and non intensive programs. The intensive ones are developed in the foreign languages centers and have as a major objective to acquire and improve the linguistic competences needed by the military leaders all along their careers as well as to acquire the NATO terminology, especially the command procedures necessary during peacekeeping or operational missions.

The military academies develop non intensive programs whose main objective is to maintain or improve the competences of oral and written communication in a foreign language. By the end of the foreign languages courses, the cadets have a language performance exam according to Stanag 6001 standards, linguistic level 2, equivalent to level B2 Common European Framework. To offer high quality programs, the teachers involved have to attend specialized courses. The specialized Directories of the Romanian MOD are responsible for organizing periodical conferences and courses with teachers’ mandatory attendance. They also have the opportunity to participate in courses abroad. The teachers use the most appropriate didactical strategies as well as the necessary logistics to achieve the main objective.

In the Land Forces Academy the cadets have the opportunity to develop sound foundations mainly in English and in any of the other two foreign languages - French and German. Efforts are made to integrate not only the most appropriate didactical strategies, but also the latest technology, such as computer assisted learning and interactive multi media into the department’s foreign language program. Additionally, selected cadets have a huge opportunity to enhance their foreign language skills through academic exchange programs.
The English courses have a dual objective: the refining of language skills and the acquisition of knowledge of the culture and history of the people whose language they study. The teachers try to enhance the cadet’s oral, reading and writing skills through vocabulary expansion, grammar review and cultural or specialized reading as well as to sharpen their abilities to reason and express themselves clearly and persuasively. Thus, during the first semester the cadets complete their preparation in grammar and syntax and get the necessary experience and skills to make the transition to the communicative course. All coursework, except occasional grammatical explanations, is in the foreign language. The students have direct access to newspapers and periodicals and the appropriate articles are used as a vehicle for classroom discussions. To acquire an understanding of and appreciation for other cultures, particularly those of Great Britain and the USA, students follow a 7 week course called Life and culture in the English Speaking World. A variety of authentic culture-rich and appropriate materials, such as meaningful texts including social situations, historical facts, cultural experience, are considered to be a key to foreign language learning.

Second language communicative competence involves both knowledge of linguistic elements and the knowledge that is required for appropriate L2 use in different contexts. To acquire proficiency in oral and written communication, students attend a third course called Communicative Issues. From Theory to Practice. It concentrates mainly on the rules of good writing, starts with sentences, paragraphs, essays, moving on to letter, memo and report requirements, focusing both on theory related to these issues as well as on practical examples, followed by different tasks that are to be solved by students. Another important part deals with nonverbal communication which we consider to be of utmost importance for our students’ future career. Students are also offered professional language classes, namely general military terminology as well as specific military terminology.

To become functionally proficient in the foreign language, students are familiarized with listening, reading and writing tests. Twice a year they also have to hand in a written project which is presented orally in front of the classroom to develop their speaking skills. In addition to assessing students’ progress and achievement, the language programs themselves are assessed through a process that includes surveys of staff and current students. At the end of the academic period, students are tested by specialized testers according to Stanag 6001 standards.

**Learning strategies.** The learning strategies can be defined as ensembles of procedures utilized by a person in order to assimilate and store information in order to use it later, in various situations.

Rubin (in Griffiths, 2004:2) defines the learning strategies in a very comprehensive way: “techniques or devices which a learner may use to acquire knowledge”.

Stern (in Griffiths, 2004:3) considers that strategies are “broadly conceived intentional directions”, and O’Malley and his collaborators are of the opinion that they are “operations or steps used by a learner that will facilitate the acquisition, storage, retrieval or use of information”.

R. Oxford, whose instrument is utilized in this study – Strategy Inventory for Language Learning - describes the language learning strategies as “operations employed by the learner to aid the acquisition, storage, retrieval, and use of information” (Oxford, 1990, p.8). She classified learning strategies into six groups:

1. memory strategies – utilized to memorize the information in a certain order; one uses sounds, body movements or locates the respective item in space;
2. cognitive strategies- are based on restructuring the information, on associating the new information with the old one, the one already assimilated;
3. compensation strategies – include the use of synonyms, circumlocations and gestures that convey the meaning;
4. metacognitive strategies – comprise those strategies which allow the individual to know himself as a learner better, to fully understand the general learning process, and to manage his concrete learning tasks more efficiently;
5. affective strategies - are based on the identification of feelings that occur in the course of circumstances in which learning is produced (anxiety, anger, content, satisfaction, etc.);
6. social strategies - include learning together with others, asking clarification and confirmation questions, asking for help, the effort to study and understand the culture of the language that is studied, etc.

Practice and research show that there are other language learning strategies except those identified so far. However, it is clear that no strategy is used in isolation, separated from the others, but they are used by the individual in various combinations, depending on his needs and possibilities.

**Anxiety.** Specialists have described various types of anxiety, the two most important being the state anxiety, which is momentary and not a feature of the personality of the individual, and the trait anxiety, a constant personality characteristic, “which predisposes an individual to perceive a wide range of objectively nondangerous circumstances as threatening” (Spilberger, 1966). The notion of state anxiety is contested by researchers like Mishcel, Peake, Endler or P. D. MacIntyre and R. C. Gardner who are of the opinion that “traits are meaningless unless they are considered in interaction with situations” (MacIntyre, Gardner, 1991)

This idea lead to the notion of situation-specific anxiety - the probability of becoming anxious in a particular type of situation. Foreign language anxiety is an example of such situation-specific anxiety, characterized by “self-centered thoughts, feelings of inadequacy, fear of failure and emotional reactions in the language classroom” (Oh, 1990). According to a definition by MacIntyre and Gardner, “Language anxiety can be defined as the feeling of tension and apprehension specifically associated with second language contexts, including speaking, listening, and learning” (MacIntyre.P.D., Gardner, R.C,1991). Anxiety is not only a result of poor performance in the language class, but it is also a cause of low results in the learning of a foreign language. In order to prevent this situation, several methods have been developed in order to reduce anxiety and increase learning in language students: Community Language Learning, the Natural Approach and Suggestopedia.

Motivation also plays a vital role when it comes to learning a foreign language. It has been defined as “the learner's orientation with regard to the goal of learning a second language” (norris-holt, 2001). It has been proved that the most successful English students are those who like the speakers of the language, admire the culture of the English speaking peoples and need this language to operate better in a society in which it is used. finegan considers that “integrative
motivation typically underlies successful acquisition of a wide range of registers and a native like pronunciation” (Finegan, 1999).

Instrumental motivation, in contrast to the integrative one, is generally characterized by “the desire to obtain something practical or concrete from the study of a second language … such as meeting the requirements for school or university graduation, applying for a job, requesting higher pay based on language ability, reading technical material, translation work or achieving higher social status” (Norris-Holt, 2001).

Even though both types of motivation are indispensable for learning a foreign language, integrative motivation is considered to be more important.

2. PURPOSE OF THE STUDY.

Our study examines the relationship between the level of linguistic competence of the cadets of the Land Forces Academy and variables like: the general level of academic anxiety, the utilized learning strategies, the motivation for learning English and the anxiety produced by it.

Methodology

Participants. The participants included in this study are the students of six study groups from the Land Forces Academy of Sibiu, two groups from each year of study.

Measures.

1. Strategy Inventory for Language Learning (SILL) is an instrument created by R. Oxford (1990) to assess the extent to which an individual uses different strategies for the learning of foreign languages. It consists of 50 items distributed as follows: nine items for memorizing strategies, fourteen for cognitive strategies, six items for compensation strategies, nine for metacognitive strategies, six for affective strategies and six for social strategies. The respondents should evaluate, on a scale from 1 to 5 to what extent the statements presented in the test are true for them. The Cronbach alpha coefficient obtained by us for this test is 0.89.

2. Oxford Placement Test 2, developed by Dave Allan (1992), consists of two parts, a grammar test and a listening one. The test categorized the students, according to the scores they obtained, into the following levels:

<table>
<thead>
<tr>
<th>Levels</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native speaker:</td>
<td>135</td>
</tr>
<tr>
<td>functionally bilingual</td>
<td></td>
</tr>
<tr>
<td>Near-native speaker:</td>
<td>130</td>
</tr>
<tr>
<td>expert user</td>
<td></td>
</tr>
<tr>
<td>Professional user</td>
<td>120</td>
</tr>
<tr>
<td>Very advanced:</td>
<td>110</td>
</tr>
<tr>
<td>highly proficient user</td>
<td></td>
</tr>
<tr>
<td>Advanced:</td>
<td>100</td>
</tr>
<tr>
<td>proficient user</td>
<td></td>
</tr>
<tr>
<td>Post-intermediate:</td>
<td>90</td>
</tr>
<tr>
<td>competent user</td>
<td></td>
</tr>
<tr>
<td>Upper intermediate</td>
<td>80</td>
</tr>
<tr>
<td>Mid-intermediate:</td>
<td></td>
</tr>
<tr>
<td>independent user</td>
<td></td>
</tr>
</tbody>
</table>

3. The academic anxiety assessment test - measures the influence of anxiety on acquiring academic knowledge and its role in generating learning difficulties. It is a test designed by Alpert and Haber (1960) and consists of 19 items. It distinguishes between anxiety that facilitates the acquisition of knowledge and anxiety that impedes its acquisition. Therefore, a score for each scale is calculated, and not a global score the two scales being antagonistic. The Cronbach coefficients we obtained are the following: 0.79 for the subscale measuring anxiety that impedes the acquisition of knowledge and 0.83 for the subscale measuring the anxiety that facilitates knowledge acquisition.

4. Attitude/Motivation Test Battery (AMTB) is an instrument designed by Gardner and consists of 11 subtests, grouped into five categories as follows:

a. Integrativness — includes the subscales named integrative orientation, interest in foreign languages and attitudes toward the target language group.

b. Attitudes toward the learning situation — includes the evaluation of the language instructor and evaluation of the language course subscales.

c. Motivation — includes motivation intensity, desire to learn the language and attitudes toward learning the language subscales.

d. Instrumental Orientation;

e. Language anxiety - comprises language class anxiety and language use anxiety subscales.

In our study we have utilized the subscales that measure motivation (motivation intensity, desire to learn the language and attitudes toward learning the language; $\alpha = .75$), and anxiety (language class anxiety and language use anxiety; $\alpha = .86$).

3. RESULTS AND DISCUSSIONS

Descriptive Statistics. Table 1 contains the percentage distribution of the levels of competence in using English in the group we investigated.

Table 2 presents the averages and standard deviations for the main variables that were measured. Thus, we can see that the subjects of the group we investigated achieved the following “rating” of the strategies used to learn English: social strategies, metacognitive strategies, cognitive strategies, compensation strategies, memory strategies, and affective strategies.

The score obtained in the listening test is higher than the one obtained in the grammar test. The anxiety level that facilitates learning is slightly higher than that of the anxiety that prevents learning. The motivation for learning English is much stronger than the language anxiety.
Table 1. The percentage distribution of the levels of competence in the investigated group (N = 121)

<table>
<thead>
<tr>
<th>English Proficiency Levels</th>
<th>%</th>
<th>English Proficiency Levels</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional user</td>
<td>1.7%</td>
<td>Mid-intermediate: independent user</td>
<td>14%</td>
</tr>
<tr>
<td>Very advanced: highly proficient user</td>
<td>11.6%</td>
<td>Lower intermediate</td>
<td>13.2%</td>
</tr>
<tr>
<td>Advanced: proficient user</td>
<td>17.4%</td>
<td>Pre-intermediate: adequate user</td>
<td>9.1%</td>
</tr>
<tr>
<td>Post-intermediate: competent user</td>
<td>19.8%</td>
<td>Post-elementary: threshold level</td>
<td>4.1%</td>
</tr>
<tr>
<td>Upper intermediate</td>
<td>9.1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Mean and standard deviation for learning strategies, Oxford Placement Test, academic anxiety motivation and language anxiety

<table>
<thead>
<tr>
<th>English Learning Strategies</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory strategies</td>
<td>1.33</td>
<td>4.11</td>
<td>3.04</td>
<td>.44</td>
</tr>
<tr>
<td>Cognitive strategies</td>
<td>1.78</td>
<td>4.50</td>
<td>3.40</td>
<td>.48</td>
</tr>
<tr>
<td>Compensation strategies</td>
<td>2.16</td>
<td>4.66</td>
<td>3.29</td>
<td>.52</td>
</tr>
<tr>
<td>Metacognitive strategies</td>
<td>1.33</td>
<td>4.77</td>
<td>3.49</td>
<td>.60</td>
</tr>
<tr>
<td>Affective strategies</td>
<td>1.50</td>
<td>4.16</td>
<td>2.67</td>
<td>.51</td>
</tr>
<tr>
<td>Social strategies</td>
<td>1.83</td>
<td>4.83</td>
<td>3.63</td>
<td>.58</td>
</tr>
<tr>
<td><strong>Oxford Placement Test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listening test score</td>
<td>54</td>
<td>93</td>
<td>78.18</td>
<td>8.37</td>
</tr>
<tr>
<td>Grammar test score</td>
<td>45</td>
<td>95</td>
<td>72.58</td>
<td>10.30</td>
</tr>
<tr>
<td>Oxford test total score</td>
<td>124</td>
<td>188</td>
<td>150.76</td>
<td>14.41</td>
</tr>
<tr>
<td><strong>Academic Anxiety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety that impedes the acquisition of academic knowledge</td>
<td>25</td>
<td>38</td>
<td>30.85</td>
<td>2.69</td>
</tr>
<tr>
<td>Anxiety that facilitates the acquisition of academic knowledge</td>
<td>25</td>
<td>40</td>
<td>32.31</td>
<td>3.66</td>
</tr>
<tr>
<td><strong>Motivation for learning English</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivational intensity</td>
<td>1.90</td>
<td>5.40</td>
<td>4.03</td>
<td>.74</td>
</tr>
<tr>
<td>Attitudes toward Learning English</td>
<td>2.20</td>
<td>6.00</td>
<td>4.94</td>
<td>.77</td>
</tr>
<tr>
<td>Desire to Learn English</td>
<td>2.20</td>
<td>5.90</td>
<td>4.83</td>
<td>.71</td>
</tr>
<tr>
<td><strong>Language Anxiety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English Class Anxiety</td>
<td>1.30</td>
<td>5.00</td>
<td>2.79</td>
<td>.76</td>
</tr>
<tr>
<td>English Use Anxiety</td>
<td>1.20</td>
<td>4.60</td>
<td>2.30</td>
<td>.65</td>
</tr>
</tbody>
</table>

Correlations

The correlation coefficients presented in Table 3 indicate the strong positive relationship between the level of anxiety that facilitates the acquisition of academic knowledge and the level of English proficiency.

Table 3. Pearson Coefficients for correlations between Oxford Placement Test score and academic anxiety

<table>
<thead>
<tr>
<th>Anxiety that facilitates the acquisition of academic knowledge</th>
<th>Listening score</th>
<th>Grammar score</th>
<th>Oxford test total score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.457**</td>
<td>.441**</td>
<td>.581**</td>
</tr>
<tr>
<td></td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 4. Correlations matrix for English learning strategies, Oxford Placement Test score and academic anxiety

<table>
<thead>
<tr>
<th></th>
<th>Memory strategies</th>
<th>Cognitive strategies</th>
<th>Compensation strategies</th>
<th>Metacognitive strategies</th>
<th>Affective strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening test</td>
<td>.213*</td>
<td>.239**</td>
<td>.350**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.019</td>
<td>.008</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grammar test</td>
<td>.398**</td>
<td>.201*</td>
<td>.292**</td>
<td>-.10*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.000</td>
<td>.027</td>
<td>.001</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td>Oxford test total score</td>
<td>.423**</td>
<td>.347**</td>
<td>.299**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.000</td>
<td>.000</td>
<td>.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety that impedes the acquisition of academic knowledge</td>
<td>.300**</td>
<td></td>
<td>.554**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.001</td>
<td></td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety that facilitates the acquisition of academic knowledge</td>
<td>.232*</td>
<td></td>
<td></td>
<td>.21</td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
These positive correlations indicate that the intensive use of cognitive, metacognitive and compensation strategies has a positive effect on the linguistic competence of a person. Table 5 contains the correlation coefficients between the English learning strategies, Oxford Placement Test, motivation and anxiety scores. We notice the significant positive correlations between the subscales measuring the motivation for learning English and the cognitive, metacognitive and social learning strategies, which indicate the fact that they strengthen and support each other. Moreover, as we actually expected, the stronger the motivation for learning English, the higher the English proficiency. The latter is negatively influenced by the language anxiety, which correlates negatively with the motivation for learning English and the cognitive, metacognitive and social learning strategies (especially English use anxiety).

Using the ANOVA statistical procedure, we studied the differences between four categories of English proficiency, regarding the extent to which the various strategies for learning English are used and the levels of academic anxiety, motivation for learning English and English learning anxiety. The four categories are:

- proficient user (N = 37);
- competent user (N = 35);
- independent user (N = 33);
- adequate user (N = 16).

The results revealed significant global differences regarding the following aspects (see Table 6):

- the degree of utilization of the cognitive strategies; the ANOVA test (F = 5.97, p = 0.001) and the post-hoc analysis (Bonferroni test) highlighted the fact that the proficient users utilize this type of strategy to a greater extent than the adequate users;
- the degree of utilization of compensation strategies; the ANOVA test (F = 5.95, p = 0.001) and the post-hoc analysis (Bonferroni test) highlighted the fact that this type of strategy is utilized to a greater extent by the proficient users and competent users as compared to the independent users;
- the degree of utilizing the metacognitive strategies; the ANOVA test (F = 4.42, p = 0.005) and the post-hoc analysis (Tamhane test) indicate the fact that proficient users utilize this type of strategy to a greater extent than competent users.

### Table 5. Correlations matrix for English learning strategies, Oxford Placement Test Score and AMTB Scales

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Motivational intensity</th>
<th>Attitudes toward Learning English</th>
<th>Desire to Learn English</th>
<th>English Use Anxiety</th>
<th>English Class Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive strategies</td>
<td>.333**</td>
<td>.406**</td>
<td>.411**</td>
<td>-.267*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.002</td>
<td>.000</td>
<td>.000</td>
<td>.012</td>
<td></td>
</tr>
<tr>
<td>Metacognitive strategies</td>
<td>.477**</td>
<td>.507**</td>
<td>.496**</td>
<td>-.332**</td>
<td>-.255*</td>
</tr>
<tr>
<td></td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.002</td>
<td>.017</td>
</tr>
<tr>
<td>Social strategies</td>
<td>.311**</td>
<td>.310**</td>
<td>.311**</td>
<td>-.281**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.003</td>
<td>.003</td>
<td>.003</td>
<td>.008</td>
<td></td>
</tr>
<tr>
<td>Grammar test</td>
<td>.338**</td>
<td>.363**</td>
<td></td>
<td>-.255*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.001</td>
<td>.001</td>
<td></td>
<td>.017</td>
<td></td>
</tr>
<tr>
<td>Oxford test total score</td>
<td>.343**</td>
<td>.384**</td>
<td>-.216*</td>
<td>-.282**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.001</td>
<td>.000</td>
<td>.045</td>
<td>.008</td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

### Table 6. Means, standard deviations, eta-square and Cohen indexes

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Proficient level</th>
<th>Competent level</th>
<th>Independent level</th>
<th>Adequate level</th>
<th>η²</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m</td>
<td>s.d.</td>
<td>m</td>
<td>s.d.</td>
<td>m</td>
<td>s.d.</td>
</tr>
<tr>
<td>Cognitive strategies</td>
<td>3.62</td>
<td>0.50</td>
<td>3.35</td>
<td>0.42</td>
<td>3.38</td>
<td>0.39</td>
</tr>
<tr>
<td>Compensation strategies</td>
<td>3.49</td>
<td>0.42</td>
<td>3.38</td>
<td>0.63</td>
<td>3.02</td>
<td>0.43</td>
</tr>
<tr>
<td>Metacognitive strategies</td>
<td>3.77</td>
<td>0.61</td>
<td>3.30</td>
<td>0.59</td>
<td>3.41</td>
<td>0.50</td>
</tr>
<tr>
<td>Anxiety which facilitates the acquisition of academic knowledge</td>
<td>33.7</td>
<td>2.58</td>
<td>32.7</td>
<td>3.73</td>
<td>30.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Motivation intensity</td>
<td>4.42</td>
<td>0.52</td>
<td>3.87</td>
<td>0.84</td>
<td>3.75</td>
<td>0.70</td>
</tr>
<tr>
<td>Desire to learn English</td>
<td>5.20</td>
<td>0.49</td>
<td>4.75</td>
<td>0.77</td>
<td>4.64</td>
<td>0.66</td>
</tr>
</tbody>
</table>

- the level of anxiety which facilitates the acquisition of academic knowledge; the ANOVA test (F = 19.83, p = 0.000) and the post-hoc analysis (Bonferroni test) indicate the fact that the proficient users have a higher degree of anxiety than the competent users, and the competent users have a higher degree of anxiety than the independent users and adequate users;
- the level of motivation intensity; the ANOVA test (F = 8.49, p = 0.003) and the post-hoc analysis (Bonferroni test) indicate the fact that the proficient users have a higher level of desire to learn English than the independent and adequate users.

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
4. CONCLUSIONS

The data collected from our research indicate that there are significant differences between the investigated categories in terms of the utilized learning strategies, academic anxiety, English anxiety and motivation for learning English.

Although the social strategies are those that the students say they use to a greater extent (learning together with others, clarification and confirmation questions, asking for help, the effort to study and understand the English culture, etc.), the significant differences between the English proficiency categories are caused by the different degree of utilizing the cognitive, metacognitive and compensation strategies by the investigated subjects. Thus, we see that proficient users use cognitive strategies to a greater extent than adequate users, but, in this respect, they do not differ from the competent and independent users. Proficient and competent users use compensatory strategies to a greater extent than independent users and the degree of utilizing metacognitive strategies appears to make, as far as the subjects investigated by us are concerned, the difference between proficient users and competent users.

These results seem to suggest that the passing from the lower levels of English proficiency to higher levels can be achieved by focusing on the use of a specific type of learning strategy. Thus, in order to pass from the level of adequate user to that of competent user, the cognitive strategies would be the most effective: deductive and inductive reasoning, context analysis, the use of environmental cues etc. To pass from the level of independent user to that of competent user, the compensatory strategies would be the most useful: the use of synonyms, circumlocutions and gestures that convey meaning, etc. To pass from competent user to proficient user, the metacognitive strategies are the best: the demarches for self-knowledge, identifying one’s own interests, needs and personal learning style, identifying the available resources and choosing the most valuable ones, creating a study program, the correct management of learning tasks, setting realistic goals correlated with the concrete tasks, planning the steps and the stages one has to go through, monitoring the mistakes, etc.. This model of transition from one level to another should be supported by the results of other studies, possibly experimental.

Moreover, proficient users have an increased anxiety level that facilitates the acquisition of academic knowledge as compared to that of the competent users; the latter have a higher level than adequate and independent users. This means that the subjects in the proficient user category can work under stress if the task is sufficiently important for them, they control their negative emotions better during examinations, are often stimulated by the emotions they have during exams, focus more easily and their mobilization is directly proportional to the importance and difficulty of the exam, as compared to the subjects in the competent user category. The latter have the same characteristics as compared to the subjects of the independent and adequate user levels.

As far as the other variables included in the study, the motivation for learning English and the anxiety related to it, are concerned, the data indicate the fact that the intensity of motivation is significantly higher in the subjects of the proficient user category, as opposed to those in the competent and independent user categories. Furthermore, the subjects in the proficient user category have the desire to learn English significantly higher than that of the subjects in the independent and adequate user categories.

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QUALITY MANAGEMENT IN ENGINEERING AND BUSINESS EDUCATION
A HUMAN RESOURCE-BASED VIEW OF EDUCATION QUALITY

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ABSTRACT: The article explores, without denying the other resources’ contribution, the quality of education from the human resource point of view, stressing the fact that its value makes up the foundation of an efficient education system. Its starting point is the analysis and interpretation of statistical data provided by national and international specialty institutions, as well as a series of studies relevant for the field of education. The teaching staff quality is reflected in “the educational product” supplied by learning institutions to the labor market. At the same time, the moral and professional component of trainers – teachers – leaves a mark on studies relevant for the field of education. The teaching staff quality is reflected in “the educational product” supplied by learning institutions to the labor market. At the same time, the moral and professional component of trainers – teachers – leaves a mark on educational organizational culture, on the educational act as well as on institutional success. The level of financial resources, in their turn, influence the entire educational flow setting up the premise for attracting and keeping personnel into the system, as well as performing the investments necessary for high-quality education.

1. INTRODUCTION

The continuous reform that Romanian education undergoes and the results contrary to original goals draw attention on both education policies’ viability and on quality and competitiveness criteria put into effect or not by national education suppliers.

Literature on the subject includes education in the category of public services (Nusbaumer, 1984), advocates for the necessity for investments in education from the point of view of its economic and social benefits (Blaug, 1972; Becker, G. S. and Mulligan G.B. 1997) and highlights that the suppliers (of educational services) should take into account their clients’ demands (Zeithaml, Parasuraman and Berry, 1990). From the education quality and efficiency indicators point of view, resources can be considered to be factors that influence education throughout its path (Damian, 2008), while human resources are considered to be the basis for formation and efficiency (Sandî, Moraçaș, 2007).

The article underlines the fact that, whereas education is one of the main European and global issues, Romania cannot treat quality criteria implementation perfunctorily especially when education is thought to be the fundamental prerequisite for economic growth, human development and knowledge society building. By bringing some requisitions of the human resources in education to the foreground, the goal is to contribute to an increase in the awareness towards the importance of this profession, as well as to increase the level of responsibility towards the human resource in the field. The starting hypothesis is that human resources are determinant for ensuring quality in education.

Including education in the public services category imposes the creation of a legislative framework able to ensure and attract the necessary human resource for efficient education.

2. QUALITY AS THE BASIS FOR PERFORMANCE IN THE EDUCATIONAL SERVICE

Before particularizing the complex problem of education some disentanglement must be made concerning term significance and concept implications on other fields and activities. The word “quality” originates in the Latin “quales” that describes a way of being.

In the long run, quality was subject to numerous research and the results revolutionized both the production of goods and that of services supplied to the population. One of the field classics, J.M.Juran, defines quality as being a “product’s faculty of being used (use fittingness)”. In order to highlight the importance of quality, he stated that “quality is a matter of collective concern”.

A unanimously accepted definition for quality provided by the International Standardization Organization (SR ISO 9000:2001) regards quality as the degree to which a set of intrinsic characteristics complies with certain demands. Quality is therefore linked to users’ and consumers’ needs, contributing to a certain degree of satisfaction, “customer satisfaction”. Hence, the permanently evolving human needs reflect upon specific satisfaction requirements that result in continuous quality improvement.

Although definitions are different, most of them lead to the idea that it is by means of quality that performance can be identified, and that once achieved, quality can bring about success.

Increase in, if possible, or maintaining of organizational performance depends on its product or service quality. Applying quality indicators to educational areas stands for an all-important measure for any education supplier that thrives for competitiveness, especially under present circumstances when the educational market is growing to be global and the chase for potential “customers”, with a will to learn, is ever-increasing.

The concept of “education” that quality refers to in this case is explained in the Romanian Language Dictionary as the activity of forming a person; of intentionally systematically and well- orderly influencing intellectual moral and physical development of children and youth or, by broadening, of people and society [1].

The International Standard Classification of Education - ISCED-97 defines education as the “deliberate and systematic communication activity meant to result in long-lasting learning” [2].
Education is included in the public services category because of its activities’ utility, that is “satisfying a social need”, the need for education [3].

The unanimous acknowledgement of the contribution of education to human development, to economic competitiveness and vitality increase, anticipated the establishment of common educational goals at European level. The European Union Council Recommendation (98/561/EC) on European cooperation in the field of higher education quality states that member states should create transparent quality assurance systems, with the main purpose of protecting higher education quality depending on each country’s economic, social and cultural framework, taking into account the European dimension and the fast-changing world.

The meetings of education ministers in the following years also focused on the issue of quality in education. In the spring of 2002, in Barcelona, chiefs of governments and states set a new desideratum: the European Union must become a global reference space in terms of education and training quality and relevance and turn into the most attractive region in the world for students, scientists and researchers. In order to have higher education institutions become more involved in quality assurance, EU countries’ education ministers, established conjunctly, during the Berlin Conference in September 2003, that “the main responsibility in higher education quality assurance belongs to each institution apart”.

Education quality stands for one of the central elements of the development of the European Higher Education System (SEIS), and is considered to be one of the main prerequisites for social cohesion, active citizenship, economic growth, human development with the purpose of passing on to a knowledge-based society.

At the National Framework for Quality Assurance in Education level [4], three definitions of quality are used:

• the one used by the European Framework for Quality Assurance in Education and Professional Training, depicts the dependence that quality in education has on its goals “quality in education and professional formation is not only a technical aspect, but it also depends on the political, individual, and institutional objectives and goals, that can be realized in various amounts of time”

• the one in EU Phare programs concerning the modernization of professional and technical education, that finds in quality a certain degree of beneficiary satisfaction: “degree of satisfaction in relation with the professional education offer, established according to standards by means of accomplishing a certain level of excellence expected by beneficiaries or other interested parties.”.

• the one in Law 87/2006 on education quality assurance, according to which quality in education is “the set of characteristics of a study program and its supplier, by means of which beneficiaries’ expectations are met, as well as quality standards”.

Education is, for any society, the driving force of sustainable development, that requires educational institutions to provide high quality services so that public trust is satisfied.

Education is intangible and perishable and the fact that it is “consumed” while it is supplied turns the learners into partners in the educational act.

Education quality stands for a permanent priority for any education supplying institution as well as for its employees.

Pope Alexander IV, in a letter to the University of Paris written in April 1255, stated that universities should “apply to research and teaching to students that should be able to freely associate with their teachers in their common love for knowledge”.

Nowadays, higher education institutions are organizations that supply professional and scientific services that provide society with spiritual products consisting of graduates’ competency and knowledge. The quality of education is not determined by the graduate, but by the value added by the educational process to his/her development, by the competency and the amount of knowledge and abilities acquired that allow him/her to successfully integrate within any of the fields of socio-economic life.

Quality in education is a relative and contextual attribute, which is evaluated, ensured and enforced under the circumstances of a competitive environment, through mechanisms similar to those found in the economy, in terms of demand and offer, suppliers and beneficiaries. Therefore, it appears that whenever there is competition between education suppliers and the government, concern should be given to respecting the law and the standards applicable to this objective.

Generally, those education suppliers that set the objective of complying with quality standards, can gain a certain competitive advantage on a given market share. In the spirit of the Quality Management Institutional System (SIMC), an increase in quality for one of the competitors brings on a comparative reduction in service quality of other universities and constitutes a warning for the institution’s quality management.

Although evaluating quality in educational services is determinant for the activity of any educational institution, most of the specialists consider that this is difficult to achieve because of its very characteristics: it cannot be separated from its final results and the actual process of educational service supplying.

### 3. EDUCATION QUALITY COORDINATES

Approaches to quality coordinates determined by educational resources, are based on the systems of indicators used for education evaluation, elaborated by: OECD, UNESCO (World Education Indicators), The World Bank and EU (the European Statistics Systems developed by Eurostat) and Romania (the National Education Indicators System - SNIE).

For illustration, one can consider the indicators drafted by UNESCO’s Statistics Institute and the OECD’s Education Indicators Classification Matrix that identify resources as factors influencing education quality.

The Romanian National Education Indicators System, within the “quality and efficiency education indicators” stipulates the subgroup “indicators on the educational system’s resources”, which includes: costs in education (from the perspective of the allotted and used up financial resources), human and financial resources. Therefore quality manifests itself beginning with resource “entries” (that should be identical to the identified requirements), during all educational “processes” when it stands for the foundation of their evaluation and financing and “exports”, where it is reflected by the degree of satisfaction that first beneficiaries have. The quality chain is therefore completed with the evaluations of beneficiaries and of public and private organizations on the labour market, as presented in figure 1.
We note the fact that the recognition by last beneficiaries of educational systems’ “exits” is in fact an acknowledgement of competences by employers and an increase in number of employees. On a globalizing labour market (the manifestations of the international labour market are considered, as for instance the inadequate enforcement of the principles of labour force mobility and equal chances) this acknowledgement multiplies future advantages. Thus, private benefits (well-prepared persons increase their chances of accomplishing their aspirations), economic and social benefits (economic development and a lower rate of unemployment accompanied by less expenses for social protection, a.s.o.), and institutional benefits (increased notoriety which attracts more numerous and high-quality resources, both students and teaching staff) are generated.

Figure 1. Qualitative Links within the Educational System.

Asked whether they are satisfied with the quality of the education received, the first beneficiaries’ answers prove that the level of quality in education is satisfactory (77.4% of those interviewed are very content or content and only 7.7% are dissatisfied or very dissatisfied) [5].

The human and the financial dimensions of quality in education are highlighted by law no.75/2005, that stipulates whenever quality is evaluated in terms of institutional capacity and educational efficiency, one must take into account the degree to which human and financial resources are available for that institution to be able to achieve its mission and objectives [6].

3.1. The Human Dimension of Quality in Education

Challenges in education as well as development in human resources make up the priorities of national reform programs within the Lisbon Strategy, for most of the member states.

The teaching staffs, pupils and students, as educational resources, make up the nucleus that determines the quality of the educational service. They are both participants in the learning process and knowledge disseminators. The human resources in education viewed as capital is appreciated by the European Council (Doc. 7619/05, point 34.) as “the most important asset of Europe”, bearing a special position both socially and economically.

A high level of competence of personnel in education provides the necessary ability to adjust the activity to new teaching methodology and to the changes occurred within the economic environment.

The mission that society assigns to education can be fulfilled only if personnel working in the education field are the product of quality formation. This requirement turns into an imperative if we consider the fact that “there is no other endogenous factor that influences students more than their teaching staff’s quality” [7].

Actually, every product of the educational process bears part of the worthiness of his/her teachers. The thing that increases the importance of the quality of the teaching staff is that, unlike other fields’ professionals, teachers build persons as well as personalities; they provide knowledge as well as competency, thus adding value to their products, to other fields, to the society as a whole. The quality of teachers is the main prerequisite for a good school, according to Jan Figel, the European commissioner for Education, Culture, Formation and Youth. Through the part they play, teachers stand for the foundation of formation quality of the “contingents enlisted” in the educational system. In their turn, all teachers have been taught. Based on the snowball principle one can assume that should the system include poor teachers, they would produce poor results who will work in all sectors, further producing poor results. The weight of teachers scoring poorly at tenurial exams in the past few years (60% as opposed to the 18 % EU average) suggests a doubtful quality of the teaching staff.

In order to prevent this, more attention should be paid to the formation process, including the continuous formation and professional development. The educational environment is growing ever more complex and heterogeneous, thus facing the teaching staff with numerous challenges. Thus, the teaching staff should deal with the challenges brought about by IC&T developments, by the changes in the social and family structure, and by the growing diversity among students, resulting from the increase in immigrants and the emergence of multicultural societies [8].

The increase in aggressiveness within learning environments demands for a high level of psycho-pedagogical training as well as teaching educators how to manage conflicts in their classrooms, how to prevent violence and aggression among students. Another aspect that must be included in the teachers’ formation is strategies for drug-use prevention, approaches to counteract media pressure in terms of promoting non-values, as well as means to cast aspersions on successes that are not founded on hard work and individual merit.

One cannot deny that success in forming high-quality teachers depends on the quality of the human resource available, but in order to make this profession appealing to candidates, a promotion campaign is needed in order to highlight the role that educational institutions play for society and for the career opportunities of educators. A model to follow is that of the states which use recruiting techniques similar to those within the business environment in order to select the best teachers and to remove poor ones from the system.

The reduced attractiveness for a teaching career for youth in Romania resulted in a 1.3% decrease in the number of teachers in the year 2006/2007 compared to the previous year [9], and for the 2005-2007 period a 3.5% decrease within the
elementary teaching system [10]. As a consequence, in the year 2007/2008, each professor taught 28 students, whereas high school level teachers taught 14 pupils [11]. At European level, (according to Statistical Informational of Central and Eastern Europe Higher Education 2004–2005) our country is one of the countries with the lowest number of teachers in relation with the number of students, as it results from table 1.

**Table 1. Number of students/teacher 2004-2005.**

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of students/teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Croatia</td>
<td>24</td>
</tr>
<tr>
<td>Romania</td>
<td>23.9</td>
</tr>
<tr>
<td>Poland</td>
<td>21.6</td>
</tr>
<tr>
<td>Latvia</td>
<td>20.3</td>
</tr>
<tr>
<td>Slovenia</td>
<td>19.6</td>
</tr>
<tr>
<td>Moldova</td>
<td>19.4</td>
</tr>
<tr>
<td>Russia</td>
<td>18.9</td>
</tr>
<tr>
<td>Hungary</td>
<td>17.7</td>
</tr>
<tr>
<td>Estonia</td>
<td>16.0</td>
</tr>
<tr>
<td>Lithuania</td>
<td>14.9</td>
</tr>
<tr>
<td>Ukraine</td>
<td>14.1</td>
</tr>
<tr>
<td>Slovakia</td>
<td>13.1</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>10.5</td>
</tr>
</tbody>
</table>

Among the causes for this decrease in persons choosing this career and for those leaving the system are: a decrease in social status for the teaching staff, low wages in relation to the responsibility awarded by society and to the other social categories, the fact that wages are the same for everyone regardless of performance and the prevalence of the “it’s not what you know but who you know” system for both employment and promotion. As to the motivating role of wages, a study performed in UK shows that wages are the main factor when deciding upon a career, in terms of choosing and keeping it [12]. In Romania teachers are poorly motivated, hardly supervised and seldom made responsible [13].

Under the circumstances it must be highlighted that a teacher’s salary represents two thirds of the GDP per inhabitant, which is very low as compared to the OCED average of 1.33 for elementary school and 1.37 for secondary education.

Much like other fields, quality in education calls for, among others, high investments in infrastructure and material resources, supplying personnel with motivating wages and the implementation of educational programs adjusted to the labor market requirements and to clients` needs (pupils, students, teaching and non-teaching staff).

As teaching implies besides knowledge, vocation, all attendants or mentors should, during university years, select and guide those students that show potential towards a teaching career. Having Adam Smith’s “invisible hand” theory as argument, some authors connect excellence in higher education to system entries, stating that “exceptional young men and women” could be “put in contact with a number of exceptional adults, that share their opinions, present papers or draft them together, each following their goals, resulting in a general positive effect on society, as those young men and women would have performances similar to that of adults”. The type of academic education is considered to be the cause for performance [14].

A model in terms of drawing the youth towards teaching is the one in Great Britain. After analyzing four educational systems, from Finland, Singapore, South Korea and Alberta – Canada, the British noticed that although operating on three different continents, the systems share the fact that they select their teaching staff from amongst the first third of college graduates. The persuasion factor is the financial one and consists of awarding bonuses of 7,000 ponds and 14,000 pounds respectively, to those who attended one year of pedagogical training.

At the same time, European officials suggested that young men and women should spend a period of trial, as they do in any other job, and be hired only after that period. Depending on the results obtained, they should be given a sufficient amount of money to ensure the socio-economic comfort they, rightfully deserve as knowledge and models providers for their trainees. Therefore, whereas recruitment and selection determine the quality of the personnel entering the system, motivation and satisfaction stand for the key issues in terms of keeping personnel and having it involved in fulfilling educational goals throughout an entire formation cycle.

4. REFERENCES

ENVIRONMENTAL ENGINEERING EDUCATION IN ROMANIA

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ABSTRACT: Nowadays, the environmental engineering problems have become very diverse and complex. For this reason, it is necessary to define the new scope of environmental engineering to cope with environmental problems and sustainable development concerns, especially in developing countries. This paper defines several of the basic components of the environmental engineering profession and the educational process needed to produce qualified environmental engineers.

1. INTRODUCTION

Nowadays, environmental issues affect almost all commercial and industrial sectors, and are a central concern for the public, governments, and even international relations. The main environmental issues of the present age are safe drinking water, wastewater processing, solid and hazardous waste disposal, outdoor and indoor air pollution, ecological risk management, and pollution prevention through better, safer products or improved process design [1].

“We shall never understand the natural environment until we see it as a living organism. Land can be healthy or sick, fertile or barren, rich or poor, lovingly nurtured or bled white.” - Paul Brooks

Environmental engineers focus on urgent matters of security, safety, and health.

The field of environmental engineering is developing as a result of changing environmental requirements. In response, environmental engineering education needs to ensure that it provides students with the necessary tools to address these challenges.

The field of environmental engineering is developing as a result of changing environmental requirements. In response, environmental engineering education needs to ensure that it provides students with the necessary tools to address these challenges.

Contemporary issues are problems and topics of emerging importance or recent discovery. Globalization refers to an integration of processes or delivery systems that transcends national, cultural and language differences. For example, awareness of the impact of inadequate sanitation on public health in many parts of the developing world and the impact of human activity on climate change are issues that are both global and contemporary [2]. The environmental engineer must be able to function in a global system for delivery of engineering projects and services practice, taking into consideration the cultural appropriateness of technology. In addition, the environmental engineer must be aware of emerging contemporary issues and of their impact on the profession.

2. ROMANIA’S ENVIRONMENTAL PROBLEMS

Currently, Romania faces acute problems concerning air, water and soil pollution, which requires large investment in the short and the long term and the participation of both the public and the private sector. Essential measures are needed in the fields of waste management, the improvement of water quality, and the enforcement of integrated pollution prevention and control.

It should be also noted that Romania will require massive environmental investment by both the government and industries to comply with EU standards.

Rapid industrialization since World War II has caused widespread water and air pollution, particularly in Prahova County, an oil refining region. The nation has 49 cu km of renewable water sources, with about 59% used to support farming and 33% used for industrial purposes. Romania’s cities produce on average 3.0 million tons of solid waste per year. Air pollution is heaviest in the nation’s cities, where industry produces hazardous levels of sulphur dioxide. In 1992, Romania had the world's 28th highest level of industrial carbon dioxide emissions, which totaled 122.1 million metric tons, a per capita level of 5.24 metric tons. In 1996, the total dropped to 119 million metric tons [3].

The structural weight of the investments on specific activities of environment protection is presented in Figure 1

Total expenses concerning environment investments, at the national level, raised in 2003 to a value of: 13 399 264 millions ROL
Romania's environment faces severe problems with regard to water quality, waste management and air and soil pollution. In general, the quality of drinking water and of groundwater is not satisfactory, and the level of sewage treatment is low. Pollution that affects surface water and groundwater is mainly caused by big problem in larger cities and industrial areas and is caused mainly by heavy emissions from the energy, chemical, paper, mining and transport sectors, as well as from domestic heating.

Improvements in the past have resulted mainly from decreasing economic activities and partly from remediating "hot spot" areas.

The critical zone or hot zone is the zone on which area systematically overpass of environmental quality indicators comparing with standardized norms are recorded, generating serious damages to the environment with consequences on human health, economy and natural capital of the country. The main critical areas are emphasized in Figure 2,3.
3. ENVIRONMENTAL ENGINEERING EDUCATION IN ROMANIA

Nowadays, environmental issues affect almost all commercial and industrial sectors, and are a central concern for the public, governments, and even international relations. There are several Universities in Romania that are presenting different programs related to Environmental Science and Engineering (table 1.). On the other hand the environmental engineering education program of the most universities of Romania is quite traditional.

The complex nature of the environmental problems of the present age implies the necessity for collaboration among engineers, social and natural scientists, economists [6]. Unfortunately, integration of the engineering curricula with social, cultural and economic sciences is not started in any fields of Engineering in Romania. So it is crucial for all Universities in Romania (especially environmental engineering fields) to modify their curricula to achieve the main sustainable development goals.

It is no doubt that the traditional program of environmental engineering cannot cope with the complex nature of the present environmental problems of developing countries. The Environmental Engineering departments of Iran’s Universities should modify their curriculum by adding several new and multidisciplinary courses in the near future.

Environmental Engineering education in Romania is at the beginning of way and there are a lot of obstacles for promoting these fields of study. The main obstacles are summarized as:

1. The budget limitation for establishment of environmental engineering programs;
2. Lack of academic staff in different new field of environmental engineering;
3. Lack of professional jobs for environmental engineering graduates;

Although many people are concerned about the state of our environment, environmental engineers are the people who do things to protect it from damage and to correct existing problems. Environmental engineers possess the scientific and technical knowledge to identify, design, build, and operate systems that make modern society possible. In addition to being a field for doing, the environmental engineering field and environmental engineering education are multi-disciplinary [7].

Table 1. Environmental Educational Programmes in Romania

<table>
<thead>
<tr>
<th>Nr</th>
<th>Main Universities</th>
<th>Name of Department Schools/Faculties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Lucian Blaga University of Sibiu</td>
<td>&quot;Hermann Oberth&quot; Faculty of Engineering Department of the Science and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technology of Materials - Environmental Engineering and Industrial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Protection</td>
</tr>
<tr>
<td>2.</td>
<td>University of Craiova</td>
<td>Faculty of Engineering and Technological Management - Industrial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>environmental protection</td>
</tr>
<tr>
<td>3.</td>
<td>Technical University &quot;Gh.Asachi&quot; Iasi</td>
<td>Faculty of Hydromechanics, Geodesy and Environmental Engineering</td>
</tr>
<tr>
<td>4.</td>
<td>The University “Dunarea de jos’ Galati</td>
<td>Faculty of Mechanics and Environmental Engineering</td>
</tr>
<tr>
<td>5.</td>
<td>University of Agronomic Science and Veterinary</td>
<td>Faculty of landscape improvement and Environmental Engineering</td>
</tr>
<tr>
<td></td>
<td>Medicine - Bucuresti</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>University of Ecology Bucuresti</td>
<td>Faculty of Managerial Engineering – Environmental Engineering</td>
</tr>
<tr>
<td>7.</td>
<td>University „Politehnica” Timișoara</td>
<td>Faculty of Industrial Chemistry and Environmental Engineering</td>
</tr>
<tr>
<td>8.</td>
<td>University Valahia</td>
<td>Faculty of Environmental Engineering and Biology</td>
</tr>
<tr>
<td>9.</td>
<td>Technical University of Cluj-Napoca</td>
<td>Cathedra of Environmental Engineering</td>
</tr>
</tbody>
</table>

They involve traditional engineering components such as mathematics, physics, chemistry, and engineering design. But environmental engineering education and practice also includes a range of other disciplines, such as biology, microbiology, ecology, public health, geology, meteorology, economics, political science, and computer science. To address the spectrum of issues facing the environment, environmental engineers are broadly educated, as well as technically trained.

4. CONCLUSION

It is necessary to define the new scope of environmental engineering to cope with environmental problems and sustainable development concerns, especially in developing countries.

Clearly, up to now the environmental problems facing Romania have not been addressed. The main obstacle to implementing environmental projects is still the lack of financing. The low amount of environment investments is primarily due to a lack of environmental financing instruments.

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COMMITMENT FOR EXCELLENCE APPROACH

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ABSTRACT: While many organisations implement and certify their quality management systems accordingly to ISO 9001 requirements, the commitment for excellence (C2E) approach, followed by recognised for excellence and subsequently excellence award, has appeared as a sustainable and more deeply sound management system promoting continuous improvement and learning. The paper presents the self assessment approach as referenced to the excellence model criteria (in number of 32) of the European Foundation for Quality Management (EFQM) and explains how to progress from a classical ISO 9001 implementation phase to the first C2E step. The RADAR concept is explained and, based on a case study from the administration field, the improvement projects launching is detailed and main lessons learnt from their implementation presented.

1. A MODEL FOR ACHIEVING EXCELLENCE

Without doubt it appears hard enough committing for the best of times in satisfying stakeholders, sustaining in increasing global competition conditions, fast technological innovation, legislation changing and frequent movement in economic, social and customer environments.

While ISO 9001 implementation approach, as a first step for a formalized quality management system, has presented its’ limits, it still frames minimal requirements for processes PDCA cycle (in other terms: processes planning, performing, controlling and improvement).

Organizations’ real need has led to a more advanced implementation framework built to assemble together all of the quality related ideas and concepts such as: TQM, processes improvement and re-design, tools and techniques for processes improvement, teamwork, management system, performance measurement, leadership, sustainable development etc. The overall framework concerning with setting the direction of the organization, managing processes in continuous change so as to continuously control and improve the performance is the excellence model and self assessment.

Recognizing the challenge, the European Foundation for Quality Management (EFQM) was created to promote world-class approaches to the management of European organizations that would lead to sustainable excellence. The achievement of excellence requires total leadership commitment and acceptance of the fundamental concepts, as stated by EFQM [1, 2]:

- **Results orientation** – agile, flexible and responsive at stakeholders needs and expectations change, achieving results that delight organization’s stakeholders; based on measure and anticipation of these needs, policies, strategies, targets, plans are set, implement and review.
- **Customer focus** – know and intimately understand their customers, the loyalty, retention and market share gain; improve the effectiveness of their response to customer needs and expectations, build and maintain sustainable relationship with all customers.
- **Leadership and constancy of the focus** – leaders set and communicate a clear direction for their organization, they unite and motivate in order to inspire other people; they establish values, ethics, culture and a governance structure for the organization that provides a unique identity and attractiveness for stakeholders; constancy of purpose and readiness during turbulence times, adapt and realign the organization’s direction in the light of fast moving and constantly changing external environments, and in so doing carry their people with them.
- **Management by processes and facts** – processes effectively deployed, managed and improved on a day-to-day basis; decision are based on factually reliable information; risks are identified based on sound performance measures and effectively managed, appropriate preventive measures are identified and implemented inspiring and maintaining high levels of confidence with stakeholders.
- **People development and involvement** – maximizing the contribution of employees through their development and involvement, recognizing the increasing importance of intellectual capital of the people and use their knowledge for the benefit of the organization, building people’s commitment, promoting personal development to allow people to unlock their full potential, encouraging loyalty for the organization.
- **Continuous learning, improvement an innovation** – effective change by using learning to create innovation and improvement opportunities to add value, knowledge capture and sharing, organizational agility.
- **Partnership development** – development and maintaining valuable partnerships, clearly mutual benefit, trust, respect, openness.
- **Corporate social responsibility** – highly ethical approach by transparence and accountability to stakeholders for their performance as responsible organization; awareness of organization’s impact on current and future community taking care to minimize any adverse impact.

