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Dear members of the Croatian Academy of Engineering, dear readers!

This past year 2007 was marked by many activities of you, members of the Croatian Academy of Engineering who devotedly made your contributions, as engineers always did, to scientific and specialist domaines, in two directions in particular: by the transfer and implementation of knowledge and technologies from around the world to your working places and by creation and development of new knowledge and technologies and their application in everyday life. Witnesses of your excellency have been your numerous duties and responsibilities as EU experts, reviewers in Croatia and abroad, government officials on all levels, invited lecturers on important conferences at home and abroad, as well as successful managers whose results have promoted high technological know-how applied in their lines of work.

Many times we have been self suppressed and not loud enough about what we do and we have to change that in the future. Therefore, I repeat that whatever surrounds us and whatever is used in every moment is made by engineers. Few times engineers have been criticized, because as a result of our knowledge and its application many problems appear, such as environment pollution or global warming, but without our ability to apply scientific achievements they would not be turned into products of market value and contributed to the welfare of the mankind, so that’s what we have to be proud of and always keep on our minds.

Some may find these words unusual, but they are by all means necessary when we speak about our achievements in the past year and expectations put before us not only in this year, but in several more to come.
At the beginning of 2007 a successful Elective Assembly was held at which we reinforced our Academy by new members from Croatia, and also from Slovenia, Slovakia and Bosnia and Herzegovina. Thus, the Croatian Academy of Engineering has acquired its regional significance as the only Academy of Engineering in this part of Europe which is the member of CAETS and EuroCase, the fact highly evaluated in these international associations that acted as patrons of our last year Conference “Engineering Education”.

2007 will be remembered as the year in which we initiated and succeeded in returning the title of engineer into our higher education system. And that is precisely the proof that we have sometimes been insufficiently alert and that by our own fault, more than the legislator’s itself, such lapses could occur. We engineers know that everything can and has to be repaired, and we have also succeeded here. Not because of us, we have our titles and nobody has deprived us of them, but for the sake of future generations who are going to meet their colleagues all over the world. The task of our Academy is not and will never be to watch its own narrow interests or the interests of its members, but to represent knowledge, creativity and competence in order to prove that we are not only equal, in proportion to the size of our country, but even better than most European countries. If we take a look at huge programmes of the European Union which has a special platform dedicated to “Engineering Education”, if the United States of America announce their programme “Engineering Education until 2020”, then the efforts we have made in the past have not been useless. Without returning of the title of engineer we could not have started our international conference “Engineering Education – the Bologna Process – Three Years Later” which has, under high patronage of the President of the Republic of Croatia, Stjepan Mesić and in attendance of experts from abroad together with our scientists and leading managers, established where we are, how we have prepared for the second part of the Bologna Process in front of us and primarily how we have prepared our students to understand the difference between the former and the new system of higher education. It should be mentioned again that engineering education for the production of the 21st century is essentially different from the one we are having today, since rapid development of technology is going to bring engineers themselves to unthinkable changes in the implementation of scientific achievements. It is on our Academy, perhaps rather than on other parts of the society, not only to keep pace with, but to be active collaborator to thousands of scientists and experts throughout the world gathered around CAETS and EuroCASE. At this very moment you are holding our new Annual which has become an internationally recognized publication (included in the ISI
Periodic Publications) and which has opened Croatian window to the world more than expected, inspired specialists from home and abroad to follow our work and evaluate if we are better or inferior than some other milieus. Average daily visits to our web site (some 420 visits a day) at the address www.hatz.hr from August 2005 have inspired us to make our pages more modern and detailed. From now on each Department, Center or Committee of the HATZ is having its own place where it is going to announce its present and future activities, successes of its members and projects with results comparable to the ones abroad.

Owing to you, members of the Academy there are more and more scientific conferences in which we are co-organizers or patrons such as the last one dedicated to the “Development of Zagreb”, that is indicative of the range of activities I have mentioned.

We have participated in the organization of the Second Congress of Croatian Scientists from Home and Abroad held in Split by the Ministry of Science, Education and Sports of the Republic of Croatia and, as on the First Congress, contributed by our efforts to the affiliation with our scientists abroad and made contacts to be resumed after the Congress itself.