Three levels of excellence might be considered: committed to excellence (C2E), recognized for excellence and finally, excellence award. There is no prerequisite to start with C2E, but even if a quality management system has been set in place and the organization appears mature enough in terms of quality management, the journey towards excellence is more important than the goal itself. The journey takes several years and burning stages clearly might damage the expected achievements. To attain sustainable excellence two aspects are addressed:
a process of systematic improvement, meaning improvement projects, effective tools and techniques focused on the prioritized improvement needs, identified by the organization itself as referenced to key performance indicators to reach key performance results and a road map consisting in plans and actions concluded finally with lessons learnt subsequently translated into the organization’s culture;
• a culture / a sense of systematic improvement to develop and support processes capable of ensuring sustained continuous improvement.

2. THE SELFASSESSMENT BASED ON THE 32 SUB-CRITERIA EXCELLENCE MODEL

Generally, supposing that an organization has implemented a quality management system (QMS), even certified it in accordance with ISO 9001:2000 or other complementary standards [3], the journey towards excellence should be initiated by several factors, such as: a certain pressure for change, a clear shared vision, the capacity for change and actionable first steps for a sustainable start.

A question might arise: why to benchmark as referenced to the excellence criteria of a world class spread excellence model while an ISO 9000 based QMS has been implemented and certified and consequently to self-assess the overall organization in order to start a C2E approach considering the 32 sub-criteria excellence model instead of the classical approach of self-assessment according to ISO 9004 guidelines (Annex ISO 9004, [3]).

Even not exhaustive, several reasons might be identified as reply to this approach:
• even if ISO 9001: 2000 standard establishes requirements for the improvement of organizations’ effectiveness and efficiency, in fact effectiveness is not addressed on a sustainable manner such as an implemented quality system usually does not include economic aspects and feed-back / adjustments as quality registrations;
• the excellence model criteria appear more broader in terms of management topics as compared to the quality related standards, including ISO 9004 guidelines (as reference for self assessment).

Results oriented cycle combined with the client focus might be considered as a highly sound approach with clear image improvement impact.

Considering the case study in discussion (a Romanian public organization working in the administrative field as intermediary organization of the European Commission for the implementation of two European Programmes), the excellence approach based on an European recognized model appears more sound, transparent and sustainable than the quality management system certified by a Romanian certification body.

Based on the EFQM excellence model (32 sub-criteria model) [1, 2], an in depth self-assessment was performed at the whole organisational level and involving all staff (approximately 70 people) during an annual team building event.

Before the event, the managers designated six moderators and organised with them preparatory meetings to commonly agree how conducting the self-assessment approach. During these meetings, the EFQM excellence model and the RADAR approach were detailed and understood, the agenda of the self-assessment event was agreed and the whole staff of the Agency was split in six working groups.

The composition of the working groups was established following the principle of diversifying the members from different departments in each group, balancing their background and competencies and avoiding persons working together in day-to-day activities so as to have a broad and aggregated overview of how the whole team perceive the organisation in relation to the excellence model sub-criteria.

During four sessions, each lasting two hours, each working group have debated in depth the current situation within the organisation based on the 32 sub-criteria of the model; the moderators used the guidance points of the model [1, 4, 5] and the RADAR for giving a final score. Connection between the excellence model criteria and the ISO 9001 requirements are given elsewhere [6].

Each working group filled in for each of the 32 sub-criteria a pro-forma containing Strengths (S), Areas for improvement (AFI), Evidence and comments and the Score following the RADAR having a different form for enablers – criteria 1 to 5 (fig. 1) and results – criteria 6 to 9 (fig. 2); for the criteria see fig. 3.

As expected, several strengths and areas for improvement have been identified for each of the 32 sub-criteria. The aggregated final score averaging the score of each group obtained after this exercise was 393.52 points (fig. 3).

In order to calculate the final score, the partial scores per criteria are multiplied as follows:
• enablers: criterion 1 x 1, criterion 2 x0.8, criterion 3 x 0.9, criterion 4 x0.9, criterion 5 x1.4;
• results: criterion 6 x 2, criterion 7 x 0.9, criterion 8 x 0.6 and criterion 9 x1.5.

In the final session of the self-assessment event, the managers presented the final score, a hierarchy of the criteria following the score, an overview gathered from all the working groups concerning the Areas for improvement. The areas for improvement were structured in some big domains: Strategic management, Human resources, Communication, Use of the resources – Corporate Social Responsibility (CSR).

In order to have a raw prioritisation, a simple method was used: each member of the staff was supposed to vote writing on a post-it one single domain to be addressed. Finally, the result of gathered votes was Human resources, Communication and CSR as main domains to be improved.

The results was unbalanced: nearly unanimously accepted by the employees, the first ranked area for improvement was “people – human resources”, related so as to strengthen the acceptance for change and promote a human resources policy, quite difficult in the context of public organisations with limited motivational shields. The challenge should be building the culture for sustainable and continuous improvement through knowledge and innovation.
**Table 1. RADAR scoring matrix enablers [1, 2]**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Attributes</th>
<th>0%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>100%</th>
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</thead>
</table>
| Approach         | - approach has a clear rationale  
                   - approach has defined processes  
                   - approach focuses on stakeholder | No     | Some   | Evidence | Clear  | Comprehensive |
|                  | Integrated:  
                   - approach supports policy and  
                   - approach is linked to other approaches as appropriate | No     | Some   | Evidence | Clear  | Comprehensive |
|                  | TOTAL                                                      | 0  | 5  | 10  | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 95  | 100 |
| Deployment       | Implemented:  
                   - approach is implemented | No     | Some   | Evidence | Clear  | Comprehensive |
|                  | Systematic:  
                   - approach is deployed in a structured way with the method used for deployment being planned and used | No     | Some   | Evidence | Clear  | Comprehensive |
|                  | TOTAL                                                      | 0  | 5  | 10  | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 95  | 100 |
| Assessment & Review | Measurement:  
                   - regular measurement of the effectiveness of the approach is  
                   - regular measurement of the effectiveness of the deployment is  
                   - measures selected are appropriate | No     | Some   | Evidence | Clear  | Comprehensive |
|                  | Learning:  
                   - is used to identify best practice and improvement opportunities | No     | Some   | Evidence | Clear  | Comprehensive |
|                  | TOTAL                                                      | 0  | 5  | 10  | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 95  | 100 |

**Figure 1. RADAR scoring matrix enablers [1, 2]**

**Table 2. RADAR scoring matrix results [1, 2]**

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<thead>
<tr>
<th>Elements</th>
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<th>0%</th>
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<tbody>
<tr>
<td>Trends:</td>
<td>Positive trends and/or satisfactory performance for about ½ of results over at least 3 years</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
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<td></td>
<td>- trends are positive AND/OR there is sustained good performance</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
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<tr>
<td>Targets:</td>
<td>Achieved and appropriate for about ¼ of results</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
</tr>
<tr>
<td></td>
<td>- targets are achieved</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
</tr>
<tr>
<td>Comparisons:</td>
<td>Favourable comparisons for about ¼ of results</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
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<tr>
<td></td>
<td>- results compare well with others AND/OR results compare well with acknowledged ‘World Class’</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
</tr>
<tr>
<td>Causes:</td>
<td>Cause and effect visible for about ¼ of results</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
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<tr>
<td></td>
<td>- results are caused by approach</td>
<td>No</td>
<td>Results or anecdotal information</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
<td>Positive trends and/or sustained good performance for about ½ of results over at least 3 years</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

**Figure 2. RADAR scoring matrix results [1, 2]**
3. IMPROVEMENT PROJECTS DRAFTING AND IMPLEMENTATION

Once fixed one tangible improvement project, such as improving people results, one comes back to enablers generating these results and then a draft for an improvement project is elaborated.

The cycle appears then simple; just deploy the improvement project related activities, assess and review where needed. Usually a RADAR concept is applied: determine the required Results, plan and develop Approaches, Deploy approaches, Assess and Review these approaches and deployments. This cycle fits quite well the Plan Do Check Act cycle, already implemented in an ISO certified organisation, so a bottom line is achieved. What’s different? The results oriented approaches.

Each group decided to propose an improvement project, to be drafted and implemented by the respective group addressing the prioritised domains.

In a second step, inter-related projects have merged and only three projects were selected to be subjected to the validation process in order to be assessed by EFQM, respectively one project per each domain: Human Resources, Communication and Corporate Social Responsibility.

When drafting the projects some questions should be addressed, such as:

- How is it relevant to the organisation and how does it serve the strategy?
- What impact will it have on the Organisational Goals, Performance Results or Business Plan?
- How does it contribute to or support other organisational Approaches?

The project planning should include key milestones, the project owner, expected completion date and status at the moment of the application submission to EFQM in order to be subjected to the validation process, including the site visit.

Finally, the RADAR is followed again. This means that the Results are clearly detailed as a reply to the questions:

- What measures will be used to ensure the improvement has been fully deployed?
- What measures will be used to ensure the improvement has been successful? – with clear reference to indicators to be monitored all-long the implementation and at the end of the project.

The Approach should describe the project and why it is necessary.

The Deployment should be formulated in terms of answers to the questions How it will be implemented, Where it will be implemented, Who contributes to the implementation.

The last section Assessment and Review should describe how the project team will:

- Monitor and record progress against plan
- Identify and record learning points
- Monitor progress against measures listed as Results

Drafting the projects on the basis of the RADAR concept ensures the bottom line for a successful implementation. It is not easy at all and the day-to-day practice, even if a QMS has set in place since several years, is not obvious to evidence, measure, assess and review on a quite regular basis.

4. LESSONS LEARNT

The main lesson learnt from this complex process was the RADAR use importance and those of both: the result and impact indicators in order to monitor improvement projects implementation.

Considering the validation site visit feed-back received from the EFQM assessor, the prioritisation process in order to select the improvement projects appears of particular importance so as to launch and than implement projects addressing different model criteria.

In our case study the implemented projects addressed the Human Resources, Communication and Corporate Social Responsibility. The importance and impact of these projects for the organisation were unbalanced and the excellence criteria addressed have not been clear enough. While Human Resources and Communication projects appeared overlapping
certain sub-criteria, the CSR project had less impact and evidence / indicators have been registered in a difficult way.

5. CONCLUSION

The prerequisite for the excellence journey is the commitment to sustainable improvement and management of change, but the effort for this journey lead to a certain gain.

Using RADAR in the self-assessment process and subsequently in the improvement projects implementation appears quite benefit in terms of a common understanding at the organisation’s level and strengthening the Results oriented approach together with the importance of the Assessment and Review in strong relation with the proposed Results.

6. ACKNOWLEDGEMENTS

The approach presented hereby is based on the experience of the National Agency for Community Programmes in the Field of Education and Vocational Training officially validated as Committed for Excellence following the EFQM validation site visit in April 2009.

7. REFERENCES

2. www.efqm.org
3. ASRO / ISO standards: ISO 9000, 14000, 28000, 27001, SA 8000 (www.iso.ch)
REALITIES AND AIMS REGARDING THE QUALITY MANAGEMENT PROCESSES FROM TECHNICAL HIGHER EDUCATION

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²Polytechnic University of Bucharest

ABSTRACT: The paper presents a synthesis of the made researches in case of the priority project with title of “Study regarding the higher education scientific management with technical profile, conferred to requirements of the market economy”, the general objective is, to identify ways and appliance for an efficient management regarding the research and education activities in technical higher education institution, according to the national strategy directions and international tendencies. The paper is structured in five parts. The first part deals with a general presentation and guideline of management quality processes of higher education institutes. In the second part after the principles and aims enouncement, there are presented the hierarchy systems and the mode of structure of regulations viewing the university management and quality processes. In the third part are described the aspects regarding the Romanian universities management and the quality processes. The next part studies the evaluation of technical higher education conformity in Romania, with requirements of beneficiaries. The last part of the study describes as conclusions the management and the curriculum’s characteristics from analyzed European and American universities.

1. INTRODUCTION

Nowadays, in agreement with the structural improvement of higher education it is accredited the idea of competition [1 ÷ 11], made only with assurance of an open and competitive education.

The competition for education organization is a concept defined as “the feature to may enter in competition with other similar education units”. The competency of an education unit is influenced by the capacity to understand and to adapt accurateness to the environment, to make available its success potential.

The hierarchical systems of the universities are made to offer real information and to improve the quality of higher education. Many students, faculties, institutions and beneficiaries of “education services” are interested to make a hierarchy of universities for different targets that responds on some requirements and real information.

The ENQA (European Network for Quality Assurance in Higher Education) sees in hierarchy of higher education an evaluation modality of universities that nowadays becomes important.

In the Romania higher education is necessary to use a valid ranking system to make it known having more transparency regarding the diversity of courses, of research and finance.

In Romania the institutional evaluations were developed in two ways: finance and quality assurance at institutional level. In the Priority Project with subject of “A study viewing the higher education scientific management of technical profile, presented to requirements of the market economy” [5], was followed the ways and realization tools of the management performance identification in technical higher education research and education activities, in concordance with the national strategies and with the identified international tendencies. The objectives were fixed such as:

- Analyzing the Romania list of specialization and curriculum, in comparison with European and with the USA;
- The analyse of Romania polices and practices, that refers on the organization and didactic activities management and researches in technical higher education in relation with the applied international one;
- To estimate the potential suppliers requirement and analyze the conformities of technical higher education from Romania.

2. HIERARCHY SYSTEMS

The international hierarchy takes origin from Great Britain [5,11], that nowadays uses official and unofficial hierarchy systems too. The official hierarchies are developed basing on the obtained results from the Exercise in Research Evaluation, led by UK, by four institutional corporations of higher education.

The centre for Higher Education Development from Germany [11], annual publishes in “Stern” magazine, a multidimensional hierarchy of universities using 40 criterions / indices, viewing the strong and weak points of higher education system in different specialties. The evaluation of higher education implies a large and complex database. In a supplementary number, each autumn is published a report viewing the higher education contribution in research.

The Higher Education Institute of Shanghai Jiao Tong [11] makes a hierarchy of all worlds’ top universities by “Shanghai classification”. The evaluated institutions area is reduced to 1000 universities from America, Europe, Africa and Asia, basing on only the research performances and on scientific quality of didactic staff, using five criterions. In the United States, the hierarchy of the universities is made in a great number of institution publications. In each year, US News makes a hierarchy of USA programs basing on two types of data:

- The opinion of the experts viewing the quality of the offered programs;
- The statistical values of the indices measure the quality of didactic staff, research and students.

In USA the made classifications are basing on the following principle:
The most used performance indices to express the high reputation and activities of the institutions of higher education in Great Britain, Germany, United States, Australia, China and Canada are:

- the number of foreign students;
- number of published papers;
- the international mobility of the graduates;
- the international weight of staff corporation.

In Romania, the base financing difference of the institution starts from the following principal elements:

- corresponding students;
- cost coefficients, for each higher education domain;
- quality indices, computed for each university.

In Romania, the international acknowledgment is materialized [14] through published papers in ISI reviews, international patterns, and by confirmation of professional acknowledgement.

Nowadays, the frequently invoked criterions for a future hierarchy of Romania universities are:

- academic prestige;
- selectivity of the students and attractive university;
- management of human resources;
- scientific research, bachelor / master and PhD study;
- performances off students and graduates;
- financial resources and assurance the conditions for didactic processes deployment;
- strategic management of the university.

3. POLICIES VIEWING THE UNIVERSITY MANAGEMENT AND QUALITY PROCESSES

The performances of universities are reflected through efficiency and quality. The two competitive valences may be obtained only through an efficient management [8, 9]. The European documents, viewing to influential quality processes from universities [12] are well known and integrated in Romania.

The document “Standards and recommendations of quality assurance in European higher education” [12], developed by European Association of quality assurance in higher education, is dedicated to the following regulations, viewing internal assurance of formative quality processes:

- politic and procedures of quality assuring;
- approving, monitoring, and periodical revising the education programs and fellowships;
- evaluation of the students basing on criterions and procedures published and applied consequently;
- assuring the quality of didactic staff;
- resources for preparing and executing the students requirements;
- the information systems of the institutes must assure the necessary information for an efficient management of the study programs;
- information of the public, viewing the offered programs and fellowships.

After the period of the quality process discussing, as an implied compound of higher education management, in Romania appears an explicit regulation process for a quality process (educational), that aims to align to the European standards and to make more objective the finance and ranking. In Romania, the legislation dedicated to the higher education follows the steps such as [1, 3, 7, 13, 14]:

- fuzzy legislation (1990 – 1993);
- fundamental law (1993 – 1997);
- operational legislation (1997 – 2002);
- legislation of preparing the integration (2002 – 2005);
- legislation of European integration (2005 – present days).

The rule dedicated to higher education may be grouped as [7]:

- fundamental rules (laws, Decisions of Government, Ministerial Order);
- specific regulations (Charta, Regulations);
- work procedures.

The project for a new law of education has a distinct title (VII – Management of Quality in Higher Education), containing general regulations to assure and evaluate the intern / extern quality of higher education.

In a study made in Technical Higher Education [7], were described 150 university professors opinions, viewing the fundamental policies, containing:

- a reduced interest in relation with the subject (only 12% of the professors completed the questionnaire);
- characterizes of policies:
  - clarity: moderate level;
  - impact on higher education management: great;
  - accordance in appliance: moderate.

The fundamental and specific policies dedicated for higher education in Romania, in principal aims the education and administrative activities, the research activities being less presented.

The financing of higher education is important for the performance management strategy. The financial methodology basing on quality indices may be characterized as scientific is an important step to make more objective the financing system of higher education.

To make perfect the financial system, which aims the stimulation and so, the quality of higher education, we make the following proposes [7, 10]:

- To increase the weight of financing basing on the indices of quality and on the indices of IC6, IC7 and IC8;
- To divide the financing indices on domain of license, eventually on specialization of the fundamental domain, engineering sciences, taking into account the differentiated costs that implies the crossing of the education programs, mainly, assuring of an adequate material fond;
- To make a differenced financing of license education for each study year, for engineering sciences in concordance with the real costs, necessary to an adequate preparation of the engineers, the difference between specialization to make at the
final of the study (taking into account the distinction real costs);

- To be necessary to update the Statute of didactic staff, taking into account the actual financing procedures in higher education, stabilized through the budget law, with express reference on the salaries;
- To set up some regulations through which the commercial societies - that takes the most part of graduates from technical domain - to be encouraged to participate at the financing of faculties and departments;
- The transfer of financial autonomy from a level of university to level of faculty or department, generalizing of some allocation procedures and adjudication of funds;
- Analyzing the possibility to establish a financial system in relation with the results from the activities, evaluated through the institution produced performances (specialists, produce from the research);
- There is imposed a correlation between the number of education – number of specialization – and budget allocation for a student and salary level;
- To stimulate the financing activity through research contracts, is necessary to set up regulations (national or at university) regarding the checking, limiting and negotiating the overhead’s level perceived from the universities.
- To manage the quality of Romania higher education there were made the following steps:
  - There were set up rules [13] and assurance the quality of educational services and those competences at universities;
  - There was experimental applied the evaluating methodology of quality and there were made corrections.
- At many universities started to operate the proper evaluating system and assurance of quality.

Applying the quality management system in higher education implies the control of cybernetic system, namely “University” as a continuous evaluation of entrances (human resources, materials, financing, information), the process (education, research), and results (specialists and produces of the research). The quality of education measures the adequate degree of the activity characteristics and of carrying out the services to requirements of the society. Such approach is present long time ago at universities from EC, where were accepted the iterative transition necessity (fig. 1), of the following steps to obtain a quality education [1 ÷ 10]:

- knowing the expressed and implied needs of the customer;
- well satisfaction of the requirements;
- knowing the “post–factum” ratings of the customers (of satisfaction or un-satisfaction);
- adapting of carrying out mode of activities till to obtain of maximum satisfaction of all customers.
- For quality of didactic processes may be useful a stability of number of places (without fees) for a period of (5 – 10) year;
- To assure the quality premise is necessary to maintain an adequate rhythm of universities extend, knowing the contradictory character of the two aspects (quality – dynamic). In this sense, in developed states, with numerous populations, the number of prestigious universities is a rate of one university for 1 million of people.
- To increase the quality of didactic process management must be encouraged the position of the students by filling out some questionnaires. The staffs of the faculty and department will obtain the conclusions, and it will be send to correction the implied factors.

### Figure 1.

- Explain the relation customer – supplier

The characterization of leading organizational structure in Romania universities in comparison with the west European one (English, French) may be making through the following attributes:

- all members of leading organizational structure (Senate, Board, etc.) are members of the respectively academicals community, they aren’t independent, and aren’t members of the local community;
- the organization structures of academically and mixed administrative functions, sometimes are confuse, especially, in aspect of responsibility and of evaluating procedures of managerial performances.

The management of university has a difficult period transition, from the super-centralized controlled system to autonomy, a system based on principles and democratic rules.

Thereto, the technical higher education may have a good effect on efficient management and it will be taking into account the following aspects:

- Instrumentation with the necessary logistic;
- To abandon the “coming up” position of directives and resources from Ministry of Education, Research and Youth, by adopting an active position;
- Applying the rules of university autonomy inclusive in domain of economy – finance;
- Awareness the importance of mission declaration;
- To Romania technical and mixed universities management there is recommended the market and entrepreneurial strategy, that implies:
  - The problems associated with curriculum and staffs are decided at departments, and by faculties are decided the standards viewing the students; the deans having integrator role;
  - The master and PhD curriculum must be associated to research grants;
  - Deans has role of integration for bachelor and post university curriculums too;
  - The rector of the university concentrates on representation problems;
  - The management of university must have an efficient marketing;
  - A very active and innovative strategic management with accepting and evaluating the risks.
Promoting of some criterions and performance indices to make these processes objective is indispensable \([1 \div 3, 11, 12]\).

The perception of the university professors, which participate at questionnaires \([7, 8]\) regarding the issues with determinant role on the quality of management of university, is:

- Financial resources and policy degree: high;
- Autonomy (curriculum, administrative, financial): high;
- The administrative management is assured or only redirectioned to academic staffs; moderate.

4. **The Accordance Degree of Romanian Technical Higher Education With Requirements of Beneficiaries**

Within the Priority Project the preoccupations are:

- Estimation of potential beneficiaries requirement, viewing the technical higher education graduates professional profile and the research results;
- Analyzing the realized produces in accordance with the requirements of beneficiaries in condition of economy market.

They are in concordance with the good practices and with policies in this domain are in course of setting up by the devoted universities.

The interest by economic organizations who have obtained the questionnaires was small, only 55 from the 250 solicited have sent the answers. The organizations that have answered will be OHR with high responsibility.

- The most part of OHR (above 78\%) are in domain of power engineering.

This may have the following explanation:

- The domain of power engineering is the field of the study too, that brought empathy, credibility, responsibility in OHR in the same domain;
- Domain of power engineering regarding the social responsibility, has a good structure, disciplinarily, and motivation;

The graduates that have obtained in last 6 years a job, in OHR may be characterized as:

- Takes part of a significant number of specializations (49), more under the number of the Romania higher education specialization;
- The notation of graduates in OHR are in range of \([5 \div 10]\), the weight being at medium level (with 7 and 8);
- The theoretical training level of higher education graduates: high or moderate;
- The practice training level: moderate - small (84\%), and high (16\%);
- The graduates integration velocity: slow (80\%), fast (20\%).

The study \([7, 8]\), reflects the following conclusions about the motivation and psychical state of the candidates at exam at higher education institute:

- The most part of the candidates declares to will activate as engineer in the chosen domain;
- The most part of the candidates motivates their chosen domain in perspective of integration into an adequate job in domain.

Other considerations that have influenced the chosen:

- High effect has the relate with specialists from the domain and family;
- Modality of examination;
- The distance in function with home, it is a major criterion;
- The candidates believe that after ending the university courses, will be possible to practice the wished profession;
- Most part of candidates that made the investigation comes from families with medium study;
- The most part of the candidates may be considered in the examination moment dedicated to studies, without a job or other faculty.

The result of questionnaire, compared with the analyze of graduates integration degree allows the following conclusions \([7, 8]\):

- They have chosen the faculty from interest (professional, material, curricular);
- Most part of candidates, comes from high schools in domain (industrial and real) being at medium level;
- The graduates declares that the formed expectation by examination in years of study were confirmed;
- The hopes of students, in professional aspect are relative reduced;
- The preferences link to disciplines of specialty;
- The performance level in study years as well as of graduates is good;
- The level of obtaining a job in the domain, is relative reduced \((25 \div 40\%)\).

To assure the consolidation and consecration of a technical faculty are necessary the followings:

- Curriculum will be in a continuous adequate improvement through mediation of internal and external tendencies from a solicited domain;
- The education process will be centred on students;
- It is imposed a continuous evaluation and correction of education process through analyzing and corroborating of participants reaction (students, potential professors, beneficiaries);
- The pragmatic site in forming of students will be assured by simulation applications too and by direct study of real installation.

- The number of higher education institutes or technical faculties, which made researches basing on grants for OHR is relative, reduced. The most part of research topics that were the object of grants in last 6 years between higher education institutes and OHR are from power engineering domain.
- The most part from OHR (55\%), appreciates that researches have great impact by direct grants on higher education institutes;
- The made researches by higher education institutes for OHR are in most part financed by OHR and only a small part financed by the national programs;
- The made recommendation by OHR, referring on educational processes in higher education, aims two major aspects: curriculum’s, respectively training, (theoretical and practice). The most part of recommendation made by OHR may be characterized by epithets of: general, without object, because they are current practices in higher education institutes. From 29 types of recommendation, there will be considered the followings:
  - Structure and organize of curriculum must be in relation with market requirements and with industrial transformation process;
• Analyzing the curriculum’s in concordance with the rhythm development of equipment / installation;
• Introducing new disciplines to form concurrencies in market concept and modalities of risk evaluation;
• Disciplines / knowledge viewing the “European Integration”;
• Integration of the students in research grants;
• Correlation of thesis with real problems from economy market. This state shows:
  • OHR doesn’t know or couple to the true appliance through which technical higher education institute may be improved;
  • Only OHR may lead to a real modernization of education processes.

The recommendations made by OHR, regarding the research activities in higher education institutes, aren’t sufficient conclusive, as to be direction for higher education institutes, in this sphere of activities. There are important the following recommendation:

• Making by researchers an integration of national industry, in ensemble with the European industry, cooperation of Romanian researchers with researchers from EU.
• Making some researches oriented to industrial necessities, a closer cooperation between higher education institutes and economic organizations.

5. VIEWING CURRICULUM AND MANAGEMENT OF ANALYZED UNIVERSITIES

The space characteristic of the European technical higher education institutes is a development under a central (parental) university – placed in a region city – (1 – 5) higher education satellite institutes, placed in smaller urban centres with certain industrial specifies. These well coordinate practice leads to economic, professional and quality improvement of higher education efficiency.

• The west European universities are in an adequate process of education systems and curriculum’s in concordance with the declaration of Bologna that doesn’t delimited only on strategies and proceedings of university management.
• The major of analyzed universities – although are declared polytechnics – develop other curriculum as technical (economics, social, a. o.). The research activity in analyzed universities is very well structured and represented, that is also important as the training activity;
• It is an essential support for curriculum’s from II and III cycle, with important weight in the budget of institution;
• The major of the analyzed universities present an important attention to student’s practice stages (weight, contain, adequate to specialization), as well as to the collaboration relations with the profile industry. The parks of science-technology are research areas, and the modern polytechnic universities are its beneficiaries.
• The organization mode, policies viewing strategies and the applied management proceedings are different referring on the analyzed universities as:
  • Organization structure;
  • Leading and functional structure;
  • Deepness and ampleness of regulation;
  • Competence and responsibilities.
  • Deepness of democratic principles and autonomy of universities.

Analyzing the curriculums of European and USA Polytechnic University’s reflects 3 fundamental characteristic of engineering science education:

• They are larger as area taking into account that in this fundamental domain is enclosed domain such as: Geographical Engineering, Engineering in Physics;
• In engineering education there are found the Information Engineering and Architecture;
• The number of license domain in “engineering science” is greater in Romania, as by the 26 analyzed universities.

Referring on specializations, the conclusion is:

• Evaluating the education that ends with diploma of engineer (license, B.Sc) the Romanian specializations aren’t covered with those from the European (the analyzed universities);
• Rating to specialization obtained from the II cycle (M.Sc., DEA) then specialities from Romanian are those as in Europe.

Taking into account the above mentioned conclusions [7], and the tendencies in Bologna declaration we believe that the curriculum from Romania technical universities presents the following priorities:

• Discharging the first cycle student’s curriculum under aspect of programmed activities in group (20 ÷ 24 hours / week) to favour individual work;
• According Diploma of General University Study (after the first part of study cycle I);
• Participating at University Consortiums;
• Emphasizing the preparation in direction of Information Engineering (domain, specializing, curriculum contain);
• Identification of financing sources, that aims the didactical laboratories and research modernizing;
• Organization of curriculum cycle I on domains, affined domains, or in technical domain (depending on student number), that will increase the efficiency of education;
• The practice in industrial entities will be more emphasized.

A synthesis will be presented from Ecole Polytechnique Fédérale de Lausanne [15] that may present a model for Romania Polytechnics.

Ecole Polytechnique Fédérale de Lausanne (EPFL) is technical university same as EPF din Zürich, with federal interest from Swiss. EPFL had a spectacular evolution after 1990, and may be characterized by a management of entrepreneurial type.

EPFL has a distinct international vocation, its professors and students being above 100 nationalities. The research activity is very intensive, for most professors much important as the education, completing substantial the incomes.

Starting with 2003, EPFL introduces the Anglican educational system, in concordance with Declaration of Bologna. The Leaders of EPFL and of substructure entities offer different facilities to a student that represents important attractive points for them.

The flow chart of EPFL executive leaders is the same as of Romania universities, but in this case:

• The role of rector is taken by the president;
• There is the function of General – Secretary that has the same responsibilities as the Scientific Secretary and Chief Secretary of Romanian universities;
The competence of vice-president is very clear stipulated. The education process is organized on faculties, colleges and sections. First two are the same as in Romania but sections are sub-units of faculties that coordinate the license domain.

Faculties have in compound institutes and centres where takes place the research activities, designing laboratories, prototypes execution and technology transfer. The laboratories are of research and didactic laboratories too. In EPFL operates for I and II cycle 5 faculties with 15 sections and two curriculums by colleges.

Each faculty has a regulation leadership, assured by the Council of Faculty, with a president (in general the dean) and an executive leadership formed by a dean, adjuncts and administrator that coordinate the minimal general services. The faculty has a great academically – administrative autonomy concretized by services at this level too (financial too) – autonomy that transfers to the levels of institutes or to the laboratories. Each section has a coordination structure - administration enough high, applied to specific problem to manifest the autonomy and the necessary competence. Institutes, centres, laboratories and workshops are coordinated by a chief – didactic staffs or researchers.

Cycle III has distinct organization and coordination in two entities: doctoral schools and continuous training school (post form).

The rules viewing the technical universities management from Swiss have two categories:

- Regulations at federal level;
- Regulations of university in cause.

In this conditions, a good part from this principles, organization strategies and procedures of both EPF, are inscribed in federal law of EPF, especially in regulation of EPF Council. Regulation of EPF Council is ample and clear.

The principles of democratic principles and autonomy of university are ample reflected in regulations, applied in management activities of EPFL. Responsibilities and decision taking are transferred to the principal actors of processes, the leaders maintaining the strategy, control and initiative functions viewing the internal regulations.

The culture of organization and the regulation ensemble (federal and proper), stimulates and constraints to make a high quality education by EPFL. Although, the examination to higher education institute is free, it is based on high school certificate; the studies imply an effort, many from inscribed students renounces or are eliminated. EPFL has set up a system of assuring the quality in course of European accreditation. At EPFL is a structure (a commission) of coordination, formed from a director and 5 professors. At the faculty, there is a responsible with assurance of quality (professor), at section and institute the responsible is the chief of section or the director of the institute.

The appreciating and ranking of educational corporation members is made based on 5 criterions:

- Qualification obtained from students;
- Number of edited scientific papers;
- Number of patterns;
- Participation at national and European grants;
- Incoming sum from grants.

Regulation of aspects related to the evaluation and quality assurance, are in directive of “making evidence of EPFL education”.

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IMPLEMENTATION OF HACCP SYSTEM IN THE PROCESS OF OBTAINING SMOKED COOKED SALAMI

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ABSTRACT: The HACCP is a management system used in the food industry to avoid putting in danger the safety of food during the whole technological process. HACCP concept is related to ensuring food safety by physical-chemical and microbiological point of view. This paper aims to present a theoretical example for implementing HACCP system on the flow of obtaining cooked and smoked salame, in order to familiarize future specialists for food industry with the methodology of application of this system and to provide a clear vision on contribution and its benefits.

1. INTRODUCTION

A system of food safety management implemented help to keep under control on the technological flow the conditions of hygiene, production spaces, equipment, personnel, but also provides the manner in which it operates in case of breaches of conditions imposed.

Among various methods to ensure hygienic production of food, the HACCP system is one that met most the suffrage of the international organizations in the field. HACCP is best suited to be implemented in economic units of food production. HACCP is an acronym derived from the expression of Hazard Analysis Critical Control Points.

HACCP’s aims:
- identify all the biological, chemical and physical hazards which may present a food intended for consumption
- identifying and analyzing hazards associated with various stages of the manufacturing process of foodstuff
- define the means necessary to eliminate or keep under control these hazards
- Ensure that these means are actually put into practice and are effective.

2. HACCP STUDY

In order to familiarize the students of the food products engineering specialty (IPA) with this system the students were taken to Scandia Cons SA to see how is applied in practice this system and after that together with the coordinator teacher they have made a case study on implementation of HACCP on manufacturing line for salame cooked and smoked. From the large variety of cooked and smoked products from SC. Scandia Cons S.A. was chose for discussion, analysis and detail summer salame because it is the most requested product by consumers.

The key to a good implementation of the HACCP system is the proper preparation and planning prior to the application of the HACCP principles. One of the first preparation activities is to gain an overall understanding of what is involved in using HACCP. In order to do this properly it is essential to select the HACCP team members based on knowledge of raw materials, products, processes and hazards.

The HACCP study is based on the HACCP principles determined by Codex Alimentarius Commission and WHO (World Health Organization). These principles are presented in figure no. 1.

2.1. Describe the product and intended use

Summer salame is part of preparations of meat cooked and smoked group. The product is presented in the form of bars of length 30-45 cm with a surface cleaner, non sticky, covering continuously non damaged, pale brown-red colour.

The physical-chemical characteristics of this type are: the validity of the product is 15 days, the temperature to be kept at 10-12 °C and relative air humidity of 75-80%. The product is intended for all age groups except infants.

The fabrication recipe for this product is:
- Summer salame (100 kg product)
  - 150 kg beef meat;
  - 17 kg Pig meat ;
  - 33 kg fat;
- Spices:
  - Universal seasoning 0.130 kg;
  - garlic 0.500 kg;
  - Salt 2 kg;
  - Smoky flavour 0.100 kg;
  - Starch 0.100 kg.
  - Rind emulsion of 0.250 kg.

Raw materials used are beef meat, pork meat and fat. Beef is received in the forequarters and hindquarters. Beef used in the manufacture of salame is meat refrigerated. For the manufacture of meat preparations is recommended meat with low fat content.

Pork is received in half carcasses, without head, fat, feet and bodies. Half carcasses may be received with or without bacon.

The meat is delivered to the slaughterhouse and chilled dry. The fat is received: dry, chilled or salted and the type of used fat is hard.

The sensorial and physical-chemical properties of raw materials are presented in Table. 1
Table 1. Sensorial and physical-chemical properties of raw materials

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Beef meat</th>
<th>Pork meat</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensorial properties</td>
<td>Colour</td>
<td>From pale pink to intense red depending on species.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taste and odour</td>
<td>Are characteristic for each species and the maximum increase during the heating treatment</td>
<td></td>
</tr>
<tr>
<td>Physical-chemical properties</td>
<td>Water</td>
<td>70%</td>
<td>62%</td>
</tr>
<tr>
<td></td>
<td>Protein</td>
<td>22%</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>Fat</td>
<td>8%</td>
<td>20%</td>
</tr>
<tr>
<td>pH</td>
<td>5.8-6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Black pepper is the whole fruit, shortfall at maturity of the plant Piper nigrum. Active principle which prints fiery quick taste is pepperine. It is used on the form of ground powder to easily disengage the active substances. He must satisfy the conditions imposed by the quality STAS 9763-1995.

Garlic bulb is Alium sativum plant. Active principle of garlic is ethereal oil. For the preparation of meat products is used minced. It can be used as dried and his hydration ratio is 1 to 4. It must satisfy the rules imposed by the STAS 1452-1990.

Liquid smoking-called "FULIROM is a flavouring substance used in the production of meat preparations. Is achieved by natural smoke absorption in aqueous solution and filtering it on the cellulose layer. It is used in a proportion of 0.5% compared to raw materials.

The salt used is rock salt edible which must satisfy the conditions imposed by the quality standards.

2.2. Construct and validate process flow diagram

The flow diagram for summer salami is presented in Figure 3.

To confirm and validate the flow diagram it is necessary to take the flow diagram into the process area and observe each step. This stage was made by the students at Sc Scandia Cons SA.

2.3. Identify hazards and control measures

Once the process flow is confirmed can begin the stage of the hazard analysis.

After the students have seen the whole technological process for the obtaining of summer salami it was used the brainstorming technique to make the hazard analysis.

Were analyzed each stage of the technological process, were identified the potential hazards and using the decisional tree it was established what stages represent a critical control point and what steps are control points. Decision tree chart is shown in Table 2.

2.4. Establish critical limits

Identify Critical Control points

Establish corrective actions procedures

Validate the HACCP Plan

After completing the HACCP study the team must achieve a fully focused documented system, usually known as the HACCP plan.

The implementation of HACCP plan requires more activities presented in figure no. 2.

The HACCP plan for the summer salame is presented in Table 3.
If we want that the implementation of HACCP to remain a success it must be considered the maintenance of the HACCP study. It is unlikely that the products produced, the process, the environment, likely hazards or the people in the facility will remain unchanged over time. It is, therefore important to ensure that changes and their effect on food safety management are properly evaluated. There are a number of activities which must be considered at this point and these activities are presented in figure no. 4.
3. CONCLUSIONS

Implementation of the HACCP system to the production of cooked and smoked salame proved to be a valuable tool for improving the safety and quality characteristics of these products.

According to information provided by SC Scandia Cons SA management count complaints from the customers has decreased significantly after implementation of HACCP system.

Quality management, in the higher education context, also covers the quality of the teaching methods used to present new concepts and knowledges.

Using brainstorming techniques with students leads to active participation of all participants and to develop the ability to keep certain situations, to analyze, to make decisions on choosing the optimal solution.

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QUALITY IN E-LEARNING

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ABSTRACT: The quality developing in higher education institutions is imposed by the management requirements, staff responsibility, performance orientation of the university activities and developing a quality culture not only for the staff but also for the students. Assurance of educational quality is a fundamental requirement for distance learning development. Factors that influence educational quality include instructional design, teaching styles, learning styles, learning objectives, content, and instructional media. The question of how e-learning can be successful becomes more urgent as we move from an “early adopter” stage to a more general offering. In a European educational market, it is critically important to gain an understanding of quality in e-learning. Many different concepts and approaches have been developed so far for many different contexts and purposes.

1. INTRODUCTION

The concept of quality in the public perception and debate today has gained the significance of a leitmotiv for the educational field in all European countries, with the same importance that equality or scientific orientation had in the educational debates of the 1970s in some European countries. Quality in eLearning has become a slogan for educational policies, practitioners and a huge demand from learners. Achieving high quality is a hotly debated and much sought-after goal in all segments of society and education. It is characterised less by its precise definition than by its positive connotation.

2. CONTENT

There are many types of e-learning. The different types of e-learning are based on:

Means of communication - There are several different means for individuals to communicate with each other and their instructor. E-learning can be conducted solely through on-line applications. In other cases, if distance is not a factor, some face-to-face communication can be included to create blended e-learning. Blended e-learning includes elements of web interaction and in-person interaction. Technology broadens the definition of face-to-face as there can be the use of two way video, and two way audio. Introducing these elements of participation create a blended e-learning experience.

Schedule - E-learning can either be Synchronous or Asynchronous. Synchronous means that real-time communication is implemented, such as video conferencing, teleconferencing, and on-line chat programs. Asynchronous indicates that other means of communication are utilized that do not require real time responses. Examples of asynchronous e-learning include: e-mail, list serves, threaded discussions, blogs, and on-line forums.

E-learning class structure - E-learning class structure addresses how the instruction is administered. E-learning can be self-paced, instructor-led, or self-study with an expert. Self-paced instruction is administered by giving the learner the materials she needs to complete the training/instruction. Instructor-led training affords the learner a guide to implement the instruction. Self-study with an expert is a combination of self-paced and instructor-led. As in self-paced, the learner is responsible for staying on task and on schedule, however as in instructor-led, there is interaction with an authority figure that checks the learners' progress.

Technologies used - Technology used to implement instruction is not limited to web-based materials. E-learning can be achieved by utilizing any form of technology that sustains information yielding media. Video/Audio tape, aside from being an obsolete technology is a viable means to implement instruction. More current technology aids the learning experience because there are more means to convey the information. Technology is the most variable element in e-learning. The more advanced the technology becomes, the more options there are to further e-learning. The creation of the Internet subsequently created e-learning, as dial-up connections were replaced by cable modems, speed and bandwidth increased; correlatively the quality of on-line instruction improved because computers were able to support the media. As speed increases and devices become smaller and more mobile; training will become more flexible and further boost the growth and popularity of e-learning.

More and more e-learning experiences are therefore occurring, but what is important for the diverse actors involved whether they be educational decision makers, training organizations, teachers or the learner themselves is to find a way to measure the quality of the training course and in particular its effectiveness (how it has been received) and its efficiency (how it has been perceived).

The issue of quality in e-learning is both topical and widely discussed. It provides material for political debate at national and European level. At first there was an attempt to find the one concept that would be right for all. Various types of analytical description now head the list. These are intended to ascertain and describe how quality development functions in different sectors of education.

Evaluating quality for an area such as learning is a difficult task as a training course is a service involving human intervention and not a linear industrial product that must be reproduced identically time and time again. It is first necessary to choose a quality approach and then parameters and/or indicators in order to carry out the assessment. Diverse approaches could be used, such as those based on customer satisfaction, systematic approaches, global approaches and total quality approaches. In the same way, diverse criteria could be used for evaluation, such as technical standards, criteria dedicated to e-learning, benchmarking exercises.
A benchmark is a criterion by which we can measure the quality of a given service or product by comparing it with other similar services and products. It allows us to fix a standard or a reference point for a given subject. For e-learning there are used a series of indicators:

- Number of pupils per computer with Internet connection (broadband/non-broadband);
- Percentage of individuals having used Internet in relation to training and educational purposes;
- Percentage of enterprises used e-learning applications for training and education of employees.

There are four dimensions of quality competence: knowledge of quality, experience of quality, design of quality, analysis and criticism of quality.

**Figure 1. Dimensions of quality competence**

**Knowledge of quality.** This means the pure knowledge of the potential for present-day quality development, and of current quality approaches. By quality approaches mean any policies, procedures, rules, tools, checklists or any other verification instruments or measure that have the purpose of enhancing the quality of e-learning products or services.

**Experience of quality.** This dimension describes the ability to use quality strategies. It is base don the experience of those involved with quality development activities and the use of quality strategies.

**Design of quality.** This dimension refers to an ability that extends beyond to use of available quality strategies, to the ability to design quality strategies for one’s content. This requires both the innovative ability to change and further develop quality strategies by applying the logic of the media system, and a creative ability to design entirely new forms of quality development.

**Analysis and criticism of quality.** This dimension refers to the ability to analyse quality development processes critically, comparing and contrasting a range of target system and perspectives. In the case of learners, this essentially means a wareness of their own responsibility for quality in e-learning. In that of providers, it means the ability to undertake quality development through a process of flexible negotiation, allowing a variety of individual and societal target system to be involved in the issues addressed by education and training.

The European Commission has supported research into the quality of e-learning at various levels.

Quality in e-learning has a twofold significance in Europe: first, e-learning is associated in many discussion papers and plans with an increase in the quality of educational opportunities, ensuring that the shift to the information society is more successful; second, there is a separate but associated debate about ways of improving the quality of e-learning itself. The European Foundation for Quality in eLearning (EFQUEL) is a membership organisation which is based in Brussels, Belgium. It is a European network with over 70 member organisations such as other networks, universities, corporations and national agencies.

The Foundation serves as sustainable and proactive network and provides valuable services to the European eLearning community. The Foundation's initiators are the European Institut for eLearning, the European Schoolnet, FIM Newlearning, the MENON Network, the University of Duisburg-Essen, Germany and the University of Reading/UK. The foundation has taken its first steps in the framework of the Triangle project.

EFQUEL mission is to enhance the quality of eLearning in Europe by providing services and support for all stakeholders. EFQUEL is built on principles of dialogue and inclusiveness to promote excellence and innovation to achieve Learning Europe. EFQUEL will provide support, transparency, open participation and leadership for a broad range of topics. The purpose of the foundation is to involve actors in a European community of users and experts to share experiences on how e-learning can be used to strengthen individual, organisational, local and regional development, digital and learning literacy, and promote social cohesion.

Four strategic projects looking at the issue of quality from different angles. These projects cover the themes of European and Regional policy (SEEL), good practice (SEEQUEL), pedagogy (Qual E-learning) and standards (EQO).

SEEL (Supporting Excellence in E-Learning) is a consortium dedicated to the study of the impact of quality policies in e-learning at local and regional levels.

The SEEL project, representing the first attempt to address the contribution of e-learning to regional development, had an ambitious remit: to identify the needs of policy-makers in the domain of effective employment of e-learning for regional development; to demonstrate the benefits of an explicit policy and to produce tools to enable this.

The project was highly productive in terms of mainstream outputs and additional related outputs – particularly in view of its short duration, and given the fact that decisions and progress at regional level are subject to administrative imperatives and may indeed be radically affected by a change of political climate.

The first major SEEL activity was a conference, was held 19-20 May, 2003, in Lisbon. Leading experts in e-learning, quality and especially, learning regions, discussed the key issues of quality in (e)learning, innovation and regional development.

Project activities resulted in a better understanding of the potential impact of quality policies on regional development; mechanisms for dissemination of local initiatives at a European level - and vice-versa - and improved networking among key stakeholders to benefit from and exchange good practice. Among the important findings was that regions are at very different stages of development in terms of the articulation and implementation of quality policies for e-learning.

Partners in the SEEL project were originally identified on the basis of their being representatives of regions or having strong connections with European regions, and/or bringing to the project sound competencies in the field of e-learning. The partnership represented seven countries: France, Germany,
Greece, Italy, Spain, Sweden and the UK and one of the distinguishing features of the project was the close cooperation between member regions, from which base a larger network was built.

The concrete outcomes of the SEEL project are:

- A Benchmarking System to help regions to identify and reflect on strategies and actions in order to improve their performance in promoting, supporting, developing, implementing, monitoring and assessing quality in e-learning at local and regional levels. Accompanying the benchmarking tool is a comparative analysis of regional reports on lifelong learning strategy and policy about the quality of the e-learning supply in four of the partner regions. This has helped the development of the benchmarking tool, and constitutes a contribution to the knowledge base.
- Quality Guidelines to enable regions to assess and develop their policy and practice in four areas: learning strategy and innovation; supporting learners and organisations; e-learning delivery and learning resource provision.
- A Strategic Framework for Quality Centres, which positions the centres firmly at the heart of the development and promotion of quality in e-learning.
- The establishment of the first regional centres of excellence (Quality Centres) in Poitou-Charentes, France, Yorkshire, UK and Sweden, which provide a hub for the project's activities and the basis for a self-sustainable network of centres.
- The start of a knowledge base, to assist observation and assessment of current innovative practices in e-learning, and observation and assessment of current tools, methods, actors and practice in quality assurance.
- A European Award for Quality, which supports and promotes the orientation of the project's outcomes, and aims to recognise good practice (actual and emerging) among European regions and territories. The first prototype awards were made to four organisations in October 2004 following the establishment of the judging process.
- National and transnational seminars to elicit regional needs in terms of quality policies
- Two international conferences, whose purpose was to disseminate the aims of the project and achieve the involvement and input of regions to the project’s outcomes.
- A series of national pilot programmes to test and improve the benchmarking tools and quality guidelines.
- A piloting report outlining the piloting methodology, activities undertaken and impact on SEEL outcomes.
- Over 80 organisations responding to the open invitation to "Join SEEL".
- Measures in place for the self-sustainability phase

The SEEQUEL - Sustainable Environment for the Evaluation of Quality in E-Learning - project originates from the joint initiative of the e-Learning Industry Group (eLIG) and of a number of European expert organizations and associations at all levels of education and training. It therefore brings together, in a fundamental way, the companies in the e-learning industry who provide the tools and services, the users, the expert organizations and agencies.

In order to define a cohesive, inclusive and robust approach to the Quality in the implementation and use of e-Learning systems and processes, the SEEQUEL project aims at taking the required step to establish a European "eLearning Quality" Forum, that will address the following issues:

- Quality assessment, evaluation and conformance practice;
- Cases of "good practice" and design guidelines;
- Quality assurance frameworks (with criteria and standards).

The main activity of the project is an inclusive and comprehensive analysis of the case for the development of a sustainable environment (eLearning Quality Forum + Laboratory) for e-Learning standards conformance and quality assurance.

The environment is based on the outcomes of a consensus-building exercise that draw upon the various approaches to quality definition and quality assurance practice currently used by a broad range of stakeholders in education and training in the public and private sectors.

The results of the SEEQUEL project are intended to serve the needs and practices of all interest groups in the field of e-learning, whether commercial or otherwise, keeping a focus on users' requirements and points of view and thus to assist in the promotion of a sustainable market for e-learning products and services.

Within the framework of the Qual E-learning project, the partners have chosen to define e-learning as any learning experiences that are adapted to specific target publics that combine ICT, high levels of interactivity and which integrate human support.

The Qual E-learning project (The quality of e-learning: evaluation of training effective impact measures) should be seen within the context of the European Commission’s e-learning.

The aim of the project is to build up a European-wide observatory for quality in ICT-based training, learning and education in Europe. The observatory collects and stores quality approaches in e-learning, as well as information about diversity of quality approaches in the European educational community to promote the idea of diversity of quality approaches.

General objectives:

- Contribute to the definition of a general framework of e-learning quality;
- Form the basis of an European debate on the characteristics of use and on e-learning quality;
- Promote a better coordination of the actions carried out in this field both by each Member State and at Community level;
- Guide the reflection and the choices of those which are and especially which could become teachers, producer-users, customers or users of these training instruments.

The Qual E-learning project includes five partners from four European Union countries, all specialists in the education sector and possessing strong networks and contacts with the e-learning field in each of their countries: France, Germany, Italy and Spain. The project is co-ordinated by GIP FCIP ALSACE.

- ADEC – Association pour le développement des entreprises et des compétence (France)
- ADEIT – Fundacion Universidad –Empresa de la Universidad de Valencia (Spain)
- DLF – De Lorenzo Formazione S.r.l. (Italy)
- GIP FCIP ALSACE – Groupe d’Intérêt Public Formation Continue et Insertion Professionnelle – Alsace (France)
- ITV Denkendorf – Institut für Textil- und Verfahrenstechnik Denkendorf (Germany)
The European Quality Observatory (EQO) project aims to establish a comprehensive European quality community of e-learning producers, researchers, journalists and decision makers – both in industry and policy – all over Europe. This also was reflected in the consortium of the project.

The European Quality Observatory is a database of quality strategies and quality services.

The quality of e-learning is not a well defined measure. Various proprietary national, regional, local approaches, limited to a certain domain, user group or context are used. There is no general framework for quality management, quality assurance or quality assessment in the field of E-Learning. Therefore even certified products and services cannot be compared.

In order to structure quality approaches for a common European and global market for educational products and services, a comparable and adaptable framework has to be defined and applied. The EQO repository is based on such an approach and concept. The main objective is to provide a comprehensive platform for developers, managers, administrators, decision makers and learners to find a suitable quality approach that fits their needs.

EQO contains a knowledge base which is the base for harmonizing the isolated approaches leading to a reference framework for E-Learning quality. The harmonization process depends on the active involvement of relevant actors (organizations, researchers, users, institutions) in the community of EQO. In this community, the reference model will be further developed in order to facilitate a consensus-based harmonization process. Secondly, the observatory will contain tools to support the implementation of quality approaches.

As a consultant or any other organisation providing services in the field of quality you can save your services in the database and make them known and available to others.

As a user of quality strategies, e.g. a decision maker in an educational institution you find Quality Approaches and Quality Services provided through comfortable search tools.

The European Quality Observatory shall become information, knowledge, and support source for educational institutions, organizations, and users.

3. REFERENCES
7. www.qual-elearning.net
8. http://iit.bloomu.edu
9. www.mccfl.edu
10. www.eife-l.org
11. www.education-observatories.net
12. http://www.hefce.ac.uk
13. www.eqo.info
14. www.qualityfoundation.org
1. INTRODUCTION

The paper is a theoretical and practical approach of the issues related to quality and compositional safety of milk from the point of view of aflatoxins content.

The main objective was achieved by presenting to students from control and expertise of foodstuffs specialization (CEPA) issues related to quality and milk safety and quality requirements imposed on it, which are important characteristics to be outlined in the current, in which all food must meet quality requirements at national and international level, established by law required by the European Union.

The first part presents factors that influence milk quality and safety and technical progress in the field of modern techniques for analysis of contaminants in milk and modern techniques of quality management and food safety.

It was underlined the fact that between the issues related with contaminants are identified aflatoxin M1 and M2 (AFM1, AFM2) Figure 1., which are hydroxyl-metabolites of aflatoxins B which can be found in milk or milk products obtained from animals which have ingested feed contaminated with Aspergillus species of moulds, it is obtained from aflatoxin B, mono-oxygenise microzomial which transform aflatoxin B cells in the liver cells (hepatices) [1]. After the aflatoxin is metabolized M1 is excreted in urine and milk.

![Figure 1. Chemical structure of AFM1 and AFM2.](image)

Before starting the analysis we held a discussion on training for work protection with clear guidelines for handling toxic substances, and also a discussion about the method, instructions on how to work and interpretation of results.

In the second stage was presented in the theoretical way and then practical the method of analysis used to quantify the data which are defining the quality and safety of milk so that the analytical model obtained and validated by the teacher coordinating by the review and processing comparative descriptive statistics will allow, at applicative level, forecasting the analysis of the aflatoxins in milk with a high analytical accuracy by students who will perform the analysis.

2. MATERIALS AND METHODS

Toxicological analysis of milk was performed in the Laboratory of Technology, Equipment and Quality Control of milk and dairy products from the faculty of SAIPM with a group of 15 students from last year of study.

For analysis was chose by students with the coordinator teacher of practical laboratory works the high performance liquid chromatographic method after a preliminary documentation from scientific databases (Science Direct, Platforms Thomson - ISI, Springer link and Ovid), the choice was presented as the most modern and most frequently used in the determination of Aflatoxin M1 [3; 4; 6] these information have provided new procedures for purification of solid phases, such as multimode columns [5]

2.1. The method principle

Before starting the work the coordinator teacher briefly presented the concepts for handling reagents and the method principle which consists in extracting the sample with chloroform and the extract was filtered and one aliquot was purified through a cartridge, and this procedure was then repeated through a RP-18 cartridge. Separation and final determination has been made using the method of high performance liquid chromatographic phase (HPLC) using...
reverse phase column with RP-18, followed by the post column derivation and by fluorescent detection.

2.2. Materials
- Auto sampler 3950;
- Smartline Pump 1000;
- Chromatographic columns of different characteristics;
- Smartline UV Detector 2500;
- System of a solid phase extraction SPE 29;
- Smartline Manager 5000;
- Computer and software for acquisition, control and processing ClarityChrom;
- grinder-mixer;
- sieve with holes of 1.0 mm (ISO R 565);
- Magnetic stirrer with heating IKARH basic 2;
- Rotary Evaporator in vacuum;
- water bath controlled thermostatically, adjusted to 60 degrees C, with the possibility of adjusting the temperature better than 0.1 degrees C;
- Analytical Balance;
- Paper for gofer filter with diameter of 24 cm, Macherey-Nagel 617 1/4 or equivalent;
- Membrane filter with pore size of 0.45 micrometers, Millipore HAWP 04700 or equivalent;
- Micro syringe of 100 micro liters;
- funnel for separation

Equipment work mentioned above was purchased in recent years by carrying out various research projects at the national and international level, including a Knauer HPLC system ideal for such analysis.

The utilization of the equipment mentioned above was done only after a precise training of students because it is extremely expensive and sophisticated.

Students had to demonstrate by the theoretical and practical test their skills in handling such equipment in other specialized disciplines.

2.3. Chemicals and standards
- Chloroform, stabilized with ethanol 0.5 to 1% by weight.
- Methanol for HPLC;
- Acetone;
- Acetonitrile for HPLC;
- Solvents for elution: be prepared the day before or remove air ultrasonic from solvents.
- Mixture of acetone and water, 98 + 2 (v + v).
- Mixture of water and methanol 80 + 20 (v + v).
- Mixture of water and acetone, 85 + 15 (v + v).
- Mobile phase for HPLC
- Mixture of water, methanol and acetonitrile 130 + 70 + 40 (v + v + v).
- Saturated iodine solution: add 2 g per 400 ml water. Mix at least 90 min. and filter through a membrane filter. It is protected from light to prevent photo degradation.
- Celit 545 washed in acid or equivalent saturated solution of sodium chloride
- Sodium sulphate, anhydrous, granular

2.4. Sample collection for HPLC
A total of 10 samples of milk were collected from 5 farms in the county of Maramures (Figure 2 for a period of 12 months (January-December 2007)

2.5. Description of working procedures
The analysis method used for AFM1 determination in milk was the AOAC Official Method 2000.08 reported by [2].

2.6. The results interpretation
Determination of parameters that characterize the quality and safety of food was 10 times made for each sample of milk, being made by working groups on every 3 students. Experimental data obtained (Table 1 and Table 2) were processed by using descriptive statistical techniques using as a software the Microsoft EXCEL program.

<p>| Table 1. Statistical data concerning the Aflatoxina M1 content from milk | 408 |</p>
<table>
<thead>
<tr>
<th>Monthly Interval</th>
<th>Farm</th>
<th>No. of samples</th>
<th>Mean (ng/l)</th>
<th>Standard deviation (ng/l)</th>
<th>Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td>Lower bound (ng/l)</td>
<td>Upper bound (ng/l)</td>
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</tr>
<tr>
<td>Ian-Mar</td>
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<td>10</td>
<td>0.024</td>
<td>0.0356</td>
<td>0.003</td>
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<tr>
<td></td>
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<td>0.0382</td>
<td>0.003</td>
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<tr>
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<td></td>
<td>0.029</td>
<td>0.0482</td>
<td>0.003</td>
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<tr>
<td></td>
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<td></td>
<td>0.025</td>
<td>0.0377</td>
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<td>0.0258</td>
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<tr>
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<td>0.0348</td>
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<td>0.020</td>
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</tr>
<tr>
<td>Oct-Dec</td>
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<td>0.0203</td>
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<tr>
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<td>0.006</td>
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<tr>
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<td>3</td>
<td></td>
<td>0.027</td>
<td>0.0270</td>
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<td>4</td>
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<td>0.030</td>
<td>0.0246</td>
<td>0.005</td>
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<td></td>
<td>5</td>
<td></td>
<td>0.015</td>
<td>0.0191</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Table 2. Statistical data concerning the Aflatoxina M2 content from milk

Factors that characterize the quality of milk in this paper have a weight and influence varying according to their nature.

From the beginning was imposed from the existence of plans the control and also the correct processing of experimental data obtained by statistical means; the analytical results obtained by students in the laboratory represented a fundamental means of knowledge of reality.

Through cognitive skills acquired, they were able to process experimental data and draw conclusions on the technical phenomenon studied, so that after graduation they will be put in the situation of study, prove, check, measure the results that define quality of products analyzed in similar to those activities.

3. CONCLUSIONS

Traceability and product quality are requirements for the European market and that in turn requires an adequate infrastructure, equipment and network services which can be provided by the existing research, so the quality of milk from
the EU Member States was established by Directive 94/46/EEC. This directive was transposed to Romanian legislation by Decision no. 389/2002 of the Ministry of Agriculture of Romania.

This paper provides the information by combining education with technical and technological information relating to the analysis of potential contaminants aflatoxicogénicas from milk.

The amount and variety of information presented will be valuable sources for future specialist who will perform in control and expertise of milk and dairy products at both National and International level where the demands are extremely high.

4. REFERENCES


**ELISA TECHNIQUES TO DETECT AFLATOXIN M₁ IN DAIRY PRODUCTS AND THE ROLE OF THESE ACTIVITIES TO THE TRAINING OF THE FUTURE SPECIALISTS IN EXPERTISE AND QUALITY CONTROL OF MILK AND DAIRY PRODUCTS**

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¹“Lucian Blaga” University of Sibiu, Faculty of Agricultural Sciences, Food Industry and Environment Protection, Department of Food Biotechnology

**ABSTRACT:** The paper has as objective the theoretical and practical presentation to students from the specialization control and expertise of food products (CEPA) of some modern techniques of ELISA to monitor this Aflatoxin in milk and dairy products. The practical training of future engineers was carried out in modern laboratories, equipped with equipment at national and international standards, facilitating the rapid integration of graduates in the process of productive enterprises from the food industry. The presentation of these screening techniques of contaminants in milk may contribute to an efficient theoretical and practical preparation of future specialists in the food industry, being a large bag of knowledge and experiences within the hours of laboratory at milk technology and a knowledge base very useful for future specialists, putting in evidence the theoretical and practical training as a basic component of education.

**1. INTRODUCTION**

The safety of dairy products is a main aspect which future food industry professionals will have to prove to perform on to the market of European jobs in the industry of milk and milk products.

Most tests planned in the education plan from technology and quality control in the milk and milk products discipline are including sensorial, microbiological and physical-chemical analysis focused on quality analysis and analysis used to identify some falsification and therefore these practical activities contribute in largely to the accumulation of last time scientific information.

![Figure 1. The structural formula of the aflatoxin M1](image)

Aflatoxin M1 (Figure 1.) is a hydroxyl-metabolite of aflatoxin B1 and can be found in milk or milk products obtained from animals that have ingested contaminated feed, it is obtained from aflatoxin B1, mono-oxygenize microzomiale which transforms aflatoxin B1 in the liver cells (hepaticas) [3]. After the aflatoxin M1 was metabolized it is excreted in urine and milk.

One of aflatoxin characteristic was sown in the studies of [1] which has reported that extracts of milk from cows fed with feed contaminated with aflatoxin have induced liver lesions which were identical to those caused by AFB1 which were shown in studies realized in laboratory on rats.

The relative quantity of aflatoxin M1 excreted is related to the amount of aflatoxin B1 from contaminated animal feed, and about 0.1% of ingested aflatoxin B1 is excreted in milk as aflatoxin M1. [5] Reported that aflatoxin M1 was detected in 8 dairy products in 166 samples tested, in the range 0.7-2 ppb.

Therefore at an international and national level these issues led to a more strict imposition of new legislative limits concerning some myco-toxins that can contaminate food and raw materials in the food chain.

According to the European Union regulations, the maximum level of AFM1 in raw milk, heat-treated milk and milk-based products should not exceed. [2]

**2. MATERIALS AND METHODS**

The analysis of aflatoxin M1 content in milk was performed in the Laboratory of Technology, Equipment and Quality Control of milk and dairy products from the faculty of SAIAPM with a group of 15 students from expertise and control of foodstuffs specialization (CEPA) in the final year of studies.

Before starting the analysis we held a discussion on training for protection work with clear instructions for handling toxic substances, and a discussion about the method, instructions regarding the steps of analysis, the work, the calculation and interpretation of results.
2.1. Samples
Samples of milk come from various manufacturers of milk being purchased from the market in Sibiu, which were marked by area of origin with P1 ... P39.

2.2. Apparatus
- Balance;
- Gloves;
- Hood;
- homogenization apparatus (vortex);
- centrifuge;
- micro plates reader with filter of 450 nm;
- micropipette of 25-1000 μl and 2.5 ml;
- gofer filter;
- plate for micro titration (96 wells);

2.3. Reagents
- Methanol;
- Standard solution of aflatoxin M1 lyophilized;
- conjugate solution (aflatoxin marked with peroxidases) lyophilized;
- antibodies aflatoxin M1 lyophilized;
- substrate solution, ready for use;
- dilution buffer solution pH 7, ready to use stop solution, ready for use;
- washing buffer solution, 20 times concentrated;

2.4. Description of working procedures

2.4.1. The method principle
For the analysis of aflatoxin M1 from milk was used the competitive immune-enzymatic test. With this ELISA kit were made 39 determinations, samples and standards were analyzed in duplicate.

The Micro titration plate of the kit consists in 12 crane strippers of 8 buckets, pre-lined with rabbit antibodies against

Table 1. Graphical layout of the samples on the first micro plate

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<th>12</th>
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<tbody>
<tr>
<td>A</td>
<td>BLANC</td>
<td>BLANC</td>
<td>P1</td>
<td>P1</td>
<td>P9</td>
<td>P9</td>
<td>P17</td>
<td>P17</td>
<td>P25</td>
<td>P25</td>
<td>P32</td>
<td>P32</td>
</tr>
<tr>
<td>B</td>
<td>S0</td>
<td>S0</td>
<td>P2</td>
<td>P2</td>
<td>P10</td>
<td>P10</td>
<td>P18</td>
<td>P18</td>
<td>P26</td>
<td>P26</td>
<td>P33</td>
<td>P33</td>
</tr>
<tr>
<td>C</td>
<td>S1</td>
<td>S1</td>
<td>P3</td>
<td>P3</td>
<td>P11</td>
<td>P11</td>
<td>P19</td>
<td>P19</td>
<td>P27</td>
<td>P27</td>
<td>P34</td>
<td>P34</td>
</tr>
<tr>
<td>E</td>
<td>S3</td>
<td>S3</td>
<td>P5</td>
<td>P5</td>
<td>P13</td>
<td>P13</td>
<td>P21</td>
<td>P21</td>
<td>P29</td>
<td>P29</td>
<td>P36</td>
<td>P36</td>
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<tr>
<td>F</td>
<td>S4</td>
<td>S4</td>
<td>P6</td>
<td>P6</td>
<td>P14</td>
<td>P14</td>
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<td>P37</td>
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<tr>
<td>G</td>
<td>S5</td>
<td>S5</td>
<td>P7</td>
<td>P7</td>
<td>P15</td>
<td>P15</td>
<td>P23</td>
<td>P23</td>
<td>P31</td>
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<td>P38</td>
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<tr>
<td>H</td>
<td>S6</td>
<td>S6</td>
<td>P8</td>
<td>P8</td>
<td>P16</td>
<td>P16</td>
<td>P24</td>
<td>P24</td>
<td>P32</td>
<td>P32</td>
<td>P39</td>
<td>P39</td>
</tr>
</tbody>
</table>

After this phase was added 25 μl conjugate to all wells except A1 and 25 μl antibody solution in all wells except A1, after which the plate was sealed and agitated for 1 minute, and introduced to the thermostat 1 hour at 37 °C

The solution from the micro titration plate was thrown and then was washed 3 times, after which was pipette 100 μl substrate solution in each well and it has been keep in thermostat for 30 minutes at room temperature. After this phase it was pipette 100 μL solution of H₂SO₄ 1M in each well to stop the reaction, and then it was read the intensity of light at 450 nm with an ELISA reader.

2.4.3. The results interpretation
It was made the average between A1 and A2 wells and this value was substracted from the standard zero absorbent.

The value of the optical density of samples and standards (the average of duplicates) was divided by the standard zero absorbent (B1 and B2 buckets) and it was multiplied by 100. Thus, the zero standards was equal to 100% (maximum absorbent) and the others optical density values were given as a percentage of the maximum absorbent according to the formula:

\[
\frac{E}{E_0} = \frac{\text{standard zero absorbant}}{\text{standard zero (50) absorbanta maxima}}
\]  

2.4.4. The calibration curve
Students have calculated the percentage of maximum absorbent for standards and have drawn on the ordered (Y axis) making correlation between concentrations of aflatoxin M1 on the X axis, thereby it was obtained a linear calibration curve in 0.03 - 1 ng / ml.

The amount of aflatoxin from the sample was expressed as the equivalent of aflatoxin M1. Equivalents of aflatoxin from the extract corresponded with the maximum percentage of absorbent which was read for each of the calibration curve.
From calibration curve can be seen exponential correlation between the absorbent (% ABS) and the concentration of AFB1 with mean square deviation $R^2 = 0.999$ Figure 2. Experimental data has formed the calibration curve which can be observed (Table 2).

Table 2. The obtained results by the ELISA reader for the calibration curve

<table>
<thead>
<tr>
<th>Bucket</th>
<th>Conc. ng/l</th>
<th>Reading no. 1</th>
<th>Reading no. 2</th>
<th>*MABS</th>
<th>**RSD%</th>
<th>***B/B0</th>
<th>Log.(Conc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>0</td>
<td>0.998</td>
<td>0.997</td>
<td>0.998</td>
<td>0.1%</td>
<td>1</td>
<td>-</td>
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<tr>
<td>S1</td>
<td>5</td>
<td>0.934</td>
<td>0.932</td>
<td>0.933</td>
<td>0.2%</td>
<td>0.94</td>
<td>0.699</td>
</tr>
<tr>
<td>S2</td>
<td>10</td>
<td>0.769</td>
<td>0.768</td>
<td>0.769</td>
<td>0.1%</td>
<td>0.77</td>
<td>1.000</td>
</tr>
<tr>
<td>S3</td>
<td>25</td>
<td>0.558</td>
<td>0.556</td>
<td>0.557</td>
<td>0.3%</td>
<td>0.56</td>
<td>1.398</td>
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<tr>
<td>S4</td>
<td>50</td>
<td>0.375</td>
<td>0.381</td>
<td>0.378</td>
<td>1.1%</td>
<td>0.38</td>
<td>1.699</td>
</tr>
<tr>
<td>S5</td>
<td>100</td>
<td>0.237</td>
<td>0.238</td>
<td>0.258</td>
<td>0.3%</td>
<td>0.26</td>
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<tr>
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<td>0.127</td>
<td>0.128</td>
<td>0.128</td>
<td>0.6%</td>
<td>0.14</td>
<td>2.301</td>
</tr>
</tbody>
</table>

Figure 2. The calibration curve for aflatoxin M1 according with the ratio of standards absorbent and standard zero absorbent correlated with the standards concentrations logarithm.

3. RESULTS AND DISCUSSION

Determination of parameters that characterize the content of aflatoxins was done 2 times for each sample being made in parallel by the student on work groups, thereby checking the accuracy of the method. The results are in Table 3. After the validation of the results by the coordinator teacher the students are making a descriptive statistical processing of the obtained data (Table 4) and are encouraged to develop a discussion beginning from the obtained results.

Table 3. The obtained results by the ELISA reader for the samples analyzed by the students

<table>
<thead>
<tr>
<th>Sample</th>
<th>Reading no 1</th>
<th>Reading no 2</th>
<th>*MABS</th>
<th>**RSD%</th>
<th>Log (conc.)</th>
<th>Conc. (ng/l)</th>
<th>Conc. (ppb.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.954</td>
<td>0.958</td>
<td>0.956</td>
<td>0.3</td>
<td>0.64</td>
<td>4.33</td>
<td>0.004</td>
</tr>
<tr>
<td>P2</td>
<td>0.934</td>
<td>0.932</td>
<td>0.933</td>
<td>0.2</td>
<td>0.68</td>
<td>4.80</td>
<td>0.005</td>
</tr>
<tr>
<td>1</td>
<td>0.889</td>
<td>0.887</td>
<td>0.888</td>
<td>0.2</td>
<td>0.77</td>
<td>5.87</td>
<td>0.006</td>
</tr>
<tr>
<td>P4</td>
<td>0.395</td>
<td>0.391</td>
<td>0.393</td>
<td>0.7</td>
<td>1.73</td>
<td>53.16</td>
<td>0.053</td>
</tr>
<tr>
<td>P5</td>
<td>0.451</td>
<td>0.453</td>
<td>0.452</td>
<td>0.3</td>
<td>1.61</td>
<td>40.88</td>
<td>0.041</td>
</tr>
<tr>
<td>P6</td>
<td>0.231</td>
<td>0.237</td>
<td>0.234</td>
<td>1.8</td>
<td>2.03</td>
<td>107.91</td>
<td>0.108</td>
</tr>
<tr>
<td>P7</td>
<td>0.856</td>
<td>0.858</td>
<td>0.857</td>
<td>0.2</td>
<td>0.83</td>
<td>6.73</td>
<td>0.007</td>
</tr>
<tr>
<td>P8</td>
<td>0.891</td>
<td>0.895</td>
<td>0.893</td>
<td>0.3</td>
<td>0.76</td>
<td>5.74</td>
<td>0.006</td>
</tr>
<tr>
<td>P9</td>
<td>0.887</td>
<td>0.882</td>
<td>0.885</td>
<td>0.4</td>
<td>0.78</td>
<td>5.96</td>
<td>0.006</td>
</tr>
<tr>
<td>P10</td>
<td>0.967</td>
<td>0.962</td>
<td>0.965</td>
<td>0.4</td>
<td>0.62</td>
<td>4.17</td>
<td>0.004</td>
</tr>
<tr>
<td>P11</td>
<td>0.867</td>
<td>0.862</td>
<td>0.865</td>
<td>0.4</td>
<td>0.81</td>
<td>6.51</td>
<td>0.007</td>
</tr>
<tr>
<td>P12</td>
<td>0.954</td>
<td>0.951</td>
<td>0.953</td>
<td>0.2</td>
<td>0.64</td>
<td>4.40</td>
<td>0.004</td>
</tr>
<tr>
<td>P13</td>
<td>0.296</td>
<td>0.202</td>
<td>0.249</td>
<td>26.7</td>
<td>2.00</td>
<td>100.94</td>
<td>0.101</td>
</tr>
</tbody>
</table>
### Table 4. Descriptive statistics of experimental data obtained in January

<table>
<thead>
<tr>
<th>Total number of samples analyzed</th>
<th>39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal value</td>
<td>0.004</td>
</tr>
<tr>
<td>Maximum value</td>
<td>0.1080</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.0299</td>
</tr>
<tr>
<td>Average</td>
<td>0.0216</td>
</tr>
<tr>
<td>Number of positive samples , ≤ 0.05 ng/l</td>
<td>7</td>
</tr>
<tr>
<td>Number of negative samples , &gt; 0.05 ng/l</td>
<td>32</td>
</tr>
</tbody>
</table>

Only 7 samples of milk were containing an aflatoxin content greater or equal with 50 ng / l which is the limit established by the (Commission Regulation, 2006).

Following discussions with the students they searched in databases of scientific and specialist journals for similar results for aflatoxin M1 content (level of contamination) in milk from several European countries.

For example in Italy, in the case of 161 samples of dairy products, only 4 (2.5%) were contaminated at a level> 50 ng / kg [4].

Results obtained by the students through statistics analysis indicate that the products reviewed by them and validated by the teacher coordinator have been made correctly so students were familiar with the stages of analysis and the methodology presented and there are not deviations.

### 4. CONCLUSIONS

This paper provide an introduction to the analysis of Aflatoxin M1 by an ELISA immune-affinity test, together with practical demonstrations conducted in the laboratory

Respecting all the requirements of national and international legislation the future specialists who will come to operate in the field of analysis and expertise of quality and safety of dairy products will be well trained in the laboratory classes and they will be familiar with modern techniques and equipment and classical analysis and regulations and laws that characterize the safety of dairy acid.

The activities mentioned in this paper have realized the assimilation of specialist knowledge and a good balance between theoretical knowledge and practical one. The curriculum of the discipline technology, equipment and quality control in milk and dairy products industry has made by
such practical works a broad range of practical skills for the future graduates who will meet the expectations of the food industry at national and international level. Therefore food industry professionals will be responsible for the safety of dairy products, participating in one of the most effective ways of screening and health promotion.

5. REFERENCES


THE IMPACT OF SUPERCRITICAL LIQUIDS USING IN THE LEADING OF EXTRACTION PROCESSES IN TRAINING TECHNOLOGICAL ENGINEERS FOR FOOD INDUSTRY

Ovidiu, Titu¹ Letiţia, Oprean¹ Mariana, Pacala¹ Ciprian, Tuşa¹ and Cristina, Tiţa¹
1 “Lucian Blaga” University of Sibiu , Faculty of Agricultural Sciences , Food Industry and Environment Protection , Department of Food Biotechnology

ABSTRACT: The extraction with supercritical fluids is a new method of separation developed as an alternative to classical methods of extraction, presents a number of advantages related to safety products and environmental protection opening wide prospects of application in the future. Supercritical systems combine the qualities of liquids and gases and a result a fluid with multiple attributes, although in a global view supercritical fluids are intermediate between those of the gas and liquids, and because of specific variations with temperature and pressure occur special features of transfer of substance. In order to understand the complexity of the study it is important to know the following aspects: physical-chemical properties, the balance dates of the system, components selectivity (thermodynamic limiting factor), resistances to the transfer of substance (factor limiting kinetic), and the model to study the transfer of substance.

1. INTRODUCTION

Like any other economic activity, food industry is purposeful human needs and the overall progress of the country. The degree of satisfaction of normal physiological consumption of the entire population depends mostly to the internal production of food. Currently, Romanian agriculture and food industry can ensure the internal food needs for a population of two to three times more numerous than those existing today.

The problem of food security is an essential component of life safety and it is putting both in terms of quantity (especially for poor products) and quality (consumption of protein foods, foods with a high content in vitamins and minerals) and the terms of the degree of industrial processing, price and environmental criteria.

A major coordinated of the agricultural policy at European and international level is the concrete value for the positive benefits of the development of food industry, according to the demands growth to environmental protection. A coordinated system of rules and regulations is limiting at the national and international level the effects of the intensification and modernization of production processes.

2. MATERIALS AND METHODS

Environmental performance of an organization has a growing importance for the stakeholders, internal or external. Getting a good environmental performance requires a commitment of the organization to a systematic approach to its environmental management - SMM - continues to improve it.

All production companies are working increasingly hard to achieve and demonstrate a clear environmental performance, controlling the impact of their activities, products or services and taking into account the policy objectives and their environmental aims.

The overall aim is to provide support to organizations interested in implementing or improving an SMM, consistent with the concept of “sustainable development” and is compatible with the entire organizational, social or cultural framework.

SMM provides to organization the order and coherency to direct their concerns on the environment by allocating resources, assigning responsibilities and ongoing evaluation of practices, procedures and processes. Such a system is essential to an organization’s ability to anticipate and achieve environmental objectives, and to ensure continued compliance with the requirements at national and international level, in force.

Environmental management is an integral part of the management system of an organization. The Development of a SMM results from a dynamic and interactive process. Structure, responsibilities, practices, procedures, processes and resources needed to implement policies, objectives and targets of the environment can be coordinated with existing efforts in other areas such as operational, financial, quality, health or safety.

The basic principles which should take account the managers to the introduction or development of an environmental management system are:

- taking into account the environmental management as one of the major priorities of the organization;
- establish and maintain communication with interested parties, internal or external;
- determination of legislative requirements and environmental issues associated with activities, products or services organization;
- Increasing the employment of the management and personnel in the environmental domain, by assigning clear responsibilities and responsibilities;
- encourage environmental planning throughout the lifecycle of the product or process;
- establish a process to achieve the level of performance fixed;
- providing sufficient and appropriate resources, including training, in order to achieve continuous performance of the levels established;
- evaluation of environmental performance in comparison with the policy, objectives and targets of the organization and environment improvement where it is necessary;
- establish a management process to enable auditing and SMM analysis to identify opportunities to improve the environmental outcomes;
- Encouraging contractors and suppliers in order to establish a SMM.

The SMM model aims a basic representation of an organization that subscribes to the following principles:

a) Environmental policy - the organization should define its environmental policy and ensure commitment to its own environmental management system.

b) Planning - organization will establish a plan to achieve its environmental policy.

c) Implementation - to ensure effective implementation it is recommended to the organization to develop capacities for action and support mechanisms necessary to achieve environmental policy, targets and its objectives.

d) Measurement and evaluation - the organization must monitor and assess its environmental performance.

e) Analysis and improvement - the organization should measure and improve continuous their system of environmental management aiming to improve its global environmental performance.

The identification of the environmental issues and assessment of impacts on the environment cover four stages:

1. Choice of an activity, product or service
   Selecting activities, product or service should be comprehensive enough for a meaningful examination.

2. Identify the environmental aspects of business, product or service
   Involves identifying a large number of environmental issues that are associated with business, product or the chosen service.

3. Identify the environmental impacts
   Involves identifying a large number of environmental impacts, actual and potential, beneficial and harmful, which are possibly associated with each identified aspect.

4. Evaluation of the importance of impacts
   The identified environmental impacts may vary from one organization to another, but important is the quantification which helps to the evaluation.

In the evaluation will take into account:

a) Issues related to environment:
   - size of the impact, probability of impact, severity occurring, duration of the impact.

b) Issues relating to the business:
   - possible existence of legal provisions and regulations, the difficulty of changing the impact, the cost of changing the impact, the effect of the change on other activities and processes of stakeholder concerns, the effect on the immigration public organization.

3. RESULTS AND DISCUSSIONS

The Environmental management was regarded in general as having an operational function, often related to the health and protection at work, while the activities of environmental protection and labour involve carrying out the costs necessary into a business, the firms recognizing that implementing an environmental management system is strategic and contribute to the whole business strategy, product design, systems design and financial information.

The environmental management system - is a management tool that allows an organization to assess and control impacts of their activities on the environment.

In order to model the environmental management have developed a multitude of standards and regulations series of standards ISO 14000, which provides the specific definition of the terms and specifications and usage guides for a wide range of items including environmental auditing, certification, labelling, life cycle assessment.

At European level has been developed Regulation 1836/1993 - EMAS (Eco Management and Audit Scheme Community) that are voluntary for member countries of the European Union.

EMAS Regulation is intended to recognize those companies who have established an environmental program, designed so as to ensure continued protection and improvement of environmental performance.

The UK has developed its own standard for environmental management BS 7750 since 1992, very close to the requirements of ISO 14000.

Table 1. Environmental issues generally tracked in a food business.

<table>
<thead>
<tr>
<th>Environmental aspects</th>
<th>Impact</th>
<th>Environmental factor affected</th>
<th>Surveillance and control systems and control</th>
<th>Technical corrections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge of water from the channel filter in the river over the channel edges</td>
<td>Soil pollution with organic substances dissolved</td>
<td>Soil</td>
<td>sensor for monitoring Height flow of water channel</td>
<td>Compliance with instructions of work</td>
</tr>
<tr>
<td>Emissions of volatile chemicals</td>
<td>Air pollution Poisoning with volatile chemicals</td>
<td>Human Air</td>
<td>Niche with forced ventilation</td>
<td>Compliance with instructions of work and IPM</td>
</tr>
<tr>
<td>Hazardous waste resulting from work in the laboratory, waste paper, broken glass</td>
<td>Increases the amount of waste</td>
<td>Soil</td>
<td>Waste paper collection and transport them</td>
<td>Compliance with PP instructions of work and IPM</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Waste paper results in the offices</td>
<td>Increases the amount of waste</td>
<td>Soil</td>
<td>Separate collection and recovery from a third firm</td>
<td>Compliance with instructions of work</td>
</tr>
<tr>
<td></td>
<td>Soil pollution</td>
<td>Soil pollution</td>
<td>Soil pollution</td>
<td>Soil pollution</td>
</tr>
<tr>
<td>Waste from the printers (cartridges),</td>
<td>Increases the amount of waste</td>
<td>Soil</td>
<td>Collecting household waste</td>
<td>Compliance with instructions of work</td>
</tr>
<tr>
<td>computers (spare)</td>
<td>Soil pollution</td>
<td>Soil pollution</td>
<td>Collecting household waste</td>
<td>Compliance with instructions of work</td>
</tr>
<tr>
<td>Waste from the flag</td>
<td>Increases the amount of waste</td>
<td>Soil</td>
<td>Collecting household waste</td>
<td>Compliance with instructions of work</td>
</tr>
<tr>
<td>Administration (office)</td>
<td>Soil pollution</td>
<td>Soil pollution</td>
<td>Collecting household waste</td>
<td>Compliance with instructions of work</td>
</tr>
<tr>
<td>Water consumption</td>
<td>Resource</td>
<td>Resource</td>
<td>Water Meter</td>
<td>Monitoring monthly consumption for the plant</td>
</tr>
<tr>
<td>Electrical energy consumption</td>
<td>Resource</td>
<td>Resource</td>
<td>Meter</td>
<td>Monitoring monthly consumption for the plant</td>
</tr>
<tr>
<td>Consumption of lubricants</td>
<td>Oil</td>
<td>Soil Water</td>
<td>Bon consumption</td>
<td>Wrap in consumption</td>
</tr>
<tr>
<td>Consumption of raw materials and</td>
<td>Resource</td>
<td>Resource</td>
<td>Bon consumer report production</td>
<td>Monthly monitoring of specific consumption of raw materials</td>
</tr>
<tr>
<td>auxiliary materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation of waste polyethylene</td>
<td>Plastic</td>
<td>Soil</td>
<td>Waste Management Report</td>
<td>Recovery from third parties</td>
</tr>
<tr>
<td>Non-ferrous metal waste generation</td>
<td>Aluminium</td>
<td>Soil</td>
<td>Waste Management Report</td>
<td>Recovery from third parties, monitoring</td>
</tr>
<tr>
<td>Metal waste generation</td>
<td>Steel stainless steel</td>
<td>Soil</td>
<td>Waste Management Report</td>
<td>Recovery from third parties, monitoring</td>
</tr>
<tr>
<td>Consumption of detergents and</td>
<td>Chemical substances</td>
<td>Soil Water</td>
<td>Bon consumer</td>
<td>Wrap in consumption</td>
</tr>
<tr>
<td>disinfection substances</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption of gas</td>
<td>Resource</td>
<td>Resource</td>
<td>Meter</td>
<td>Monitoring monthly consumption for the plant</td>
</tr>
<tr>
<td>Consumption of electricity</td>
<td>Resource</td>
<td>Resource</td>
<td>Meter</td>
<td>Monitoring monthly consumption for the plant</td>
</tr>
<tr>
<td>Consumption of drinking water</td>
<td>Resource</td>
<td>Resource</td>
<td>Meter</td>
<td>Monitoring monthly consumption for the plant</td>
</tr>
<tr>
<td>Atmospheric emissions (explosion /</td>
<td>CO₂, CO, NO₂</td>
<td>Air</td>
<td>Analysis report</td>
<td>Intervention plan in case of fire</td>
</tr>
<tr>
<td>fire)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generate noise</td>
<td>Noise</td>
<td>Human</td>
<td>Analysis report</td>
<td>Wrap in the maximum allowed under the law in force</td>
</tr>
<tr>
<td>Waste paper results in the offices</td>
<td>Increases the amount of waste</td>
<td>Soil</td>
<td>Separate collection and recovery from a third firm</td>
<td>Compliance with instructions of work</td>
</tr>
<tr>
<td>(cartridges), computers (spare)</td>
<td>Soil pollution</td>
<td>Soil pollution</td>
<td>Collecting household waste</td>
<td>Compliance with instructions of work</td>
</tr>
</tbody>
</table>

Knowledge and skills necessary to achieve environmental objectives must be identified.
They should be considered in the selection, recruitment, training, skills development and training of personnel.
The organization must identify training needs. All personnel whose work may have a significant impact on the environment must be adequately trained.

It must establish and maintain procedures for staff or members, at all levels and in all relevant functions, to be aware of:
- the importance of compliance with environmental policy, procedures and requirements of environmental management;
- significant environmental impacts, actual or potential, of their activities and beneficial effects to the environment by improving their individual performance;
- powers and responsibilities in achieving compliance with environmental policy, procedures and requirements of
environmental management, including requirements relating to emergency preparedness and response capacity;
• the possible consequences of deviations from specified operating procedures.

It is recommended to an organization to introduce an effective system of environmental management to protect human health and the environment from potential impacts of activities, products or services and to help maintain and improve environmental quality.

The introduction of a SMM can help an organization to provide confidence to interested parties on the fact that:
• There is a commitment on the management regarding the requirements of its own policies, objectives and environmental targets;
• Emphasis is placed on prevention rather than corrective action;
may provide evidence of a reasonable concern on environmental issues and conformity to regulations;
• Designing systems include continuous process improvement.

An organization whose management system includes an SMM has the framework to balance and integrate the economic and the environmental interests. An organization that has implemented an SMM can obtain significant competitive advantages.

The introduction of a SMM may lead to advantages in economic benefits which must to be identified to demonstrate to stakeholders and especially to shareholders the value that it is for the organization the applying of a good environmental management. It also provides the possibility for the organization to make the link between objectives and environmental targets and financial results and thus to ensure that resources are available where they are bringing the most benefits, both financial and environmental.

Potential benefits arising from the application of an SMM are:
• ensuring consumers on the introduction of a commitment to environmental management that can be demonstrated;
• maintaining good relations with the public and local authorities;
• meet the criteria and improving access to capital;
• obtaining insurance at a good price;
• improving the image and increasing market presence;
• performance criteria for certification of the seller;
• improved control over costs;
• limitation of incidents involving legal responsibility of the manufacturer;
• demonstrate a reasonable concerns on the environment;
• conservation of raw materials and energy;
• simplification of approaches for obtaining permits and authorizations;
• encourage the development and transmission of solutions regarding the environment;
• improve relations between industry and public authorities.

4. REFERENCES
A KNOWLEDGE MANAGEMENT APPROACH THROUGH INTELLIGENT AGENTS AS DATA MINING TECHNIQUES

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2 Computer Science Department, Petroleum-Gas University of Ploiesti, no. 39 Bd. Bucuresti, 100680, Ploiesti, Romania, iliviu@upg-ploiesti.ro

ABSTRACT: We live in a knowledge society and our concern should be how to use knowledge to improve the quality of our activities, no matter what the field we attend to. Data mining techniques are involved in different knowledge processes, as we can see in various public applications of researchers. Nowadays, intelligent agents as data mining techniques, represent an important opportunity to optimize knowledge management. In this paper the authors considered an example of “data mining agents”, outlining their major involvement in the complex process of knowledge management for engineering.

1. INTRODUCTION

Knowledge management (KM) became a discussion topic for different people, researchers or not, which activate in various domains such as business, education, communication, health, engineering etc. Data are produced and stored daily, processed, transmitted in different locations without any concern of their powerful meanings. Many questions search answers that can be given by these data considered initially without significance. In recent years, managers focused their work on finding methods and techniques to organize huge data provided by transactions or other activities and to extract useful patterns. Knowledge replaces data and a new concept appears: knowledge management.

Data mining (DM) can be considered a KM tool involved both in industry and academia, used to translate structured data into knowledge. Organizations often attempt to transform raw data into usable knowledge as a part of their knowledge management initiatives [3]. An increasingly important task in data mining is to mine complex and heterogeneous types of data, including multimedia data, text data and the World Wide Web [4]. Intelligent agents can interact with DM, generating a new research subject.

Data mining is considered the automated process of patterns extraction representing knowledge implicitly stored in large databases, data warehouses, and other huge information repositories. Data mining is also a multidisciplinary field, working in areas that includes database technology, artificial intelligence, machine learning, neural networks, statistics, pattern recognition, knowledge based systems, knowledge acquisition, information retrieval, high performance computing, and data visualization.

A data mining agent is a software program built for the primary purpose of efficiently finding information that operates in a data warehouse. This type of agent is able to detect major trend changes, as well as to detect new pertinent information. If a new piece of information is found, the agent will generally attempt to alert the end-user of the new information [9].

In the current paper we discuss about data mining making a significant contribution to a knowledge management effort in the engineering field. Our goal is to show how agents such as DM techniques can be used for building organizational knowledge, which would lead to a better performance.

2. KNOWLEDGE MANAGEMENT

In this age of knowledge-based society, many enterprises start to emphasize the management of knowledge. KM is considered a strategy of getting the right knowledge to the right people at the right time (just-in-time knowledge management) [5] and helping people share and put information into action in ways that will improve organizational performance.

An equation with three concepts: data, information and knowledge define KM (figure 1). As we know, data are mostly structured, factual, and often numeric, and reside in database management systems. On the other hand, information is factual, but unstructured, and in many cases textual. Knowledge extracted from data is inferential, abstract, and is needed to support decision making or hypothesis generation.

In the technical, engineering disciplines, specialized knowledge becomes outdated faster than other and to integrate knowledge management into the value creation processes is indispensable. Identifying the necessary IT infrastructure is only one aspect of KM. Other challenges involved can be: developing an adequate company culture, encouraging staff members to constantly generate, use, save and distribute knowledge etc.

![Figure 1. Data, information, knowledge.](image)

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In literature [2] the knowledge management involves the following components:

- knowledge selection/mining;
- knowledge obtaining;
- knowledge learning;
- knowledge creation;
- knowledge diffusion;
- knowledge construction/coding;
- knowledge warehousing.

The goal of knowledge management is for an organization to be aware of individual and collective knowledge so that it may make the most effective use of the knowledge it has [1].

Considering a process with inputs and outputs, a question appears: where does KM act? In the enterprise-wide processes, knowledge in and knowledge of the process is fragmented; it is distributed across people, equipment, functions and even organizations.

Systematically examining a process to understand where and how knowledge develops is a good starting point for subsequently improving the performance of that process through a KM initiative. Depending on the results of that examination, several options for action are available [10].

In the next section, we present the interaction and integration of agents in engineering for “mining” data.

3. INTELLIGENT AGENTS AS DATA MINING TECHNIQUES IN ENGINEERING

An agent is designed to automate frequently accessed tasks and to determine the patterns in the requests, or in the performance in the tasks. According to Wooldridge [7, 8] intelligent agents are defined as agents, capable of flexible autonomous action to meet their design objectives and present the following characteristics: reactivity, pro-activeness, sociability, self-analysis, learning, adapting and improving through interaction with the environment.

Combining intelligent agents with enterprise knowledge portals is a powerful technique that can deliver to a user exactly what he or she needs to perform his or her tasks [6].

Intelligent agents-based systems were initially applied to fields such as production, processes control, telecommunications, air traffic control, transport and road traffic management, electronic commerce, etc. Nowadays, more and more application fields are being approached in order to introduce multi-agent systems, a possible taxonomy of these being the following:

- systems and methods of designing complex distributed computing systems;
- technologies source for developing virtual systems;
- models of real complex systems.

The efficiency and safety of modern diagnosis technologies have been constantly improved and, as a result, they have become more and more appropriate for diagnosing complex distributed industrial applications. In order to transfer these technologies to the industrial world, it is necessary to integrate them into an existing regulation system, into a SCADA (Supervisory Control and Data Acquisition) system, or, as an alternative, to develop a new diagnosis system.

Adopting a multi-agent architecture for diagnosis implies connecting the most advanced regulatory industrial architectures, the latest software technologies and modern diagnosis approaches.

It is reasonable to use multi-agent systems within industrial applications, as agents lend themselves to modular, decentralized, unstructured and complex applications, a new target field being, in this respect, that of the oil industry. Most of the problems posed by oil exploring and exploitation, oil refining and processing, its distribution and management may be solved by means of intelligent agents. Several examples of multi-agent systems applications in the oil industry are: identifying the exploitation field, describing oil supply, assessing oil and gas quality, researching the way oil wastes are distributed within the oil field, resources exploitation, unifying management etc.

Using multi-agent systems to solve diagnosis problems in case of improper oil wells operation or work accidents during oil recovery represents a viable solution.

Considering all these, for the applicative part of the paper, and taking into account the complexity of a technical diagnosis system in the oil industry, we have designed a multi-agent system that is used in the process of separating the oil collected in a park of separators and tanks.

The designed model consists of three software entities (figure 2):

- Process entity – separation of extracted fluid from petroleum deposits in two phases: petroleum and deposit water (salty water) through a fluid worming process with warm water.
- Tank entity – considered a warming unit to provide warm water for separation process.
- Pump entity – supplying water (liquid) both to warming unit and process.

These three entities change messages and possess the agents’ properties. The agents designed for process control develop the real time control plan to reach their objectives. The planning process is made as a distributed and cooperative planning, each agent making its own plans and through negotiation the agents adjust their plans to accomplish the proposed jobs. Another three utilitarian agents will be added at the model to have a correct execution of multi-agent system designed in Zeus software (ANS agent, Facilitator and Visualiser) [11, 12].

![Figure 2. Informational data flow.](image-url)
Each agent can be describing using PAGE (Perceptions, Actions, Goals, Environment) description:

- **Process Agent**
  - Perceptions: cost, fluid units;
  - Actions: negotiates with Tank Agent to obtain fluid at minimum price;
  - Goals: separation oil deposits' fluid;
  - Environment: park of separators.

- **Tank Agent**
  - Perceptions: cost, fluid units;
  - Actions: negotiates with Process Agent to obtain a maximum cost and negotiate with Process Agent for a minimum cost;
  - Goals: offers fluid to process and gets fluid from the pump;
  - Environment: park of separators.

- **Pump Agent**
  - Perceptions: cost, fluid units;
  - Actions: negotiates with Tank Agent to obtain the best cost;
  - Goals: offers fluid to the tank at a reasonable price;
  - Environment: park of separators.

The multi-agent system ontology is presented in the figure 3.

Pump Agent interacts with all agents, establishing a subordinate relation with Tank Agent and uses coordination protocol FIPA Contract Net Contractor. As a respondent strategy, the Pump Agent uses Decay Function strategy.

In figure 4 the informational data flow is presented, highlighting the messages exchanged between agents.

This community of agents can be populated with other agents, as follows:

- **DiagAgent** – an agent responsible with diagnosis. This agent gets measurements at real time from sensors, verifies that the sensors operate properly, detects anomalies in process functioning and notifies the interested parties;

- **DMAgent** – a data mining agent. The integration of DMAgent in the current agents’ community causes improvements in negotiation process, minimizing the time of negotiation by decreasing the number of agents negotiations.

The data mining agent implements specific data mining techniques and algorithms. An interface module should support inter-agent communication. The process module contains methods for initiating and carrying out the data mining activity, capturing the results of data mining, and communicating it to result agent or the facilitator agent. The knowledge module contains meta-knowledge about data mining methods (what method can be applied for what type of problem, input requirements for each of the mining methods, format of input data etc.).
A multi-agent system architecture based on data mining contains specialised agents as follow: Facilitator Agent, DMAgent, User Agent and a Broker Agent.

DM task planning is realized by negotiation between the FacilitatorAgent and DMAgents through messages. A possible situation is when a UserAgent sends a request to the FacilitatorAgent to inform that it would like to do data mining with other agents in the agency. The UserAgent gives some information about model definition, model type, inputs, constrains etc. When the FacilitatorAgent receives the request from the UserAgent, it negotiates with the BrokerAgent to identify the proper agents to launch for the proposed task. The DMAgent is responsible for completing the task, while the FacilitatorAgent continues to plan future DM requests. When the DMAgent completes its job it returns the results and the FacilitatorAgent transmits them to the UserAgent.

4. CONCLUSIONS

The implemented multi-agent system is based on a net-like architecture, in which each agent communicates with all the other agents. For a robust behavior of the system, there must be a good coordination of the agents, and that is to be achieved by using coordination protocols provided by Zeus environment. Communication between agents is realized by means of interaction strategies in which there are specified the conditions to which agents may pass when receiving messages that contain certain information.

The application presented in this paper emphasizes the fact that agents-based methods represent in nowadays world a flourishing domain, both from a theoretical and a practical approach. We considered that data mining based on agents is a challenge in engineering fields.