Ethical issues and high ethical behaviour of each individual is a prerequisite for future relations in one’s milieu, as well as for relations between the people in the world. Unfortunately, ever more often we are faced with different kinds of unethical behaviour, so we have put all our efforts to issue a booklet, a Conference Proceedings of our scientists who have discussed about those issues at our Symposium about Ethics held June, 3, 2005. From then on ethical problems not only have not lost on their importance, but their implementation in almost every area becomes prerequisite for adoption and administering of programmes, plans and decisions, as well as relations among people in general.

By means of a growing number of our Centers and their activities through the year we demonstrated that taking over and carrying out different scientific and specialized projects were integral parts of our activities, so Croatian Academy of Engineering was included in the report of the Ministry of Science, Education and Sports adopted by the Government of the Republic of Croatia in July 2007 as one out of four important scientific organizations in Croatia together with Croatian Academy of Sciences and Arts, Academy of Medical Sciences of Croatia and “Miroslav Krleža” Lexicographic Institute.
Dear members and friends of the Academy, we have entered 2008, the year in which we mark 15 years of our successful work and we should express our gratitude to all those who have, with devotion and enthusiasm, built in their knowledge and free time so that we could become what we are today. We should honour our late members and during the year focus on the election of new members, a new and even stronger leadership of the Academy, since in the course of this year elections are to be made the results of which will be announced on the next Assembly in 2009. Therefore, according to the Statute of the HATZ on this Assembly we intend to promote some of our members into members emeriti and during the year have another election for new, even more creative members.

We have entered the process of the foundation of Croatian Chamber of Engineers Technologists for those technical and biotechnical areas which have not been covered by the system of chambers we’ve had so far and for which there is a daily demand. Preparations are made for the Draft of the Act to be submitted to the Croatian Parliament.

Due to the fact that, unlike many others, the Croatian Academy of Engineering is largely performing on the basis of self-financing and on account of its leadership volunteering, the results achieved last year are the more significant. Special thanks should be expressed to our supporting members from business who are donators of our prizes, higher education institutions and members of the Academy the contributions of which make a better part of our budget. In the future it is our intention to increase our activities and to closely cooperate with the Government of the Republic of Croatia and Croatian Parliament on the drawing up of strategic documents for their needs.

Prof. Zlatko Kniewald, Ph.D.
President of the Croatian Academy of Engineering
Part I

Scientific Conference
Engineering Education –
The Bologna Process –
“3 Years Later”

Selected papers from Conference held in Zagreb,
November 8 – 10, 2007
JANEZ POTOČNIK  
Member of the European Commission  
Brussels,  
09.10.2007

Professor Zlatko Kniewald, Ph.D.  
Croatian Academy of Engineering  
By email: kniewald@kroha.hr  

Dear Professor Kniewald,  

Thank you for your email dated 2 October inviting me to attend the conference you are jointly organising with the University of Zagreb entitled ‘Engineering Education – the Bologna Process 3 years later’ which will take place from 8 to 10 November 2007.  

Unfortunately, I regret to advise you that I will be unable to join you in Zagreb due to prior diary commitments that week.  

I wish you all the best with this event.  

Yours sincerely,  

Jan. Potočnik  

Address: European Commission, B-1049 Brussels - Telephone: 00 32 2 298 86 70 - Telefax: 00 32 2 298 82 88
The Bologna process is certainly the most important reform of the Croatian higher education system since independence. The reform changed virtually every part of the higher education sector and in this short text I will present some of the more prominent changes. The review and accreditation process of the old study programmes was undertaken and successfully completed in 2004 and 2005. In all, over 1100 study programmes have undergone an accreditation procedure, and 900 programmes have received accreditation. During the process, which included over 1000 domestic and international reviewers, all study programmes were harmonized with the principles of the three-cycle study system and ECTS credits have been introduced. Thanks to these changes the first cycle of higher education now in most cases lasts three instead of four years enabling students to sooner acquire their higher education qualification and to sooner enter the labour market. Moreover, ECTS credits facilitate student mobility by helping higher education institutions understand more easily the amount of work that a student invested in a particular subject. It is now easier for Croatian students to continue the second cycle of their studies at another institution in Croatia or abroad, and to transfer credits between academic institutions. After graduating from Bologna study programmes all students will be issued a diploma supplement that follows the model developed by the European Commission, Council of Europe and UNESCO/CEPES, in English and Croatian and free of charge. This is a standardized document of all Bologna graduates which describes in detail what type of study
programme a student completed, what their knowledge, skills and competencies are and what is the position of that study programme in the Croatian higher education system. This document will increase the employability of higher education graduates both domestically and abroad, and it will facilitate academic mobility of students. In September 2007 the Croatian Parliament passed the Act on Academic and Professional Titles and the Academic Degree which sets forth a comprehensive system of titles for students graduating from the Bologna study programmes and at the same time sets the rules for translating old academic and professional titles into the Bologna system. It is important to mention that students graduating from technical sciences in Croatia will receive titles that include both the Bologna standardized bachelor / master titles, and the traditional ingenieur title. This stipulation was introduced following a consultation with the stakeholders and ensures comparability of the old and the new student qualifications. At the beginning of 2006 a working group formed by the Ministry of Science, Education and Sports began the development of the Baseline for the Croatian Qualifications Framework (CROQF). After discussions of the draft document with stakeholders, the Croatian Government adopted the Baseline for the Croatian Qualifications Framework in July 2007. The Baseline determines the glossary of terms, outlines the CROQF aims and principles and sets out the credit ranges and qualifications gained. The CROQF allows Croatia to develop a coherent system of qualifications and greatly improve the quality of all forms of education and employability of all citizens. For this purpose, the national committee for establishing and implementing the CROQF was established in September 2007. It may be interesting to note that Croatia has advanced the furthest in the region in developing its comprehensive qualifications framework, and that we have sent the Baseline for the CROQF to other countries in the region as an example of good practice.