5. REFERENCES

WAYS TO FURTHER IMPROVE THE QUALITY OF EDUCATION
BY APPLYING THE METHODOLOGY “SIX SIGMA”

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ABSTRACT: The aim of this work is to present a case study for the ongoing quality improvement training through practical implementation of the “six sigma” method to reduce or eliminate the inappropriate results in practical training of students. It is a test methodology for the implementation of “six sigma” to continuous improving mainly used in industry in a segment rarely used the services of education, with customization in the field of military training. The study complies with methodology stages of the “six sigma” presented in the reference work in the field and the conclusions presents the performances of students who increased significantly, succeeding fewer qualifications of “unsatisfactory” from 18 to 1, and the number of “very well” grades increased by 59.3%.

1. INTRODUCTION

Philosophy, six sigma "is based on the assumption that most of the elements to meet business organizations have a normal statistical distribution. In this case, the standard deviation of this distribution may be taken as the unit of measurement for assessing the likelihood of finding an event or other distribution of the mean. This shows that:

- the likelihood of events to be in [-σ, σ] is 68%;
- likelihood that the event should be in [-2σ, 2σ] is 95%;
- likelihood that the event is in the range [-3σ, 3σ] is 99.73%;
- likelihood that the event should be in [-6σ, 6σ] is 99.9997%

Setting the objective of a three-sigma capability is indicated for once, because it allows the organization to prepare a basis for improvement. When the management will become more process-oriented, higher objectives such as "six-sigma capability" will become possible. Such objectives will require fundamental changes in organizational philosophy and culture.

Process improvement six sigma is to reduce or eliminate losses that may occur due to existing or potential defects such as reduction in scrap costs and touches 10%, reducing customer complaints or minimize billing errors.

The principle behind six sigma is a process that the outcome (Y) is dependent inputs (X) in that process. Or mathematically speaking:

\[ Y = f(X) \] or \[ Y = f(X_1, X_2, \ldots, X_n) \] (1)

The six sigma improvement must discover X’s (inputs or causes) of a serious quality problems (that result in a "Y” inadequate), to remove "X” can not comply and provide the control so that these "X” - and are non-default "Y” - are inadequate to stop back.

2. PROJECT DEFINITION

2.1. Project Identification

a) The proposed project to improve. After a conference on quality problems in the Senate academy concluded that an important area for improvement is the complaints (complaints) from the beneficiaries. Presenting a statement of such complaints (complaints), rector said that they mainly refer to:

- shootings from infantry weapons with a rate of 35% of graduates do not meet minimum scale of accuracy (75 of 100 possible points);
- a percentage of 25% of graduates do not know the English language in accordance with STANAG 2222;
- Physical training at a rate of 10% of graduates does not fit well to scale back on the ground varied distance of 3000 m (15'30’’);
- to prepare topographic graduates 15% of the determined coordinates of the station on the map with an error greater than 25 feet.

b) Assessment of problems that could lead to projects to improve the problem and selecting priority - priority improvement project for the academy

The criteria underlying the selection project are:

1. Frequency - the need to correct a problem that occurs frequently, not an accident;
2. Importance - after completion, must obtain results to justify the effort;
3. Duration - the project must have a duration less than one year;
4. Impact - it must be measured by:
   - maintaining beneficiaries through compliance with the requirements imposed by operational units;
   - attracting new customers: the reputation of a very good academic training will attract customers from different structures of the national defense system;
   - non-decreasing costs by reducing quality costs of organizing and conducting training courses for post-graduation;
   - winning a better reputation at national and international;
   - reducing the periods of training missions to theater of operations;
   - increasing confidence in their preparation.
5. Urgency - the correction of these problems is required;
6. Risk - the project may not lead to obtain the expected results;

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7. Possible resistance to change - the project may cause some resistance from those involved;
8. The degree of success of the project - there must be no obstacles to the desired results;
9. The problem must be measured - is the existence of compulsory data.

<table>
<thead>
<tr>
<th>Claims</th>
<th>Selection criteria</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy shootings with infantry weapons;</td>
<td>5  5  2  5  5  3  4 4  5 38</td>
<td></td>
</tr>
<tr>
<td>Knowledge of a second language</td>
<td>1  3  2  2  3  3  3  5 25</td>
<td></td>
</tr>
<tr>
<td>Physical Preparation</td>
<td>2  4  2  4  4  3  2  3  5 29</td>
<td></td>
</tr>
<tr>
<td>Preparation of topographical</td>
<td>1  3  2  3  4  2  3  2  4 24</td>
<td></td>
</tr>
</tbody>
</table>

As a result of this matrix outlines the priority problems which proved to be increasing precision shootings executed with infantry weapons, and it is therefore most important project to improve the academy.

2.2. Project Definition and Mission

a) Formulate the problem. In formulating the problem was taken to be specific, observable, measurable and controlled.

PROBLEM: The shootings of infantry weapons with a rate of 35% of graduates do not meet minimum scale of accuracy (75 of 100 possible points)

MISSION: "Improving the score of each graduate at least 10 points during the second half of the university"

b) Establish team

In order to begin the process of improvement, the Senate has appointed a team to analyze the situation and identify the best of the proposed project. From this team belong to teachers and administrative tasks in line with education.

3. MEASUREMENT

3.1. Measuring Failure

The scale of the shootings with precision weapons infantry is measured through assessment practice in the training polygon for each student (graduate) and scoring with qualifications which are then processed in notes 4 to 10. Evaluation is running:

- the academy (supplier) - sitting in the assessment;
- the operational units (beneficiary) - during the preparation missions.

To improve the project was established as a sample of four groups of study 2 year who have held military training module, in which it was prepared and executed meeting individual firing a gun battle. After conducting this meeting, the results (study groups) is illustrated in the following table.

<table>
<thead>
<tr>
<th>Group study</th>
<th>Executed sitting</th>
<th>Very Good</th>
<th>Good</th>
<th>Satisfactory</th>
<th>Unsatisfactory</th>
<th>Grade on group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 21</td>
<td>24</td>
<td>6</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>GOOD (83.4%)</td>
</tr>
<tr>
<td>Group 22</td>
<td>24</td>
<td>7</td>
<td>8</td>
<td>4</td>
<td>5</td>
<td>GOOD (79.2%)</td>
</tr>
<tr>
<td>Group 23</td>
<td>22</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>5</td>
<td>GOOD (77.3%)</td>
</tr>
<tr>
<td>Group 24</td>
<td>26</td>
<td>9</td>
<td>10</td>
<td>3</td>
<td>4</td>
<td>GOOD (84.6%)</td>
</tr>
<tr>
<td>Overall</td>
<td>96</td>
<td>27</td>
<td>36</td>
<td>15</td>
<td>18</td>
<td>GOOD (81.2%)</td>
</tr>
</tbody>
</table>

Of qualifications is observed that no study group has obtained the qualification generally very good, the share of unsatisfactory grades amounting to 18.8% share in the NATO standards shall be considered as unacceptable.

3.2. Defining Limits and Process Description which Create Problems

Was a process flow diagram which generates the problem. It presents in simple, understandable and transparent basis for all relevant conduct flow using fewer symbols. Construction of flow charts that enabled all team members to improve understanding of the process as a whole.

This flow chart shows the process as it takes place in reality, so that all team members will have common image, correct this process. Moreover, the team will not need to invest time and energy to see the physical, often willing to consider certain issues, to explore theories about the causes of the problem, or examine the impact of proposed solutions.

<table>
<thead>
<tr>
<th>Process</th>
<th>Goal</th>
<th>Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning meetings</td>
<td>Distribution in space and time to schedule</td>
<td>• Establishing inappropriate time modules;</td>
</tr>
<tr>
<td>Conduct hearing theoretical learning the</td>
<td>meetings in the discipline</td>
<td>• Establishment of places of meetings.</td>
</tr>
<tr>
<td>rules and conditions</td>
<td>Acquisition conditions and rules of</td>
<td>• Ignorance of the hearing;</td>
</tr>
<tr>
<td>Conduct hearing practical ownership of the</td>
<td>conduct specific meeting</td>
<td>• Ignorance of the rules during the execution of shootings;</td>
</tr>
<tr>
<td>operations for shooting</td>
<td>Practical skills training to travel, taking</td>
<td>• Failure to operational procedures.</td>
</tr>
<tr>
<td>Conduct training session</td>
<td>specific positions and handling of</td>
<td>• Skills incorrectly formed;</td>
</tr>
<tr>
<td>Enforcement hearing</td>
<td>weapons</td>
<td>• Guns broken;</td>
</tr>
<tr>
<td></td>
<td>Gathering operations in the actual</td>
<td>• Untrained staff;</td>
</tr>
<tr>
<td></td>
<td>shooting of hearing</td>
<td>• Polygon downtime.</td>
</tr>
<tr>
<td></td>
<td>Assessing the level of preparedness of</td>
<td>• Training &quot;hot&quot; enough;</td>
</tr>
<tr>
<td></td>
<td>students</td>
<td>• Downtime polygon;</td>
</tr>
</tbody>
</table>

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3.3. Confirmation (or Alteration) Mission

Thus confirming the mission of improving the score of each graduate at least 10 points during the second half of the university.

4. ANALYSIS

4.1. Identification Causes that Create Problems

To examine the relationship question - was used this effect diagram (Fishbone Diagram) is aiming to identify the characteristics, to undertake the initial analysis, discuss the findings, the facts, to identify correlations between the various causes of the problem and the overall process.

![Fishbone Diagram](image)

**Figure 1. Fishbone Diagram to identify the causes that generate the problem**

4.2. Estimation / Grounds for Weighting Potential

The team chose the basic causes (roots). They are located off the branches and they are represented in the table below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Number</th>
<th>%</th>
<th>Cumulated %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient training</td>
<td>32</td>
<td>37.6%</td>
<td>37.6%</td>
</tr>
<tr>
<td>Operation of invalid targets</td>
<td>20</td>
<td>23.5%</td>
<td>61.2%</td>
</tr>
<tr>
<td>Ignorance of the meetings</td>
<td>10</td>
<td>11.8%</td>
<td>72.9%</td>
</tr>
<tr>
<td>Lack of operations for shooting</td>
<td>8</td>
<td>9.4%</td>
<td>82.4%</td>
</tr>
<tr>
<td>Number of hours per day</td>
<td>6</td>
<td>7.1%</td>
<td>89.4%</td>
</tr>
<tr>
<td>Inconstancy aiming</td>
<td>4</td>
<td>4.7%</td>
<td>94.1%</td>
</tr>
<tr>
<td>Incorrect operation of weapons</td>
<td>3</td>
<td>3.5%</td>
<td>97.6%</td>
</tr>
<tr>
<td>Damaging trigger weapon</td>
<td>2</td>
<td>2.4%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 4. Estimating the potential causes**

![Pareto Analysis](image)

**Figure 2. Drawing on the Pareto chart referring to causes and their share**

4.3. Data Collection

To gather sufficient information on how preparation and execution of shootings with infantry weapons is necessary to specify the conditions under which you run the session with individual gun battle which as I noted in a previous chapter is one of the most important preparing for combat in a military ground forces. In accordance with instruction manuals, this meeting is mandatory for military training and the results obtained by them have a high coefficient in assessing their work and selections for different missions.

Given these prerequisites to be met, the analytical program of this discipline attaches great importance to this meeting. They are the basis for transformation in grades note.

4.4. Analysis Results

Cases confirmed by results
- raining "hot" enough;
- incorrect operation targets;

Cases disposed of results:
- large number of hours per day;
- lack conditions
- lack for shooting operations aiming fickleness;
- incorrect operation of weapons;
- forcing trigger firearm.

5. IMPROVEMENT

5.1. Improvement Alternatives Identification

Cause A. Insufficient training:
A.1. - Modification by replacing the analytical program of meetings with the operations of the assembly shooting sessions for training;

A.2. - Increasing the total number of hours in the discipline "Instructions for shooting with infantry weapons" by decreasing the number of hours of other subjects.

Cause B. Operation incorrect targets;
B.1. - Replacement of devices operating targets set at each shooting;
B.2. - Purchase of the devices operating targets compatible with other NATO;
B.3. - Increasing the level of sensitivity of targets.

5.2. Assessment Criteria Alternatives

1. Total cost
2. Impact on problem

<table>
<thead>
<tr>
<th>Cause</th>
<th>Alternative</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient training</td>
<td>A.1. - Modification by replacing the analytical program of meetings with the operations of the assembly sessions to practice shooting</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A.2. - Increasing the total number of hours by decreasing the number of hours of other subjects.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Operation incorrect targets</td>
<td>B.1. - Replacement of devices operating targets set at each shooting:</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B.2. - Purchase of actuation devices are compatible goals of NATO;</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B.3. - Increasing the level of sensitivity of targets.</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 5. Matrix evaluation of alternatives

5.3. Design Improvement

a) Resources required

<table>
<thead>
<tr>
<th>Nr. crt.</th>
<th>Causes (with the largest share)</th>
<th>Corrective action</th>
<th>Resources required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Insufficient training</td>
<td>Amend by replacing the analytical program of meetings with the operations of the assembly sessions to practice shooting</td>
<td>1 instructor 1 days changes 1 days calculation requirements, 1 days notice and approval</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Motokilometers necessary technique and vehicles traveling to/from area 240 km Ammunition required performance of a greater number of meetings shooting real 1478 cartridges.</td>
<td>2 administrative staff</td>
</tr>
<tr>
<td>1.</td>
<td>Operation invalid targets</td>
<td>Purchase of devices operating targets of &quot;NATO compatible;&quot;</td>
<td>2 technical staff 3 days approval 1 days transport 3 days training and fitting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 devices operating targets 20 targets in feet of ballistics gel.</td>
<td></td>
</tr>
</tbody>
</table>

Table 6. The resources required course of action to improve

b) Procedures for applying

<table>
<thead>
<tr>
<th>Nr. Crt.</th>
<th>Causes</th>
<th>Corrective action</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Insufficient training</td>
<td>Amend by replacing the analytical program of meetings with the operations of the assembly sessions to practice shooting</td>
<td>• It changes the contents of the meetings of assembly operations for shooting with a shooting adapted meetings; • The subject of the new content catalog for opinion and approval; • It instructs Scheduler preparation programming schedules in accordance with the hearing; • It sets out the administrative tasks necessary for the allocation of sessions;</td>
</tr>
<tr>
<td>2.</td>
<td>Operation invalid targets</td>
<td>Purchase of devices operating targets of &quot;NATO compatible;&quot;</td>
<td>• be drawn up with staff responsible for procurement documentation and identify resources needed cash purchase necessary equipment; • It is subject to the approval documentation; • The purchasing and receiving equipment from the supplier; • It assembles evidence and still working; • The technical staff training which serves;</td>
</tr>
</tbody>
</table>

5.4. Changing Culture

<table>
<thead>
<tr>
<th>Source resistance</th>
<th>Obstacles</th>
<th>Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Interest decreased due to stress; Reluctance due to time spent in higher polygon;</td>
<td>Appropriate modification of the zone; Provide transportation to / from the polygon;</td>
</tr>
<tr>
<td>Commanders</td>
<td>Reluctance due to complex administrative problems involved in organizing the meeting shooting; High stress level of danger of some shooting sessions;</td>
<td>Awareness of the importance of the problem; Involving all those responsible for organizing and conducting meetings.</td>
</tr>
<tr>
<td>Instructors</td>
<td>High stress level of danger of some shooting sessions; Reluctance due to modification of analytical programs.</td>
<td>Awareness of the importance of the problem; Time necessary Ensure necessary changes.</td>
</tr>
</tbody>
</table>
5.5. Planing Implementation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing analytical program</td>
<td>1 instructor</td>
<td>3 days changes;</td>
</tr>
<tr>
<td>Changing schedules appointments</td>
<td>1 planner</td>
<td></td>
</tr>
<tr>
<td>Calculating resource requirements</td>
<td>2 administrative staff</td>
<td></td>
</tr>
<tr>
<td>Advising and approving documents and managing the documentation</td>
<td>Head of Department Surrogate for</td>
<td>1 days notice and approval;</td>
</tr>
<tr>
<td>necessary allocation of funds</td>
<td>logistics</td>
<td></td>
</tr>
<tr>
<td>Preparation of documentation required justice care</td>
<td>Surrogate for logistics</td>
<td>3 days approval</td>
</tr>
<tr>
<td>materials endorsement and approval documentation;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transporting organization and execution of the deposit</td>
<td>Surrogate for logistics</td>
<td>1 days transport</td>
</tr>
<tr>
<td>institution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
<td>Head shop</td>
<td>3 days training and fitting</td>
</tr>
<tr>
<td>Personnel training</td>
<td>Commander polygon</td>
<td></td>
</tr>
<tr>
<td>Monitoring results</td>
<td>Head of Department Responsible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assurance Quality</td>
<td></td>
</tr>
</tbody>
</table>

6. CONTROL

6.1. Design Elements of Control

<table>
<thead>
<tr>
<th>Variable</th>
<th>How to measure</th>
<th>Where</th>
<th>Standard</th>
<th>Who measured</th>
<th>Who decides</th>
<th>What is done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning training</td>
<td>Identification and modules per day</td>
<td>Scheduling</td>
<td>According to the</td>
<td>Head office planning</td>
<td>Prorector</td>
<td>Rescheduling and recovery program</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>analytical program</td>
<td>education</td>
<td></td>
<td></td>
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<td>Scores obtained at the</td>
<td>Read on Target</td>
<td>The alignment</td>
<td>FB ≥ 21</td>
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7. REPRODUCTION AND DETERMINATION OF RESULTS OF NEW PROJECTS

7.1. Reproduction Results

a) It will study the feasibility of introducing a greater number of training session for each shooting, by reducing the hours allocated to meetings of the operations of assembly shooting for the study of groups 2 and 3 years.

b) It will arrange for distribution to a 24 devices compatible action of NATO targets covering needs such equipment for each objective provided in the shooting sessions in the execution shootings simultaneously on three lines of fire.

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Since the evaluation of alternatives for improvement "increase the total number of hours in the discipline" Instructions

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8. CONCLUSIONS

Following project implementation to improve performance by students from year 2 to sitting with a gun firing increased significantly, succeeding the fewer qualifications of "unsatisfactory" from 18 to 1, and the number of grades "very good" were increased by 59.3% (from 27 to 43 qualifiers for the "very good").
The documents management of education have been adjusted according to the plan of implementation so that improvements were due to the compartments of administrative responsibility for computing and allocating the necessary resources involved in conducting two sessions of shooting practice introduced by improvement. Following the implementation of the second measure of improvement (the purchase of actuation devices are compatible goals of NATO) to behave the way of new targets during these meetings was likely to be a saving of about 45 cartridges, 6%. The graph below highlights the economy cartridges obtained by applying the measures to improve the principle of cancellation due to the effect of vibration of the new devices allow adjustment and maintaining sensitivity to the target penetration by bullet (116 cartridges taught before compared with 166 cartridges returned after the application measures to improve).

Another aspect worthy to consider is the increasing interest of the students obtained by removing from the analytical program of meetings assembly shooting operations that they already knew since I. These meetings are generally held "flat" without a deep emotional involvement of students since they brought no new information and the pace was generally uneventful and routine. The degree of danger that it involves an actual shooting session (even training) and the desire to obtain higher qualifications have capacitive student interest and motivation. But costs have increased due to the implementation of measures to improve because the acquisition devices operating targets and the introduction of two sessions of shooting led allocation of resources in cash total of 32,240 lei broken down according to table 9.

Some costs will be amortized but over time as these types of devices operating targets may be used in a wide range of meetings and shooting performance and efficiency because of their high costs of maintenance are low. Despite these costs, the benefits obtained through the application of improvement "six sigma" has offset these costs and have shown that there is a wide beach that improvements can be made with very good results, which led to the leadership academy to continue the process started by identifying and other segments that can be applied successfully.

9. REFERENCES
PERFORMANCE INDICATORS IN EDUCATION

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ABSTRACT: This paper discusses the development and use of performance indicators in education and vocational training. Stakeholder issues and the role of the Quality Assurance Agency (QAA) within this area are additionally considered. The paper concludes with a brief discussion on developments in education and work-based learning.

1. INTRODUCTION

Developing robust and meaningful performance indicators is difficult in any situation. Indicators for higher education and for vocational training are particularly difficult in view of the diversity of both institutions and students. A wide variety of stakeholders maintain an interest in performance indicators (such as student staff ratio’s, pass rates etc), and based on this recognition of the multiplicity of both market sectors an evaluation of the outcomes generated by appropriate performance indicators will encourage individual institutions to increase access, and maximise achievement for all who can benefit. Analysis of cumulative indicators that track performance over several years will prove far more informative than those for an individual year. The development of sector level and institutional levels of performance rather than descriptive statistics are required to ensure that the derivation of performance indicators is not merely regarded as a metrics project.

2. THE DEVELOPMENT OF PERFORMANCE INDICATORS

The definition of performance indicators as a “standardised approach to the professional assessment of an organisation’s effectiveness and efficiency which leads to a profile of the organisation’s performance on fundamental matters” (SOED, 1993) (McCulloch et al, 1996) can be directly related to the definition of quality given in BS EN ISO 9000:2000 “quality – degree to which a set of inherent characteristics fulfils requirements” Both definitions suggest that a qualitative or quantitative determinant may be derived as an outcome indicator of performance / quality measurement.

Higher education establishments are finding that they are the subjects of increasing scrutiny. The more traditional providers of academic and vocational delivery they are faced with increased competition from virtual and distance learning provision, borderless education and a more globalised education market which uses delivery methods which range between synchronous and asynchronous. Concerns about standards and demands for public accountability have become prominent (Leathwood et al, 2000). At government level there is a renewed call for sound research evidence to inform policy (Blunkett, 2000). Questions about standards are now raised which are framed with a renewed emphasis on vocationalism and the preparation of students for the world of work, moves to embed such skills into undergraduate provision have recently been taken in a number of universities.

The National Committee of Enquiry into Higher Education (the Dearing Committee) (NCIHE 1997) identified the need to establish a common system of measuring aspects of the performance of higher education institutions. In 1997 the funding councils were asked to discuss with government ways of developing performance indicators for the higher education sector. The Performance Indicators Steering Group (PISG) was established to develop indicators that would be acceptable both to institutions and to a wide variety of stakeholders in higher education. The first PISG report (HEFCE 99/11) published early in 1999 was followed by a consultation document that was sent to all UK higher education institutions. This report showed PISG’s approach as one which intended to develop a series of specific performance indicators that would allow stakeholders to extract those indicators which they regarded as significant, in order to create their own group of key performance indicators. This self-selection of performance indicators would allow an assessment to take place that may consider externalities outside the formative evaluation of the learning process.

3. PERFORMANCE INDICATORS

Initially assessment efforts strove for universal performance indicators.(Cabrera et al. 2001). Considerable effort was allocated to creating performance indicators that addressed the three main functional units of an educational establishment - research, service, and teaching and learning. Of the three areas, teaching and learning has been the subject of most attention (Burke and Serban, 1998; Whiteley et al.1992). The relevance of individual performance indicators is dependent upon the type of indicator that is required for the study.

The difficulty in determining relevant performance indicators can be overcome by the strategy of once having defined the object of the study, deconstructing it into activities whose performance can be measured (Levy, 2001). The classification of indicators as simple (neutral descriptions), general (data unrelated to goals) and performance (possessing a point of reference or goal against which a performance is compared) (Cave et al. 1997) allows study to be undertaken across the extent of the organisational / delivery function. For example, in an educational establishment or training organisation overall enrolment is a simple indicator as it provides a neutral description (Barnetson et al. 2000). Student’s feelings of how enrolment affects the feeling of community would be a general indicator, because the indicator’s evaluation is unrelated to institutional goals. If however, the institute is targeted to increase students admissions by ≥2% each year the percentage change in admissions would be a performance indicator as it is...
4. THE IDENTIFICATION OF FIVE ORGANISATIONAL ELEMENTS THROUGH A CONFIGURATION ANALOGOUS TO THE “SIMPLE PROCESS”

model and the identification of the “changing role of the process owner” in BS 7850 to which performance indicators may be applied (Kaufman, 1998) considers the following elements:

1. Inputs are raw materials (e.g. resources, policies, communal characteristics)
2. Processes are how inputs become products, outputs and outcomes
3. Products are results that are fed back into the system to become outputs and outcomes (e.g. module results which lead to the qualification award)
4. Outputs are aggregate products of a system (e.g. qualification awards, publications)
5. Outcomes are the effects of outputs on society (e.g. employment rates, life expectancy).

By focussing attention on specific areas of performance, performance indicators can be used to shape what issues we think about. For example, a destination survey which measures employment rates indicates to institutions that this outcome is of importance to the agency that mandated its introduction; by the action of measurement it makes the institutional performance on this issue public. By focussing institutional attention on their performance indicator results, governments may impose a policy agenda on institutions by embedding assumptions related to purposes, goals or values into the selection and structure of indicators (Barneton et al, 2000). Performance indicators have the ability to alter the power to set priorities and goals to those who create and control the documentary decision-making systems (Newson, 1994).

Performance indicators can also be used to shape how we think about an issue. For example the inclusion of performance indicators that demonstrate positive outcomes of a policy agenda and the exclusion of performance indicators that demonstrate negative outcomes generates evidence that legitimate a particular policy agenda. Consequently, the use of performance indicators affects how institutions and policies are evaluated, as the power to delineate what evidence is considered relevant is shifted to those who create and control the performance indicator systems.

Performance indicators are occasionally complicated, and often controversial. In general terms they consist of a ratio, which comprises a numerator and a denominator. A robust indicator requires general agreement about the values that go into both of these. Additionally performance indicators need consensus that a higher ratio is ‘better’ or ‘worse’ than a lower ratio. The interpretation of indicators is generally at least as difficult as their construction.

5. EXISTING INDICATORS

Although there is a wealth of information collected and published about education and vocational training, it does not always lend itself to the construction of performance indicators. Interpretation is especially difficult given the heterogeneity of the sector, the student population and the qualifications offered. The use of statistics at both sector and institutional level are available for:

- Financial profiles and unit expenditure statistics;
- Research statistics;
- Student population profiles;
- Qualifications obtained;
- Participation rates for the sector;
- Post qualification, first destination statistics;
- Application and admission statistics.

While not claiming to be performance indicators, these statistics provide a wealth of information designed to assist in institutional management decisions, and provide information to others outside, but involved with the sector.

Existing indicators are based upon, but not limited to the following:

- Student numbers;
- Nature of provision;
- Student completion;
- Student qualifications;
- Student progression;
- Funding Outturn;
- Non-funded income;
- Participation of under-represented groups;
- Learning outcomes;
- Efficiency of learning and teaching;
- Student employment;
- Research output / extension of knowledge;
- Application of the knowledge and resources of education to the needs of business and society more generally.

In developing performance indicators there is a pressure between the needs for accuracy and simplicity. An indicator will usually be more meaningful if shown by subject, or age of student etc. This approach has however in the past lead to pages of tables with small sub totals. Information regresses to being simple data. Performance indicators require measures which, so far as is possible are defined by clear unambiguous descriptions, which limit the scope of interpretation and are able to be audited.

6. STAKEHOLDERS

Differing stakeholders will regard differing indicators as particularly important. In setting out performance indicators the higher education funding council England (HEFCE) in the report HEFCE, 99/11 considered the following stakeholder groups:

- Government departments;
- Funding councils;
- Research councils;
- Senior management and governors of institutions;
- Employers of graduates and employer organisations;
- Prospective students and their advisers;
- Current students;
- Alumni;
- Other providers of funds, such as regional Development Agencies, Training and Enterprise Councils, local education authorities, charities etc.;
- Academic staff;
- Central bodies concerned with education, representative bodies, the QAA etc.;
- Professional bodies;
- The general public.
The background to the HEFCE study centred on the needs of prospective students and of the general public. Additionally, interest has been shown in the employment record of students—enabling a more informed choice to be made by prospective students. Recognising the claims of stakeholders is part of the new vocabulary of education management (Macfarlane et al. 1999). The active management of stakeholder interests involves control linked to market forces and based on performance indicators (Randle and Brady, 1997). Institutions through mission statements now explicitly acknowledge their obligations to meet the expectations of a range of stakeholders, are supported by the Deering Report, which makes numerous references to the importance of meeting stakeholder interests. However, while it is easy to list stakeholders, and promise to safeguard their various interests at institutional level, significant conflicts can arise in managing their competing claims.

Stakeholder mapping has previously been employed as a means of exploring the relationship between education and stakeholder interests at the institutional level (Thorne and Cuthbert, 1996), the practical responsibility for managing these relationships often occurs at the micro or programme level. Moreover, the challenges in balancing competing demands and expectations tend to be more acute in vocational areas of the education curriculum. Programmes with 'vocational intent' (Brennan, 1985) will inevitably attract the active attention of a wider range of stakeholders. Sponsors expect value for money and service quality.

7. THE ROLE OF THE QUALITY ASSURANCE AGENCY (QAA)

The QAA review and report on the performance of over 180 universities and colleges of higher education. These institutions cover a wide range of activity, have varied backgrounds, and operate in a climate of rapid change. Their student numbers range from 120 to 200,000. Most institutions provide programmes in a number of subject areas, while others, such as art colleges or music schools, specialise in one area. The QAA also review the higher education programmes offered by some 270 further education colleges.

It is the responsibility of each institution to offer a good quality education and to ensure that appropriate standards are achieved. It is QAA's role to provide assurance that quality and standards within higher and further education are being safeguarded and enhanced. This is done through reviews conducted by teams of reviewers, most of whom are academics, but with some members drawn, where appropriate, from industry, commerce, and the professions. QAA reports are published. This information is helpful to prospective students and their advisers, when applications are made to universities and colleges. It may be used also by employers who recruit graduates, and by those professional and regulatory bodies that recognise higher education awards that count towards their qualifications. Currently, in most instances, there are no national standard assessments or curricula; as such it is unsafe to assume that a degree (or other qualification which has a similar methodology for delivery and assessment) in a given class in a given subject is equivalent in all institutions. The QAA has started to develop benchmark information at subject level to explore the feasibility of establishing reference points for threshold, modal, and other levels of standards.

8. VOCATIONAL QUALIFICATIONS

National Vocational Qualifications (NVQ's) are qualifications that relate to the skills and abilities needed by people working in particular occupations. NVQ assessments ensure that candidates are competent within the workplace. Assessments are carried out to national standards and can include portfolio development and observation. In support of the rejection of allegations that some vocational degrees are "vacuous" courses that do not constitute genuine academic discipline (Floud 2001), research showed them to be rigorous and challenging programmes in their own right. The robustness of the assessment process both in terms of methodology and content is a key factor in the acceptance of the qualification. The qualification success is based upon acceptance both by employers and employees, and performance indicators need to develop the strategy for acceptance by both sectors. Employers acceptance in terms of the vocational skills and benefits in the workplace, and employees acceptance for qualifications with robust structure, meaningful content and transferable acceptability within employment sectors. Increasingly, with viability as a consideration, award programmes within further and higher education are engaging with employers, organisations, and industry, either within programme development, or revue process, effectively ensuring vocational relevance. This breaking down of the barriers between vocational and non-vocational courses to an indicator of vocational relevance of a programme may enable a student to be considered as an independent learner, with a range of generic skills, capable of significant contribution in their chosen field of work.

9. INDUSTRY CONCEIVED QUALIFICATIONS

The post-secondary learning environment has become increasingly competitive in the last decade (DoE, 2000). The pre-eminence of the traditional universities as the major providers of higher education is being challenged by non-traditional organisations, such as corporate and virtual providers. Numbers of pre-print archives, electronic journals and virtual libraries are on the increase. The growth of the information society, and the importance of knowledge based rather than manipulative skills, aligned with the increased availability of communication and information based technologies has facilitated the development of flexible 'virtual' learning environments.

Employer demand is now moving toward flexible education and training, which can be tailored to company needs, allowing re-training of employees to improve competitiveness and recognition of the learning needs of employees in globalised businesses. There is a movement toward the accreditation of internal training by organisations through links with Universities and professional bodies. The aim of some organisations being the ability to award their own degrees. This form of educational award may be considered as an investment with a long pay-off period. Participating organizations argue that the people who enter higher education at the beginning of the period of great expansion take time in reaching positions of influence in industry. Recent trends show an increasing demand for industry-orientated courses, training in industry is at a higher level than ever before, and there are signs of increasing success in the many schemes for bringing about a closer relationship between industry and education. These awards should be comparable with any relevant benchmark information recognised within the UK.

The increasing diversifications of the forms of learning opportunity available (Goodyear, 1995) give rise to the following three influences:

- a. Economic;
• b. Social;
• c. Learning autonomy.

a) Economic

There are economic incentives to institutions to increase the throughput of students. Academic institutions are under the increasing pressures of staff, student ratios, space, equipment and servicing. Viability of course delivery can be viewed as a function of resources used / student cohort. As the Educational Institution obtains revenue through tuition fees, academic integrity and the robustness of the examination process should be demonstrated as being traceable throughout the pedagogic structure of the process.

b) Social

There are social incentives to broaden access across the diverse gamut of student backgrounds, to include the consideration of the raising of participation rates of ethnic minorities and groups that are under represented in various sectors of the economy.

c) Learning Autonomy

Students are increasingly aware of their own role in the learning process. Greater autonomy in the form of self directed learning and CPD, is required by the learners, and is reflected by the employers who wish to employ personnel with a demonstrable capacity for on-going self directed learning. The response to these pressures has been the promotion of distance learning. It is however recognised that distance learning leads to unacceptably high dropout rates (Goodyear, 1995), and it is for this reason that employers welcome successful students who have shown the commitment and ability to complete a course in this way. The benefit to the student of distance learning is that it absolves students of the requirement for a fixed attendance at an academic institution. It allows the student to progress toward the module completion by a more flexible working approach.

The consideration of the provision of credit for differing forms of knowledge and learning is a matter which the both Universities and organisations will need to address. The development of modular frameworks has already made curricula more flexible, although the size of a module is still an issue. Credit frameworks are central to enable recognition of learning in different contexts, and to the ability to bank and transfer credit gained at different times and in different locations (HEFCE, 2000). The Credit Accumulation and Transfer System (CATS), including its UK derivatives and the European Credit Transfer System are examples of flexibility between jurisdictions, frameworks and periods of learning. The accreditation of learning and achievement is one of the central functions of HE. In exercising this function, any University as a HE provider considers how learning that has taken place in a range of contexts may be assessed and formally recognised through accreditation. Design of the new programme will need to consider this.

10. REFERENCES

SERVICE QUALITY IN THE LOW-COST AIRLINES

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ABSTRACT: Any economic organization has to train its people in order to keep customers satisfied that implies to provide products of good quality due to the intense competition and the increased requirements of well-informed and educated customers. Regarding the airline industry reality confirms that the low-cost carriers have revolutionized it, making worldwide travel affordable for all and forcing the established brands to take a long hard look at their operations. However, some airlines have experienced considerably more success than others. To a certain extent, this was due to the attention paid to service quality provided by such a company. The paper presents the results of a research with regard to the evaluation of the customer satisfaction level concerning the service quality provided by a low-cost airline. Also, to identify specific requirements important for the passenger and to emphasize the existing correlation between different market shares and the importance attached to different dimensions of service quality. With that end in view, a SERVQUAL questionnaire was designed and used.

Keywords: low-cost airline, service quality, customer satisfaction

1. INTRODUCTION

The importance of concepts like customer satisfaction, service quality and quality management emerged as a result of the intense competition, the increase requirements of customers and society and the high complexity of goods and services.

The necessity that economic organization to be focused on these concepts is justified by the fact of quality became a critical factor for success from the end of the last century. This feature of the competitive environment has been a consequence of the social, political and economic changes ascertained all over the world.

Likewise the airline industry, driven by liberalization and globalization, has forced many airlines to become much more customer or service oriented and to introduce cost control measures in order to improve efficiency. It has also provided airlines greater flexibility to develop international routes because of the globalising industry competition.

Nowadays, many airlines are entering into collaboration and partnerships with other companies in areas such as maintenance, code sharing and reservation systems.

Gradually, airports have been evolved into multifaceted hubs including duty free shops, hotels, conference centres, and shopping malls.

According to IATA (2007), over 2.1 billion passengers departed on scheduled journeys in 2006, therefore, the air travel is still the fastest-growing market. [17]

Taking into account all changes emerged in this field, large carriers and smaller ones have made from service quality a milestone of their corporate strategy.

The goal of any service company, including airlines, is to develop services which attract and keep customers satisfied, loyal and speak well of the airline. [7] It is well known that retention of an existing customer is much cheaper than to acquire a new one.

2. CUSTOMER SATISFACTION

The concept of customer satisfaction (table 1) interested many researchers and practitioners for more than three decades because customers are the revenue primary source for the economic organizations.

Table 1. Definitions of the customer satisfaction

<table>
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<th>Defining customer satisfaction</th>
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<tr>
<td>A statement of needs, wants and expectations during a lifecycle of a product that are met or exceeded having a result the action of buying again, loyalty and a positive word of mouth shared with others. [2]</td>
<td>Brown, 1992</td>
</tr>
<tr>
<td>“Everyone knows what (satisfaction) is until he/she is asked to give a definition. Then it seems, nobody knows“ or “Satisfaction is the consumer’s fulfilment response. It is a judgment that a feature of a good or service, or the good or service itself, provided (or is providing) a pleasurable level of consumption – related fulfilment, including levels of under- or over-fulfilment ... “ [10]</td>
<td>Oliver, 1997</td>
</tr>
<tr>
<td>Person’s feelings of pleasure or disappointment resulted from the comparison of the perceived outcome (or performance) of a product in relation to person’s expectations. [9]</td>
<td>Kotler, 1997</td>
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It can be noticed that a declining customer retention rate usually indicates a declining customer satisfaction rate. It is important for an economic organization to find out the causes behind the increasing dissatisfaction, as if it is getting worse further, profits will begin to fall.

Nowadays, smart economic organizations aim not only to satisfy their customers but also to delight them. That calls for exceeding customer satisfaction, not just meeting them. Satisfaction is not a universal phenomenon and not everyone gets the same satisfaction out of the same experience. The
reason is that customers have different objectives, needs and past experiences that influence their expectations.

3. SERVICE QUALITY

It is very important to distinguish between customer satisfaction and service quality. Service quality is a form of attitude representing an overall assessment of working on long term, while satisfaction means a specific judgment of the transaction on short term. The level of customer satisfaction is the result of customer’s comparison between the quality of the expected service in the service encounter and the quality of the perceived service. This means that the assessments of satisfaction need customer’s experience while quality need not.

The quality of the perceived service by the customer can be different from the quality of the delivered service. This makes a distinction between technical quality, or “what” is perceived by the customer, and functional quality or “how” is the service provided.

Technical quality is the most critical aspect and is concerned with the psychological interaction occurred during the transaction. It is based on customer’s perception and it is extremely subjective and includes all the customer’s instructions brought during the transaction.

Functional quality is based on the people’s skill and the service system to provide good quality, which has to be monitored.

4. MEASURING SERVICE QUALITY

To measure service quality in the airline industry means to analyse some important aspects such as:

1. The “moments of truth” – They appear at every interaction between a customer and the service provider. Airline passengers can experience many service encounters with front-line employees (from ticketing, checking, boarding) as well as in-flight attendants (during the travel), which are called “moments of truth”. Practically, customer compares his/her expectations about the service to be provided with his/her perceptions concerning the delivered service. Customer’s satisfaction or dissatisfaction is a function of the difference between expected and perceived service. The more perceived service exceeds expected service, the higher customer’s satisfaction will be. Otherwise, the more perceived service falls short of expected service, the higher customer’s dissatisfaction will be. Therefore, service quality is defined in terms of customer’s satisfaction or dissatisfaction. A customer satisfied will repeat his/her purchase, while a dissatisfied one will not only buy again but he/she will tell others his/her troubles, and cause the company many problems in future, such as a bad image of the brand, customer’s loss, negative advertising, and so on.

2. The customer’s complaints – They are measures of the available quality at certain moments. A tool that helps company to continuously monitor service quality. Referring to various specialized studies, it should be observed that passengers’ complaints categories included reservations/ticketing/boarding problems, fares, baggage claims, processing refunds, processing times to resolve complaints.

3. The impact of other factors such as weather, holidays, and so on. The best solution to control any seasonal trends is to gather annually data in a large scale.

Service quality of airlines is an important issue not only for airline managers; it is also a key factor in building long-term brand recognition.

5. TOOLS FOR MEASURING SERVICE QUALITY

The service literature proposes a number of models and the most popular tools for service quality assessment described by Franceschini et al. (1998) are given below: [6]

1. SERVQUAL was developed by Parasuraman, Zeithaml and Berry inspired by a conceptual model offered by them in 1985. In this model service quality is assessed by calculating the difference or gap between what customers expect and what they really perceive. SERVQUAL has been revised in 1988, 1991, 1994, and 2003.

2. Two-way was developed by Schvaneveldt in 1991, evaluated service quality from two viewpoints. First “objective” included the presence or absence of a particular quality dimension, and the second “subjective” included the users resulting sense of satisfaction or dissatisfaction.

3. SERVPERF was developed by Cronin and Taylor (1992), the main feature of this tool is its focus on customers’ perceptions.

4. Normed Quality (NQ) was proposed by Teas (1993) to better define the meaning of expectations. Expectations may be understood by customers in two distinct ways, ideal level or feasible level. The NQ method focuses respondents’ attention on both kinds of expectations, but asks the customer for another set of questions, stimulating potential personal peculiarity effects.

5. QUALITOMETRO was proposed by Franceschini and Rossetto (1997) for assessment and online quality service control and monitoring. It is also used in situations where there are periodical service users. An important feature of this method is the possibility of a separate measurement of expected and perceived quality without the potential for cross influence.

In 2002, Chang and Lim carried out a comparative study of relevance for SERVQUAL and SERVPERF scales to airline industry. In their opinion, SERVQUAL model is more adequate for airline service industry than SERVPERF. [3]

All the studies of Parasuraman and his research team were to develop, test and refine a scale for measuring service quality as perceived by customers; it was called SERVQUAL, a five dimensional, two part measurement tool. The first part and the second one of SERVQUAL measure on the one hand customers’ expectations and on the other hand their perceptions along different kinds of service attributes grouped into five dimensions. Parasuraman defines these five dimensions as the following:

a) Tangibles: appearance of physical facilities, equipments, personnel, and communication materials.

b) Reliability: ability to perform the promised service dependably and accurately.

c) Responsiveness: willingness to help customers and provide prompt service.

d) Assurance: knowledge and courtesy of employees and their ability to inspire trust and confidence.

e) Empathy: caring, individualized attention the organization provides its customers.

The SERVQUAL tool has many advantages. Among these are:

• It is accepted as a standard for assessing different dimensions of services quality.

• It has been shown to be valid for a number of service situations.
It has been demonstrated to be reliable, meaning that different readers interpret the questions similarly. The instrument is parsimonious in that it has only 22 items. This means that it can be filled out quickly by customers and employees. Finally, it has a standardized analysis procedure to aid interpretation and results. [5]

The SERVQUAL instrument is useful for performing what is called gap analysis. Because services are often intangible, gaps in communication and understanding between employees and customers have a serious negative effect on the perceptions of services quality. It can be used to explore differences in perceptions between customers, managers, managers and customers, and between employees.

This tool empirically relies on the difference in scores between expectations and perceived performances. The 22 items are divided along the 5 dimensions mentioned above, with a seven-point scale accompanying each statement in order to test the strength of the relations. Mathematically, service quality can be expressed as:

\[ SQ_i = \sum_{j=1}^{k} \left( P_{ij} - E_{ij} \right) \]  

where: \( SQ_i \) = perceived service quality of individual “i”,
\( k \) = number of service attributes / items,
\( P_{ij} \) = service quality perception of individual “i” for service attribute “j”,
\( E_{ij} \) = service quality expectation of individual “i” for service attribute “j”.

Up to now there are over 5,500 research articles on this model. [8] There were published studies which include banking, education, health, hotel, information system and e-commerce, marketing, public services, retail, transportation, tourism and hospitality.

6. BLUE AIR – AN IMPORTANT ROMANIAN LOW-COST AIRLINE

Blue Air is the only low-cost airline from Romania which has 100% local capital and it was founded in 2004; practically, operates close to other two Romanian airlines, that is Carpatair, the regional operator that has been running since 1999, and the flag carrier TAROM, having a valuable experience before 1989.

The purpose of Blue Air is to change the air transport into an accessible service to all categories of passengers, its slogan being “Security and accessibility”. Blue Air is authorized to perform international regular flights of passengers, charter on demand, international flights of passengers of charter type and cargo transports.

Blue Air’s crews are including the most experienced pilots and air hostesses from Romania. Most of Blue Air’s pilots have over 10,000 flying time on various types of aircrafts, performed at famous airlines from Europe, successfully operating on the whole world. Among its pilots, there are the most experienced ones on Boeing 737 from Romania (over 10 years experience on this type of aircraft). Crews have licenses according to the requirements of the European regulations JAR-FCL 1 (Joint Aviation Requirements – Flight Crew Licensing) which guarantees the highest standards of security and professionalism.

Flight security is assured in compliance with internal and international regulations. Blue Air followed a complex process of certification in accordance with the European legislation EU-OPS and PART 145.

Referring to Blue Air’s performances, in figures 1 and 2, it can be observed the evolution of the turnover and of the passengers’ number for the last two years and the estimations made for Romanian airlines for 2009.

In 2008, Blue Air had a turnover of 120 millions €, with 41.17% more than in 2007 and transported 1.2 millions passengers, with 33.33% more than in 2007. [14]

![Figure 1. The evolution of the turnover for Romanian airlines](image1)

![Figure 2. The evolution of the passengers’ number for Romanian airlines](image2)
In 2008, the low-cost air transport ran into about 260 millions € and it is estimated an increased with 12%, approaching to 300 millions € in 2009.

At present, a segmentation of the low-cost market in accordance with each fleet owned by the main low-cost airlines shows that the first three have about 80% of the profile market, thus:

1. Blue Air has 35% of the market share, followed by
2. Wizz Air with 31% market share, and
3. My Air with 13%, and
4. Others (GermanWings, Sky Europe, EasyJet or Ryanair) having 21%.

Blue Air’s plans for 2009 aim to operate with 10 aircrafts and to keep the leader position on the profile market, with a market share over 35%. Therefore, company will undertake some actions, such as: [12]

- To inaugurate two new destinations alongside the winter schedule for 2008-2009, because of the increasing costs due to the rise in the price of oil, and, particularly, to monitor the ones opened last years;
- To increase frequency on many destinations, specially, towards the ones from France and Germany, and will be kept some others profitable, such as Lanark because of the rising demand (even 500 passengers a day for business, not only for holidays), Köln, Stuttgart, Madrid, Brussels;
- To continue fleet renewing program started in 2008 in order to reduce maintenance costs and to increase capacity (that will be over 10% through 10 aircrafts operation);
- To improve loading factor to 90% through the destinations mix offered in 2009;
- To develop an air taxi company called – Direct Air Service;
- To honour the agreement with Romanian Post to perform air transport services for it. Value of the contract being 44.84 millions €, without VAT (Value-Added Tax), for three and a half years.

In order to maintain the rate of growth, at present, Blue Air has 600 employees, and it estimates that the employees’ number will rise to 800 over the end of 2009.

A good point is the fact that “Despite of the economic evolution, people will continue to travel by air, but they will look twice at the price of the tickets. This will have as an effect the passengers’ orientation from traditional carriers to low-cost carriers.” stated Wizz Air’s Communication Manager. [11]

7. RESEARCH

In this paper it was used SERVQUAL, a tool developed by Parasuraman and his research team in 1988, which measures service quality based on five dimensions: tangibles, reliability, responsiveness, assurance and empathy. [11]

The aims of this survey were to find out the perceptions of Blue Air’s passengers about the service quality of this important low-cost airline from Romania and to analyse the influence of demographic and occupational variables on the frequency of using Blue Air’s services. To identify the main reasons for the passengers do not want to travel again with this company, and to know where could act so that to improve service quality and to have satisfied customers and efficient business.

This research was carried on January 2009 – March 2009. Estimations of the airline referring to the passengers’ number being about 1.7 millions for 2009.

Having in view various required aspects and complexity of the analyzed subject, a pilot sample of 120 passengers was taken into account.

Practical research solution was the survey of the market. This study adapted the SERVQUAL scale to the specific context of airline industry; there were modified attributes under the same five dimensions of the model.

Orientation over the respondents reveals the fact that:

- 75% prefer to travel by air,
- 52% travel once at several months,
- 59% are male,
- 72% are 18 to 29 years old,
- 46% are professors, doctors, lawyers, engineers, economists, architects, and so on,
- 52% have a monthly average income over 1701 lei,
- 55% travel on touristic purpose, and only 19% for business purpose.

Taking into account the level of satisfaction at the achievement of certain requirements, the biggest share was represented by the ones who state that are extremely satisfied about the low fare - 67%, followed by the ones who are satisfied about the observance of the standard of service performing, representing 52%, prompt answer at Call Centre appealing – 45%, existing connections with other flights, and prompt solving of complaints - 41%, airline’s website answers to customer’s questions, and flight frequencies towards a certain destination – 39%, and on a small proportion the ones who are very satisfied about the luggage security – 29%.

Considering the importance agreed by the passenger the way airline answers to certain requirements, the biggest share was represented by the ones that consider extremely important the low fare – 70%, prompt answer at Call Centre appealing – 46%, flight frequencies towards a certain destination – 40%, airline’s website answers to customer’s questions – 37%, existing connections with other flights – 36%, luggage security – 32%, prompt solving of complaints - 29%, followed by the ones who consider unimportant the observance of the standard of service performing, representing 28%.

No further requirements about Blue Air’s services were formulated by the respondents.

Taking into account the marks given to different aspects which outline service dimensions, mark three is given to all service dimensions with shares that vary from 30% for airline understands customers’ interests to 57% for airline provides consistently good ground or in-flight services.

Relying on passengers’ assessments about personnel’s performing when they buy tickets or at the airport, it can be observed that 53.67% are satisfied and very satisfied about the relationship with personnel, while 30% are at the limit of satisfaction, 6.33% are dissatisfied, and 10% of them did not express any opinion.

Among the reasons mentioned by most of the respondents which determined them not to travel again with Blue Air are, as follows: delays at departure – 19%, then the fact there are not flights towards certain destinations – 18%, delays at arrival – 17%, and on the last places being inadequate performing of Blue Air’s personnel when buy tickets, and other reasons (such as impolite ground personnel, opened or lost luggage), each of them with 2%.
Most of the investigated persons expressed the intention to travel again, representing 64%, while 31% do not know, and 5% do not want to travel with Blue Air.

8. CONCLUSIONS

Economic organizations can use SERVQUAL questionnaires both to investigate customers’ expectations and to assess their perceptions on different dimensions of the service quality.

It is important for a company to find out those causes that made the service not to be satisfied for customer, to get solutions and to adopt the adequate measures to correct and improve service.

From the analysis of the marks given to different aspects which outline service dimensions referring to tangibles, reliability, responsiveness, assurance and empathy, it can be observed that mark 3 is given with shares that vary from 30% to 57%, which means there is the possibility to improve Blue Air’s services quality, having in view that 5 is the maximum mark.

Referring to the level of satisfaction at the achievement of certain requirements, passengers stated that are extremely satisfied about the low fare, but there were identified problems on luggage security.

Concerning the importance agreed by the passenger the way airline answers to certain requirements; it can be observed that respondents considered unimportant the observance of the standard of service performing which is normal because the ones who choose to travel with a low-cost airline do not expect too much value for the money paid. But worldwide, customers became more and more exigent and it is interesting to note how the focus of one of America’s top low-cost airlines, JetBlue, has switched from cost control to service quality and have success. [4]

There are also problems about how are customers treated on the subject of the personnel’s performing when passengers buy tickets or at the airport, company’s management has to identify these incidents, take corrective measures and try not to be repeated.

The main reasons for why passengers do not want to travel again with this low-cost airline are:
- delays at departure,
- there are not flights towards certain destinations,
- delays at arrival.

To come to customer’s assistance, today, Blue Air is operating in thirteen countries as compared to 2004, when it operated only in four countries.

Nevertheless, more than a half of the respondents want to travel again with Blue Air, one third are hesitating and company has to make efforts to gain them, and 5% of them are dissatisfied, so that management has to identify the reasons of trouble and adopt corrective measures.

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WHO ARE THEY AND WHAT DO OUR CANDIDATES WANT? - PART I

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ABSTRACT: In a competitive environment, information about clients is a key element for the development strategy of an institution. The paper presents the research methodology used by the Department of Economic Engineering from “Hermann Oberth” Faculty of Engineering in Sibiu in the 2008 Faculty Applicant Survey. The study was conducted in order to find out more information about the applicants’ decision-making process when selecting an area of study or a faculty of interest. The information is useful for faculties’ recruiters in order to set up the recruitment strategy. The results of the study are presented in the paper “Who are they and what do our candidates want? – part II”.

1. INTRODUCTION

The „Hermann Oberth” Faculty of Engineering in Sibiu, through the Department of Economic Engineering has carried out a marketing research among the candidates at the admission for undergraduate studies 2008, in order to gather information regarding the candidates’ profile and also information regarding the rival faculties. The results of this study are useful to the faculty’s management for the development of a proper strategy to attract candidates. The educational strategy’s purpose is the permanent success of the training process and the way to accomplish this purpose is to provide the services required by the candidate, using the best processes. The training process is supplemented with a value flow which is composed of creating the value and creating the non-value which can be outlined only with the analysis of the value’s complete flow along the entire training process. The purpose of the training process is to create extra value from the candidate’s point of view. The value’s flow pursue is made horizontally for each issue, eliminating the hierarchical thinking and on compartments thinking. The training process has to include minimal resources and maximum efficiency.

The conducted study was made by consulting the secondary sources with which the information has been obtained, on epistemological steps undertaken by the researcher in order to discover the evolution of the studied phenomena, the scientific research methodology has a special significance. Aiming the discovery of the research methods’ scientific theory, the total number of principles on which the management builds the investigation. The managerial scientific research methodology includes the total number of principles, rules, methods, techniques and instruments of the managerial investigation. The managerial scientific research methodology basically defines the research methods’ scientific theory, the total number of principles on which the management builds the idea related to the means and ways of the field’s knowledge and action development process.

The conducted study goes towards a normative explanation and an understanding of the educational activity. It aims to define and argue for the principles that guide the educational projection and accomplishment process, at the level of system and of process. From the post-modern perspective, the study represents a managerial activity of the higher education system and process, specially designed and accomplished for the adjustment and self-adjustment of the educational activity, under the context of certain intra, inter and trans disciplinary approaches, with the purpose of permanently perfecting and self-perfecting the education’s subject and object.

The present study was conducted in order to find out more information regarding: the candidates’ general profile for the admission at the “Hermann Oberth” faculty of Engineering of Sibiu; the sources of information used by the candidates; the reasons why candidates choose to enrol at the Faculty of Engineering; the candidates’ options for the areas of study offered by the Faculty, as well as the candidates’ profile who decide for “first option” for a particular area of study; the basic rivals of the Faculty of Engineering regarding the offered undergraduate programmes; the profile and preferences of the candidates who filled in an application form to other faculties as well. The present paper shows aspects regarding the candidates’ profile at the 2008 admission at the “Hermann Oberth” Faculty of Engineering.

2.2. The research methodology

Defined as the total number of theoretical, technical and epistemological steps undertaken by the researcher in order to discover the evolution of the studied phenomena, the scientific research methodology has a special significance. Aiming the knowledge in the management field, the managerial scientific research includes the total number of principles, rules, methods, techniques and instruments of the managerial investigation. The managerial scientific research methodology basically defines the research methods’ scientific theory, the total number of principles on which the management builds the idea related to the means and ways of the field’s knowledge and action development process.

The conducted study was made by consulting the secondary sources with which the information has been obtained, on which the research’s objectives have been established and the questionnaire has been elaborated.
Then, the primary research was made by applying the questionnaires on a representative sample of candidates at the admission for undergraduate studies at the Faculty of Engineering in July 2008.

Altogether, there have been collected and validated 528 questionnaires from a total number of 907 candidates, which represents a 58.2% collection rate from the total number of analysed population (±2.645% error for a 95% results’ guarantee probability).

For a better investigation of the studied phenomenon, the questionnaire included both closed questions and open questions, therefore offering the respondent the possibility to answer according to his own beliefs. The questionnaire was structured on three parts: the first part included questions related to the candidates’ options concerning the existing educational offers on the market as well as the reasons for their choices; the second part referred to the informational sources used by the respondents in the admission process at the Faculty of Engineering; the third part included questions concerning the candidates’ options about the study programmes offered by the Faculty of Engineering; the last part was destined for getting information related to the candidates’ profile according to segmentation criteria, such as: the graduated high school and its area of activity, the grades’ average from the high school years, the monthly total net income / family member and sex.


The detailed analysis outlined the following characteristics of the candidates at the 2008 admission at the “Hermann Oberth” Faculty of Engineering of Sibiu.

3.1. The candidates’ profile on area of provenance and graduated high school (Figure 1)

43.4% of the admission candidates come from Sibiu, 13.8% come from other parts of Sibiu county (most of them from Medias) and 42.8% candidates come from other counties, most of the localities from the bordering counties of Sibiu: Valcea, Alba, Brasov, Hunedoara, Mures. The main high schools in Sibiu where candidates come from are (% from the total respondents): Ghe. Lazar National College – 7.57%, Independenta College – 6.81%, O. Goga National College – 5.11%, GS Energetic – 5.11%, O. Ghibu High School – 3.97%, CFR High school – 3.03%, The Economic College – 2.27%, GS Avram Iancu – 2.08%, Other high schools – 11.42% (each high school with a percentage of under 2%).

With regard to the high schools where candidates in Medias come from (the second largest city supplier of candidates), we mention that 10.2% of the total number of respondents come from three high schools in Medias (SNG Medias – 5.11%, St.L. Roth High School in Medias – 2.84%, Axente Sever High School in Medias – 2.27%). The rest of the high schools in Medias provide 1.2% of the total respondents. Only 2.4% of the respondents come from the high schools in all other localities in the county of Sibiu (except Sibiu and Medias cities).

As a conclusion, we can mention that the “Hermann Oberth” Faculty of Engineering of Sibiu attracts candidates in Sibiu county and bordering counties, especially Valcea and Alba.

It is worth noticing the small percentage of candidates who come from other localities in Sibiu County (13.8% of the total respondents).

3.2. Candidates’ profile on monthly net income / family member (Figure 2)
The monthly net income per family member in the candidates’ families stands at a low level (especially for the candidates who come from the counties Brasov (especially Victoria and Fagaras cities), Olt (especially Caracal and Slatina cities), and Hunedoara (especially Orastie and Deva cities). This low income will influence the candidates’ decision who filled in an application form to various faculties (high probability for them to choose in the end a faculty where they have been accepted on the no fee places), but also the decisions of the future students concerning employment during school.

3.3. Candidates’ profile according to sex

73.3% of the respondents are male, a thing which is considered normal given the faculty’s technical field. (Figure 3).

3.4. The candidates’ profile according the grades’ average on high school years (Figure 4)

4. CONCLUSIONS OF THE RESEARCH

After this research, we have reached the following conclusions:

- The Faculty attracts candidates from the country’s central area – Sibiu County and the bordering counties as it follows: 57.2% of the candidates come from Sibiu County, 42.8% of the candidates come from other counties, such as 23.5% - Valcea (Ramnicu Valcea, Dragasani, Horezu, Calimanesti, Babeni); 6.1% - Alba (Sebes, Alba Julia, Blaj, Aiud, Cugir); 3.0% - Mures (especially the city of Tarnaveni); 2.7% - Olt (Caracal and Slatina); 2.1% - Hunedoara (Orastie and Deva) and 3.4% represents the percentage for other counties;
- The very small percentage of the number of candidates who come from cities from Sibiu County, others than the city of Sibiu and Medias:
  - 43.4% of the candidates come from Sibiu County;
  - 11.4%of the candidates come from Medias.
  - 2.4% of the candidates come from the rest of the localities in Sibiu County (Talmaciu, Cisnadie, Agnita, Avrig, Dumbraveni, Saliste, Ocna Sibiului, Miercurea Sibiului, Marsa, Copsa Mica, etc.).
- Four high schools in Sibiu (CN Ghe.Lazăr, CT Independența, CN O.Goga, GS Energetic) provide approximately 25% of the total number of candidates and three high schools in Medias (SNG, Lic. St.L.Roth and Lic. A.Sever) provide approximately 10% of the total number of candidates.
- The main high schools in Sibiu where candidates come from are (% from the total respondents: Ghe.Lazăr National College – 7.57%, Independența Technical College – 6.81%, O.Goga National College – 5.11%, GS Energetic – 5.11%, O.Ghibu High School – 3.97%, CFR High School – 3.03%, Economic College – 2.27%, GS Avram Iancu – 2.08%). The candidates from the rest of the high schools in Sibiu hold a percentage of under 2% of the total respondents.
- The main high schools in Medias where candidates come from are (% from the total respondents): SNG Medias – 5.11%, St.L.Roth High School– 2.84%, Axente Sever High School in Medias – 2.27%. The candidates from the rest of the high schools in Medias hold a percentage of under 2% of the total respondents.
The technical field of the Faculty attracts male candidates in a much higher percentage (73.3%) as against the female candidates (26.7%).

The net monthly income / family member is situated at the level of the Faculty at the value of 528.51 lei. This value is much lower for the candidates coming from the counties Olt (289.93 lei), Brasov (349.58 lei) and Hunedoara (396.25 lei). This low income will influence the candidates’ decision who filled in an application form to various faculties (with a high possibility for them to choose a faculty where they have been accepted on the no-fee places), but also the future students’ decisions regarding employment during school.

The faculty attracts candidates of a medium to good level of education (calculated according to the grades’ average on high school years). The average value of the grades’ average on high school years for the total respondents is 8.44. There are no major differences between the candidates’ provenance geographical areas. Significantly higher values of the grades’ average on high school years are held by candidates who come from O. Goga National College in Sibiu (9.14), Ghe. Lazar National College in Sibiu (9.09), S.Brukenthal National College in Sibiu (9.03).

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WHO ARE THEY AND WHAT DO OUR CANDIDATES WANT? - PART II

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ABSTRACT: While the faculties may know a great deal about students that walk through their doors, little is known about the decision-making process undertaken by applicants when selecting an area of study or a faculty of interest. Given the expansion of bachelor degree offerings now available on the local market, the Department of Economic Engineering from “Hermann Oberth” Faculty of Engineering of Sibiu conducted a marketing research study among the 2008 applicants. The paper presents the results of this survey and the information is useful for faculties’ recruiters in order to guide recruitment and enrolment strategies. The paper is a continuation of the work results presented in the “Who are they and what do our candidates want? – part I”.

1. INTRODUCTION

The quality of a management decision usually depends on the quality of information, which stands at the basis of this decision.

The marketing research is a systematic approach for gathering facts and numbers which would ground the decisions necessary to an institution’s management. The quantitative research is an instrument used to generate information which is later on used to generalize the behaviour, attitudes and opinions of the entire population from where the sample has been selected.

The “Hermann Oberth” Faculty of Engineering of Sibiu – through the Department of Economic Engineering – has conducted a marketing research among the candidates at the admission to undergraduate studies in 2008, in order to get information regarding the candidates’ profile as well as information concerning the rival faculties. The results of the research are useful to the faculty’s management for the development of a proper strategy to attract applicants.

The educational offer for undergraduate studies of the “Hermann Oberth” Faculty of Engineering of Sibiu for the academic year 2008/2009 consisted of 17 study programmes afferent to 12 areas of university studies.

2. THE RESEARCH’S OBJECTIVES AND METHODOLOGY

2.1. The research’s objectives

With the conducted study, the “Hermann Oberth” Faculty of Engineering wanted to get information regarding:

- The candidates’ general profile at the “Herman Oberth” Faculty of Engineering of Sibiu admission;
- The information sources used by the candidates;
- The profile and preferences of the candidates who filled in an application form to other faculties as well;
- The most important rivals of the Faculty of Engineering regarding the offered undergraduate programmes;
- The reasons why candidates choose to enrol to the Faculty of Engineering;
- The candidates’ options for the areas of study offered by the Faculty, as well as the profile of the candidates who choose as “first option” for a particular area of study;
- The candidates’ options regarding the areas of study offered by the “Hermann Oberth” Faculty of Engineering of Sibiu

2.2. The research methodology

After having established the research’s objective, the research team has analysed the ways to obtain information. The secondary information is already available facts and numbers, which had been collected for another purpose and by another organisation. By consulting the secondary sources, it has been obtained the information which helped establish the research’s objectives and elaborate the questionnaire. The primary data are facts and numbers, specially collected to provide the necessary information for reaching the study’s objectives. The primary research has been made by giving the questionnaire to a representative sample of candidates at the undergraduate studies admission at the Faculty of Engineering, in July 2008. There have been collected and validated a total number of 528 questionnaires, from a total of 907 candidates, which means a collection rate of 58.2% from the total of the interviewed population (±2,645% error for a 95% results’ guarantee probability).

The paper presents the results of the study regarding the candidates’ options with regard to the areas of study offered by the “Hermann Oberth” Faculty of Engineering of Sibiu, as well as the information regarding the rival faculties and universities. The 12 areas of study from the Faculty of Engineering are further on mentioned for exemplification as it follows: Field 1, Field 2 … Field 12. We have to mention that at the “Hermann Oberth” Faculty of Engineering of Sibiu, the candidate can apply to more than one area of study, being admitted to one of these according to the favoured option and the admission average (calculated as the baccalaureate average – 50% and the grade obtained at the baccalaureate exam at one of the disciplines Mathematics / Computer Science / Economics – 50%).

3. THE RESULTS OF THE RESEARCH

3.1. The candidates’ options regarding the areas of study offered by the “Hermann Oberth” Faculty of Engineering of Sibiu

- The candidates’ options regarding the areas of study offered by the “Hermann Oberth” Faculty of Engineering of Sibiu are outlined in Figure 1. It can be noticed that the most favoured fields (option 1) are: 1. Field 6; 2.Field 5; 3.Field 8; The most wanted areas of study, regardless of the candidate’s option order are: Field 5; Field 6 and Field 9.
3.2. Rival faculties and universities

- 60.6% of the applicants to the undergraduate studies' admission from the “Hermann Oberth” Faculty of Engineering have filled in or intend to fill in an application form to other faculties as well. This percentage is higher among the candidates from other places in Sibiu County (72.6% of the respondents in other places in Sibiu County) and from other counties (66.4% from the respondents in other counties).

- The rival faculties and universities for the Faculty of Engineering are generally outlined in Figure 2. The rival faculties are: The Faculty of Economics (“Lucian Blaga” University of Sibiu), The Faculty of Sciences (“Lucian Blaga” University of Sibiu), and The Technical University in Cluj Napoca, The Bucharest Polytechnics, The Faculty of Agricultural Sciences, Food Industry and Environmental Protection (SAIAPM – “Lucian Blaga” University of Sibiu).

- 43.8% of the respondents who have applied to other faculties as well, do not prefer the Faculty of Engineering or they are still undecided. Among the faculties preferred by those we mention: The Technical University in Cluj, The Faculty of Economics – “Lucian Blaga” University of Sibiu, Bucharest Polytechnics or other faculties, in a small percentage, generally of a different profile than the one offered by the “Hermann Oberth” Faculty of Engineering (e.g. medicine, journalism, etc.). One possible explanation is the fact that these candidates...
have chosen the Faculty of Engineering “as back-up” (Figure 3).
- 30.0% of the respondents who have applied for other faculties, do not prefer the “Hermann Oberth” Faculty of Engineering. For them, the “Hermann Oberth” Faculty of Engineering is a back-up alternative. The faculties/universities preferred by these are: The Technical University in Cluj, ULBS – The Faculty of Economics, Bucharest Polytechnics.
- Single cases, but many, prefer faculties different from the ones offered by the Faculty of Engineering (e.g. letters, journalism, history, medicine, police academy, the military academy etc.).
- 13.8% of the respondents who have filled in an application form to other faculties as well, are not yet decided with regard to the faculty they want to follow. They are waiting for the results of the admission to make a decision.

**Figure 3.** The candidates’ preferences who have applied to other faculties, in general

- The most important competition for each field (according to the alternatives considered by the candidates who have chosen as “first option” for that particular field) is outlined in table 1. We should mention that a high number of respondents in the fields “Industrial Engineering 1”, “Engineering and Management”, “Computers”, “Environment’s Engineering” have applied to a varied number of faculties, different as area of study than the one already studied (each with a small percentage). One possible explanation might be that they chose the Faculty of Engineering “as back-up”.

**Table 1.** Rival faculties and universities, according to the area of study

<table>
<thead>
<tr>
<th>Field</th>
<th>Main competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Engineering 1</td>
<td>Faculty of Economics, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Industrial Engineering 2</td>
<td>Faculty of Economics, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Mines, Oil and Gases</td>
<td>Faculty of Economics, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Engineering and Management</td>
<td>Faculty of Economics, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Computers and Information Technology</td>
<td>Faculty of Sciences, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Electronic Engineering</td>
<td>Bucharest Polytechnics</td>
</tr>
<tr>
<td>Environment Engineering</td>
<td>Faculty of Agricultural Sciences, Food Industry and Environmental Protection, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Transportation Engineering</td>
<td>Faculty of Sciences, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Applied Science and Engineering</td>
<td>Faculty of Economics, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Systems Engineering</td>
<td>Faculty of Economics, “Lucian Blaga” University of Sibiu</td>
</tr>
<tr>
<td>Electronic Engineering and Telecommunications</td>
<td>Faculty of Sciences, “Lucian Blaga” University of Sibiu</td>
</tr>
</tbody>
</table>
4. CONCLUSIONS AND RECOMMENDATIONS

As a result of the research conducted several proposals and suggestions will be developed, which are extremely important for the formulation of a coherent strategy and for the development of a portfolio of concrete projects in university management. These recommendations and suggestions are formulated along three directions.

1. For the category of potential candidates who regard the „Herman Oberth” Faculty of Engineering as a back-up alternative in their choice of a university, concrete actions are recommended in order to increase the faculty’s profile.

2. Suggestions and recommendations meant to extend the educational offer, as it is considered that such an extension could have a major impact on the faculty’s renown, on the premise of the existence of scientific competencies.

3. Suggestions and recommendations regarding the admission activities and the correlation of the supply and the demand for degree places.

The following are recommended in these three directions:

- Getting involved into the process of school orientation through concrete actions conducted in highschools (presentations, implementations of some course modules).
- Promoting the achievements of some successful groups of students, activities and projects, career models and very successful graduates.
- Getting the economic agents involved into the students’ extra-curricular activities, with a view to future recruitment and even to the financial support of some students’ education.
- Promotions among students.
- Organizing the “Open Gates” event within the Academic Days of the “Hermann Oberth” Faculty of Engineering.
- Attracting the future candidates into interdisciplinary research collectives of the highschool student- university student type. Getting highschool teachers involved in such collectives.
- Extending the study programme at a regional and European level by developing bachelor’s and master’s specializations in foreign languages in partnership with prestigious universities in Europe, which will attract foreign students.
- Developing integrated educational offers, through a diversified offer of professional training, life-long learning and master’s programmes targeted at the adult market.
- Drawing up statistics regarding the inclusion on the labour market of faculty graduates from the previous three years.
- Organizing annual meetings with the faculty graduates in order to interest them in the faculty’s policy of teaching and research development.
- Adjusting admission to each specialization’s specificity, which will lead to the creation of optimal selection criteria. For each academic major an analysis of the main competitors on the market is recommended.
- Correlating the offer of subsidized places for various majors with the demand for these fields of study. For an optimal distribution of subsidized places, the management should take account of the market research results, so that the number of places should be positively adjusted for those majors in high demand, and conversely, the number of places should be decreased for those majors in low demand.

In order for this information to be used as support in the managerial decision, such a research should be conducted every year. Reiteration has the important role of revealing trends as well as of eliminating the risk of conducting a singular research based on an atypical year. Both elements confer accuracy to the decisional act.

5. REFERENCES

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3. Savescu, R. coord. (2007), Who are they and what do they want marketing research study, "Hermann Oberth" Engineering Faculty of Sibiu, Romania, Department of Economic Engineering.
HACCP STUDY AND VALIDATION BY QMSFSM FOR BREWING PROCESS – APPLICATION FOR TRAINING OF STUDENTS FROM FOOD TECHNOLOGIES

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ABSTRACT: The Government of Romania by decision no. 924 of 11 August 2005 concerning the approval of the general rules for food hygiene, published in the Official Gazette no. 804 of 5 September 2005, requires the implementation of the management system of food safety – HACCP (Hazard Analysis of Critical Control Points) for any organization in the food chain. To achieve the “HACCP Study” the top management of the firm called by decision a team of food safety (TFS). The TFS must have a combination of multidisciplinary knowledge and experience in the development and implementation of food safety management (FSM). The TFS for the “HACCP Study” documents and implements a system procedure that meets the requirements 7.4, 7.6 and 7.7 included in the reference standard SR EN ISO 22000:2005. This article will present, with the aim of training complex of students from “Brewery technology” discipline, an example of procedure for the “HACCP study and QMSFSM” (Quality Management System and Food Safety Management) validation for the brewing process, which should contain information on the list of flow diagrams, analysis and assessment of hazards, decision tree, HACCP plan, location plan, protocol validation of QMSFSM.

1. INTRODUCTION

Brewing technology is one of the oldest and most complex food technologies. It is even considered the oldest biotechnology. Acquisition/learning technology beer by students from specialization Food technologies presupposes a solid knowledge of theoretical chemistry, biochemistry, microbiology, physical-chemistry, chemical engineering, etc. Today, be noted that training for technologist engineers in the brewing industry is very important the sustainable and efficient learning, too, considering the growing competition, take in the brewing industry, particularly through the globalization of trade. Enlarging the area of distribution at the international level, which is difficult management issues of quality, food safety and consumer protection, involves the activation in the brewing industry of very good specialists.

First, to face competition from beer manufacturers are compelled, by legislation of the European Union, to prove that their work is certified in terms of quality products and services according to the standard SR EN ISO 9001:2008 and in terms of food safety requirements of the standard SR EN ISO 22000:2005.

In this article wants to show that the teaching of Brewing technology must be made in the perspective of knowledge and observance of the mandatory requirements of SR EN ISO 22000:2005, too, and positive role that has tackled this theme to comprehensive training of students.

2. METHOD AND CONTENT

By presenting how to implement the HACCP Study on brewing process in the discipline Brewing technology teacher lead students to make an ample investigation in the wide scope of fundamental theoretical and technological knowledge that they have, make some connections and associations so that they get to obtain/discovery of new data/information.

Drawing HACCP plan (Appendix 7.6), previously assumed completion Appendix 7.3, Appendix 7.4 and applying decision tree (figure 3), cause stimulation of the student's critical thinking, active reporting on (an informed choice and well-documented sense) to the dates of the problem. This approach will allow the student to choose the best option for solving technological situations.

By drawing HACCP Study allow a better organization of information technology by students and sent a direct reference to the real production situation by drawing flow technology, plans for the location, control and monitor the phase of the technological process, etc. It is proposed that a lecture on HACCP study to take place after a visit in a brewery. Thus, it creates a permanent connection between what he knew already, what was seen at the brewery and what exactly is learning. HACCP study approach in preparing students demonstrate, once again, the importance of work/school team, an ownership of shares made with the result drawing, based on records and new experience gained, the reports of activity. This influence is shown schematically in figure 1.

Figure 1. The role of drawing of HAACCP Study in the systematization of knowledge of students
Further, it shows how to design a HACCP study for a beer manufactory which produce pasteurised beer in bottle. HACCP study should include chapters presented in the table 1.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Name of chapters from HACCP Study</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1.</td>
<td>Guard page</td>
<td></td>
</tr>
<tr>
<td>C2.</td>
<td>Table with revisions of HACCP Study Content</td>
<td></td>
</tr>
<tr>
<td>C3.</td>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>C4.</td>
<td>Application domain</td>
<td></td>
</tr>
<tr>
<td>C5.</td>
<td>Reference documents</td>
<td></td>
</tr>
<tr>
<td>C6.</td>
<td>Definitions and abbreviations</td>
<td></td>
</tr>
<tr>
<td>C7.</td>
<td>Rules of procedure and responsibilities</td>
<td></td>
</tr>
<tr>
<td>C8.</td>
<td>Annexes and recordings</td>
<td></td>
</tr>
</tbody>
</table>

### Table 1. Name of chapters HACCP Study

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Name of chapters from HACCP Study</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1.</td>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>C2.</td>
<td>Application domain</td>
<td></td>
</tr>
<tr>
<td>C3.</td>
<td>Reference documents</td>
<td></td>
</tr>
<tr>
<td>C4.</td>
<td>Definitions and abbreviations</td>
<td></td>
</tr>
<tr>
<td>C5.</td>
<td>Rules of procedure and responsibilities</td>
<td></td>
</tr>
<tr>
<td>C6.</td>
<td>Documents associated</td>
<td></td>
</tr>
<tr>
<td>C7.</td>
<td>Annexes and recordings</td>
<td></td>
</tr>
</tbody>
</table>

### C1. OBJECTIVES

C1.1. This procedure describes the process of developing a HACCP study, that makes analysis and evaluation of hazards to draw HACCP plan.

C1.2. Food Safety System (FSS) validation purpose is to check if all elements of the HACCP plan are appropriate and adequate in terms of the relevant risks.

### C2. APPLICATION DOMAIN

Applies at S.C. BEER S.A.

### C3. REFERENCE DOCUMENTS

Registered in the List of Reference documents.

### C4. DEFINITIONS AND ABBREVIATIONS

C4.1. Definitions: registered in the List of definitions.

C4.2. Abbreviations: registered in the List of abbreviations.

### C5. PROCEDURE RULES AND RESPONSIBILITIES

C5.1. Responsible: Leader of Team of Food Safety (LTFS).

C5.2. Resources:

- availability of procedures and work instructions for;
- audit staff properly trained and audited;
- allocation of consumable materials required;
- allocation of time required.

C5.3. General:

S.C. BEER S.A. manufactures various sort of beer that makes the HACCP study. Stages through which to HACCP study are:

- description of raw materials and products;
- identify the intended use for the product;
- drawing up flow diagrams;
- identify hazards;
- relevant risk control.

Are having in view: product requirements set by the Technical specification of product, technical procedures (Technical rules), manufacturing procedures (Technological product instructions), manufacturing licenses, requirements of the client (mentioned in the contract/order).

C5.4. Description of raw materials and products: TFS examines materials, ingredients and finished products and identify the sensory, physical-chemical and microbiological and contaminants of them and ways of handling, storage and use. This analysis helps determine TFS dangers which threaten security (safety) products or endanger the health or life consumer.

Raw materials, ingredients, packaging is described in the Technical files (code: TF Year No.) in accordance with the Design-development procedure. Products are described in Technical specifications (code: TS Year No.) in accordance with the Design-development procedure. The products described are included in the List of Technical files and List of Technical specifications.

C5.5. Identify intended use for the product: HACCP Study considers the possibility that products will be consumed by population groups that are not susceptible to disease. In case do not get products to market to certain groups of consumers team will specify this.

TFS anticipate the use of products and, by case is included on the package how to use. For each group of products under HACCP Study, in the technical specification shall specify the category of consumer to whom it is addressed. To preserve evidence of safety food of products shall be taken and preserved samples in accordance with the Specific sampling procedure.

C5.6. Drawing flow diagrams:

In this phase the TFS makes placement manufacturing sections (Appendix C7.6), flow diagrams for the process technology exhibition and notification of any crossing or return flow. In figure 2 is presented one sequence from flow diagram of the whole technological process of obtaining beer. All flow diagrams will be included in the List of flow diagrams (Appendix C7.1).

**Figure 2.** The flow diagram sequence from the flow of the whole technological process of obtaining a beer.
After drawing the flow diagram for each product separately TFS verify compliance with the existing situation in practice, recording findings in the protocol of the meeting of TFS. This verification is done to ensure the reliability of FSS (Food Safety System), but mostly for information necessary for the functioning system. Flow diagrams are from data that are updated and that include the latest changes and modernization of equipment working.

C5.7. Identifying hazards: Identifying hazards is the key step of FSS. TFS members, by experience in the technological process, hygiene and microbiology, identify all hazards associated with getting products in all stages of manufacturing.

Also, TFS will make the assessment of gravity and probability of occurrence of hazards and will identify the preventive measures to be taken. Identifying hazards is documented in the form Analysis and assessment of hazards (Appendix C7.3 – in the article is given a sequence by all Appendix C7.3). The dangers of physical, chemical and microbiological that may arise are identified and evaluated by TFS in terms of the following criteria: probability of occurrence and gravity of hazards.

Gravity is defined as representing the consequences suffered by a consumer as a result of exposure to a danger. TFS considered three levels of gravity:

- Large (M) - fatal consequences, severe disease, incurable damage, that occurs either immediately or after a longer period.
- Average (Mm) - substantial prejudice and/or disease.
- Minor (m) - minor damage, no effects or minor effects or consequences that occur only after exposure to high doses over long periods of time.

The probability of occurrence of physical, chemical and microbiological hazards is defined as the frequency of having a hazard in food consumption at the moment. The probability is determined by measurements or observations. TFS considered three levels of probability:

- Large (M) - appears systematically, repeated.
- Average (Mm) - may appear, is going to appear.
- Minor (m) - is practically impossible to produce, unlikely hazard theory.

In determining the level of risk for each hazard identified was used table 2.

<table>
<thead>
<tr>
<th>Gravity</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Medium</td>
<td>2</td>
</tr>
<tr>
<td>Small</td>
<td>1</td>
</tr>
</tbody>
</table>

Depending on the gravity and probability of occurrence, TFS established four levels of risk defined as:

Level 1 - requires no danger of taking additional measures.

Level 2 - requires risk taking periodic steps-often single action.

Level 3 - requires risk taking overall control measures (hygiene programs, equipment calibration measurement and control, review procedures for supply).

Level 4 - requires risk taking specific control measures.

In drawing HACCP plan shall be discussed only hazard level 3 and 4, considered relevant hazards.

C5.8. Control of relevant hazards:

C5.8.1. Establish of control measures:

TFS establishes control measures for each relevant hazard. For all the hazards relevant documentation will be available to prove that the parameters in the critical control points are monitored. Control measures are documented in the HACCP plan (Appendix C7.5).

C5.8.2. Determination of critical control points (CCP):

For all identified hazards relevant apply Decision tree (figure 3), which involving successively to respond to each question in the order indicated in figure 3. Applying Decision tree for the products included in the HACCP study is documented in the form: Applying decision tree (Appendix C7.4).

C5.8.3. Establish critical control limits for each CCP:

Limits for critical monitoring parameters established for each critical control point, defined by TFS as values that have resulted in reducing, preventing or eliminating the occurrence of hazards relevant. Establishing critical limits is done by using the TFS literature, standards, rules, data from suppliers, experts in technology, hygiene and microbiology. TFS can be supported in establishing critical limits of the design team new product or existing product improvement or specialist consultants. Critical limits based on subjective, data such as visual inspection of the product, process, handling, are supported by instruction and training. Critical limits are approved by all members of the TFS in meeting of TFS and documented in the HACCP plan.

C5.8.4. Establish monitoring system in each CCP:

ESA establishes a monitoring system for each critical control point, which consists of a sequence of measurements/observations planned to show whether CCP is monitored. Monitoring system is documented in the HACCP plan. Monitoring methods and frequency established by the TFS are able to identify any non-conformity regarding the critical limits and time to isolate the defective product prior to use/consume. Monitoring is carried out under the monitoring program, too, which contains forms for recording.

C5.8.5. Establish corrective actions for each CCP:

TFS for each CCP establishes corrective actions documented in the HACCP plan to be implemented when monitoring indicates that were not respected the critical parameters in CCP. Corrective actions are based on assessment of hazards, the gravity and their probability of occurrence and use of final product. When staff responsible for monitoring notify a...
situation a situation which is outside of the critical limits for a parameter, must be considered in three aspects:

- decision implementing corrective actions will be taken when a CCP was being detected outside of the control, so there is possibility of occurrence of a potentially relevant identified.
- identify of the causes that generated the nonconformity.
- maintaining of records that describe the outcome of the corrective action applied of CCPs.

In the interest of the company TFS establishes corrective action plan that takes into consideration the most unfavourable situation before the occurrence of deviations from critical limits. If CCP was not under control, the products made are treated in accordance with established procedure for control of defective product: Control of defective product.

C5.9. The location plan:

In the location (Appendix C7.6) are presented: the locations of equipment technology, points of the distribution of water, points of the wastewater discharge, circuit products and personnel, the storage of cleaning tools, the placement of garbage containers and disinfection points.

C5.10. Validation of combinations of control measures: Monitoring programs, which are prepared based on previous experience and guidelines approved before implementation of QMSSFM are verified and validated by the TFS. According to the annual planning through Quality and food safety Objectives monitoring programs are analyzed and verified by the TFS is to determine measures of improvement, if necessary. Records on the validation of the monitoring programs are in the protocol of TFS.

C5.11. Validation of FSS:

In one month from the implementation of Food Safety System (FSS) TFS has an obligation to perform the verification system and TFS will prepare the Protocol of validation of FSS. Validation consists in assessing on the field of flow diagrams to get the products, schedule of production space, a hazard analysis and evaluation, decision tree and a HACCP plan.

Validation of FSM is to validate combinations of control measures before implementing control measures to be included in the operational prerequisite programmes (PRPop) and HACCP plan, and any changes to their. Validation is performed by TFS and validates the following:

- control measures selected in PRP (prerequisite programmes) and HACCP plan are able to ensure the control of the hazards for food safety for which they were designed;
- control measures are effective and together are capable of ensuring the control of the hazards identified for food safety in order to obtain products that satisfy of defined acceptable levels.
- Evaluation results of the individual verification regarding the communication, the conclusions of the PRPop analysis and effectiveness of human resource management and training.

If the validation result shows that one or all of the above items can not be confirmed the control measures and/or their combinations change and reassess. TFS will prepare the validation protocol of FSS (Appendix C7.7). By the objectives of QMSSFS are planned periodic analysis of the FSMS by TFS and in context the analysis of management situation relating to the evaluation and validation. TFS performs validation of a food safety system by validation of FSS protocol when any change of raw materials, auxiliaries, composition, process technology, hygiene procedure occurs.

C5.12. The continuous improvement of the process performance:

Is achieved by keeping control of the control points and critical control points.

C6. DOCUMENTS ASSOCIATED

- System procedure - Control of unconformity.
- System procedure - Corrective and preventive actions.
- Process procedure - Communication.
- Process procedure - Control of production processes and product.
- Process procedure - Monitoring and measuring processes and product.
- Technical procedure - Technical standards of production.
- Operational prerequisite programme (PRPop) – beer manufacturing.

C7. ANNEXES AND REGISTRATION

Table 3 is presented the list of Appendices and records of HACCP Study.

<table>
<thead>
<tr>
<th>No.</th>
<th>Annex</th>
<th>Form Denomination</th>
<th>Code</th>
<th>Duration of storage (years)</th>
</tr>
</thead>
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<td>C7.1</td>
<td>List of flow diagrams</td>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>C7.2</td>
<td>Flow diagrams</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7.3</td>
<td>Analysis and assessment of hazards</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7.4</td>
<td>Decision tree</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7.5</td>
<td>HACCP plan</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7.6</td>
<td>Plan location</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7.7</td>
<td>Protocol of validation of QMSFSM</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. RESULTS

Carrying out HACCP Study, students may be able to prepare a correct schema technology and a plan for placement, considering all aspects of technological and organizational, in order to obtain safe products. Making the HACCP Study of students contributed to increasing responsibility for their own training. Students answered a questionnaire by the way are asked to consider the theme presented. The result was very good in the sense that students are very open to integrative lectures that update and increase their knowledge in the area studied.

4. APPENDIXS

LIST OF FLOW DIAGRAMS

Code form Appendix C7.1

Appendix C7.2

FLOW DIAGRAMS

Table 3.

<table>
<thead>
<tr>
<th>Code: … No. …</th>
<th>Edition :</th>
<th>Revision :</th>
<th>Date: yyyy</th>
<th>Copy no.:</th>
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<tr>
<td>S.C. Beer S.A.</td>
<td>Code …</td>
<td>…</td>
<td>…</td>
<td>…</td>
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</tbody>
</table>

Name of Flow diagram* design flow that includes developing technology

Code form Appendix C7.2
<table>
<thead>
<tr>
<th>Stage/Process/Operation</th>
<th>Type hazard of contamination</th>
<th>Probability</th>
<th>Gravity</th>
<th>Risk level</th>
<th>Why? (justifying the decision taken at the previous column)</th>
<th>Analysis of control measures</th>
<th>Measurable critical limit</th>
<th>HACCP Plan/PRP or PCC/HACCP Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet milling</td>
<td>Microbiological</td>
<td>Mm</td>
<td>m</td>
<td>2</td>
<td>Development lactic bacteria, molds.</td>
<td>- Compliance of work and hygiene instructions.</td>
<td>- Effect of eliminating / reducing risk.</td>
<td>- PPPOp</td>
</tr>
<tr>
<td>Wet cooling</td>
<td>Microbiological</td>
<td>m</td>
<td>Mm</td>
<td>2</td>
<td>Development acetic and lactic bacteria, wild yeast.</td>
<td>- Compliance of chart production. - Compliance of graphics and hygiene instructions.</td>
<td>- Effect of eliminating / reducing risk. - Microbiological monitoring of laboratory.</td>
<td>- PRP</td>
</tr>
<tr>
<td>Filtration</td>
<td>Microbiological</td>
<td>Mm</td>
<td>m</td>
<td>2</td>
<td>Development wild yeast, acetic, lactic and coliform bacteria, molds.</td>
<td>- Compliance with instructions for managing the process of filtering.</td>
<td>- Effect of eliminating / reducing risk. - Microbiological monitoring of laboratory.</td>
<td>- PRP</td>
</tr>
<tr>
<td>Physic</td>
<td></td>
<td>m</td>
<td>Mm</td>
<td>2</td>
<td>Presence filtering particulate material.</td>
<td>- Compliance with instructions for managing the process of filtering.</td>
<td>- Effect of eliminating / reducing risk. - Monitoring: pressure filter.</td>
<td>- PRP</td>
</tr>
<tr>
<td>Microbiological</td>
<td></td>
<td>Mm</td>
<td>m</td>
<td>1</td>
<td>Presence microorganisms: wild yeasts, bacteria, molds.</td>
<td>- Performing laboratory tests.</td>
<td>- Effect of eliminating / reducing risk. - Microbiological monitoring of laboratory.</td>
<td>- PPPOp</td>
</tr>
<tr>
<td>Wash bottles</td>
<td>Chemical</td>
<td>m</td>
<td>Mm</td>
<td>2</td>
<td>Presence of traces of wash solution (caustic soda).</td>
<td>- Performing test with phenol-phthaleine.</td>
<td>- Effect of eliminating / reducing risk. - Monitoring: general laboratory.</td>
<td>- PRP</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td>Mm</td>
<td>M</td>
<td>3</td>
<td>Presence of foreign bodies: broken glass and other foreign bodies.</td>
<td>- Monitor at the lamp control with trained personnel.</td>
<td>- Effect of eliminating / reducing risk. - Monitoring: lamp control.</td>
<td>- PCC/HACCP Plan Totally eliminate</td>
</tr>
<tr>
<td>Pasteurization in bottle (milk past)</td>
<td>Microbiological</td>
<td>Mm</td>
<td>Mm</td>
<td>3</td>
<td>Presence of lactic bacteria and yeas.</td>
<td>- Compliance with the instructions of the pasteurization.</td>
<td>- Effect of eliminating / reducing risk. - Monitoring: temperature, flow, microbiology.</td>
<td>- U.P.: mm 20 - PCC/HACCP Plan</td>
</tr>
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Developed: 
Name and surname: 
Signature: 
Date of coming into force: 
Date of validation: 

Code form Appendix C7.3
**DECISION TREE**

<table>
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<tr>
<th>Stage</th>
<th>Process</th>
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<th>Questions from decision tree</th>
<th>CCP/CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>NR</td>
<td>Q1</td>
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</tbody>
</table>

**HACCP PLAN IN PROCESS**

<table>
<thead>
<tr>
<th>Stage/ Process / CCP</th>
<th>Important hazard</th>
<th>Measure</th>
<th>Critical limits</th>
<th>Monitoring</th>
<th>Responsible</th>
<th>Corrective actions</th>
<th>Responsible</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurization: in bottle</td>
<td>- Microbiological contamination (surviving micro-organisms)</td>
<td>- Compliance of regime flow-temperature</td>
<td>- U.P. (Pasteurization min): 20 °C</td>
<td>- Pasteurisation conditions:</td>
<td>- Operator from pasteurisation, e.g. Heat exchanger</td>
<td>- Returns beer to fermentation and reconditioning</td>
<td>- Registration on C. Report production from pasteurisation</td>
<td></td>
</tr>
<tr>
<td>Injection/empty bottles</td>
<td>- Presence of foreign bodies: (broken glass, other foreign bodies, closures, etc) not eliminate to conditioning</td>
<td>- Permanent visual control (screen light)</td>
<td>- Totally eliminate</td>
<td>- Permanence conditioning before emptying bottles</td>
<td>- Operator from pasteurisation, e.g. Heat exchanger</td>
<td>- Eliminate possible foreign bodies and rewash bottles, Warning supplier</td>
<td>- Registration in le register report</td>
<td></td>
</tr>
</tbody>
</table>

**LOCATION PLAN**

**VALIDATION PROTOCOL OF QMSFSM**

**5. CONCLUSIONS**

By addressing the theme HACCP study and validation QMSFSM for the brewing industry in training students of the Food technologies specialization is favourable the development of integrated thinking students with the opportunity to promptly/quickly find quick solutions for any type (organizational, technical, scientific, human resources, etc.). This is a solid foundation for optimal solution in process technology. The key to effective training is a continuous exchange between accumulation of theoretical knowledge, work practice and development.

**6. REFERENCES**


STUDY REGARDING THE IMPORTANCE OF THE ACTIVITY OF TRAINING IN QUALITY MANAGEMENT WITHIN THE DEPARTMENT OF POST-SALE SERVICES IN THE KNOWLEDGE-BASED ORGANIZATION

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⁴ “Lucian Blaga” University of Sibiu, cristina.tanasescu@ulbsibiu.ro

ABSTRACT: The scientific paper presents a laborious and well-documented study regarding the importance of the activities of training in the field of quality management, within a department of post-sale services, in a real knowledge-based organization. The study which is carried in the scientific paper emphasizes the importance of the activity of training and it is based on the idea that, nowadays, the client notices in detail the way and the duration in which the personnel approach each intervention. It emphasizes the principles of quality management, the fact that the client continually evaluates the services he receives. With the purpose of obtaining a maximum level of motivation of the personnel, the study emphasizes the knowledge acquired by each employee after having followed a few training activities, specific to the approach field. The study is presented in the university courses on Industrial Engineering and in the MA university courses at the “Lucian Blaga” University of Sibiu.

1. INTRODUCTION

The activity of training is one of the extremely important factors which determine the level of performance in a company. The management team of the company should permanently focus on the activity of training since, in the industry of motor vehicle repair, the dynamic of changes is very high and without a well-defined activity of providing support to the introduction of new products on the market, the sale itself as well as the product image will be endangered. The studies previously have done have revealed a high level of employee qualification within the company, which is an essential factor in rising its competitive level on the market and a real advantage in terms of competition. [1]

One of the major factors is the management of the career of every employee particularly with the personnel with university studies who are indirectly productive. In daily experience there are frequent cases when the employees are very well technically trained but are not stimulated to develop their abilities to communicate in order to manage the team performances; gradually they will become non-motivated. The manager should use his/her couch/mentor abilities, identify urgently such cases and provide the conditions for the employee to overcome situations of the kind.

In specialized studies [3], we find that „the concept of career must be wide enough to include the working experience as well as lifestyle or life conditions because one’s professional life plays an important part within one’s career“. In the same volume, paragraph 4.8.3. (Career Planning), we find that „the individual must plan his aspirations and abilities and understand which efforts or training and developing requirements will be necessary by means of evaluation and counselling. In its turn, the organisation must identify its needs and opportunities, plan its employees and provide them with the necessary information and the adequate training for career development, which means that the organisational needs cannot be fulfilled if the individual needs are tolerated.”

Nowadays clients notice in detail the way in which the employees in the technical department approach each intervention and permanently evaluate their actions from the point of view of the speed of identifying the nonconformities.

Any type of repair should be done „precisely and in time” when the client requires the intervention and in the most advantageous conditions on the part of the client. [2]

Considering the details mentioned above, the technicians should take part to all the training activities supplied by the representing company of the producer in Romania no matter what the specialisation specific to their jobs are. Therefore, there are programs of certification for technicians (directly productive employees), service advisors, receptionists, sales manager, economic manager, after-sales services manager.

The courses designed for the directly productive employees are divided into three categories of specialisation according to the complexity of the training required: technicians with training level BASIC who execute tasks with a low level of complexity, technicians with training level SPECIALIST and technicians with level of training MASTER. [1]

In order to highly motivate the employees, it is very important for the company to provide the conditions of participation to such courses (transport, accommodation, trainers both theoretically and practically competent). The costs for any training activity covers a large part in the expenses budget of the company. The effect of the investment in the activity of training will be noticed in a while since its objective is to motivate the members of the team, to assure the stability of the team, to rise trust in their own potential, to rise the efficiency and productivity of the directly productive employees.

In order to achieve the level of training required, some standards of performance have been implemented and the level of achieving these standards has been determined by means of regular testing.

The evaluation of employees within the company should be done at least half-yearly so as to get an efficient management
of human resources. The implementation of an evaluation system of the performances of employees is necessary to get the achievement of the following objectives: [9]

- to identify the real needs of training and professional development of the employees;
- to rise the level of motivation by means of changes in the pay packets (basic salary, supplementary stimuli such as car, telephone);
- to give the feed-back to the employees directly from the hierarchical manager;
- to improve visibly the communication between the employee and the hierarchical manager.

After the evaluation, the hierarchical manager and the employee, with the agreement of the department manager, will do the planning (Gant map) of the stages which are necessary for the professional development of the employee.

This way the employee gives his/her accept.

Within the company there is a regular activity of internal training which is parallel to the activity of training within the representing company of the producer, which is meant to develop professionally the employees, to reduce the number of revenues and to rise the service quality.

This process of self-instruction is a part of the program of improving the level of performance of the employees within a company.

Therefore, the technicians who take part to a training course organized by the representing company of the producer are obliged to assimilate all the information taught as well as to hand in the course resources (printed or electronic) so that it could be stored/filed in a specially designed library. [8]

By means of organizing internal trainings, the employees who took part to a course of external training communicates the information they have assimilated to the other colleagues who did not take part to those courses.

Permanent training should be provided to those employees who have already been certificated by the producer.

To this purpose, a new standard of performance has been introduced which mentions that each company should assure the participation of its employees to at least two days of training each year.

This standard must be applied to the employees who are directly productive, to the service counsellors/receptionists and specialists in exchange pieces.

In order to reduce the costs of participation of the directly productive employees to all the training courses organized by the producer, a decision of implementing a program of internal training has been taken.

Thus, we have entitled two people in the technical department of the company to participate to the training courses organized by the producer in both the technical and non-technical field.

These internal trainers of the company provide the teaching of all courses organized by the producer to the employees directly productive.

This is why a special place in the company has been designed for trainings and equipped with all the necessary logistics to assure the conditions for the activity of training.

Besides the technical training, the two trainers provide the analysis of any repeated service intervention, of the cases additional to repairs with a high level of complexity in diagnosis, of any situations that involved the customer’s dissatisfaction.

It is extremely important for the employees to take part to Eurotraining events which give the opportunity to test the performance of new car models, particularly to test alternatively and compare with the cars produced by the competitors. [6]

2. CASE STUDY. PROBLEMS

The monitoring activity of the financial results of the activity of the After Sales department provides a detailed perspective which assures the decisions that should be taken to use appropriately the existing resources within the service workshops and to optimize costs.

Considering the present economic context and the incomes, the focus of management has been shifted from the Sales Department to the After Sales department.