In its report on higher education in Croatia the OECD mentions several important areas in which the Bologna reform has had a positive influence on the overall quality: attendance rates in classes have increased, as well as the exam passing rate, courses have been adapted in such a manner to promote learning throughout the semester, the overall quality of study programmes has increased, there is greater emphasis on providing support services to students and the quality assurance system has been reformed. According to the Bologna Stocktaking Report that was presented to European ministers of higher education in May 2007 Croatia has made exceptional progress and received an average grade of 4 (up from 3 in 2005). The Bologna process has also significantly contributed to the strengthening of student role in university governance. Student representatives in the higher education institutions’ representative bodies have suspension veto power over decisions by the Senate which are of
special interest to students (such as the system of study, quality assurance and student welfare). Since 2006 students have been involved in internal quality evaluations by some faculties and universities, most often through student surveys. From the beginning of 2007 the nine-member Board of the Agency for Science and Higher Education includes a student representative nominated by the Croatian Student Council. Under the Bologna reform several new higher education institutions have been established. Since 2005 public polytechnics have been founded in Šibenik, Gospić, Vukovar, Knin and Slavonski Brod, a public school for professional higher education was founded in Virovitica and a new university was founded in Pula. These higher education institutions give students the opportunity to study and acquire higher education qualifications closer to their home, thus significantly decreasing the costs of higher education. The OECD report on higher education in Croatia has explicitly recognized the increase in funding for new academic and teaching staff, most of whom are in regional institutions, and has called such efforts from the Government “impressive”. From 2004 to 2007, 1,457 new jobs have been created in the higher education system. 1,740 jobs have been created for junior researchers alone. Also, since 2005 the Ministry has allocated funds to support the creation of 400 developmental posts in higher education institutions per year. The Bologna Process and Bologna reforms are a long term project which has so far achieved remarkable results. Some of these achievements have been described above, and they were given credit from the OECD report. The results of many positive changes will not be visible overnight, however, and a lot more work, patience and effort is needed to achieve the goal we set in front of us: to become the most competitive educational system in the region.
Bologna Process at the University of Zagreb

Abstract

The main propositions of the Bologna process have been gradually implemented into the activities of the University of Zagreb during the last decade. Today we can distinguish main stages, not only those that already started, but also those that are in front of us. Looking backward, these stages, although were the time steps ahead, were not performed with a sufficient intensity, so that as a result we have a list of open problems which, if will not be properly treated and resolved in near future, could become serious obstacles for the further development of the Bologna concepts. Before going through the main stages, it is worthwhile to add that the main motivation for initiating changes in the Croatian higher education system was related to the prevailing conclusion that many indicators show unsatisfactory state of performance of the system itself. The strategy was to apply propositions of a well accepted European programme to shed light into the most dubious and most critical segments and practices in our higher educational institutions.
Introduction

The Bologna process in Europe dates back to 1999 when the Ministers of Education and university leaders have launched the programme. They gathered at the University of Bologna and agreed upon voluntarily participation in the process without legal binding treaty or regulation. All signatory countries, today there are 45 of them, are taking part in decision made to support and implement principles adopted in ministerial meetings that are organized every two years. From the historical perspective, this is probably the most important higher education reform within European academic community. Nowadays, all country members of the Bologna process are strongly committed to create a European Higher Education Area by 2010. Most likely, in a very near future, higher education experts will be taking 2010 as a milestone when analysing higher education system and its main features.