In order to reassure the dynamic of implementation of the correction measures, it is recommended to analyse the following indicators at least once a week: [5]

- the check of appointments for car service (time/number of days for intervention planning – lead time);
- number of cars repaired (invoiced devices);
- number of productive hours related to number of cars repaired (invoiced devices);
- number of invoiced hours related to cars repaired (invoiced devices).

The indicator PRODUCTIVITY is given by the relation between the number of productive hours (hours of work) and the number of hours of presence.

The reference value of this indicator should be between 85%-90% and illustrates the degree of utilisation of the workshop capacity.

If productivity is much below 85%, it is required to identify urgently the causes which have generated this fall.

Productivity can be influenced by: [7]

- the market (the volume of service interventions);
- the training level of the technicians;
- the manner in which the activity of the workshop is coordinated (allocation of interventions with high level of complexity to technicians which are not properly trained, the delayed repartition of interventions, the wrong identification of exchange pieces);
- the lack of coordination at the level of workshop manager (for example, for the interventions on damaged cars the specialised technician must get involved for the power train);
- the revenues to service due to the employees’ inadvertences.

The indicator EFFICIENCY is given by the relation between the number of invoiced hours and the number of productive hours (hours of work).

The value of this indicator must be 100% and indicates if the technicians can obey the deadline established by the producers to deal with the service operations.

The process of training must reassure the achievement of the main objective from the point of view of rising the performance level, that is all qualified technicians should have a productive potential as close to 100% as possible. In the case of the newly employed technicians the productive potential is
accepted below the level of 100% in the induction period (90 days).

We intend to reveal the influence of the activity of external and internal training on the company performances. Therefore, we will deal with two case studies.

At the end of the studies we have underlined the contribution of the activity of training in the quantitative performances of the technicians and, on the other hand, in their qualitative performances.

The former study of the activity within the Post Sales Department focused on the evolution of the level of performance in terms of number of invoiced productive hours. We have selected and processed the data mentioned in table 1 for a period of four years, between 2005-2008.

The results of the study are presented in Figure 1.

Table 1. The experimental data (invoiced hours).

<table>
<thead>
<tr>
<th>Total number of invoiced hours</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1960</td>
<td>2117</td>
<td>2342</td>
<td>3063</td>
</tr>
<tr>
<td>February</td>
<td>1995</td>
<td>2031</td>
<td>2794</td>
<td>3176</td>
</tr>
<tr>
<td>March</td>
<td>1999</td>
<td>2275</td>
<td>2797</td>
<td>3601</td>
</tr>
<tr>
<td>April</td>
<td>2144</td>
<td>2040</td>
<td>2808</td>
<td>3485</td>
</tr>
<tr>
<td>May</td>
<td>1749</td>
<td>2038</td>
<td>3169</td>
<td>3212</td>
</tr>
<tr>
<td>June</td>
<td>1896</td>
<td>2254</td>
<td>2760</td>
<td>2664</td>
</tr>
<tr>
<td>July</td>
<td>2662</td>
<td>2355</td>
<td>3076</td>
<td>2933</td>
</tr>
<tr>
<td>August</td>
<td>2497</td>
<td>2601</td>
<td>2838</td>
<td>2836</td>
</tr>
<tr>
<td>September</td>
<td>2264</td>
<td>2260</td>
<td>2871</td>
<td>3112</td>
</tr>
<tr>
<td>October</td>
<td>1914</td>
<td>2896</td>
<td>3217</td>
<td>3415</td>
</tr>
<tr>
<td>November</td>
<td>1894</td>
<td>2846</td>
<td>3402</td>
<td>3441</td>
</tr>
<tr>
<td>December</td>
<td>2312</td>
<td>2075</td>
<td>2232</td>
<td>2707</td>
</tr>
<tr>
<td>Average</td>
<td>2107</td>
<td>2316</td>
<td>2859</td>
<td>3137</td>
</tr>
<tr>
<td>Total invoiced hours</td>
<td>25286</td>
<td>27788</td>
<td>34306</td>
<td>37645</td>
</tr>
<tr>
<td>Percentage of annual rise</td>
<td>100%</td>
<td>110%</td>
<td>123%</td>
<td>110%</td>
</tr>
</tbody>
</table>

The latter study has analysed the evolution of the level of individual performance in the case of the directly productive employees who have intensively participated to training programs.

The level of performance mentioned is described in terms of several indicators: number of productive hours invoiced to external and internal customers, the average number of hours invoiced every year, the total number of training days. [4]

We have selected and processed the data mentioned in Table 2 considering a time period of four years between 2005-2008.

Figure 2 represents the graphic results this study.

Table 2. The experimental data (average invoiced hours).

<table>
<thead>
<tr>
<th>Technician / average number of invoiced hours</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technician 1 - HM</td>
<td>74</td>
<td>103</td>
<td>87</td>
<td>106</td>
</tr>
<tr>
<td>Technician 2 - OA</td>
<td>70</td>
<td>62</td>
<td>63</td>
<td>99</td>
</tr>
</tbody>
</table>

3. DATA ANALYSIS AND RESULT INTERPRETATION

After analyzing the data specific of the organization in discussion, we created the graphic representations which illustrate the influence of the training activity on the evolution of the level of performance both quantitatively and qualitatively.

Therefore, Figure 1 represents the average evolution of the invoiced hours in the period 2005-2008.

Figure 1. FDistribution of all sales hours, between 2005 and 2008.

We have noticed that the average number of invoiced hours rises progressively from a year to another and this evolution is due to the rise of professional training of the technicians.

Figure 2 represents the quantitative level of performance of the technicians who have participated to intensive training programs.

Figure 2. Evolutie performanta tehnicieni
We have noticed that, although the quantitative level of performance of the technicians fluctuates, it is still ascendant. We must mention that the participation of the directly productive employees to trainings means not coming to work. Thus, the level of quantitative performance (the number of invoiced hours falls when the technicians are in a training session) is affected.

Figure 3 illustrates the level of participation to trainings in the case of the two technicians whose performance level is being analyzed.

We have noticed that the number of training days of technician nr. 2 falls in 2008 since he obtained excellent results in the previous tests showing that his training level was high.

Due to the results of the tests, technician nr.1 had to attend again part of the programs which brought about additional costs to the company.

Figure 4 shows the number of training days that the employees attended.

Considering the number of the training days, we notice that the organization permanently invested in rising the level of training of its employees.

In Figure 5 we have noticed that the tendency of revenues in service is falling in relation to the number of service interventions.

The same tendency occurs with the number of revenues to service in relation to the number of invoiced hours only in the period 2007-2008.

At the end of the diagnosis process of the internal conditions of the company, we have identified a series of demotivating elements in the activity of the directly productive employees. Therefore, a practical study has been done in order to reassure the motivation of the employees who work in the post sale department.

The study revealed the following elements/signals which illustrate the demotivation of the directly productive employees:

- they do not communicate when they are required to work after working hours in order to end an intervention;
- they do not volunteer;
- other people are to blame: „i had to paint it like that because the tinker hadn’t done a good job”;
- the technicians do not try to fasten the delayed interventions;
- they require free days saying that something urgent has come up;
- there are constant arguments about the manner in which the working tasks are distributed (some are given easy, well-paid tasks, other are given a larger number of more complex tasks);
- if the workshop chief is not technically competent, the technicians with high qualification believe they are indispensable and they become undisciplined;
- they consider they do not need to be trained;
- they are frustrated with no reason;
- they do not trust their own potential;
- they do not take responsibilities;
- responsibilities.
In order to eliminate the demotivation of the employees in the after sales department, we have applied the following methods of motivation as described in Figure 6.

**Figure 6. Methods of motivation.**

The quality of work depends considerably on the motivation of the employees.

In order to work at the highest level of performance, the employees must be permanently involved and stimulated so as to create a feeling of acceptance and the wish to follow their leader in order to achieve the objectives of the company.

a) Psychological motivation:
- employees promotion/career management:
  - mechanic – after participating to a well-defined training program, he was promoted as diagnosis technician;
  - newly employed engineer – promoted as technical consultant;
  - technical consultant – promoted as service manager;
- models to be followed are presented through clear examples: people, solutions to difficult cases, level of implication, availability to working long hours in special situations;
- the successful participants to training programs for certification organized by the car producers are given prizes;
- the technicians who manage to get the certification were shifted to a higher position in the salary;
- actions of the type kaizen 5s took place following a well-defined plan and great results have been obtained in terms of organization, aesthetics, clearness;
- in the workshop we displayed a planning with the number of hours worked by each technician at the end of each month so that the employees could see the level of performance they achieved;
- individual performances are recognized within the team and at the end of the year the most performing technician in each department gets a prize and congratulations in the final meeting;
- particular cases of employee involvement are pointed out as well as the importance of their work;
- there are regular discussions about the organisational climate, organisational culture, behaviour of employees;
- the people who do not obey the behaviour rules of the company, both internal and external, are sanctioned.
- the disturbing factors which created an inadequate climate within the company, have been eliminated.

b) Physical motivation:
- the salary grid has been shifted so as to coordinate the wages and the performance;
- we managed to align to the salary system existing on the market of auto services;
- a new standard of performance has been created; knowing and accepting it motivates the employees without creating the image of a standard that cannot be achieved:
  - 100h/month for the car service workshop;
  - 100h/month for commercial cars;
  - 125h/month for damaged cars workshop (tin shop/dye works);
- the system of salary has been changed so as the value of the commission should not be limited by a maximal limit;
- the transmission and reception of feed-back was assured and there was a tendency in all workshops to achieve and overcome the level of performance;
- the concept express service has been implemented in a new location where we do only revisions and regular jobs of maintenance. the location is used in turn by each technician for one week so that each technician could periodically do revisions (jobs in which the level of performance/productivity/efficiency is high).

c) Indirect motivation:
- when a special situation occurs, we can assure the necessary support (car, medical support, social support)
- the employees are nominees to the prizes given by the company: the employee of the month, the employee of the year, prize for the best manager, prize of encouragement for new employees.

4. CONCLUSIONS

The research previously done have revealed that the high level of employee qualification within a company is an essential factor in rising its competitive level on the market and taking advantage over the competitors.

The activity of training provides the achievement of the objectives of the company by means of the assimilation of technical and non-technical knowledge on the part of the employees. [10], [11]

The rise of efficiency of the directly productive employees and the sale of more hours of manoeuvre automatically lead to the sale of more exchange pieces which rises up the company incomes.

Once the level of professional competence has risen, the defaults are easily identified in a relatively short time period
and the long-term effect is to attract more customers in the geographical area covered by other services.

Nevertheless, although companies invest impressive sums of money in the activity of training, the inappropriate selection of the employees who participate to such activities may lead to important economic losses.

Therefore the management of the activity of training should be correlated with the management of human resources.

It is essential to notice, stimulate and appreciate enthusiasm, volunteering, common sense, loyalty to the company, professionalism, and logically-structured thinking.

Alongside with prediction, organization, coordination and control, motivation is one of the major functions of management. [1], [7]

5. REFERENCES
STUDIES AND RESEARCH ON CUSTOMER COMPLAINT MANAGEMENT IN THE ACTIVITIES OF POST SALE SERVICES WITHIN THE KNOWLEDGE-BASED ORGANIZATION

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ABSTRACT: The scientific paper approaches the problem of the management of the client’s complaints within the activities of services which are specific to knowledge-based organizations. Taking into account the specific nature of the activity of repairing vehicles, the care for the CUSTOMER should be the top priority within the policies of such organizations. “Empathy” is the key word, which should be in the way of thinking of all the company’s employees, no matter if they carry their activity in a workshop, in the department of exchange component supplies or in the management area. The paper presents a complex study within a real organization and underlines the idea that all protests, the clients’ complaints, have to be treated with maximum attention because they are real sources of improving the organization’s activity. The study emphasizes the fact that the analysis of the evolution of protests, of the complaints within a knowledge-based organization, is carried each trimester and the entire correspondence and documentation which were the basis of the final complaint are kept as a record regarding the quality of that respective service of the product, for at least 3 years. The study is presented in the university courses on Industrial Engineering and in the MA university courses at the “Lucian Blaga” University of Sibiu.

1. INTRODUCTION

“There no better learning than in a difficult situation.” – Benjamin Disraeli

As mentioned in specialized literature, „ the customers’ expectations regarding the people who perform services are clear. Clients expect the services to look good, to be done with responsibility, to inspire safety, to be empathetic, and more than anything – to be trustworthy.” Consumers expect companies to do what they say they will. [1]

Philip B. Crosby has introduced the concepts of ”Do it right first time ” and ”Quality is free” according to which „ Everything should be well-done the first time and every time” and respectively, „Quality doesn’t cost; what costs is lack of quality”. [2]

Nowadays we must take into account more than ever the way we manage the relationship with our clients which are the key to success within any kind of organization.

Even if there is no unique recipe to success that we could use in any situation, the study on customer complaint management in the activities of post sale services has helped us select and highlight a series of practical issues to apply successfully in order to get the customer satisfaction as a result of an appropriate complaint management. [3]

If we prevent and manage correspondingly the relationship with our customers, we will succeed in creating the basis of a profitable partnership both in the present and future, and in making the customers loyal to our organization.

By analysing the present economic context, we can notice certain specific characteristics of the markets and customers in the field of products and services within the car industry, as shown in Figure 1:

- Products and services have already become
- The life cycle of a product is more and more reduced;
- The service intervals are more and more larger.

Figure 1. The characteristics of the car market

The difference is made to a large extent by the integrated solution provided by every producer alongside with its representatives in the other areas. Therefore, it is obvious that the field of after sale services is the one to have our attention in order to exploit all the available resources. [5]

Considering the specificity of the car repair activity, the first place in the company’s politics should be taken by the interest towards the CUSTOMER. We cannot assure and develop a long-term relationship with the customer without taking into account this challenge.
The system of quality management has been introduced in order to reassure all the conditions for solving the customer complaints in the shortest time lap possible and with the maximum efficiency.

“Empathy” is the key word which should be found in the way of thinking of all the employees, no matter if they work in the management department, reception department, in the service workshop or the spare supply department. [8]

All the customer complaints must be seriously approached since they can be real resources of improvements in the activity. [10]

At the end of the study, we will identify the main causes that lead to customer complaints regarding the activity within the After Sales department and the sequence of stages that should be followed in order to get customer satisfaction. To this purpose, we will have to answer several questions, such as:

- Why do clients complain?
- Why do clients write a complaint before trying to talk about it first?
- Do clients feel more secure if they make a written complaint?
- Why do clients want to talk to the general manager instead of talking to the service advisors or the department managers?

After we know every detail of the processes that take place within the organization and answer correctly to the five WHY questions, we will get the answers needed to establish the improvement measures which must be applied in order to rise the level of client satisfaction.

At the end of the study, we have identified a series of causes that have generated customer dissatisfaction, some of which will be mentioned below.

Clients are dissatisfied because: [12]

- They do not trust (any longer) the service team;
- They do not trust the contact person;
- They have no more patience because deadlines were not kept to;
- The service diagnosis was wrong;
- After the specific interventions of maintenance, there were new disfunctions with the car and the car had to be back to service;
- The problems that the customer didn’t report were not taken into account (there was no general review of the car);
- Customers trust the diagnosis devices more than the technical staff;
- Not all spares are available in the company stock and the customer does not always agree to the delivery time;
- Customers do not read the usage manual and feel that certain systems within the car do not function;
- Customers want to benefit of concessions basically undeserved because they rely on the brand of the product and do not consider the manner in which the product has been exploited.

The list could be continued as we get into the details of each particular case. According to specialized literature, working with humans implies obeying some behaviour rules which should be studied and comprehended; otherwise performance would decrease [10].

Considering the real requirements of the customers, we will have to choose the correct means of communication. Statistically it has been proved that earning a new client costs at least 5 times more that keeping an existing client; this is why it is extremely important to manage successfully those situations that might lead to customer dissatisfaction. [11]

2. CASE STUDY. PROBLEMS

Within the present economic context, particularly considering the revenues, management focus has been transferred from the sales department to the after sales department.

This is why we have done a case study which reveals the importance of a correct management of customer complaints and the way in which this process influences the quantitative and qualitative performance of the organization. Thus, we have analysed the evolution of customer complaints referring to the services in the After Sales department. The customer complaints have been classified according to several criteria as shown in Figure 2.

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Further on, we will describe the working way specific for the process of customer complaint management. [7] Complaints are received in written format, by e-mail or verbally (by telephone or personally). No matter the way the complaints are received and what their nature is (with a reason or without reason), they are all recorded, immediately published in the application available in the system of document management and transmitted to the managers of the department that the complaint is addressed to and to the general manager (to be informed). In each case, we complete a protocol of processing the complaint and we analyse the history of the car. After analysing all the data, the department manager has to take measures to improve the nonconformities noticed by the client and the replies to the client, in written format, as follow:

- Letter/fax, transmitted in 48 working hours after the day/time of receiving the written or verbal customer complaint;
- Letter/fax or e-mail, transmitted in 24 working hours after the day/time of receiving the customer complaint by e-mail.

Letters will be always signed by the department manager and will be registered before being sent. A copy of the reply sent to the client will be transmitted to the representative of the producer in Romania. The replies sent by e-mail will be later printed and filed. When it is impossible to send the client a final answer according to the deadline mentioned above, the department manager will send an intermediate letter to the client, keeping to the deadline, and mention that the final answer will be sent later, as soon as possible. In order to highlight and analyse all the registrations, the data of each
complaint will be recorded in „COMPLAINT REGISTER”, as shown in Table 1.

### Table 1. Complaint register

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Day of receiving the complaint</th>
<th>Customer identification data (name/ telephone)</th>
<th>Customer complaint description</th>
<th>Day of ending the complaint</th>
<th>Observations</th>
<th>Case details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thus, the status of each complaint can be permanently followed by the company managers. In order to choose the solution to end up the case, the department manager must take into account both the customer dissatisfaction and the costs involved by the solution. After analysing each complaint, the department manager decides if a corrective or preventive action is necessary. The organization must encourage the initiation of the corrective or preventive actions by all personnel categories, particularly the directly productive staff. All the complaints that have a connection with the issues mentioned below must be presented to the representative of the producer in the shortest time:

- cases which generate negative advertising;
- cases when the car is stolen according to the electronic systems;
- cases that involve the Ministry of Internal Affairs and the Ministry of Public Administration or other investigation authorities (for example, interventions in case of car arsony);
- cases that evolve in the direction of starting judicial processes;
- cases that have implied deaths or injuries;
- cases that have caused damages higher than the car value;
- cases that can affect the image of the product on the market.

We have selected and processed the data mentioned in Table 2, for a time lap of four years, 2005-2008, in order to make this study.

### Table 2. The experimental data (customer complaint analysis)

The analysis of the complaint evolution will be done according to the form „ANALYSIS OF CUSTOMER COMPLAINT”, Appendix I. [13] Each case which has generated a complaint, a revenue to the service must be carefully processed with the personnel in the department involved. The analysis of the complaint evolution is done quarterly and the whole correspondence and documentation used to end up the complaint is kept as a record of the service/product quality for a period of at least 3 years. The original documents, starting with the complaint received from the customer and ending with the document that reveals the level of customer satisfaction referring to the way the case has been solved, will be kept in the archive by the department manager as a quality record for three years. [14]

## 2. DATA ANALYSIS AND RESULT INTERPRETATION

Consequently to the analysis of the data of the organization researched, we have done the graphical representations which reflect the evolution of customer complaints between 2005 and 2008. Figure 3. illustrates the graphical representation of the evolution of customer complaints starting from the criteria of classification mentioned in Table 2.

![Figure 3. Complaint analysis between 2005 and 2008](image)

We can notice that, although the number of service commands rose in 2008 with 39% compared to 2007, the number of complaints fell with 36%. This evolution was influenced by the improvement of communication at the level of the interfaces with the customer (reception, spare sales, info-desk).

We have also noticed that the level of customer dissatisfaction has decreased after assuring mobility even since the moment when the vehicle became immobile. The approach of the conflicting situation is done from positions that are no longer opponent and the customers already trust the solutions suggested by the company employees. Thus, we manage to highlight the benefits offered by the company and the transformation of a conflicting situation into a sale argument.

![Figure 4. Analysis of complaints according to the complaint format](image)
We notice that between 2005-2007 the number of written complaints is higher than the number of complaints received in other format. In 2008 the number of these complaints decreased as a result of communication improvement and efficient management of the relationship with the customer. At the end of 2007 we implemented the concept of mobility by providing the customer with vehicles to replace their owns in the period when their own cars are being repaired.

Figure 5. is a graphical representation of the evolution of the number of complaints according to the cause that generated customer dissatisfaction and implicitly, customer complaint.

We notice that a large part of the complaints are caused by the repair time and repair quality. The repair time is influenced both by the complexity of the diagnosis and the disponibility of certain items in the company stock. The level of competence of the directly productive staff has increased by means of the technical trainings which influenced the decrease of the number of complaints referring to the repair quality with 30% in 2008 compared to 2007.

Figure 6. is a graphical representation of the evolution of customer complaint according to the customer’s attitude at the moment of the complaint. [15]

Figure 7. Customer complaint analysis according to suggestion making

We can notice that approximately 65% of the customers made suggestions regarding the manner in which they understand to end the unpleasant situation that generated the complaint.

Figure 8. is a graphical representation of the level of customer satisfaction at the moment of ending the complaint procedure.

One can notice that the managing of more than half (57%) of the complaints has led to achieving their satisfaction and implicitly the consolidation of the partnership between company and customer. In 27% of the cases we have succeeded in achieving the partial customer satisfaction. [4]

As shown in Table 3., in 14% of the cases we haven’t achieved the customer satisfaction, each of these cases proving that we should still be looking for new methods of complaint management.

Table 3. The experimental data (level of the satisfaction)

<table>
<thead>
<tr>
<th>Final level of customer satisfaction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally satisfied</td>
<td>5%</td>
</tr>
<tr>
<td>Satisfied</td>
<td>52%</td>
</tr>
<tr>
<td>Less satisfied</td>
<td>27%</td>
</tr>
<tr>
<td>Dissatisfied</td>
<td>10%</td>
</tr>
<tr>
<td>Very dissatisfied</td>
<td>4%</td>
</tr>
<tr>
<td>Registered in the data base</td>
<td>100%</td>
</tr>
</tbody>
</table>

We must mention that the participation of the indirectly productive staff to trainings on the management of customer relationship is a major factor in the evolution of the company performances.
Consequently to the study, we have identified a series of expectations common to all customers:

- they want mobility to be supplied;
- they want to have control;
- they want to be listened to;
- they want to be respected;
- they want their social status to be recognized;
- they want to feel secure, to trust the staff they are interacting with;
- they want to know everything that happens with their own goods.

According to the customer expectations which were correctly identified in advance, we must choose the right means of communication, otherwise our efforts might be useless and even add tension to the situation.

In order to manage a complaint, one must follow the next stages:

1. get ready for the customer objections and listen to them attentively;
2. identify the total number of objections;
3. redefine the objections and get the customer acceptance;
4. turn all the objections from general objections to specific ones, otherwise we cannot isolate and knock them down;
5. make each objection clear in order to get to the one that has generated the complaint and make all efforts to isolate it from the rest of the objections; then, communicate the actions that follow in order to minimize the negative impact to the customer.
6. reassure the customer of all your attention and support (of both the manager and the team), give the visit card of the department manager to the customer. Focus on the importance of communication in managing the relationship service-client alongside with the fact that in the future the communication with the team members will improve. Thus the authority of the employees whom the customer has interacted and will interact with is not undermined. Great importance should be given to this stage since the customer might want to interact only with the company managers in the future.
7. take measures needed to remedy and prevent the reoccurrence of a similar situation.
8. We may be in one of the situations mentioned in Figure 9 in our relationship with the customers.

In this situation the customer wins, we solve the situation favorably to the customer, but our loss is maximized. Thus, we create a precedent which will be difficult to overcome later on.

LOSE – LOSE situation

In this situation both the company and the customer are disadvantaged, reciprocal accuses are made, no connection is made between the two parts.

WIN – LOSE situation

This is the situation that we must get to no matter what position we take. Both the company and the customer must get the maximum result, thus building the basis of a long-term relationship.

In Table 4 one will find some words and expressions to use during the actions within the process of managing the situations generated by customer dissatisfaction.

Table 4. Words and expressions recommended/not recommended

<table>
<thead>
<tr>
<th>Words(expressions to use)</th>
<th>Words not recommended to use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer name</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>It is impossible</td>
</tr>
<tr>
<td>You</td>
<td>It’s not part of our politics</td>
</tr>
<tr>
<td>Thank you</td>
<td>Excuse me</td>
</tr>
<tr>
<td>I am sorry</td>
<td>The problem</td>
</tr>
<tr>
<td>Of course (we do)</td>
<td>We have no time</td>
</tr>
<tr>
<td>It is possible</td>
<td>I am not in charge of</td>
</tr>
<tr>
<td>I assure you</td>
<td>You are wrong</td>
</tr>
<tr>
<td>Situation</td>
<td>Never</td>
</tr>
</tbody>
</table>

Although there are different points of view at the moment, the daily experience has proved that, speaking of availability, no customer should be left waiting when he/she wants to talk to the company manager.

When talking to a customer, we must pay attention to a series of aspects such as:

- customer listening should be active, empathy-based. It is recommended to use the technique of paraphrasing through which we make sure that both we and the customer have understood what the customer wants to communicate to us.
- We should ask efficient questions in order to identify the customer needs and wishes. We should ask open questions (when?, how?, where?, who?) and avoid close questions, yes/no questions (May I?, Do you have to?, Would you like to?);
- We must underline the advantages of the solutions suggested by us through questions addressed to the customer „Which is in your opinion the best solution for you?” We should avoid answers such as „I can’t”, „it’s not possible”. We permanently make sure that the customer has correctly understood our point of view;
- We should always provide solutions so that the customer could make a choice according to our suggestions;
- The discussion/meeting should end with a positive message.

Communication barriers in the process of communicating with the customer can be resistant to change, habit, lack of safety, relation history, fear to fail, judgement stating, labelling suppositions, choice of the wrong means of communication (the customer wants to speak, but he gets messages on fax).
It proved that 20% of the customers are interested in other brand although they are satisfied by both products and services, 30% are loyal to the brand although they are not satisfied with either the product or the services and 50% can become loyal as a result of the actions taken to correspond to their expectations. Two thirds of the customers give up the products or services of a company because they find the „Customer care” system inefficient, not paying enough attention to customers.

3. CONCLUSIONS
The previous studies have revealed that a successful management of customer complaint is an essential factor in increasing the competitive level of a company on the market and in providing a considerable advantage in terms of competition.

If the level of professional competence increases, the vehicle failures are correctly and easily identified in a relatively short time lap while the long-term effects will be the reduction and even elimination of the situations that generate customer complaints.

Thus, the company can complete its customer portfolio with more satisfied customers, which leads to a major benefit – fetching customers in the cover geographical area of other services.

The availability to supply mobility to customers by assuring a vehicle to use in the period when the customer’s own vehicle is in service is one of the most efficient means of solving customer complaints.

In order to manage correctly and efficiently the situations generated by customer complaint, the person who discusses with the customer must have knowledge of the objection managing techniques and behaviour manipulation techniques.

Moreover, in dealing with complaints, the department manager should master the managerial functions of Prevision, Organization, Coordination, Control and Motivation.

Script-based management is a systematic application of alternative images of the future complex systems used to identify and determine potential success and benefits.

This instrument should be permanently used in order to identify the possibility of reoccurrence of conflicting situations and establish the means of action.

Here is a set of suggestions selected at the end of the study which can be use as a guide.

- The correct management of the relationship with the customer should always be in the foreground and the principle „the customer is right” should be applied and not only be desirable;
- In most cases the nonconformities appeared because of a bad communication;
- Never approach complaints generally, turn them into particular ones;
- Never interrupt the customer when speaking;
- Always thank the customer for the information transmitted and for the chance to improve the quality of our services;
- Reassure the client that successfully solving the situation has become a priority for you and that you make all efforts to get a win-win relationship;
- According to possibilities, supply a vehicle to the customer which he/she can use as long as his/her own vehicle is in service;
- Always stick to the promises you make;
- Always do something in addition to surprise the customer;
- Take measures meant to prevent the reoccurrence of similar situations.

No matter how good we are at dealing with complaints, their prevention is essential.

After a complaint is made, the whole team will be involved and lots of resources will be wasted.

By means of a correct management of customer relationship, we can create the basis of a profitable partnership both in present and future, overcoming the difficulties generated by the present economic situation. [3], [9]

4. REFERENCES
THE IMPORTANCE OF COMMUNICATION IN TRAINING ENGINEERS

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ABSTRACT: The paper presents the results of a scientific research conducted over a period exceeding 3 years, having the following objectives: analysis of efficiency, effectiveness and importance of communication in training engineers at the "H. Oberth" Engineering Faculty, "L. Blaga” University of Sibiu. Using 3 tests and 4 questionnaires there were collected information from students. The results after processing the collected data clearly show that after attending the “Business Communication” course students have acquired theoretical and practical-applicative knowledge, of great importance to their career, allowing them to capitalize on their professional knowledge through the transmission of clear, accurate and consistent messages (verbal, nonverbal and written). Business communication is useful for searching, exercising, or keeping a job, and facilitates hierarchical promotion. This is why the "business communication" discipline should be included not only the curricula of all engineering faculties but also in those of other faculties.

1. THE NEED OF RESEARCHING THE IMPORTANCE OF COMMUNICATION IN TRAINING ENGINEERS

In the context of rapid economic and technological change, professional communication supports the decision-making process, allowing restructuring, which is vital to the survival of an organization. Countless Internet-based applications have turned globalization into a reality that even the smallest organization does not lose sight of. Moreover, professional skills alone are not sufficient as the professional skills of an individual are often ineffective and poorly exploited. Communication skills were identified to be a second requirement for a post, according to the American Society of Personnel Administrators (Curtis, Winsor and Stephens, 1989). Many employees already possess business communication skills that they have learned in school or through personal efforts. Others, however, still have a lot to learn. Employers should develop methods of assessing these skills and provide training where required. But schools have to do so first, through the training programs they offer.

To prove the previous statements, and as a result of a fruitful collaboration between the "Hermann Oberth" Engineering Faculty and the University of Missouri, Columbia, USA (1993-1994 and 1995-1997), appropriate steps have been made in order to add "Business Communication" to the curricula of the various specializations of the faculty. Thus, starting from the 1998-1999 academic year, the curriculum of the Economic Engineering students’ was expanded to include the above-mentioned discipline. This was taught 4 hours per week (2 hours of course and 2 hours of seminar) during a whole semester (14 weeks). Three years later there have been produced original teaching materials to support the discipline: a course book and an exercise book [5, 6].

Starting from the 2001 - 2002 academic year, the "business communication" discipline began to be studied also by students of other specializations: Machine Manufacturing Engineering, Machine - Tools and Textile Technology and Equipment. The discipline is studied during an entire semester and is allocated 2 hours / week (one for lecture and one for seminar). Later, other specialities introduced the "Business Communication" discipline to their curricula, but there are still specializations where the discipline is not being studied. There are also two post-graduate specializations in which elements of business and managerial communication are taught.

Since the academic year 2006-2007, when "Lucian Blaga” University participated in the program for methodology testing and accreditation standards for different types of programs and higher education providers (a program of the Romanian Association for Quality Assurance in Higher Education ARACIS), the "Business Communication” discipline was included in the curricula of several specializations and masters. After being evaluated, the “L. Blaga” University received the highest rating, that of "high confidence".

It is also necessary to carry out adequate scientific research in order to ensure: the quality assessment of the discipline’s activities, changing the content of teaching activities, continuous improvement of teaching materials, teaching techniques and evaluation, highlighting the role and importance of the discipline in training engineers, the impact of knowledge, skills, abilities and acquired skills in communication on the integration of engineers in the labor market, assessment of the needs for improvement and continuous training of engineers who are already employed, etc.

For this work, there was chosen a scientific approach that aims to highlight the importance of the “Business Communication” discipline in training engineers. The research is intended to be a small step forward in this area and seeks to provide objective arguments for maintaining or introducing the discipline in the curricula of all specializations which train engineers.

2. OBJECTIVES OF RESEARCH

The role of "Business Communication" is clear and specific: the accumulation of theoretical knowledge and training communication skills, which ensure higher professional performance of future engineers. The question is whether this goal is achievable and whether the approach succeeds. Thus, in order to see if the discipline improves the communication skills of students, the students’ progress must be researched. But this is not enough. The approach should be complemented by an analysis of the impact of the acquired knowledge (theoretical and practical) to see whether they are useful in practice. Emphasis should be placed on skills gained in communication,
because they are easier to observe and because they provide adequate use of professional knowledge into practice.

Starting from the considerations mentioned above, research objectives are:

O1 - efficiency analysis of educational activities held as part of the "Business Communication" discipline, on students it is aimed to measure how the students acquire new skills or improve their communication skills learned in training. In this case, efficiency expresses the ratio between the effects of the improvement of business communication skills and the resources and efforts spent in this regard by participants in the learning process (professors and students).

O2 - effectiveness analysis of business communication skills acquired in the training of engineers in college the purpose is to observe how the business communication skills acquired in college meet certain needs (both of employees and employers) of employment. Thus, effectiveness reflects how the business communication skills, acquired by engineers in faculty, meet the practical communication needs encountered during their professional activities.

O3 - emphasizing the importance of communication in training engineers aims to identify objective reasoning to demonstrate the need for a proper importance of teaching communication skills to future engineers, regardless of the specialization for which they are trained.

3. RESEARCH METHODOLOGY

To achieve the research results there have been applied the following research methods: direct observation, conversation, testing, written questionnaire, systematization, processing and interpretation of experimental data and analysis. Through direct observation and conversation the tests and questionnaires that were used to approach the objectives of the research were reached. Thus, the research plan that was used is presented in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Research Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
</tr>
<tr>
<td>O1 - Communication Efficiency</td>
</tr>
<tr>
<td>O2 – Communication Effectiveness</td>
</tr>
<tr>
<td>O3 - The importance of communication</td>
</tr>
</tbody>
</table>

Two tests were taken from the literature [6] and adapted (tests 1 and 2) so as to serve the research’s objectives. Test 3 is designed in a personal manner. All questionnaires are especially tweaked (having underwent a personal makeover) to serve the purpose of research, as indicated in Table 1.

All tests and questionnaires used are designed using the method of scaling based on semantic differentiation.

To highlight the efficiency of the educational activities involved in "Business Communication" (O1), first an assessment of behavioral types of subjects was performed, using the first questionnaire (Questionnaire 1), based on the model of personality described in papers [3, 5]. It allows students to identify their communication style. It is given only at the beginning of the course.

The first test (Test 1) assesses students’ oral communication skills. The second test (Test 2) shows the attitude during communication allowing the assessment of their ability to communicate in different situations, namely: interpersonal communication, group communication, communication in meetings and communication in public. The second questionnaire (Questionnaire 2) highlights the ability to communicate in writing. The third test (Test 3) evaluates the clarity of written communication, based on Gunning’s formula which is an algorithm that allows the calculation of the "fog index". The formula was developed by two prominent researchers in the field (Rudolpf Flesch and Robert Gunning, quoted in paper [6]). Tests 1, 2 and 3 and questionnaire 2 were carried out 2 times: at the beginning of the course (before) and upon its completion (after). This strategy allowed the evaluation of students’ progress as a result of studying "Business Communication", showing its efficiency.

Assessing the effectiveness of knowledge and skills gained by students during the "Business Communication" course (O2) should be carried out by using the third questionnaire (Questionnaire 3) at the end of the didactic activities of the discipline. Students estimate the effectiveness and importance of knowledge and skills gained in communication regarding two aspects: finding a job (employment) and career (throughout their activity). This information is complemented with that offered by more senior students, who have studied this discipline and have been working during university. Their questioning was done using a sequence of the fourth questionnaire. This questionnaire was developed as part of a broader research “Today’s Students - Tomorrow’s Workforce”, carried out at the "Hermann Oberth" Engineering Faculty, Sibiu [7]. In order to process the results especially designed MS-Excel spreadsheets were used in conjunction with SPSS (Statistical Package for the Social Sciences).

The importance of communication in training engineers (O3) is assessed based on the conclusions of the research of the efficiency (O1) and especially the effectiveness of communication (O2). These will be combined with theoretical
aspects of literature and information derived from direct
observation on a proper analysis intended purpose.

4. RESULTS OF RESEARCH

Because the research conducted was ample, it is difficult to
show all the results. Because of this there will be highlighted
only some of the results, considered significant. Even if the
results of the research will be presented partly, the research’s
findings will show complete results.

Results of the first questionnaire (Questionnaire 1) showed that
most students fit the “sociable” and “directive leadership”
behavioral type, which is about 80% of the total. It is possible
that these types of behavior correspond to those wishing to
follow the engineering profession. People with a "sociable"
type of behavior work well in teams, get involved
enthusiastically in all kinds of activities, are inventive,
spontaneous, have the ability to generalize and are persuasive.
People who exhibit the "thinker’s" behavioral type have good
problem-solving capabilities, work properly organized, are
pragmatic, keep stride ensuring the completion of tasks. Those
who fit the “directive leadership” category are distinguishable
primarily by their managerial abilities, while the “story-teller”
types have the ability to mobilize teams.

The results obtained in testing the students' oral communication
skills (using Test 1), are presented in the graph showing the
results of situation before (Figure 1) and after attending the
discipline (Figure 2).

The second graph (Fig. 2) shows a visible improvement of
communication skills of students and show that, in some cases
(IE and MU), the percentage of students who have difficulties
has halved. One can easily see that the best performances were
achieved by students of the Economic Engineering (IE)
specialization. These study "Business Communication" 4 hours
per week, compared to 2 hours per week for others.

The second test (Test 2) pragmatically illustrates the behavior
of students during the communication process. The results
were complemented by an assessment of student performance
in written communication, based on a comparative evaluation
of students’ first and last home activity, using the second
questionnaire (Questionnaire 2).

For the carrying out of the analysis, the following aspects were
considered: group communication, communication during
meetings, interpersonal communication, public communication
(all assessed using Test 2) and written communication (home
activity evaluation using Questionnaire 2). The situation
recorded before and after the course has not shown a clear
distinction between the different specialties, but the students'
progress is undeniable.

Again, the "Business Communication" course proved to be
effective as it reduced by over 50% the number of students
with serious difficulties in all types of communication,
doubling the number of students considered very good in that
regard, speaking only about the extremes. The average
situation has become less prevalent as the students followed the
course, making tomorrow's engineers good communicators.

Since written communication is very important, this research
has expanded to assess the clarity and accessibility of texts
written by students, using the third test (Test 3). In this respect,
the used method was Gunning’s. The fog index calculated with
this method shows that short sentences or phrases are most
easily understood.

The assessments show a clear progress after attending the
discipline. This is highlighted by the prevailing mark for the
assessments of each type of communication, as shown in Table
2.

<table>
<thead>
<tr>
<th>Situation</th>
<th>group</th>
<th>meetings</th>
<th>interpersonal</th>
<th>public</th>
<th>written</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>M = 35.25%</td>
<td>S = 36.25%</td>
<td>M = 32%</td>
<td>M = 33.25%</td>
<td>B = 34.75%</td>
</tr>
<tr>
<td>after</td>
<td>B = 43%</td>
<td>B = 35.5%</td>
<td>B = 39.5%</td>
<td>B = 40.75%</td>
<td>B = 45.25%</td>
</tr>
</tbody>
</table>
The foregoing highlight the striking fact that the educational activities taught during "Business Communication" classes result in an improved student performance in all the analyzed types of communication. The effectiveness of the discipline is different for students from all 4 analyzed specialties. It is noted that the efficiency is higher for Economic Engineering students, whose number of weekly hours allotted is double than that of other specializations. The results of the tests and questionnaires used clearly show that the discipline is effective in training students, significantly improving their ability to fructify professional knowledge through communication.

In assessing the effectiveness and importance of communication, the interviewed subjects should possess work experience. Because such surveys would be less readily available, the effectiveness was assessed by interviewing students having attended the discipline, complemented by interviewing students in senior years, who have been working during college.

Thus, the third questionnaire used (Questionnaire 3) was submitted to students upon completion of the discipline in order to have them express an opinion on the communication skills that they consider to be important in various practical situations in their future career. Therefore, the results of the questionnaire should be considered as an estimative evaluation of the effectiveness of communication, performed by students in the first two years of study. The rating scale used is from 1 to 5, where 5 - not at all important, 4 - less important, 3 - average importance (Neutral), 2 - important, 1 - very important.

The questionnaire covered two aspects of effectiveness and importance of communication: in recruitment and in career. No notable differences were observed between subjects’ responses according to specialization by gender or by the year of study (students were of similar ages - only a few years’ difference in some cases). For this reason, the answers are presented together.

Regarding the effectiveness of communication in recruitment, students’ views show that in order to find a job, the most important aspect is related to drawing up the necessary documents for the interview; i.e. the Curriculum Vitae (CV) and the application letter (88%). Because these documents provide the candidate only with a call for an interview, the importance given to finding a good strategy for employment is natural (67%). Both issues are covered by the “Business Communication” discipline, proving that in this respect the discipline is considered effective.

According to students, professionalism is the most important quality in employment (59%). However other aspects are considered to be important; proficiency in business communication (37%) was considered almost as important as professional experience or the ability to perform tasks. The interviewees believe that the most important aspect that for an employer is job suitability (69%). This is followed by motivation and communication skills, including communication in foreign languages (36%).

The analysis of previously presented information shows that students considered the communication skills acquired in college to be effective in finding a job and in career-related activities.

The most important features of an employee, as deemed by the interviewed students, are a responsible attitude (71%), the ability to solve problems (61%) and sincerity (54%). For the three mentioned features communication plays an important role. Sincerity is provided solely through open communication, which is what the students actually get. Moreover, the issue of the ability to solve problems is also studied in "Business Communication". It is therefore highlighted the effectiveness and importance of communication in an indirect way.

Interviewed subjects considered that promotion is the most important way to motivate employees (96%). Important are also the obtained results (51%) and received responsibilities (43%). It is obvious that between the obtained results and promotion there is at least a logical correlation.

Business communication literature [1, 2, 4, 5] shows that people are promoted to a greater extent due to their communication skills rather than for their professional savvy.

So, in this case, the views of students indirectly show the effectiveness of communication and its importance.

Of great importance are the views of the subjects on communication issues that they consider to be appreciated by employers. They were organized in accordance with the content of the course’s syllabus and that of the applicable side of “Business Communication”.

Following the hierarchical organization of the concerned issues it is observed that most important are considered group communication skills (68%) and written communication skills (65%), which subjects consider to be of similar importance. On a second level of importance the subjects placed conflict-solving skills (57%) and body language (54%). On the third level is placed the ability to listen actively (41%). This is particularly interesting if one takes into account that when addressing on this topic during one of the activities, most students showed that they had not been trained in school on this topic.

The most important issues concern both verbal and nonverbal communication, both oral communication and written communication, both interpersonal and group communication. All the above highlight the effectiveness and importance of communication, as it is perceived as a result of studying the discipline from the curriculum of the specialization of the interviewed students.

The fourth questionnaire was designed for a broader research on the professional expectations of "Hermann Oberth" Engineering Faculty students’ [7]. The research was aimed at students in senior years; students who have had some work experience as a result of internships and as a result of the fact that many of them were employed during university years. A sequence of the questionnaire (Questionnaire 4) covers the aspects of the effectiveness of Business Communication.

Of the 620 4th and 5th year students, studying at the time of research (2007) at the Faculty of Engineering "Hermann Oberth" of Sibiu 461 students were interviewed from 8 specialties (including the previously analyzed 4 specializations: IE, TCM, MU, UT). Of these: 72% are male and 28% are female, 60% live in Sibiu and 40% live in another town (in Sibiu county or another county), 59% live with parents and 41% live alone (on student campus, in a rented or a personal home). Research results [7] concerning the issue addressed are summarized below.

Since most of the interviewed students have had internship experience, it can be considered that their views on the effectiveness of communication are more objective. Table 3 presents the importance given by employers to characteristics (attributes) of the employees, according to the respondents.
No significant differences were found based on gender, regarding the views of the subjects. Distribution on specialization of the respondents, on the same issue is presented in Table 4.

### Table 4. The importance given by employers to employees’ characteristics [%]. Distribution on specializations

<table>
<thead>
<tr>
<th>A GOOD EMPLOYEE HAS TO …</th>
<th>Total no.</th>
<th>UT</th>
<th>IE</th>
<th>TDDH</th>
<th>CALC</th>
<th>TCM</th>
<th>MU</th>
<th>EM</th>
<th>TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>... carry out work-related tasks, even if not clearly defined</td>
<td>76%</td>
<td>89%</td>
<td>64%</td>
<td>62%</td>
<td>84%</td>
<td>85%</td>
<td>71%</td>
<td>75%</td>
<td>79%</td>
</tr>
<tr>
<td>... not to exceed deadlines set for different tasks</td>
<td>91%</td>
<td>97%</td>
<td>86%</td>
<td>97%</td>
<td>93%</td>
<td>89%</td>
<td>89%</td>
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<td>... to be creative and find solutions to various problems</td>
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<td>... to be willing to work overtime</td>
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<tr>
<td>... to take initiative and make proposals</td>
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<td>69%</td>
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<td>... to continuously improve their knowledge</td>
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<td>89%</td>
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<td>... to know how to operate the computer</td>
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<td>... to be able to communicate easily in writing</td>
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<td>51%</td>
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<tr>
<td>... to have verbal communication skills</td>
<td>83%</td>
<td>78%</td>
<td>93%</td>
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<td>83%</td>
<td>74%</td>
<td>83%</td>
<td>86%</td>
</tr>
<tr>
<td>... to know how to integrate into teams and resolve conflicts which may occur</td>
<td>86%</td>
<td>83%</td>
<td>90%</td>
<td>92%</td>
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<td>... to know at least one foreign language</td>
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<td>67%</td>
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<td>87%</td>
<td>89%</td>
<td>89%</td>
<td>83%</td>
<td>85%</td>
</tr>
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</table>

Legend: TDDH = Transport, storage and distribution of hydrocarbons; CALC = Computer Science; EM = Electro mechanics; TT = Textile Technologies (other abbreviations are explained above – see 4.1)

It is observed that employees’ communication abilities are of particular importance (Table 3). Verbal communication (83%), group (conflict resolution and integration in a team - 86%) and written communication (56%) are ranked among the most important issues addressed by employers. Also, communication is vital in improving one’s knowledge (86%); it is relevant in the ability to take initiatives and make proposals (73%). Regardless of specialization, students have similar views (Table 4) and show that they need theoretical and applied knowledge in professional communication.

### 5. CONCLUSIONS

Communication is a way of rendering specific knowledge for engineers. It is of overwhelming importance to their career, allowing them to make the most of their professional knowledge by conveying crisp, precise and coherent (verbal, nonverbal and written) messages. Business communication is of use in searching for, practicing and keeping a job, facilitating hierarchical ascension.

The results of the researches are in full agreement with the objectives and the aim of the research. These have evinced the fact that studying the “Business Communication” discipline is efficient, efficacious and of lofty importance to the
development of the future engineers. The planning side of the research is original and the methodology underpinning the research has facilitated its successful completion. Tests and surveys have been used either specifically designed by the author or borrowed from the specific literature and adapted to the needs of the research.

Most students who have taken part in the research fit the “sociable” and “directive leadership” behavioural type, which is about 80% of the total. The evaluation of their communicational performances, before and after taking the course demonstrates the efficiency of communication through a visible improvement of their communicating abilities; in some cases the percentage of students having communicating difficulties has halved.

Concomitantly, the number of students with peak results has doubled. The best performances have been scored by Economic Engineering students whose number of weekly classes is double compared to the other specialties (4 hours/week compared to 2 hours/week in the others’ case).

The post-lecture evaluations have shown an undeniable progress. The students have learnt to better communicate verbally and nonverbally, managing to also express themselves better in writing; more intelligible and neater. If initially 49% of the students had problems in clearly putting together sentences, after the completion of the course only 22% still persisted in these difficulties. The enterprise eloquently highlights the fact that the didactic activities underlying the “Business Communication” discipline have resulted in an improvement of the students’ performances across all types of communication analyzed.

The results of the tests and surveys employed noticeably evince the fact that the discipline yields perceptible effects in the professional development of the students, significantly enhancing their communicating abilities. The results of the surveys also point towards the efficacy and the importance of communication in finding a job and exercising one’s profession.

The students find that having studied the discipline they have developed abilities in drafting the documents necessary for an interview and in formulating a good employment strategy. Performances in the field of business communication are deemed almost on a par with real working experience or with the ability to successfully complete tasks by the students.

The overall opinion of the respondents regarding the importance and the efficacy of business communication to the career derives from analyzing the most important traits of an employee. Of prime importance are considered a responsible attitude (71%), the problem-solving capacity (61%) and sincerity (54%). Throughout these three, communication stands abreast. Sincerity is a byproduct of open communication, which is what the students are treated to during their lectures and applicative activities. On the other hand, the issue of the problem-solving capacity is also tackled by “Business Communication”. Therefore, the efficiency and the importance of communication are unambiguously shown indirectly.

The findings of the researches validate the theoretical hypothesis according to which people are more likely promoted due to their communicating abilities than due to their purely professional abilities.
MULTIMEDIA IN ENGINEERING AND BUSINESS EDUCATION
MULTIMEDIA AND WEB 2.0: NEW CHALLENGES OF VET

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ABSTRACT: The number of Virtual Learning Environments (VLEs), based on multimedia and web 2.0 concepts, is increasing and they have been advertised as being a solution for the remote and cross-border vocational educational training (VET). Hence, VET institutions are increasingly turning to VLEs in order to: save the time of teaching staff; facilitate the integration of distance and self-based learning during the period without face-to-face meeting teacher / students and provide a service for students, increasingly looking for the new technologies as a more exciting medium for finding information. The aim of this paper is to underline the penetration of new multimedia and internet technologies in the VET field, to underline the advantages (and weak points) of traditional, in-classroom activities versus taking those activities online and to analyse the results based on these technologies obtained in transnational projects in the framework of the Leonardo da Vinci European Programme (Romanian case study – Romanian contractors).

1. INTRODUCTION

Broadly speaking, eLearning refers to any educational circumstance significantly using the internet resources for teaching and learning. Of course, there may be as many definitions of eLearning concept as there are academic and/or research papers focusing on this subject [1,2,3], but the common sense of this term is reflected by the evolution of “distance education” concept in the new technological era.

Nowadays, the Internet is becoming the preferred educational channel for trainers and students, since it provides all the critical components for distance learning: instant access to: huge libraries (with needed study materials), on-demand delivery of video, images, animation & text, and of course, real-time interaction between learning process participants: students and teachers. Of course, this migration is possible due to technological progress: the “movement” from Web 1.0 (characterized by email, forums/lists, web sites, linking pages, etc) to Web 2.0 (personal blogs, collaborative wikis, shared bookmarks / photos / docs, social spaces, etc).

Of course, this “movement” doesn’t focus only on technology aspects but on pedagogical elements, too: nowadays, the teacher evolves from mentoring students (as knowledge resource) to knowledge facilitator [4].

In these circumstances, the Virtual Learning Environment (VLE) becomes a part of the eLearning (global) concept arena. Usually, a Learning Environment (LE) is “the place and setting where learning occurs; it is not limited to a physical classroom and includes the characteristics of the setting” [5]. Hence, the Virtual LE tries to emphasize these characteristics. A common definition regarding VLE presents it as “a system that creates an environment designed to facilitate teachers in the management of educational courses for their students, especially a system using computer hardware and software, which involves distance learning” [6]. In order to help in identifying VLEs, some criteria were defined [7] and allow the conceptual development of this idea:

1. A virtual learning environment is a designed information space.
2. A virtual learning environment is a social space.

3. The information/social space is explicitly represented: the representation varies from text to 3D immersive worlds.
4. Students are not only active, but also actors: they co-construct the virtual space.
5. Virtual learning environments are not restricted to distance education.
6. Virtual learning environments integrate multiple tools.
7. The virtual environment overlaps with the physical environment.

Unfortunately, Dillenbourg [6] is pessimist regarding the possibility of VLE to improve education: “Potentially yes, but probably not”. This scepticism is based on the fact that “it is very difficult to set up the conditions that turn potential into actual effects”. In this case, will VLE die [7]? Probably not, saw Styles [7] because “it appears to be in robust good health when the current usage and size of market is considered, but there is a worrying trend towards bloated and monolithic systems with endless features being bolted onto them”.

Beyond the technology support (and the afferent technical development), VLEs can contribute to distinct educational improvements, too [10]:

- VLEs increase interaction between learner, content, and the group
- VLEs eliminate barriers in providing a learning environment
- VLEs create motivating, self-learning experiences for students

From the vocational training point of view, „the idea of civilization falls into a techno-bureaucracy” [11] and the VET centres are encouraged to intensify the market-model and of course, to promote the new eLearning and mLearning models.

Nowadays, the quality in VET can be categorized [12] into different clusters (in accordance with the target they are trying to achieve):

- Didactic and pedagogic perspective: the quality of the teaching and learning process are focused on.
- Social perspective: the goal is to find the correct answer to the educational social demand.
- Economic perspective: all expenses linked to educational sector should be cost-effective.
• Consumer perspective: the students’ demands must be taken into consideration.
• Management perspective: the organizational aspects and processes of education are focused on.

Of course, in these circumstances, a marriage between VLE and VET could be very happy: the virtual environment overlaps with the physical environment and the time / space barriers are broken. Moreover, the new learning philosophy focuses on the “individual learner” although it recognizes that education is a social process. The following figure tries to put the accent on the balanced approach – classical education vs. eLearning (Figure 1).

![Figure 1. Classical education vs. eLearning: a comparative vision.](image)

Hence, education traditionally oriented to learning models with focus on the instruction, where the teacher transmits information to students (one-way messages to be lectured, and assigned to the student) move-up to the learning centred on the student and tries to develop an education process based on the collaborative knowledge creation process (learning is based on a collaborative social endeavour).

Is it a conceptual (r-) evolution or a simple technological evolution?

2. TOOLSET OF VLE AND THE NEW LEARNING TRENDS

Web 1.0, the first generation of web development technologies, made possible the development of eLearning 1.0 (characterized by static implementation), and whose main objective was the use of internet in order to replicate the instructor-led experience. The teacher was providing the course materials and information, the assessments and simulations on the web-site and the student had to read and learn the content and do the assessments, which were finally evaluated by the instructor. The main communication method was the email [13]. Hence, this period were characterized by the fact that the role of the web was “as information portal”:

• Everyone had their personal own corner in the web-space;
• Each one need to be the first to own the information exclusivity
• The www was divided into “working directories”
• In these circumstances, the main disadvantages were focused on the lack of interaction(s) and the reduced scalability.

The second web generation (Web 2.0) offers a great deal of technological improvement (enhanced communication, secured information sharing, interoperability and collaboration capabilities), making possible evolution to the so-called dynamic behaviour of the web-sites, which led implicitly to second version of the eLearning concept [13]. The new eLearning 2.0 focuses on the “social learning”, by improving the collaboration features and considering the web as a platform. Hence, the main trends of this web generation can be linked to:

• Participation: every aspect of Web 2.0 is driven by participation; focus on the community power to create, to test and to validate knowledge.
• Decentralization: Web 2.0 is decentralized in its architecture, participation, and usage; power and flexibility come out from distributing applications.
• Modularity: Web 2.0 materializes the integration of diversity and the building of a whole that extend the sum of parts.
• User Control: the users can control the content they create.
• Globalization: global information available to local social contexts (people can create, find, organize, and share information in a locally way that is globally accessible).
• Outsourcing: involves the transfer of the management of an entire business function to an external service provider.

As it can be seen, Web 2.0 is more based on technological advances than conceptual evolution in field. As Reed Hastings, CEO Netflix said, “Web 1.0 was dial-up, 50K average bandwidth, Web 2.0 is an average 1 megabit of bandwidth and Web 3.0 will be 10 megabits of bandwidth, which will be the full video Web, and that will feel like Web 3.0”.

Hence, the main differences between the two web generations can be synthesized and are presented in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Comparison between web 1.0 and web 2.0 characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Web 1.0</strong></td>
</tr>
<tr>
<td>read only web</td>
</tr>
<tr>
<td>focused on companies</td>
</tr>
<tr>
<td>home pages / forums / lists</td>
</tr>
<tr>
<td>owning content</td>
</tr>
<tr>
<td>HTML, portals</td>
</tr>
<tr>
<td>web forms</td>
</tr>
<tr>
<td>mainly text &amp; images</td>
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</tbody>
</table>

Of course, one of the main idea which can explain the new tendencies in VLEs development and the interest of VET is linked to the fact that the new students’ generation (i.e. Net Generation, Millennials, Echo Boomers, iGeneration, Generation Y) are strongly connected with computer use, use of “beeps” on cell phones and Xbox video game console as day-to-day usage and their interest is focused more on communities relations rather than high tech skills development. Hence, today students are far away from the people the actual (classic) educational system was planned to teach.

Hence the main questions are: must the vocational training centres continue to implement the classical education system or it must migrate to the new technological framework? Is the VET prepared to change the education structure, to adopt the new technological style and to better “attract” the Net Generation vocational training?

For the moment, the answer is an opus mixtum, i.e. a mélange of face-to-face / on-line and in-action education (Figure 2):
Nowadays, various Web 2.0 tools are necessary to be used to help out teachers in the new educational context. These tools are not exhaustive, but are the most used at this moment and seem to be the necessary steps to climb to the next floor: the participatory education. Hence, the new education becomes more social and people can contribute as much as they can consume.

3. VLES AND SMES: ELEARNING IN THE WORKPLACE

It is evident that eLearning can be a good alternative for learning in the workplace, i.e. for competence development of SME employees. As it was previously seen, eLearning allows for just-in-time updating as it can be organized for anyone, without space and time limits. Moreover, eLearning may also be cost-effective “because the learner does not have to leave work to participate in courses that require presence and often imply both travel and accommodation expenses” [14].

From a technological point of view, eLearning may require a minimum of ICT-knowledge, both for learners and trainers; the teachers still need some supplementary abilities to prepare the learning content.

But in which way the academic experience in eLearning can be useful for the economic sector? Are there the same issues? The first steps necessary to obtain the right answer(s) are linked to the factors which can influence the level of ICT use in learning approaches in the European workplace (but, of course, some aspects can be available worldwide) [14]:

- the lack of training culture within the SME
- lack of appropriate learning materials
- the attitude of individual managers
- lack of access to sufficient bandwidth to ensure high quality training.

Moreover, the author assert: „The development of learning in Europe has been dominated by the metaphor of the virtual classroom and the virtual university, it has equally been dominated with an obsession with technology and very little attention has been paid to vocational and occupational learning or the development of elearning environments in less formal learning contexts”.

Meantime, in US the problems seem to be more or less equivalents [14]:

- lack of training or learning in the SMEs: managers and employees are often to busy that „training and preparing for future improvement is not an option”
- lack of infrastructure
- justifying eLearning: frequently it is possible by using „a cost-benefit analysis and show a positive Return of Interest (ROI)”
- understanding training needs: usually, SMEs do not have „a training specialist or any other individual (or department) dedicated solely to analyzing businesses needs and performance gaps”, and the managers are engaged with everyday jobs.
- missing of organisational perspective: often, SMEs act as “individuals” and try to find personal answers (more expensive and suboptimal);
- All these issues can be solved by “building the capacity of the organization and the capacity of individuals who comprise it” [14]. Some solutions can be obtained from the high education experience and others ones directly from the market demand:
  - Learning needs must be identified by using specific programmes and / or questionnaires and not through practical experience.
  - Companies must use specific / dedicated (in situ) location(s) for eLearning activities; “in the workplace” does not mean “in the same place” as the current job.
  - SMEs must use the academic and / or other (more experienced) economic players experience to select the necessary infrastructure (hard + soft) for eLearning development.
  - The learners selection must be based both on their interest in the field and on the strategic development policy of the enterprise.
  - Oppose to academic level, the SMEs must focus on "learning by doing”. Hence, the learning structure must be oriented to applicable rules, and the trainers must have practical experience (in the course field) obtained during their own activity.

A global solution? „Fusion of Education and Business” the authors said in the same article [14]. Hence, a join between .com and .edu can be useful. The success of small SMEs will be dependent on their capacity to balance the own (economic) mission with “the missions and goals of the individual workers”. Hence, the eLearning in the workplace will permit to capture know-how of experts, to improve the organisation’s knowledge management, and to train people in order to increase the workforce potentiality.

4. THE ROMANIAN CASE STUDY

Our study has been based on the Romanian promoted pilot projects targeting eLearning or developing, among other tangible training outcomes, eLearning, too. These projects are characterised through an important transnational cooperation and expertise component, so even if the considered case study projects were strongly supported by Romanian organisations, the European state of art and tendencies in eLearning might be noticed.

4.1. Assessment of eLearning results

The General Directorate for Education & Culture, responsible, among other European financing initiatives, for the Leonardo da Vinci Programme, has established a set of results / outputs assessment indicators. Among these indicators / descriptors, one might select / adapt those appropriate indicators for
eLearning resources as pilot projects’ results / outcomes, as follows:

- Communication & media used – quality of interaction between material and target group / course participant, choice of media with respect to content, stated objectives and target group / course participant, pertinence and integration with respect to specific features;
- Evaluation – assessment criteria and procedures, ongoing and final assessment tests, quality of feedback with respect to answers to self-assessment questions, measurement of pathway target group / course participant level of satisfaction (presence of activities aimed at assessing pathway target group / course participant satisfaction, presence of activities aimed at assessing qualitative dimension of course teaching staff or of ODL’s pathway tutors);
- Technology
  1. audio-video support: material organisation (credits, modularity, passage from one module to another), aesthetics (image definition, shot, montage, audio definition, synchronicity / complementarity between sound and image);
  2. electronic support: material organisation, aesthetics (image definition, image composition, rhythm of images, audio definition, synchronicity / complementarity between sound and image, technical quality of drawings / photographs / graphic animation, quality of typography features and text readability, use and features of reminding symbols), ergonomics and use of media, produced information etc.

4.2. Analysis of Pedagogical Components

In accordance with the quality criteria and regulations established in the frame of the Leonardo da Vinci Programme, a number of pilot projects with Romanian promoters were financed, respectively 8 projects in 2000 exercise and 6 projects in each 2001, 2002, 2003 and 2006, 3 in 2004 and 2 in 2006. The analysis of pedagogical components will map out the four pillars defined in [15].

4.2.1. Learning goals and content presentation

The identification of the learning goals and objectives provides the basis for the instructional design, development, delivery, and assessment of an eLearning system. These defined goals serve as the agreement between the teacher and student, defining what is to be trained. Communicating these learning goals is an important step in assuring an effective learning experience.

Learning goals should be defined as part of the instructional design plan and specific instructional activities should be directed toward providing learners with the necessary skills, knowledge, or experiences to meet the goals and objectives of the course.

To identify courses with learning goals and content presentation, all project web servers were searched for relevant course. Hence, out of 32 developed courses (i.e. six in 2000, six in 2001, 2002, and 2005, five in 2003, 1 in 2004, and 2 in 2006) have online course content presentation and a description of learning objectives (see Figure 3).

4.2.2. Interactions

Whether learners interact with one another, or with an instructor, new information is acquired. Such interactions form the basis of the community of learners. The challenge for distance educators is to design into the eLearning environment strategies and techniques for establishing and maintaining "learning communities" among learners separated by space and/or time.

Following the analysis of this kind of criterion, the results are depicted in Figure 4. We can notice that the percentages of web site and course interactions have decrease in 2001 and 2002 (from 62% in 2000 to 50 % in 2001 and 30% in 2002) and have increased after this period (67% in 2003, 67% in 2004, 83% in 2005 and 100% in 2006).

4.2.3. Assessment and measurement

In a distance education model, assessment and measurement become even more critical in the absence of the face-to-face interactions, enabling teachers to estimate student response, feedback, and progress toward goals. Creativity in design and approach to assessment and measurement strategies can serve both elements.

In this case, out of 22 IT courses (i.e. 5 in 2000, 4 in 2001, 2 in 2002, 3 in 2003, 2 in 2004, 4 in 2005 and 2 in 2006) have online course assessments (see Figure 5). It was unexpected the low percentage linked to projects started in 2002, but this was only a particular aspect.
4.2.4. Learner support systems and services

Among the most important components in the design of distance education programs are those that establish the organizational and administrative infrastructures to ensure that such programs can be efficiently and effectively developed, managed, and executed. The learner support systems must be complete, quick responding, and customer-oriented. In most cases, these services may be the only link the learner has with the institution apart from the instructional activities.

In this particular case, we have 26 projects that have fulfilled this criterion, i.e. 5 in 2000, 2 in 2001, 5 in 2002, 4 in 2003, 3 in 2004, 5 in 2005 and 2 in 2006 (Figure 6).

![Figure 6. Learner system support and services](image)

Finally, a global evaluation had been completed (Figure 7) regarding the accomplishment of all four pedagogical requirements linked to on-line course development. It appears from this case study that a higher percentage was obtained in terms of more eLearner customer oriented, more user-friendly and interactivity.

5. CONCLUSIONS

Taking into consideration the analysis of the pedagogical components one might notice a decrease tendency from a year of selection to another and in a certain extend some unfulfilled criteria.

Our first question following this assessment was whether the study was too ambitious or whether we expected too much from the Leonardo da Vinci pilot projects. We are tended to conclude that regarding the pedagogical components of eLearning, the Leonardo da Vinci projects explored some new pedagogical methods, but a huge demand is for improvement into this field.

Secondly, the continuous decrease of the project number and financing might explain to a certain extend the decrease tendency noticed into criteria fulfillment. Considering the pilot projects for the 2003-2006 exercises, some progress based on the current pillars was obtained in terms of more eLearner customer oriented, more user-friendly and interactivity.

6. ACKNOWLEDGEMENTS

The approach presented hereby is based on the projects managed by the National Agency for Community Programmes in the Field of Education and Vocational Training (ANPCDEFP) during the period 2000-2006.

7. REFERENCES

ADLIB NETWORK AND WEB FEED POWERED E-LEARNING SYSTEMS

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ABSTRACT: This paper explores the use of online social networking systems such as Hi5, MySpace or Facebook integrated with feed aggregators as adlib alternative educational platforms. The main goal of this article is to define ways in which the structure and dynamics of social networks powered by the data flow of web feeds can be used to semi-automatically create adlib educational platforms using data freely available on the Web. Such systems may prove to be efficient in providing general and specific information on a wide range of topics as well as interaction with teachers and specialists in the respective educational fields. The main advantage of combining the network interaction paradigm with the automated information flow of web feeds is using existing platforms in order to create new digital frameworks to support lifelong learning but also conventional education. The paper will conclude by outlining specific functions such a system could perform, the advantages of building a learning community on top of popular social networking systems and the use of customized web feeds (e.g. via Yahoo Pipes) as means of retrieving data and managing the information flow.

1. INTRODUCTION

The World Wide Web is constantly evolving towards new paradigms, adding content richness and content metadata to its web pages, like tags, categories, descriptors, markup language versions for web pages and so on. Organizing content in both a human-readable and a machine-readable format has become almost imperative. Perhaps the best example of a solid information base generated by a succession of refinements is the world-renown Wikipedia – the free encyclopedia. Though the concept behind it seems simple, the true strength of such systems lies in the networked communities behind them. The same is true for many new media systems that manage user generated content.

In the context of 21st century education, such successful endeavours seem to pave the way towards a change of paradigm. Future education processes will need to rely less on the isolated existence of exceptional pieces of educational content, but on managing the informational flow through customizable feeds, intelligently build APIs and most importantly on the inherent interaction between users and stepwise refinement.

In what follows this paper will try to underpin several key features for competitive e-learning systems based on combining the power of social networking communities and that of remixing data through mashups.

2. SOCIAL NETWORKING

2.1. The Network Society

Since the dawn of mankind, community has been the key concept for evolution. Resource sharing and communication between the members of such social structures have empowered the human race to be what it is today. However, traditional communities have always been geographically oriented in a so called space of locations [1], as Manuel Castells puts it. Nowadays, digital or virtual communities are based on an informational flux continuum and have new rules and social patterns that need to be researched in depth in order to define how they function and what the main characteristics that define them are.

In this perspective, the most involved individuals will tighten up their relationships by means of electronic communication and form the social center while others will gradually distribute along the informational network according to their level of interest and involvement. Conceptually speaking, the digital community is not determined by a geographic location, but rather by a certain set of common interests.

In this respect, virtual communities have their own dynamics and structure, much like the physical ones.

The Internet, regarded as the framework for virtual communities, may be defined in this respect as the sum of all the informational human interactions achieved by using the interconnected network systems. Even though this definition may seem simple, it contains some key elements that must be underlined. Firstly, the information in itself: the whole network is pointless without the content. Secondly, the exchange: the reason to be of communicational networks is the exchange of information. Thirdly, the human side: there is no point in having technology and informational networks without the human beings that send and receive information. There is no exchange of information between machines just for the sake of disseminating certain types of content.

By the end of the nineteenth century, Tonnies has defined the existence of social groups by two key concepts: gemeinschaft that is the totality of the direct and personal connections between the individuals that share the same set of values, in other words the communicational background of a certain group, and gesellschaft, that is the sum of the formal, impersonal links that operate at the level of social organization. Durkheim has provided a more nonindividualistic explanation stating that social phenomena can be considered to take place when the sum of interactions between the individuals generate a certain reality that can not be defined exclusively by characteristics that are specific exclusively to the individual. In this respect he defined two types of societies, the traditional one - the so called mechanical, in which the differences between individuals are minimized - and the modern/contemporary one, also known as organic society, which thrives on individuals that have very distinct roles, positions and characteristics. Out of these models, hundreds of various platforms have developed, be it in
an already considered classical way, or specifically targeted in frameworks such as Ning, that promotes a vertical hierarchy among the users. Of course there are ups and downs concerning the implementation of such services. Educational and distance learning projects are bound to benefit, internal communication in a company can be boosted significantly, virtual job markets are created (a good example of such so-called professional network is LinkedIn), or simply their originally intent purpose to encourage people to interact with one another is also beneficial. However, the downside is that within corporate networks too much idle conversation will significantly decrease productivity, also one’s abilities to socially interact in a direct manner may decrease abruptly since the individual is using a computer generated interface and an avatar instead of a smile and good manners to socialize. Regardless of the consequences and in whatever form they may exist, social networking services are the main element of virtual communities.

2.2. Digital Communities

Digital, virtual or online communities, regardless of their formal designations, can be defined as social groups in which individuals interact in an indirect manner, meaning that the sum of communications is mediated by a computerized interface. Besides the services described above, there are numerous other alternatives to complete the communicational process. Newsletters, forums, instant messaging, video chat or even email come together to complete the digital information exchange puzzle. Even if they are aggregated in the traditional formats of the community that does not necessarily mean that there is always a strong connection between the members. According to Howard Rheingold [2], the links in this type of communities are forged in time, over a rather long period of exchange of information, and the real strong interpersonal connections come into being only when an individual has shared enough sentimental content in public.

In the context of a larger and larger implementation of the Web 2.0 concept, a fusion between the specific technologies and the social mechanisms becomes clearer and more and more voices are already outlining the concept of 2.0 communities, as the virtual communities depend directly on the level of interaction between the users. Therefore, in all cases, a decisive factor of the well being of a virtual community is reciprocity, perhaps the most important aspect in the unwritten social contract between the members. Reciprocity is at the core of all the file sharing communities, and even stands for most of what the Open Source concept is nowadays.

Yet, virtual communities are infinitely divers by their intrinsic nature and most of the members are largely unaware of the advantages and disadvantages of being in a certain position in this hierarchy. Also the levels of interaction, in terms of intensity and duration, vary significantly. The range spreads from comments and tags, basically the electronic equivalent of a message board, to the most intense form of immersion in the virtual - the MMORPG (Massively Multiplayer Online Role-Play Game).

2.3. Social Networking Systems

Taking into consideration the present tendency in the development of social networking systems, of merging them with or transposing them over existing systems, the economic actors of the online market seek solutions for quick profit out of their popularity. This type of fad can provide the surge in interest needed in developing world-wide webbed educational models.

One of the best tries at defining social networking sites describes them as being “web services that allow individuals to build a public or semi-public profile within a closed system, to input a list of other users that are connected to them in some way or another and visualize their own and the others’ lists of connections (the nature and naming of these links may vary)” [3]. Most often, building a profile means inputting some content (be it personal data or some other information/media valuable to the community). Sometimes, individuals interact solely through the content they share with the community. There are always some rules for differentiating successful or popular content from the less desirable kind like rating, ranking, tagging or commenting.

2.4. Stepwise Refinement

One of the most important features of the human evolutionary process that has been successfully imported into most process-planning activities it stepwise refinement. Finding solutions, assessing their fitness, improving them by redefining, redesigning or recombining and then repeating the process infinitely is as much a part of natural evolution as it is a part of every human activity. In the context of the World Wide Web, our best example yet is that of Wikipedia in terms of refining content as mentioned above. The result of collective community-based assessment and improvement is an astounding amount of fairly reliable content constantly updated, constantly renewed and constantly improved. Phenomena like this can also have unpredicted outcomes such as the incidental advent of highly-reliable human-defined taxonomies which can be used to sort or tag content all over the web through conceptual search engines with increased relevance and readability, and decreased ambiguity or redundancy [4].

3. REMIXING THE WEB

“The boundary between mashup and remix is a bit fuzzy, though. Mashup and remix are terms that have their origins in popular music. Roughly speaking, a remix is an alternate version of a song, while a mashup brings together elements of two or more songs. The term mashup has expanded recently to describe the combination of video from multiple sources in a new video” [5].

Most pundits prefer using the term remix for repackaging information without combining it with other content and the term mashup to refer to combination of data from a set of different sources. Still, as Raymond Yee suggests in [5], one should not strive to draw the lines too bluntly between the two concepts.

3.1. Introducing Yahoo! Pipes

Yahoo! Pipes is a feed aggregator and mashup tool available online since February 2007. It predates the similar, graphically richer Microsoft Popfly. Its main aim is mixing feeds and extracting information from various websites and generate different syndications as output rather than a visually rich website.

“Pipes is a hosted service that lets you remix feeds and create new data mashups in a visual programming environment. The name of the service pays tribute to Unix pipes, which let programmers do astonishingly clever things by making it easy to chain simple utilities together on the command line” [6].

Though apparently a simple tool, it allows well versed developers to build powerful refinement and data mining web applications. As a visual programming environment, Yahoo! Pipes proves easy to use even for non-programmers. Some of
The strength of Yahoo! Pipes compared to the Popfly Mashup tool is that it features more complex structures, thus allowing users with programming skills to develop applications that go beyond a mashup website. Also, besides this, pipes can output in three different file formats: XML RSS, JSON (JavaScript Object Notation) and PHP. As XML doesn’t implicitly support arrays, JSON can prove useful in circumstances where the pipe uses the Term Extractor or String Tokenizer for example. In addition to the aforementioned, specialists have emphasized the fact that Yahoo! Pipes proves to be very friendly towards mobile mashups.

Figure 1. Yahoo! Pipe - Using a Fetch module to retrieve content from Youtube

3.2. Using Yahoo! Pipes as a Data Mining tool

One of the key advantages of a mashup tool such as Yahoo! Pipes is the ease with which one can create data mining in order to retrieve specific content from different sources. In the context of this paper, one can conceive a simple pipe application that allows the user to build a custom feed of educational content available on YouTube for example. Using user inputted keywords and a restriction to the educational system powered or rather more appropriately empowered by two of the most important features of Web 2.0 networked communities and web feeds should fulfil the needs of those who yearn for online alternative educational systems. The ability to spontaneously improvise based on retrieving one’s necessary knowledge, packaging it, and adapting it to the needs and wants of an audience was one of the most appreciated skills in ancient rhetoricians. Even now, the most appreciated educators are those that are capable of sharing their knowledge with spontaneity, seamlessly linking one topic to another and delivering the most relevant information within lectures or tutorials. An automated customizable e-learning system powered or rather more appropriately empowered by two of the most important features of Web 2.0 networked communities and web feeds should fulfil the needs of those who yearn for online alternative educational systems. The concept of adlib learning systems follows basically the same steps as ancient rhetoricians:

1. Retrieving information by using web services or data mining tools such as Dapper or Yahoo! Pipes;
2. Repackaging, recombining and customizing information according to the needs of the user through feed mashup tools such as Yahoo! Pipes;
3. Delivering the educational feed/package to the user in the context of a networked public (8), in fact delivering it to an entire community able and willing to rate, rank, tag and comment it;
4. Improving the educational feed/package through interventions and customizations by the members of the community as part of a human evolutionary computing process;

The possibilities are limitless, but isolated use of such tools may prove to finally be a random effort.

3.3. Automatically Tagging Content with Yahoo! Pipes and Wikipedia

By combining the power of Yahoo! Pipes with the immense human indexing system that is Wikipedia, one can tag any content available on the web, on any webpage.

Human computing is another one of the most recent fads in the development of yet more powerful, more intelligent indexing systems. Some have used online games as means of correctly tagging images on the World Wide Web thus rendering Google image search more relevant.

Most researchers don’t realize that we already have a huge index of human-readable tagged concepts embedded within the very structure of Wikipedia (now boasting almost 3 million articles only in English). By restricting a Pipe to Wikipedia, one can extract tags, categories and related concepts to a certain given keyword. This may prove to be very helpful when trying to explore the reaches of a certain educational niche. In the perspective of such a procedure, one cannot deem that Wikipedia is somewhat unreliable because such a technique simply makes use of its taxonomy and article-to-article links, not its detailed content or references. Ref. [7] and Ref. [4] are interesting researches into the potential of Wikipedia.

Figure 2 shows a Pipe that delivers a list of concepts related to a certain term, effectively tagging that term. Thus, pipes can be used to extend a “tag cloud” within a unified taxonomic system.

The point of doing this is circumventing the ambiguous and sometimes contradictory tagging systems for content available within Web 2.0 websites and bringing all content tagging to some sort of common denominator automatically. Also, let us not forget there still is valuable content out there on the World Wide Web which is not tagged at all.

4. ADLIB LEARNING SYSTEMS

The ability to spontaneously improvise based on retrieving ones necessary knowledge, packaging it, and adapting it to the needs and wants of an audience was one of the most appreciated skills in ancient rhetoricians. Even now, the most appreciated educators are those that are capable of sharing their knowledge with spontaneity, seamlessly linking one topic to another and delivering the most relevant information within lectures or tutorials. An automated customizable e-learning system powered or rather more appropriately empowered by two of the most important features of Web 2.0 networked communities and web feeds should fulfil the needs of those who yearn for online alternative educational systems. The concept of adlib learning systems follows basically the same steps as ancient rhetoricians:
As described in Figure 3, the system comprises two main elements – the social networking application and the mashup application. Users of the social networking system will create educational mashups in their fields of interest. They will then post them within the system and link them to other similar mashups. Other users are encouraged to comment on the value of the mashup, merge it with others in order to obtain a better educational package.

Figure 3 is an example of such a system design. The content providers are any educational or non-educational websites or systems which contain valuable information that the user can
use to set up a feed. The feed can be built using multiple such sources or even by using search engines’ results. The resulting feed or educational package will be delivered to the community via a widget, a badge or some type of feed aggregator depending on the social networking system. The information contained in such a feed can be highly customized by adding user input fields that use keywords to gather the most relevant information from several given sources.

Still, one of the key points of this new educational concept is the fact that it encourages remixing, repackaging of information, it encourages community-based stepwise refinement.

Connecting social networking systems such as Facebook, MySpace or Hi5 to feed mashup and aggregator tools such as Yahoo Pipes could be done by using widgets or badges thus integrating automatically updated educational content within social networking systems. Feedback from the user community could be directed both towards the content and the packaging part of the educational feed, thus constantly improving the e-learning system both intrinsically and structurally. Such systems may prove to be efficient in providing general and specific information on a wide range of topics as well as interaction with teachers and specialists in the respective educational fields. The main advantage of combining the network interaction paradigm with the automated information flow of web feeds is using existing platforms in order to create new digital frameworks to support lifelong learning but also conventional education.

Non-dedicated e-learning platforms such as the one described in this article have often proved to be more successful than other similar endeavours that rely on defining closed systems with specific educational purpose. The strong points of this concept of adlib e-learning systems based on aggregated educational content delivered through social networking systems are the support for user creativity and innovation, the fact that users have to interact in a familiar environment (the social networking system they were already using) and the integration of the user community within the educational content remixing and repackaging process thus improving the whole system evolutionarily. Such a model would

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6. REFERENCES

MULTIMEDIA ELEMENTS DEDICATED TO BUSINESS ENGINEERING AND EDUCATION

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ABSTRACT: Generically, media notion includes all public information sources, either are written (press – newspapers, periodicals; books like dictionaries for instance etc), audio (radio), audio-video (cinemas, television). In this context, the Internet (the NET), is as well a global means of communication, but at the same time represents a “multitude” of medias, meaning Multimedia. The Internet represents a giant warehouse of information. The most important Internet service is the Web (www = World Wide Web); Web pages (hypertexts) and the connection between then as browser, offer possibilities, most difficult to quantify, of Multimedia in all domains, including business engineering and education. This paper presents the main structural elements of the www architecture, certain services and applications dedicated to business engineering and education.

1. THE INFORMATION IN THE INDUSTRIAL SOCIETY. DIGITAL ERA

The shift from the mechanistic era of the entire economical productive economy towards the information industrial society (from the industrial revolution to the information revolution) was possible due to the explosive development of the IT field (information technology; IT&C – computers; IT&T – telecommunication).

It is indisputable that the Internet is one of the fundamental aspects of the IT. In the Cold War context, the Internet was exclusively used in the military field; to be mentioned is the fact that the Internet began with the military scientific project ARPA/NET. The U.S. space program, the N.A.S.A. and the significant amount of funds allocated have contributed to the remarkable development of the Internet in the academic field and government logistics.

With the pass of the Internet network on commercial principles, as immediate effect we can name the appearance of new services, such as advertising, electronic commerce and network access services, due primarily to companies providing Internet services. Thus it was inaugurated the largest outlet in the world, a global market, expanded at the whole planet.

Professor Dr. Mircea Miclea (from the Department of Psychology, University Babes Bolyai University in Cluj Napoca, director at The Center for Applied cognitive psychology, and founding editor of the journal ”Brain, cognition, behavior, former Minister of Education and current Chairman of the Presidential Commission for Education), calls the younger generation - "digital generation".

Extrapolating, it can be assumed that the whole human society passes through an "era / digital period". Activities of human society worldwide are deeply marked by information, in the globalization context, limited natural resources and the need of sustainable development [1].

2. MULTIMEDIA AND INTERNET ELEMENTS

Generically, media notion includes all public information sources, either are written (press – newspapers, periodicals; books like dictionaries for instance etc), audio (radio), audio-video (computer networks, cinemas, television).

In this context, the Internet (the NET), is as well a global means of communication, but at the same time represents a “multitude” of medias, meaning Multimedia.

The most important Internet service is the Web (www = World Wide Web); Web pages (hypertexts) and the connection between then as browser, offer possibilities, most difficult to quantify, of Multimedia in all domains, including business engineering and education.

In the current IT logistics (software - hardware), the multimedia elements are rapidly evolving and developing; on the other hand, the Internet is in itself a complex and complete multimedia instrument, in a dynamic emphasis, imposed by the phenomenon which generate the globalization and the sustainable development.

Websites can be categorized by many factors, but the main factor remains the subject of activity (or content) of the website. From a technological point of view, one website can be made from any type of static data and information, chat rooms, sales products and services, ads, forms to fill out online, digitized sounds, videos, images and animation, special effects, dynamic menus, and many, many others (table 1).

Generalizing and analyzing the achievements to date, the subject (theme) of a website can be a so-called blog, web portal, web catalog, virtual shop, bank, virtual university, library, virtual encyclopedia, web magazine, newspaper and almost anything. If at the beginning there wasn’t put too much emphasis on the aesthetic side, these days are granted increase importance not only to the content, but also on aesthetics, dynamics and attractiveness (table 2).

Currently, the Internet contains hundreds of millions of web pages on the various subjects and languages; in October 2006 a monitoring Internet company - Netcraft, which produces statistics about the Internet since 1995, announced that there were 101,435,235 Web sites, each with its own unique domain name (compared to 18,000 sites in August 1995).
The web site concept also designates a group of multimedia web pages (containing text, fixed images, animations, etc.), accessible on the Internet, in principle, however, usually on a specific theme, and are connected together by so-called hyperlinks. Various websites may be created by an organization, an individual, public institutions etc.. Usually a website is managed (created, maintained and updated) by a so-called webmaster, but there are other possibilities:

- The website is updated automatically and permanently based on a database;
- Its pages are created automatically and dynamically according to the user in a web application;
- The website is created and is administered by its users, by techniques known under Web 2.0.

At the beginnings, each website was accessed by indicating the specific numerical address (IP address). Later on, for the websites have been introduced also the domains names that allow the address in a more comfortable manner using words easy to remember; web sites addresses should be clearly defined, unique in the world and even guaranteed to owner respectively.

A web site usually consists of several web pages, documents that are created using a programming language such as HTML, PHP, ASP etc. being accessible to visitors via the HTTP protocol, which transfers information from the server to a browser. A web page is called so because it displayed on a monitor, it resembles a page of newspaper, and web pages however it can be easily displayed using the normal functions of mouse and browser used by "shooting" up and down. Also, a website can be viewed on any device connected to the Internet able to display information through the HTTP protocol (mobile phones, PDAs, etc.).

A web site consisting of several pages has usually a page called the main homepage, which links to the secondary pages. Structures and schemes "navigation" of the web sites are very different, depending on the goals, desires and possibilities of the owner. Usually this homepage is just the start page of the site, which the owner of the web makes it known to the public as a starting point for all of its content.
Table 2. Specifications of the components of Web service; facilities and opportunities

<table>
<thead>
<tr>
<th>Number</th>
<th>Components</th>
<th>Definitions and content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>World Wide Web, WWW, Web</td>
<td>Part of the Internet consisting of billions of documents stored on the HDD of computers located anywhere in the world, accessible through the network with a navigation program (browser)</td>
</tr>
<tr>
<td>2</td>
<td>Uniform Resource Locator = URL</td>
<td>Each document has a unique address used to access the navigation program. It is written without spaces and is composed of 3 parts: the protocol used, the computer host name and path</td>
</tr>
<tr>
<td>3</td>
<td>Web page</td>
<td>File - document belonging to <a href="http://WWW">WWW</a>. A page can contain text, images, sounds and animated sequences</td>
</tr>
<tr>
<td>4</td>
<td>Web site</td>
<td>A collection of Web pages maintained by a corporation, educational institution, a government agency or even an individual</td>
</tr>
<tr>
<td>5</td>
<td>Hyperlinks</td>
<td>Strings of characters or images whose selection causes display of a page located on the same computer or somewhere on the network</td>
</tr>
<tr>
<td>6</td>
<td>Web browsers</td>
<td>Applications designed to display Web pages. The most common Microsoft Internet Explorer, Opera, Mozilla Firefox, Netscape etc.</td>
</tr>
<tr>
<td>7</td>
<td>Internet Service Provider = ISP</td>
<td>Company that provides Internet access. After completion of the contract, notify the service provider number, user name (as that will make the connection) and a password</td>
</tr>
<tr>
<td>8</td>
<td>Bookmarks</td>
<td>Markings inform the navigation on the display of the contents of a page, but different applications may give somewhat different interpretations placed markings. Displaying the HTML code of a page on the Internet is done by selecting in the navigation option View/Page Source</td>
</tr>
<tr>
<td>9</td>
<td>Search engine</td>
<td>It is a single server that navigates the Internet and catching title, keywords and content of pages that comprise the sites. All pages are found and recorded in a database. When a user searches on a search engine after a certain phrase or word, the search engine will look in that database and according to certain criteria will create a priority list of results that will display as a result. The most popular engines are: Google, Yahoo, AltaVista</td>
</tr>
<tr>
<td>10</td>
<td>Blog (short for web log = log on the Internet)</td>
<td>It is a web publication that contains articles or regular and ongoing upgrade, which usually have personal, as a rule updating blogs is not changing the text so far, but additions to text us, like a journal, all contributions are shown in reverse chronological order. There are several platforms for blogs, of which we mention: Wordpress (the most known and used blogging platform), Blogger, etc.. All blogs and authors of blogs were called Blogosfera. Besides, blogs are one of the many facets of the phenomenon called Web 2.0</td>
</tr>
<tr>
<td>11</td>
<td>Twitter</td>
<td>It is a site founded in 2006 by a private company in San Francisco, California U.S.A., which allows users to write messages of up to 140 characters. It is described as SMS the Internet. Users can send and receive tweeters can sit through the Twitter, SMS, or applications such as ”Tweetie“, „Twitterific“, „Twitterfon“ and „TweeetDeck“</td>
</tr>
<tr>
<td>12</td>
<td>Tag</td>
<td>It is a unique system to promote sites through association with various words and / or phrases considered representative. For each website are generated statistics on the number of visits, visitors IPs, date and time it was accessed the site, etc.</td>
</tr>
<tr>
<td>13</td>
<td>Plugin:</td>
<td>A program that integrates into a site or another program to perform basic specific functions</td>
</tr>
</tbody>
</table>

3. NEW ASPECTS OF THE BUSINESS ENGINEERING

The essence of a business is, ultimately, in obtaining a profit, after meeting the demand from the market on a particular category of goods (product or service).

The architecture of the modern marketing strategy for the selling of a product or service in the current political and economic conjuncture consists of the following steps:

1. Prospecting the market and selecting an application, which currently is not satisfied, the most successful areas are the "niche" domains, which quickly satisfy a particular juncture;
2. A business plan, economical and technical;
3. The production of a certain goods category, at a level of quality and production costs, to create a brand, to eliminate competition and to impose the firm on the market;
4. The whole activity and process stages are IT assisted.

An organization (company) can absorb information from other organizations that are considered market leaders in this field based on the results achieved, aiming at continuously improve them [2].

To achieve this goal can be used benchmarking as a source of acceleration of organization’s progress.

The essence of benchmarking is to choose what is best in a business, to adapt what is best from a company and to continuously improve your operations, by appropriate and specific strategies to ensure success.

Benchmarking is a tool used in management quality, appeared in early 1980 and first time was used by the US company Xerox, following the sudden decline of its market share.

As underlined in a report, the Committee on Industrial Productivity in the Massachusetts Institute of Technology, benchmarking has been in recent years, an essential factor for success of the biggest known organizations in all areas of the economy.
Currently, the rapid development of benchmarking lead to including it in the tools to improve the quality standard "ISO 9004-4: Quality management and quality system elements - Part 4 - Guidelines for the increase of quality."

Specialists have brought a relatively high number of definitions of the new tool used in quality management and marketing. Among the most significant set of definitions are the following:

- In business, benchmarking is a process in which a company compares its products and methods with those of the most successful companies in its field, in order to try to improve its own performance;
- Benchmarking is the process of comparing the cost, time or quality of what one organization does against what another organization does. The result is often a business case for making changes in order to make improvements;
- Also referred to as "best practice benchmarking" or "process benchmarking", it is a process used in management and particularly strategic management, in which organizations evaluate various aspects of their processes in relation to best practice, usually within their sectors. This then allows organizations to develop plans on how to make improvements or adopt best practice, usually with the aim of increasing some aspect of performance. Benchmarking may be a one-off event, but is often treated as a continuous process in which organizations continually seek to challenge their practices;
- Benchmarking is the process of identifying, understanding and adopting the methods and processes of any outstanding world organization, in order to increase the organization’s performance (the American Center for Quality and Productivity);
- Benchmarking represents the research of the best processes, procedures or results relevant to achieve the business targets. Therefore, the goal is to learn to improve ones performance (D.T. Kears – Xerox GM);

There is no single benchmarking process that has been universally adopted. The wide appeal and acceptance of benchmarking has led to various benchmarking methodologies emerging. The most prominent methodology is the 12 stage methodology by Robert Camp (who wrote the first book on benchmarking in 1989):

5. Select subject ahead;
6. Define the process;
7. Identify potential partners;
8. Identify data sources;
9. Collect data and select partners;
10. Determine the gap;
11. Establish process differences;
12. Target future performance;
13. Communicate;
14. Adjust goal;
15. Implement;

There are organizations which use other benchmarks models tailored to their needs (Figure 1).

The mutual beneficial exchange of technical information and documents, technologies and processes for casting, sales opportunities (raw materials, metal and nonmetallic materials ancillary foundry, SDV technologies, equipment technology, casting), can be achieved thru the "SHARED" methodology, as the exchange of multimedia on the Internet (audio or video products).

By applying specific benchmarks techniques, it can be concluded that the firm can reach a level of excellence, to place it among consecrated producers; at the moment is opportune a collaboration between these agents, in which each part has a number of solutions in the field, but who still has development needs. On the Internet is practiced, current and effective, an exchange of multimedia products: movies, books, games, photos, software, etc., in other words, the various users of the Internet "shall jointly share" various goods, generic practice called "SHARED".

“SHARED” is the past and / or past part. Of the “share” noun with the meaning of: part, quota, exchange (give and receive something else similar).

Intransitive verb has the meaning of: "to share, to take part, to participate". In English, in this sense, are usually present the expressions: "to share in", "to share out", “a share in doing something”, “founder's share”, “share in profits”, “to pay one's share”, “to share something with somebody.”

This procedure can be completed within one month, demanding 5-10 days, depending on the size of the organization being evaluated and the evaluation fields.

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**Figure 1. Different benchmarking model**
In this way, it can be achieved quickly and with mutual benefits, a beneficial exchange of technical and technological documents, strategies and sales opportunities, steps and tactics which can assure the quality, the implementation of the most modern and effective quality management systems.

4. EDUCATION AND LEARNING THROUGH THE INTERNET

E-learning methods include traditional techniques or modern technology using IT&C technologies (multimedia processing and communication Asynchronous or Synchronous) leads the subject to obtain experience in understanding and mastering the information and skills in a field of knowledge [3, 4].

In essence, e-Learning provides convenient and efficient access to information and knowledge and a new and effective method of teaching, learning and evaluation of knowledge, training and ongoing training. In this sense, e-learning is an alternative to lifelong learning in the information society of today or tomorrow.

Building an information society (which will transition to the knowledge society) can not be made without research and investment projects, both in the IT&C and education. No technology, no theory, no approach will not eliminate or neglect professor-student relationship. All will be convenient and efficient tools to reach both the teacher and the student. Sometimes these tools may be unique compared to the traditional tools of education. Some representations may be reproduced or simulated only through the computer that offers methods and techniques of graphics, animation and sound.

Educational software means any software in any format (or exe) that can be used on any computer that is a subject, a theme, an experiment, a lesson, a course, etc. as a single solution or alternative to traditional educational methods (table, chalk, etc.).

E-learning technologies that are widespread today are the result of evolution, both pedagogical and psychological methods of education and IT&C technologies (Web technologies, multimedia technologies, communication technologies). Thus, using the Internet, software developing Web products, record audio / video data storage on CDs and the results of implementation of computer graphics it has been made possible the development of online courses, educational software for various disciplines, library and virtual campuses.

In the future, it will appear platforms that are based on management architecture which are using Web services architecture (XML format). Software components and systems will self describe, meaning that thru a standard protocol can be accessed and opened conveniently and efficiently. Many old applications will be improved in this respect. For example, Microsoft is preparing new version of the Windows operating system-named Longhorn-which will provide thru the Microsoft Office package (version 1.1.) the interpretation of the XML format.

For the not too distant future, there will appear the following platforms: Smart Display, Tablet PC, Media Center, SPOT (Smart Personal Object Technology) [5, 6].

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WIRELESS TECHNOLOGIES FOR IMPROVED E-LEARNING PLATFORMS USED IN HIGHER EDUCATION

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ABSTRACT: E-learning is a rapidly evolving domain implying new applications and services based on information and communication technologies. In this context the current paper approaches the problematic of using the broadband wireless technologies (WiFi 802.11n, WiMax etc.) and Internet network in order to realize a platform for e-learning activities between distant locations of the universities. Besides of the description of the platform structure, in the first part of the paper it is made also a comparative analysis of the existing wireless technologies that allows live data communications. The e-learning system presented in this paper is based on client/server architecture. The client applications can be run on cell phones, PDAs, or laptops and the server application can be installed on desktops or laptops. The trainer operates on the server side. To enter the e-learning system, students first need to run the client side application. The students can use various portable devices to communicate with the trainer. For wireless connection to the wired network it is Cisco Aironet 1121 802.11g access point - AIR-AP1121G-A-K9 from the Cisco Aironet 1100 Series Access Point and the interaction between trainer and students it based on wireless video cameras.

1. INTRODUCTION

Institutions around the world are confronted with the challenge of expanding access to education. The demand for increased access comes from a number of different pressures: an increasing percentage of the population participating in higher education; workforce retraining for a dispersed population; population growth in a specific geography; and global demand and opportunities for specialized programs.

Regardless of the reason for expanding access to education, technology should be seen as an enabler to:

- Reach students who can’t (or won’t) come to campus
- Accommodate more learners with a given physical infrastructure
- Prepare to support lifelong learning

“Virtual campuses” can be the instrument in opening facilities to learners. Typically, virtual campuses allow remote access to university courses and course materials, provide electronic communication facilities, and offer teacher support both virtually and through real-time video links.

The virtual campus concept is being further developed to create new ‘workplace’ environments for research and learning, using information and communication technologies (which links up huge arrays of computers) to enable researchers and students to collaborate in virtual laboratories. Because of technology advance, nowadays emerged the concept of mobile learning which represents the newest modality for implementing virtual campuses. Such developments bring benefits for the development of specialized course software, for example – but also create new challenges.

Technical challenges of mobile learning include:

- Connectivity and battery life
- Screen size and key size
- Multiple standards, multiple screen sizes, multiple operating systems
- Repurposing existing e-Learning materials for mobile platforms
- Accessibility and cost barriers for end users

In this context the current paper approaches the problematic of using the broadband wireless technologies and Internet network in order to realize a platform for e-learning in a university campus (between two near laboratories for example) and between distant locations of the university (between two towns for example).

2. WIRELESS CONNECTIVITY FOR MOBILE LEARNING

Currently there are significant efforts in e-learning domain to enable anytime, anywhere access to educational material. At the same time, learner’s expectations regarding the type and quality of content have risen rapidly in recent times, driven largely by their experience with electronic entertainment. To support this development effort there are various mobile terminals (smart-phones, PDA, etc) which differ in terms of data reception, processing and presentation.
Wireless networks such as WiFi, WiMAX and 3G enable the anytime, anywhere paradigm and represents the candidate wireless technologies for e-learning. Using them and implementing mobile computing, can be quickly and cost-effectively deployed broadband communications to areas not currently served, with little or no disruption to existing infrastructures [2], [3].

Benefits of using wireless e-learning methods in higher education rely on the following facts:

- for students and faculty, wireless networking delivers productivity and convenience. With anytime, anywhere access to resources, students can conduct schoolwork in unconventional settings—the campus quad, cafeteria, student centre, library and many other places around the campus. Similarly, wireless enables instructors to deliver lessons outside of the classroom, such as lab exercises in outdoor settings.
- for the IT technicians and engineers that ensure the installation and maintenance of the communication systems, wireless approach represents a comprehensive broadband network solution that can be deployed very simple and without the administrative overhead of traditional wired LANs.
- instructors can complement classroom instruction with on-line activities to create an integrated learning experience.
- by providing easy access to communications tools such as e-mail and on-line group discussion boards, wireless facilitates team building across multiple disciplines.

2.1. WiFi (Wireless Fidelity)

The Wireless Fidelity (WiFi) technology can be used to analyze underlying factors that may impact the successful implementation of e-learning strategies.

Wi-Fi networks are based on 802.11 standards (with his new versions b/g) and evolve higher data rates and better quality of service in comparison with Bluetooth or ZigBee. In the table 1 are summarized the performances of the different version of Wi-Fi networks.

Wi-Fi is similar to a traditional Ethernet model, and requires configuration to set up shared resources, transmit files, and to set up links (for example, headsets and hands-free devices). It uses the same radio frequencies as Bluetooth, but with higher power resulting in a stronger connection. Also, Wi-Fi requires more expensive hardware in comparison with Bluetooth.