A management of the Bologna process is given to the Bologna Follow-up Group and each country member has its representatives who together with representatives from the European Commission and other European organizations such as, e.g. the European University Association, the National Union of Students in Europe etc., follow up on the recommendations delivered at the bi-annual ministerial meetings.

The main propositions of the Bologna process have been gradually implemented into the activities of the University of Zagreb during the last decade. Today we can distinguish main stages, not only those that already started, but also those that are in front of us. Looking backward, those stages, although were the time steps ahead, were not performed with a sufficient intensity. As a result we have a list of open problems, which, if they will not be properly treated and resolved in near future, could become serious obstacles for the further development of the Bologna concepts. Before going through the main stages, it is worthwhile to add that the main motivation for initiating changes in the Croatian higher education system was related to the prevailing conclusion that many indicators show unsatisfactory state of performance of the system itself. The strategy was to apply propositions of a well accepted European programme to shed light into the most dubious and most critical segments and practices in our higher educational institutions.
When was the Bologna process initiated at the University?

The beginning of the implementation of Bologna concepts could be traced back to 1997, one year before signing the Bologna Declaration, with initial attempts in the inauguration and gradual implementation of European Credit Transfer System (ECTS). When related to study programmes, ECTS should be based on the students’ involvement in the study, measured by the working time necessary to accomplish given parts of the programme.

Although Croatia was among countries that joined the Bologna Declaration fairly early (2001), it took us another couple years to actually implement study programmes according to the Bologna scheme. All Croatian universities enrolled first ‘Bologna generation’ students in academic year 2005/2006, with an exception at one of the faculties of the University of Zagreb (Faculty of Mechanical Engineering and naval Architecture), which started a year earlier. While the whole education process should be shortened, three level systems, now defined slightly differently as Bachelor (3 or 4 year), Master (2 or 1 year) and Doctoral (3 years) have been preserved. In particular, introduction of three cycles was one of the biggest changes for many European countries and as such required major changes within the whole HE structure.

For the University of Zagreb, as for the national higher education, efficiency is of utmost importance in order to shorten duration of undergraduate study and to improve completion of study. On average, students needed almost 8 years to graduate, and only 40% succeeded. For master and doctoral students there are no reliable statistics, but available data show extremely poor completion. Bearing in mind those facts as well as modest financial resources, Bologna process creates a new framework which could have positive impact on efficiency, faster and more successful exit, and could raise the overall number of citizens with university diploma.

Starting belief was that Bologna process should facilitate better employability of graduates, ‘convertibility’ within European HE Area (and European Research Area), increase of number of individuals holding university degree and improvement of quality of education.

What is behind us?

Once it has been decided to join the Bologna programme, the next stage covered legislative changes in which University actively participated from
2002 on. Although the new law from 2003 provided a framework, a series of practical questions regarding governance and funding of universities, as well as a system of quality assurance, remained unanswered. If they will not be resolved soon, these shortages will be more and more serious obstacles in the future development of the whole higher education system. There are also new laws on recognition, academic titles etc. however, frequently they are not harmonized neither within the national system or European practice and as such their implementation is quite problematic.

Although, there are still many issues to be resolved, the whole process has been definitely speeded up and it seems we are on the way. It is hard to think or argue with sound arguments to go back. However, at the same time, still a lot of work has to be done if we do not want to experience failure, in particular on a quality level of our higher education system. This is not an issue only of the University itself, but a national issue how to gain a good position of our educational system within Europe.

The first step in the introduction of the new study system with bachelor and master degrees was initiated by the University leadership at the end of 2003, with the aim to make preliminary considerations of future curricula in all university units. Benchmarking and the consideration of future demands of job market were the main milestones at this stage. Also, University leaders asked for the considerations of possible horizontal (between various programmes) and vertical (between study degrees) linkages within the University which would enable more intense mobility of students and staff. This stage was completed by the fall of 2004. Some units made a considerable progress, while others remained at the formal level. The consequence is that today we encounter more and more questions on the reliability and purpose of study programmes or their parts, while the questions of relations between bachelor and master programmes will very probably come into focus in next few years when the master programmes will be in the process of realization.