2.2. Third Generation Wireless Format (3G)

The 3G mobile phone technology is particularly suitable for developing personalized e-learning systems because of its mobility, portability wherever, whenever, whoever. The relatively high speed data transmission of 3G mobile phones allows an optimal personalized e-learning environment.

The 3G is the third generation of telecommunication standards and technology for mobile networking, superseding 2.5G. It is

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**Table 1. Performance parameters for different categories of WiFi networks.**

<table>
<thead>
<tr>
<th>IEEE standard</th>
<th>Maximum speed of data transfer</th>
<th>Operation distance</th>
<th>Frequency</th>
<th>Type of modulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.11</td>
<td>1 Mbit/s</td>
<td>20-100 m</td>
<td>2.4 GHz</td>
<td>DSSS</td>
</tr>
<tr>
<td>802.11a</td>
<td>until 54 Mbit/s</td>
<td>35-120 m</td>
<td>5 GHz</td>
<td>OFDM</td>
</tr>
<tr>
<td>802.11b</td>
<td>5.5 Mbit/s</td>
<td>38-140 m</td>
<td>2.4 GHz</td>
<td>DSSS</td>
</tr>
<tr>
<td>802.11g</td>
<td>until 54 Mbit/s</td>
<td>38-140 m</td>
<td>2.4 GHz</td>
<td>OFDM</td>
</tr>
<tr>
<td>802.11n</td>
<td>until 300 Mbit/s</td>
<td>70-250 m</td>
<td>2.4 GHz</td>
<td>OFDM</td>
</tr>
<tr>
<td>802.11 y</td>
<td>until 54 Mbit/s</td>
<td>50-5000 m</td>
<td>3.7 GHz</td>
<td>OFDM</td>
</tr>
</tbody>
</table>
based on the International Telecommunication Union (ITU) family of standards under the IMT-2000.

International Mobile Telecommunications-2000 (IMT-2000), better known as 3G or 3rd Generation, is a family of standards for wireless communications defined by the International Telecommunication Union, which includes GSM EDGE, UMTS, and CDMA2000 as well as DECT and WiMAX.

The 3G networks enable a wider range of more advanced services while achieving greater network capacity through improved spectral efficiency. Services include wide-area wireless voice telephony, video calls, and broadband wireless data, all in a mobile environment. Additional features also include HSPA (High Speed Packet Access) data transmission capabilities able to deliver speeds up to 14.4 Mbit/s on the downlink and 5.8 Mbit/s on the uplink.

Unlike IEEE 802.11 networks, which are commonly called Wi-Fi or WLAN networks, 3G networks are wide-area cellular telephone networks that evolved to incorporate high-speed Internet access and video telephony. IEEE 802.11 networks are short range, high-bandwidth networks primarily developed for data. The technical complexities of a 3G phone or handset depends on its need to roam onto legacy 2G networks.

**Figure 4.** Speed versus mobility for different wireless technologies candidate to the implementation of an e-learning system.

**Figure 5.** The data transfer speeds available for different cellular networks including 3G.

**Zigbee** – With effective Communication range of 20 meters and data-rate of about 40-240 Kbps, Zigbee is a new upcoming technology for short-range wireless communications. With low power consumption and less cost compared with Bluetooth and Wi-Fi, Zigbee is a promising technology for applications which are not too much bandwidth hungry.

**2.3. WiMAX**

WiMax, the Worldwide Interoperability for Microwave Access, aims to provide wireless data over long distances in a variety of ways. It is based on the IEEE 802.16 standard, which is also called Wireless MAN. WiMax operates in 10–66 GHz frequency range, a typical cell radius of max. 50 Km and a transmission speed of up to 75 Mbit/s.

**Figure 6.** WiMax connection architecture for mobile learning applications.

The maximum speed anyway is not achieved on long distances. Real world application tests show that 5 to 8 km is a more practical figure. Real world connectivity tests achieve data rates between 500kbit/s and 2 Mbit/s, per user (depending on conditions at a given connection point). This bandwidth is enough to support simultaneous Internet Access, VoIP and IP video for e-learning services. WiMAX technology is evolving rapidly thus ensuring significant performance improvements and expanded service opportunities on an ongoing basis.

The basic difference between WiMAX, 802.16 and Wi-Fi, 802.11 (and related standards) is that Wi-Fi is a local area network (LAN) technology; and WiMAX (whether fixed, nomadic, or mobile) is a wide-area network (WAN) technology.

### 3. THE PROPOSED WIRELESS PLATFORM FOR E-LEARNING

The purpose of this paper is to formulate a functional platform that supports the e-learning objectives: study individually and freely. The proposed platform is integrated with operation system and application software developed with JAVA 2 Micro Edition and Flash Lite version 1.2, respectively. This platform gives learners the ability to learn anytime and anywhere.

The e-learning system presented in this paper is based on client/server architecture. It is intended to be used as a modern didactical method for teaching and evaluation activities in the field of electronics engineering and especially in communication technology domain. The proposed platform use wireless fidelity (Wi-Fi) and Internet technologies in a simple and reliable configuration that enable mobile and adaptive e-learning between two remote didactical laboratories situated at long distance. For wireless connection to the wired network it was used Cisco Aironet 1121 802.11g access point - AIR-AP1121G-A-K9 from the Cisco Aironet 1100 Series Access Point. The client applications can be run on cell phones, PDAs, or laptops, and the server application can be on desktops or laptops. The communication media between the client and the server is Bluetooth, Wi-Fi, Internet.

As main element of interaction between trainer and students it were also been used some wireless video IP cameras of type NC 1200 - W10 supporting 640x480 resolution (VGA) at an frame rate of 25 fps. These cameras can operate with many protocols such: TCP/IP, ARP, ICMP, HTTP, SMTP, FTP, DHCP, DNS, NTP, PPPoE, DDNS.

The interface with the e-learning platform was through Ethernet 100 Base-TX / 10Base-T (RJ45 x 1) or wireless (Wi-Fi) IEEE 802.11 b/g. The trainer works on the server side. After initialization, the trainer will advertise the e-learning.
service by registering the e-learning service in the service discovery database and wait for client’s connections. The students can use various portable devices to communicate with the trainer. To enter the e-learning system, students first need to run the client side application. After the application is started, it will automatically search the available e-learning services. Then the student can select one trainer (corresponding to one e-learning server) from the discovered trainer list. Chosen a specific trainer, the student can login the system with username and password. Once the student successfully logs in, the connection is setup between the client and the server. The client and the server will be disconnected when the student exits the application or the trainer stops the e-learning service.

Our e-learning platform provides five functionalities for the trainer:

• Assists the academic trainer to lecture. The system provides the trainer a visualized graphic user interface GUI). Through the GUI, the trainer can easily know how many

students are currently in the system. He/she can upload the lecture notes or questions and navigate between them. The system also presents visualized feedback information and statistic information, which can help the trainer adjust his lecture according to the responses of the class instantaneously.
• Allows the trainer to propose some summative test on some predefined directions of study (the main directions the students can take classes at the university)
• Interactions between academic trainer and students. These interactions include two parts: get students’ answers to the questions and response back the results to students right away. In addition to that, the trainer can also get instant comments from students.
• Provide statistic information for the academic trainer. The statistic information can help the trainer to know how well the students perform in the class.
• Automatic evaluation to provide results for summative tests so that the employer can set the employment test levels for the new generation of graduates.

Figure 7. The simplified architecture of the proposed e-learning platform. There are used WiFi and Internet technologies in a simple configuration enabling mobile and adaptive e-learning between remote didactical laboratories.

4. CONCLUSIONS

In this paper we have address the problem of creating an experimental platform that use wireless fidelity (WiFi) and Internet technologies in a simple and reliable configuration to enable mobile and adaptive e-learning. By deliberately designing a relatively simple, easy-to-use system we could obtain a good level of acceptance by the users.

5. REFERENCES

NEW TOOLS FOR ENGINEERING EDUCATION IN 21TH CENTURY

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ABSTRACT: Engineering is everywhere. An engineering education starts with a creative child's first lesson in science or math. The teacher who delivers that lesson, and the lessons that follow, is an engineering educator, and the mission of the new skills is to help engineering educators do their jobs as best they can. Today’s technology, though, offers students all kinds of new, highly effective tools to use to learn on their own. The rapid technological progress influences the methods and possibilities of learning and teaching. This paper presents some of the WEB 2.0 technologies and new Google programs that help students and teachers in their activities.

1. INTRODUCTION

Web 2.0 is a term that means a whole lot of interactive and collaborative aspects of Internet occurred in 2004-2005. The term Web 2.0 does not refer to the second version of a software or web techniques. It is a question if you want to formulate it, but it has no clear answer. A simple web search finds hundreds of millions of results for this question. Some possible definitions appear at 10 definitions of Web 2.0 and their shortcomings. The inventor and the promoter of the term Web 2.0 is Tim O'Reilly. He organized the first Web 2.0 conference and described this period as "an attitude not a technology, and more recently Web 2.0 has been redefined as platform within the category of network". The Internet has become a means of transport for conversation and the conversation is happening increasingly in real time; blogging, Podcasting, publishing information, scheduling, all these have become ubiquitous and everyone can participate in these processes. For differentiation, the traditions that existed before the web to the Web 2.0 are called, all symbolic, Web 1.0. According to Web 2.0 content and information on the web are no longer offered to visitors only by media, governments and private firms but also by individuals, linked together through informal networks based on the Internet, and contribute and participate actively in providing and disseminating information across the globe via the web [1]. The most eloquent example includes weblogs, portals, webpage to exchange files, music, movies and software such as Flicker, YouTube and sites for file sharing. Web 2.0 can be viewed as a revolution of broadband map; the user can stay connected to the net all the time being no longer obsessed with the connection fee. The name of Web 2.0 is the second stage in the development of World Wide Web and includes tools as well as services. Techniques used by Web 2.0 dates back in the 90's but nowadays only have a very high prevalence today, blogs, podcast, wikis, collaborative bookmark system, LOL (published by many for many), web APIs, web services online, Ajax, Ruby on Rails, etc..

Since 2005, the terms are defined specifically for Web 2.0:

- Differences between local applications and Web have been attenuated. Many programs update themselves, taking contact with the author automatically, sometimes secretly. In this context, the browser becomes the most important program of the user. The user of the Internet until recently has been to see everything that others have created; in turn, the user becomes a creator of web information through the so-called blogs. Many people do publish their private information.
  - Storing user data, which takes place primarily on the local computer, which will be published later in the web, is firstly displayed on the web. The local access increases the web applications because it leaves the hypothesis of a permanent link to the web. Some Web search engines are able to access local data and also the user.
  - New web-based applications will affect you, even when the wealthy do not have technical knowledge, through shared access to resources, access to information through fresh participation directly via the web so as to spread information and opinions.

Currently, a description of Web 2.0 could be made by means of the following [2]:

- includes a very large range of applications and services using the Web as a platform for unified communication and organization;
- is built on an architecture that encourages the active participation of users;
- allows easy interaction between users who share the same interests.

To provide users so as to be able:

1. to produce content to share with others, so as to increase interaction;
2. an experience much closer to desktop applications with intuitive graphical interface, with a good, programmable, especially transparent interface;
3. to facilitate public access to a database through APIs; has the ability to connect different applications or services and collect data from various sources - RSS, blogs;
4. to talk “about socialization of information - a concept and some applications, the emergence of collaborative tools like Wiki's, a social platforms like MySpace, Hi5, LinkedIn and Second Life, the blogs, structures of communication and data documents, collections of bookmarks (like digg or delicio.us), video clips (YouTube) or images (flicker) etc;
5. a syndication - RSS and structures tags: type classification tree removal and application of labels so as to avoid one being descendant of another but to allow it to be part of several categories;
6. an increased usability - improving the user experience; a democratization of content and distribution (user-created content, distributed freely

RSS is an abbreviation for Really Simple Syndication, and its symbol appears on your site or weblog where it is used. In the educational process, the teacher may create a website or a blog that will present information. RSS Using this updated information in a given time will automatically be directed to all students who have subscribed to the unit website. Web publishers use RSS format to provide easier news headlines published on the site, accompanied by brief descriptions and links to corresponding pages on the site. Lately, more and more sites offering news and press articles have been using the RSS format. It is an open protocol for publishing information on the web. An RSS - Rich Site Summary feed - (known as the RSS feed or RSS channel) is basically an XML file that describes the content of a site that has been updated concomitantly with it. An RSS feed is useful information that should not be included in a regular site that will raise interest in seeing if changes have acquired content. It is enough to use RSS or Atom technology (which is somewhat similar) to receive “alerts” and be notified on delivery of content (whether it is text, image, audio-video or combinations) in the program used to read the RSS information streams, when there was a change of content of the site. Using RSS technology, both a professor and a student can obtain in real time and without too much effort or time consumed information fields and information of interest. Moreover, if we know that the information may be useful to other people and if we can share with them, which is an important aspect of work in cooperation, Web 2.0 specific. In general, RSS can be used in education as follows:

- to improve the visibility of a course that will be bigger, better, simple as to indexing and monitoring;
- Participants may be provided with a list of RSS links related to the analytical program of the course, which may also offer suggestions, that subscribe to and may contain feeds: course website, blog teacher / facilitator, blogs of experts in the field, participants’ blogs, some relevant sites, feeds search for specific terms;
- It is also useful for participants to visit the collections of RSS links of the teacher / facilitator; the other participants can find such RSS links with us. All these are elements that help creating end strengthening community of learning.

Participants may be provided with a list of RSS links related to the analytical program of the course, which may also offer suggestions, that subscribe to and may contain feeds: course website, blog teacher / facilitator, blogs of experts in the field, participants’ blogs, some relevant sites, feeds search for specific terms.

- In a similar manner they can build a list of RSS links relevant to a group working for common interest or practice;
- Students who completed their diploma papers, Masters or PhD under the guidance of a teacher, can suggest for documentation a list of RSS links, which will be upgraded over time.

Examples of web applications for reading streams are: Google Reader, Bloglines, Feedbucket. Browsers such as Microsoft Internet Explorer 7, Mozilla Firefox, Safari or Opera have integrated support for RSS feeds.

The Steps in creating an RSS feed are:

1. RSS desktops and webs are built so as to facilitate the construction of the RSS. RSS Build your hand, its encoding may be achieved using graphic guidance and resources help. Webmasters (or people who post) can control what information to be inserted in the RSS feed, so as to take a decision on whether they should public the

Figure 1. Web 2.0 technologies

2. WEB 2.0 AND RSS IN EDUCATION

Web 2.0 technologies can be used as mechanism of support for training and developing teaching materials, evaluate and analyze student progress, conducting informative presentations and training, planning time, the timetable and schedule of activities, development projects in collaboration, many leading centering on the participant / student are: blogs, wiki sites, RSS, collaborative bookmark system, Podcasting. These technologies are used in traditional education, but also in the continuous or at online. Attributes of Web 2.0 technology is related to:

- easier and faster access to information exactly when and where necessary;
- integration of teaching activities in a variety of Web 2.0 technologies;
- expanded opportunities for collaboration and information through social bookmarking services / collaborative bookmark;
- ways to increase use and teaching practices and the heterogeneity of types of diversity training due to new technologies;

RSS or “Really Simple Syndication (RSS 2.0)” - is one way that can be obtained in real time (within an hour) and free information on web sites is considered to be interesting to one who has established a flow of information. In other words, if while browsing the web we discover some sites whose content has been updated in accordance with your interest and if those sites allow export of RSS, you can subscribe to these updates through RSS technology [3]. So you will receive when you make changes to sites deemed worthy of watching the latest news headlines and articles, some of the content (short summaries), but links being related to them.

Figure 2. The symbol of RSS
whole material or only part of it (especially in articles); Transfer Feed to the server. Once RSS has been built to be transferred to the server this can be done automatically by the software generating RSS. It is placed at the root of the site’s objectives.

2. RSS Notification of the site by use of graphic systems. To make visitors aware of the RSS feed and that is available, use a use graphics on the site. It has become a standard for sites that have such resources to signal through a difference that says: orange RSS or XML.

3. Include information in the HTML page so that RSS readers should automatically detect it. After you publish an RSS it is important to make visitors aware of the fact that the feed exists. Specialized programs will immediately detect it if a small portion of the code will be inserted in the HTML page header.

4. Displaying content on the website Content from a RSS feed can be easily inserted into a website, offering visitors an alternative way to view this content.

Google Labs launched in October 2005 web based products such as Google Reader, which allows reading the RSS and Atom information flows. RSS Reader as we know it day is the interface created relatively recently, at the end of 2006. Information sharing with Google Reader was made simple and diverse, so that everyone can have access to that information. We can choose either to send a link via email (with a brief description of up to 2000 characters of that news), which directs the user (if he/she wishes) to share information, or can choose to create (in fact the application creates a Google Reader) a classic web page (see this effect in figure below) that includes information we share[4]. Such as the times we read information that we want to share with other users, access key sharing, Share, which has the effect of sending information to the others sharing that account. If then we veer round the operation on sharing, access the button “sharing”.

Using RSS technology, a teacher and a student can obtain in real time and without too much effort or time consumed information fields and information of interest. Moreover, if we know that the information may be useful to other people and we can share it with them, this is an important aspect of work in collaboration, Web 2.0-specific. Also, RSS applications are easy to use as interfaces and attractive facilities that can be obtained through the use of their material, determining what we recommend our students to use because they are a real assistance in obtaining resources and complete information, regardless of anyone’s field or subject of interest.

3. GOOGLE APPLICATIONS IN EDUCATION

Google products are the last generation a reflection of the major Web2.0 concept. This software also integrates the latest technologies that have had a major educational impact. Although Google’s mission is to provide the best, easiest, most attractive and fastest experience in retrieving information on the Internet, the developer of the largest search engine in the world by offering the “Google for Educators” a range of applications, less known that allows teachers around the world to enjoy the power of its products in schools. Further we will present some products whose role in the process of education is very important regardless of its specialization (architecture, engineering, geography, literature or mathematics).

Web Search is the most important search engine, this name being associated with the Interne Google provides a number of search methodologies to locate information available on the web as images, video, maps, blogs, and groups.

Google Scholar is an important tool for finding specific information (articles, research papers, doctoral theses) stored on academic sites, libraries, various professional societies or universities, especially in circumstances in which some resources are not available to the public [4].

Book Search is the service offering books in an electronic format (downloadable in PDF format) with full texts of those which are no longer protected by copyright [8]. In this project Google has as its partner’s great libraries and publishing houses worldwide. Books that are still protected by copyright only offer a brief presentation, and provide the text limited. This service has the great advantage that it operates directly in the browser and provides, in addition to the book and different ways of viewing; it can carry out searches inside books. In addition, the user has the option to purchase on-line card you want. Web Book Reader is closely related to Google Scholar order to identify works that make reference to the book.

Afterwards subscribers to the site can search for desired information and are about to reach RSS so that any desired changes should be reported to the user.

Response by the RSS which has been "subscribe" to receive e-mail address specified user whenever a change is made on the connection.
Google Video allows users to view, upload and arrange videos without installing any software [9]. Recent acquisition (2006) of YouTube, which allows the web to share video content online has turned into an extraordinary opportunity for the education sector. The trend is that video with a strong impact will lead to a higher level, beyond the rigidity with which one was accustomed. The most resounding example is given by the University of California Berkeley, one of the most prestigious institutions of higher education in the United States, which decided to post free clips of some of its courses on the website YouTube, particularly on topics such as mediation conflict or biotechnology. The “Reporters’ Center” page has been recently launched; through it students in Schools of journalism were given access to very important people in the field.

Figure 6. Reporters’ Center page in YouTube site.

Google Suggest displays suggestions for similar searches on text that the user wants to find and has that code snippet already typed as a query in the box.

Google News is a news service aimed at those who wish to be informed any time. Google News uses headlines and small pieces of text of articles published by news providers around the world. The News Archive is one of the most interesting features that makes indexation, organization, analysis possible and displays news, articles and information in the archives of Google, according to time criteria.

Picassa is a software offered by the American company that helps users find, edit and share pictures (including video files) by yourself.

Google Blogs creates a weblog of their own for the user [5]. The weblog is another significant tool that can carry out education using a student teacher. It can be used in various fields. Access to information is in both directions, the teacher will display various information on the weblog on which students will contribute through comments they make, the information that they propose.

Figure 7. Google weblog example

Google Sites allows you to create a personalized homepage that gives users access to information mostly on no more than a single page[7].

Figure 8. Google Sites example

Also this enables collaborative access to data by several people. The site can be visited by several persons who may be persons entitled to change the information published “owner”, collaborators, people who can make various suggestions about the information on the site and people who can view information on the site, called “viewers.”

Figure 9. Site share between multiple persons

4. USING THE GOOGLE SITE SOFTWARE IN ENGINEERING COLLABORATIVE EDUCATION

From an educational point of view collaborative education can be extremely important. Tendencies in matters of computer-assisted instruction move on to collaborative educational platforms, meant to meet all requirements of the system’s users. The main approaches of computer-assisted instruction—the educational approach and the technological approach—reflect the transition from the use of methods in the teaching-learning process to the use of concepts, as well as from providing solutions to providing support. Computer-supported collaborative learning (CSCL) is a new branch in the science of learning, concerned with the study of the way people can learn together with the help of computers. CSCL appeared in the 1990’s as a reaction to the computer programs that forced students to learn as isolated individuals. The captivating potential of the Internet of connecting people in innovating ways offers a stimulus for research in CSCL. The collaborative activity determines:

5. Global collaborative innovation, which pools the best ideas, from all the viewpoints, of the product’s engineering;
6. Online creation and collaboration for technology teams, which are dispersed all over the globe in the extended enterprise;
7. One single PLM platform for managing intellectual property to ensure rapid availability of information relating to the product when necessary;
8. A perception similar to reality, which allows users to see the product in realistic virtual scenarios;
9. Ready-to-use PLM operational processes, from the planning of the new product down to its market launch.

Google site is a software that allows rapid creation of a site with functionalities resembling software platforms which need significant investment, especially during this period of crisis.

A first example is the achievement of an online course. The coordinator of the course is the owner who proposes the course syllabus. Concurrently, he can announce the topics, the initial work algorithm. The collaborators within the subject may change the syllabus, the working algorithm, as well as the documents published, they have access to the site and make their contribution in this direction. From the viewpoint of the Google Sites software, they are collaborators, that is, they can modify the materials proposed by the owner, without, however, having the right to modify the aspect and structure of the site. The material devised is then presented before the students, who are visitors and have only the right to see it. For Google Sites they are Viewers. They can send questions and suggestions based on the course seen. Discussions with the students follow and the final variant is established. For example, the measuring of some forces in the splintering process presupposes:

1. The layout of the installation is presented;
2. Its functioning is presented;
3. The experiments are carried out and the results are presented under the form of multimedia elements;
4. The cooperative results are analyzed and commented on.

All the stages presented above are achieved by the collaborative activity of the owner (the teacher), collaborators (collaborators from one subject and groups of subjects) and the viewers (the students).

Another example is the creative designing on the Internet of cutting tools, using Google Sites. A site was designed via which the teacher and the members of the team collaborate on the achievement of the product. During a first phase, those interested may apply, having to pass several tests.

To join the design team, participants must go through the tests, then the results will be analyzed and the candidates having given correct answers to over 95% of the questions will be accepted on the design team. The tests shall be corrected by the research team coordinator.

The analysis criteria shall be set by the teacher but each user who is a collaborator is allowed to propose new ideas; the latter shall be analyzed and, if agreed upon, will be added as new criteria. Setting the most important criteria shall be done by means of a questionnaire.

Each member of the team can use constructive solutions existing in the data bases of the laboratory or of the big, tool-building companies. The solutions in the database of the platform may be filled in by users.

![Figure 10. Test page for the course registration](image1)

To join the design team, participants must go through the tests, then the results will be analyzed and the candidates having given correct answers to over 95% of the questions will be accepted on the design team. The tests shall be corrected by the research team coordinator.

The analysis criteria shall be set by the teacher but each user who is a collaborator is allowed to propose new ideas; the latter shall be analyzed and, if agreed upon, will be added as new criteria. Setting the most important criteria shall be done by means of a questionnaire.

Each member of the team can use constructive solutions existing in the data bases of the laboratory or of the big, tool-building companies. The solutions in the database of the platform may be filled in by users.

![Figure 11. Webpage with important criteria analysis](image2)

For each splintering tool designed, a scoring system shall be set by collaborators.

![Figure 12. Webpage with important criteria for classification](image3)

Each member of the team shall grade on each separate criterion and, function of the main criteria of classification, shall fill in, online, solutions-parameters, being allowed to add images, projects, video.

5. CONCLUSIONS

Using software packages that meet the Web 2.0 requirements and especially Google products are particularly important in engineering education. They allow access to information in various fields which is extremely interesting allowing collaborative work between people from different parts of the globe. Access to multimedia information is an important factor in preparing students. Creating rapid collaborative sites is another aspect worthy to note that the educational process is more efficient.

The positive effects of using Google in education are much more numerous. Among the advantages that clearly contribute to the quality of education, are:

- differentiated pedagogies for student practice; cooperative learning (the active participation of students);
• involvement in carrying out the tasks proposed for learning;
• sharing experiences;
• achieving knowledge transfer;
• confrontation of ideas;
• developing a positive attitude towards learning new technologies and Web 2.0;
• improving the quality of learning and teaching;
• achievement of multiple social interactions;
• development of communication.

It is true that Web2.0 technologies require other ways of exchanging and managing information that we are dealing with a new educational context, with new procedures, roles and relationships in shaping and nurturing the younger generation. But equally true is that while using Google in education seems to be taken for granted at this time, educational efforts undertaken by the U.S. company should turn into an invitation to all teachers to use its services both in the teaching-learning process and the professional development.

6. REFERENCES
5. http://blogsearch.google.ro/?hl=en&tab=wb;
7. http://sites.google.com/;
ABSTRACT: A computerized presentation represents a modern theoretical source for learning. Visualizing the phenomena that take place at the molecular level brings forth a superior understanding and depth for the study. For "visual arts" students and not only, this is an efficient way of presenting the information. In this manner, the paper presents the 3D simulation of the reactions that occur in the tinctorial processes on fabric support - acid dyes.

1. INTRODUCTION

The dynamics of studying processes represents a challenge for the current stage of development in the field. Computers, along with technology, allow the use of new methods in preparation processes optimizing the access to a constant education. This type of education has the major advantage of permitting the independence of time and space and the adaptation of the working schedule to one’s personal needs.

Thus, presentation of a theme using simulation and animation has a great impact, both favorable and efficient, contributing to a better understanding and to a profound study.

In the dying process of the textile fabric and the acid dyes occur chemical reactions that can be simulated dynamically.

The paper presents these chemical reactions divided in different categories of dyes. Both the chemical bonds and the mechanisms leading to their formation are evidenced here. Due to this organization of the material the student can easily: – visualise the dying phenomenon
– distinguish the various structures of textile supports.
– realize the parameters’ influence on these reactions.

The general formulae of an anthraquinonic acid dye and the wool fibre can be considered as given in figure 1 and in figure 2.

2. WOOL - ACID DYES SYSTEM

In the macromolecular chain, protein natural fibres (wool, all silk) contain (1) amino groups (-NH₂), (2) carboxylic groups (-COOH) and (3) peptide bonds (-CO-NH-). Amino and carboxylic groups are placed at the extremity of the macromolecular chains and to the sideway structure of some amino acids.

In terms of the pH dyeing medium, fibres ionization distinct occurs [Figure 3].

Into an acid medium, in the wool fibre, an activation of the amino groups (due to H⁺ ion) occurs, which become adsorption centres for the anions from solution [Figure 4].

Due to the reduced dimension of the anion “X” firstly it forms the salt “H⁺N-F-COO⁻ + H⁺X⁻ → X⁻H⁺N-F-COOH” (reaction no. 1):

\[
\text{H}^+\text{N}-\text{F}-\text{COO}^- + \text{H}^+\text{X}^- \rightarrow \text{X}^-\text{H}^+\text{N}-\text{F}-\text{COOH}
\]  
(1)

An intermediate stage occurs in the reaction no.1, do to the affinity of the proton H⁺ for the carboxylic group (reaction no. 2).

\[
\text{H}^+\text{N}-\text{F}-\text{COO}^- + \text{H}^+ \rightarrow \text{H}^+\text{N}-\text{F}-\text{COOH}
\]  
(2)

Then the salt “RSO₃⁻” “H⁺N-F-COOH” is formed more slowly, replacing the first salt, due to bigger affinity of the RSO₃⁻ ion for the fibre (reaction no. 3).

\[
\text{X}^-\text{H}^+\text{N}-\text{F}-\text{COOH} + \text{RSO}_3^- \leftrightarrow \text{RSO}_3^- + \text{H}^+\text{N}-\text{F}-\text{COOH} + \text{X}^- \]

(3)

Basically it is considered to be an ion exchange mechanism. All this process is represented through a 3D simulation in the figure no. 4, where “H⁺X⁻” represents the uncoloured acid used for the acid medium.
3. WOOL - METAL COMPLEX DYES SYSTEM

Chrome dyes are acid dyes with a complex-forming group, normally 2 OH groups on aromatic ring in an o-position to an azo-group [Figure 5]. With transitional metal ions, particularly chromium or cobalt, this produces a stable dye complex (dye pigment) with the fiber, which considerably improves the durability of the dye and the fastness of the dyeing.

Thanks to their good levelling properties and very good wet fastness after chroming, chrome dyes are used principally to obtain dark shades (greens, blues and blacks) at moderate cost. There are disadvantages, however, in their use: long dyeing times, difficulties with shading, the risk of chemical damage to the fiber during chroming and the potential release of chromium in the waste water.

Comparison of residual chromium content in sewage:
- traditional afterchrome dyeing 20–150 mg/l
- theoretical chromium factor 1–6 mg/l (i.e. in relation to the stoichiometric dye quantities for binding to wool)
- 1:1 metallic complex dyeing 3–13 mg/l
- 1:2 metallic complex dyeing < 13 mg/l

The residual chromium quantities in the sewage from chromium dyeing can be reduced as follows:
- increase the bath exhaustion.
- adsorb excess chromium (III) from the dye solution on the wool.
- the optimum pH of 3.5 cannot be achieved using normal dyeing methods as the pH drifts towards 4.5.

Chroming of dyes is used to form chromium complexes in the fiber, which develops the final shade and improves light-fastness, especially wet fastness. A prerequisite is the presence of complex-forming groupings in the dye molecule, mainly OH- and COOH- groups in the ortho position. Most chrome dyes are soluble in water. These are azo dyes, which have OH-, COOH- or NH2- groups in ortho position to the azo group, and azo and triarylmethane dyes with salicylic acid groups and anthraquinone dyes with OH- groups. Dyes with these groupings form complexes with trivalent chrome, with the displacement of the H atoms in the complex-forming groups.

The chrome atom can form 6 saturated bonds building stable rings with 5 or 6 atoms.

After chromium salt treatment has taken place, a distinction is made between:

I. Pre-mordant process: with wool (mordant dyes; chromium dyes) the application of the dye onto the premordanted wool provides immediate permanent colouring and therefore makes shading easier. However, only a relatively small number of dyes are available for this process. The process is fairly time consuming, provides little fiber protection and is hardly ever used.

II. Single-bath chrome dyeing process: the simultaneous application of dye and chromium salt to wool, and therefore the dyeing and development of the shade is made possible in a slightly acidic bath. Here also dyes with the most rapid complex-forming are selected, having good levelling and similar exhaustion properties from a slightly acidic bath. Special chromium mordants or potassium dichromate and ammonium sulphate is added. Suitable chrome dyes are applied together with special chromium mordants or potassium...
dichromate so that the slowly forming chromic acid pigment is absorbed into the fiber.

The process is important because of the relatively short dyeing time, good fiber protection, low sensitivity to the presence of other metal ions in water, equipment etc. The dyes have good balance and extremely good process and end-use fastness. With dark colours there is a tendency for the dye liquor to show lower exhaustion, which often results in poor rub and wet fastness. Colour levelness is much more difficult for slightly damaged wool.

Union fabrics are dyed using union fabric chromium dyes in the single-bath chroming process. These are dye mixtures made from substantive dyes, using chromium dyes in the singlebath chromium process. Union fabric chromium dyes are only of minor significance.

III. After-chroming dyeing process: achieves the good process and end-use fastness for wool. Dyeing takes place in a slightly acidic bath. After complete exhaustion of the bath, a hexavalent chromium salt is added (usually potassium dichromate), and the chromium pigments build up on the fiber during the rest of the dyeing process. The final colour is only seen after successful chroming, which makes shading more difficult.

Adsorption of the chrome complex dyes follows the same principles as acid dye.

The tinctorial mechanism into the Wool – chrome complex dyes system is essentially based on the forming – after dye and chrome hexavalent salt adsorption – of a complex “keratin – chrome dye”.

From a chemical point of view they can be regarded as acid dyestuffs that contain suitable functional groups capable of forming metal complexes with chrome. They do not contain chrome in their molecule, which instead is added as dichromate, or chromate salt to allow dye fixation.

Whereas in the formed complex there is Cr$^{3+}$, in fact Cr$^{6+}$ (hexavalent) salt is utilized because these are adsorbed / desorbed more rapidly.

When dyeing wool with afterchrome dyes, acidic dyes with groups that can be sequestered are applied and after treated using potassium dichromate. After Cr$^{6+}$ has been reduced to Cr$^{3+}$ (reaction no. 4) by the functional groups of the wool it is probable that a 1: 2 metal-dye complex is formed. A final chroming liquor can contain tri- or hexavalent chromium, whereby the latter represents the most problematic component because of its cellular toxicity.

\[
\text{Cr}_2\text{O}_7^{2-} + 6e^- + 14H^+ \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} \quad (4)
\]

The increase of pH value determines a decrease of the reduction speed. It is proved that for a complete reduction of the Cr$^{6+}$ it is necessary a minimum acid quantity and the chromium sorption process is maximum at the pH = 5.5.


Cr$_2$O$_7^{2-}$ or HCrO$_4^-$ ions resulted from potassium dichromate, respectively potassium chromate hydrolysis and are adsorbed by the wool fibers at the current pH used on for wool dyeing. The adsorption of these ions depends on pH values and on the salts concentration.

The ion species from a dichromate solution mainly depends on pH values. In diluted solutions potassium dichromate is partially hydrolysed, as in the reaction:

\[
2\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{Cr}_2\text{O}_7 + 2\text{K}_2\text{CrO}_4 \quad (5)
\]

The dichromate solution bear a slightly acid medium due to the dichromic acid formation. On the other hand, potassium chromate is hydrolysed (reaction 6):

\[
2\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O} \leftrightarrow 2\text{KOH} + 2\text{KHCrO}_4 \quad (6)
\]

The increase of the temperature determines an increase of the HCrO$_4^-$ ion concentration which will combine with the wool.

Different type of complexes can be formed in which one dye molecule [figure 6] or 2 dye molecules can split.

3.1. Figures

![Figure 5. Chrome dye forming](image-url)
The conclusion of this paper is that the 3D simulations adequately present the dyeing process mechanisms of proteic fibers with the acid dyes.

4. REFERENCES

IMPLEMENTING E-CONTENT IN THE FIELD OF MECHANICAL ENGINEERING – A LESSON LEARNED

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ABSTRACT: E-learning solutions in the mechanical engineering field can be spectacular as design but very hard to implement. This paper provides relevant aspects on designing and implementing the e-plasticity asynchronous e-learning solution within Land Forces Academy, Romania. The obtained results led to the increasing of the e-learning capabilities achieved by the Land Forces Academy. The paper concludes with several recommendations for using e-plasticity educational module and provides future research issues within the plasticity domain.

1. INTRODUCTION

The educational module addresses an issue of wide interest for the academic community, the autofrettaging of artillery barrels, with broad applicability in the military field. The hydrostatic procedure, the first that was used for the autofrettaging of artillery barrels, consists in loading the tube from the inside with a controlled pressure, higher than the pressure corresponding to the elastic limit state, which produces an elastic-plastic state in its wall, with the inner layers stronger plasticized. After the unloading of the tube, considered perfectly elastic, it no longer comes back to its original dimensions, fact that determines the appearance of a state of deformations and remnant tension. In order to analyze the state of deformation and tension in the case of elastic-plastic stress in thick-walled tubes of sufficient length, the plastic flow theory was preferred. It enabled an incremental approach, which complies very closely with the experimental results. The mathematical model was based on this theory. Obviously, the behavior of the material was taken into consideration. In the plastic flow theory, the constitutive equations are formulated incrementally in the form of differential links between deformations and tensions. The coefficients involved in this link are dependent on the tension that is reached.

Due to the complexity of the constitutive equations of the mathematical model, the solution of the problem can not be any other except the numerical one, by using the finite element method. Our own finite element computer application was incorporated into the e-Plasticity educational module [1].

The proliferation of the technology of information and communication led to an exponential increase of the distance education’ programs in all the colleges and universities around the world and especially in the United States of America, where in some years the evolution was spectacular. The engineering courses present a certain domain of knowledge from a specific viewpoint. The interest in the field of Interdisciplinary Engineering Department from the Missouri University can be regarded as a benchmark in this field. The year 2004 through the award won by Timothy A. Philpot and his team including Richard Hall, David B. Oglesby, Nancy Hubing, Ralph E. Flori, Vikas Yellamraju [2], have imposed the e-learning products in the field of mechanical engineering of the Department of Interdisciplinary Engineering.

The asynchronous e-learning solution, e-plasticity, designed and implemented by the authors of this article, sets the Land Forces Academy on an avant-garde position, as far as the e-content promotion in the field of mechanical engineering is concerned. At the same time, it aims to continue to develop the e-learning capabilities accumulated so far and to construct a capability in the field of mechanical engineering e-content. This issue is related to the educational dimension of the Land Forces Academy by developing an educational module for students regarding the theory of plasticity. To implement the Advanced Distributed Learning or e-learning represents the latest initiative in a long campaign destined to capitalize the benefits of information technology and to simulate the development of education and training in the Land Forces Academy [3].

2. THE RESEARCH METHODOLOGY

The research methodology was carried out into a five-stage process. During the first stage, the e-learning educational module was designed, projected and developed. Three principles underlie the design and development of the e-learning module:

- ensuring access to the e-Plasticity module even for those without advanced knowledge of computer use.
- integration of the psycho-pedagogical principles and methods into forms adapted to the age and training level specific to the technical higher education. They will ensure the maximum instructional efficiency of the created content, according to the objectives of the teaching activities.
- compliance with the international standards (SCORM 2004 collection) will ensure that this content is reusable, it can be used on a wide variety of training platforms, and it
facilitates the international integration of the community of those who develop educational content.

During the second stage, the e-plasticity educational module was designed on ToolBook Instructor courseware, which provides a comprehensive authoring solution to create effective software application simulations, assessments, and rich, interactive e-learning content. ToolBook's smart software application simulation recorder and easy-to-use simulation editor help you to quickly develop effective and interactive simulations that automatically assess and record user performances through SCORM and AICC standards.

Figure 1. Example of e-plasticity application window

It is easy to create realistic software simulations. The application’s exportation as a series of DHTML web pages allows students with internet access to view the e-plasticity educational module in a web browser with no Neuron browser plug-in. The use of the DHTML format maximizes the interactivity – including Actions Editor programmed behavior, but older versions of browsers do not support DHTML. The dynamic HTML or the DHTML adds to the HTML the ability to create interactive features, such as buttons that respond to click, running text, animations and many others. The items programmed from the Catalog have these features incorporated. ToolBook Web Specialist automatically converts the application into web pages using DHTML. The factors affecting a DHTML application exported in a web browser are: internet connectivity speed, media file size in applications and page design complexity, all of these contributing to the time necessary for downloading the application. The necessary time for the running of the application in a web browser can be reduced by creating a book designed to use media items and files in an efficient way.

During the third stage, throughout the first semester of 2008/2009 academic year at the Land Forces Academy, the autofrettaging of artillery barrels based on the plastic flow theory was planned for teaching. This subject was taught in three ways: in traditional class, face to face approach, by using a mixed method for the e-plasticity educational module and by utilizing a mixed mode method. Each group included 18 students.

In two weeks, the traditional group studied the basic theory, took up laboratory classes and performed practical exercises in the classic manner of teaching.

The e-learning group was trained for using the educational module. It was distributed to all the students who had Internet access, or via the university Intranet, by means of flexible transfer options. The students could view the course either in a web browser associated to the HTML format (Hypertext Markup Language) or by using the Neuron plug-in to make the course look like a ToolBook book (native file.tbk) in a web browser. Thus, the possibility to distribute the course as a runtime application accessible from the hard disk or CD-ROM was created. The e-learning group was able to use the educational module any time, anywhere they wanted.

The mixed group attended the same classes as the traditional group and the students could use the e-plasticity educational module any time they wanted.

The fourth stage was planned for the assessment of the knowledge and skills accumulated by each working group.

The e-learning educational module was also used for testing the teaching efficacy of the e-learning group. One of the elements that definitely strengthen the e-Plasticity educational module is the Test module. An important part in developing a course is the ability to assess the user’s way of learning in terms of the submitted material. To assist in this requirement, the ToolBook instructor offers question items used in the testing of the students' knowledge.

The question items facilitate the creation of different types of questions, including multiple choice questions, true/false items, fill-in-the-blanks, matching, and others. The question items determine the answers given by the users, calculate the score, and provide feedback. The properties of the dialog box of a question vary slightly, depending on the type of the question item, but most question items facilitate the following: the recognition of each possible answer, the identification of the correct answer, the number of times the student can answer a question, the options to designate a score for the respective question, options for providing feedback to the student [4].

The designed items targeted aspects concerning [5]:

- the quality of the didactic material: is the didactic material sufficient to achieve the learning objectives? Is the difficulty of the material suitable? Is the informational material user friendly?
- the student-centered learning: can students provide feedback? Were they helped?
- the access to the educational items: was the material accessed without problems? Are the components adequate? Were the laboratory applications easily accessible?
- the improvement of the designed activities.
- the planning and the analysis of the educational module design, targeting elements of visual organization, the use of colors, elements of e-reading.

The data we obtained were statistically processed and the results of our study confirm that e-learning enables the introduction of the new formula in teaching mechanical engineering courses based on asynchronous e-content by providing extra information or additional methods learned in traditional courses.

The article also contains the comparison of the efficacy of the traditional, asynchronous and mixed modes of learning.

3. RESULTS

The results obtained for all the three study groups were classified according to the occurrence frequency, calculating the relative frequencies, the cumulative frequency, the arithmetic mean, the dispersion, the standard deviation, and the coefficient of variance.
Data for the traditional group are presented in Table 1. In the final testing, for the traditional group, we have obtained an amplitude of the grades for $w = 2.50$ points, with the arithmetic mean $\bar{x} = 8.28$, which indicates a high level of achievement of the designed educational objectives. The calculated standard deviation, $S^2 = 0.45061$, indicates a very small dispersion, which shows that the obtained grades characterize the group very well. At the same time, the coefficient of variance is very small, $C_v = 8.109427 \%$, which shows a very good homogeneity of the study group.

### Table 1. The results – traditional group vs. e-learning group

<table>
<thead>
<tr>
<th>Grade classes</th>
<th>Occurrence frequency</th>
<th>Relative frequency</th>
<th>Cumulative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1 / 3</td>
<td>5.56%</td>
<td>5.56%</td>
</tr>
<tr>
<td>7.50</td>
<td>4 / 2</td>
<td>22.22%</td>
<td>27.78%</td>
</tr>
<tr>
<td>8</td>
<td>3 / 3</td>
<td>16.67%</td>
<td>44.44%</td>
</tr>
<tr>
<td>8.50</td>
<td>5 / 6</td>
<td>27.78%</td>
<td>72.23%</td>
</tr>
<tr>
<td>9</td>
<td>4 / 4</td>
<td>22.22%</td>
<td>94.44%</td>
</tr>
<tr>
<td>9.50</td>
<td>1 / 0</td>
<td>5.56%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100%</td>
<td>-</td>
</tr>
</tbody>
</table>

Mean $8.28 / 8.17$ Standard deviation $0.45061$ $0.47222$

The results obtained by the study group, for which we applied the asynchronous educational module, are also presented in Table 1. The coefficient of variance is very small, $C_v = 8.41450 \%$, showing a very good homogeneity of the study group, a homogeneity that was also encountered in the case of the study group where the traditional method was used.

We processed the results obtained for the mixed group in Table 2, following the same methodology of statistical processing of the results. The values obtained for the standard deviation and for the coefficient of variance, showed that the homogeneity of the study group is very good and that the obtained grades characterize the group very well.

### Table 2. Results – mixed group

<table>
<thead>
<tr>
<th>Grade classes</th>
<th>Occurrence frequency</th>
<th>Relative frequency</th>
<th>Cumulative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>5.56%</td>
<td>5.56%</td>
</tr>
<tr>
<td>7.50</td>
<td>6</td>
<td>33.33%</td>
<td>38.89%</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>38.89%</td>
<td>77.78%</td>
</tr>
<tr>
<td>8.50</td>
<td>4</td>
<td>22.22%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100%</td>
<td>-</td>
</tr>
</tbody>
</table>

Mean $8.39$ Standard deviation $0.20987$

The results for the three groups are similar, but this does not involve the conclusion that traditional learning can be replaced by forms of advanced distributed learning.

In order to create distance learning programs, fully corresponding to the learning needs of the participants, special attention must be given to the instructional design, to the activity of training planning, which is carried out by teams made up of specialists in information technology and communication, specialists in the field of the approached study, as well as specialists in psycho-pedagogy.

In most traditional education situations, which are face-to-face, all the elements of instructional design are entirely the responsibility of the teacher who leads the activity. This situation changes in the case of distance distributed learning. The leading professor is more of an expert in the respective field of study and can no longer be held responsible for the whole activity of teaching and learning. The development of distribution means of individual study materials, in the case of distance learning, requires team effort, with an important contribution from the designers of the educational-instructive process and from the producers of media technology. When making electronic learning offers, they exploit their specialized skills in various types of media productions, the competences in the field of the topic to be studied and the competences of providing help for learners to cope with the learning situations mediated by technology.

The application of the impact questionnaire aimed at measuring the effectiveness of the three forms of learning. The important responses highlighted the excellent results obtained by the mixed group, as well as the acceptance of the asynchronous e-plasticity educational module (figure 2).

**Figure 2. Overall teaching results**

Furthermore, the application of the impact questionnaire has led to an improvement of the e-plasticity educational module. We made changes to the e-Plasticity educational module, based on the analysis of the responses. These changes focused on: increasing the interactivity of the online learning solution, differentiating the author level and the reader level, using the Actions Editor tools and the OpenScript, using the resources in applications and in navigating within the application.

The elements that the study groups indicated as effective were:
- jumping/moving from page to page by using the menus, the buttons from the status bar or keyboard;
- the intuitive menu and the drag-and-drop capabilities used for creating book pages;
- the hyperlinks, which enabled the users of the application to move from one page to another. Thus, a user can view a page out of the normal sequence of pages or even from another application;
- the visual appearance modification of the objects by changing the line style, the filling color and the filling pattern;
- the text-information correlation. Text fields or recording fields are added to the e-Plasticity module in order to transmit information and instructions. Graphic elements are also added inside the objects-fields in order to call forth interest in the text.

The e-Plasticity educational module combines exercise with demonstration and evaluation. The exercise is interactive and enables the students to experiment with buttons, menus, fields for entering text or other objects in a simulated interface. The demonstration shows the student how to address an online requirement and does not require input data or interaction.
Finally, the evaluation, designed as a test, offers the student only one chance to complete each step in a simulated requirement [6].

One element that can be improved is represented by the software simulations. Most of the students indicated this option as having low impact elements in the presented module. The software simulation enables the students to try the interface of a program or to visualize the steps for the achievement of a requirement. Because a simulation is close to the actual experience of using the software application, it is a very efficient method for learning the procedures and for getting familiar with the program.

The e-Plasticity educational module can be transmitted by means of the Internet or CD-ROM and can be used on any Learning Management System in accordance with the SCORM or AICC standards.

4. CONCLUSIONS AND FUTURE DEVELOPEMENTS

Among the novelties introduced by the scientific research project, both in Romania and worldwide, the most notable are:

- the creation of an educational module in the field of plasticity, an approach that is new both in Romania and abroad, with the incorporation of a mathematical model of solving a non-linear problem by means of an incremental approach of the elastic-plastic solicitation;
- the possibility to develop courses with a psycho-pedagogical value without the help of a programmer;
- the possibility to create e-content of a technical nature.

A big advantage of this new approach on certain key concepts is the fact that the team involved in the project is a complex one, with specialists in the field of mechanical engineering, psycho-pedagogy and professional training, specialists in the SCORM 2004 standard, experienced developers, instructional designers, testers, etc., which ensure the complexity of the solution and the quality of the results [7].

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

One major lesson of this case study is represented by the problems of complexity. With a strong interdisciplinary character, according to the above objectives, the authors, specialists in fields of mechanical engineering, computer science and instructional design and pedagogy, designed and implemented an educational module entitled e-Plasticity. It satisfies the requirements of the beneficiaries of the e-learning courses by: complying with the didactic principles (knowledge systematization, linking theory to practice, intuition principle, accessibility principle, principle of the valid learning results), adapting content to the age, needs and interests of learners, accurately and completely formulating the objectives by using behavioral terms (which involve the mentioning of condition, behavior and performance level), as well as selection of active teaching methods appropriate for e-learning (observation, tutorial, exercise, hypermedia, simulation, discovery learning, demonstration, modeling, problem solving, case study, etc.).

What’s next? New ways of transforming our lives by means of digital technologies have appeared and we have witnessed the emergence of new tools and services in the recent years. Some of these were presented as Web 2.0, others as social software. The significant attributes displayed by these tools and services bear on: knowledge creation, knowledge management, knowledge sharing and knowledge dissemination. These technologies change the way we deal with knowledge. Those involved in education raise two problems: first, they provide the learning process with new instruments, new and useful ways to support learning, and second, they imply that, due to the changing nature of human knowledge management, it is necessary for us to change our priorities when it comes to the things we must learn.

It is important to note that the social software provides a mechanism for the transformation of education [8]; it assigns these technologies for obtaining educational benefits.

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6. REFERENCES

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