When comparing University of Zagreb with other European universities, it is clear that, firstly, we have extremely high number of bachelor programmes and there is almost one to one correspondence of bachelor and master programmes. This will enable students in between programmes mobility as well as bachelor programmes will produce to narrowly educated graduates with questionable competencies for employment. Because of blurred picture of their own competencies after the first three years of university education and confusing messages that students are receiving from the world of work, there is a tendency of escape – the con-
tinuation of education. Enrolling into the second cycle is not negative per se, however, it should not be a consequence of badly structured system and disharmony of reformed higher education and still not prepared working environment. In order to overbridge some of those problems, and to help its students, University of Zagreb tried to develop communication with representatives from different relevant institutions (i.e. Chamber of commerce) and to introduce all relevant information regarding new scheme of education as well as to develop better mutual understanding.

The formulation, submission and evaluation of new study programmes was a final step, done in the first part of 2005, before engaging a first generation of students from the fall 2005 on into the Bologna study system. Again, some programmes were well prepared, while others were more or less a formal transfer of old contents and methods into a new framework. In addition, little was done towards establishment of a consistent system of programmes at the university level. Parallelisms, lack of prerequisites for intra-university mobility, lack of links between complementary and equivalent programmes were issues noticed already then, but relegated for future considerations and improvements. The reason was not only the lack of time. University was, and still is, too fragmented to be able to undertake a qualitatively new approach supported by appropriate decisions. However, this process of rationalizations of the entire university study system is an inevitable necessity which will have to be reopened very soon. The characteristic example of this kind related to technical disciplines is the lack of cooperation between faculties in the planning and performing of modules of basic parts of curricula common to almost all corresponding study programmes.

On the other side, it is becoming more and more evident that an issue of the working load, number of courses per semester as well as type of exams and the way they are performed is becoming more and more a topic to be resolved. In many cases students are overloaded within courses (i.e. their working load) and in total number of courses they have; teaching style and the way of evaluating students’ work and knowledge (competencies) did not change significantly and/or sufficiently; and the overall result is that there is a real danger that the final number of students which will be ready to enrol in Fall in first semester of master programmes will be very low. Therefore, it is possible to identify problems on the level of individual programmes and/or within the University structure. Accordingly, it seems unavoidable that both top-down and bottom-up approach will be needed to produce qualitative changes and to synchronize the whole system.
Although ECTS has been implemented and it has been quite long within the University system it is still not in its full and adequate implementation. Credits were distributed mostly with respect to the staff involvement (hours of lectures, seminars etc). There is still no clear feedback from students of the actual working load they have within individual courses, neither there were systematic approach to collect those data (with some exception within some faculties or performed by individual teachers). The consequence is that presently, firstly students, and then others, recognize disproportions which often directly affect efficiency in studies, and are a source of many discontents. To improve this situation, it is necessary to make a systematic survey of students’ working load, and to use a rule already introduced in the University statute (about 28 to 29 hours of work corresponding to one ECTS credit). This is an urgent task since all experiences show that few years are needed in order to get relevant indicators.

Third cycle of education, with two type of studies according to our law, has been introduced, but it is still in the very initial phase. At the moment University has approximately 60 doctoral studies approved or in the process of accreditation. However, it is still far away from the point when we will be able to state confidently that we succeeded in organizing research based doctoral programmes with efficient and productive doctoral candidates. We are faced with nonexistent scheme of financial support of doctoral programmes, doctoral programmes that are much more alike to old type of master programs, but now lasting three years, unresolved issue of teaching load when teaching at the doctoral programmes level etc. One of the consequences of such a system is that completion of doctoral programmes is very low (according to some data only 20%, while in well organized universities in Europe is between 70 and 90 %), fairly small research productivity (i.e. published papers) of doctoral candidates and absolute closeness towards international doctoral candidates.

University introduced quality culture, but it requires much more nurturing, as well structuring. Although some instruments have been implemented (such as students’ evaluations) this is just a bare start and there is real thirst of introducing mechanisms which will help better understanding, support and promotion of quality culture which will need to become an inherent part of every single individual within the academic community and not forced from the top.

Two years of practising of new programmes indeed shed a light on real and deep problems accumulated during years, as it was expected. Lack of space, equipment and other material resources, and particularly lack of
various profiles within the teaching and research staff, are now much more evident than before, in particular when they are related to more demanding standards inherent to the principles of Bologna process. It is now an obvious and widely accepted fact that it is not possible to accomplish successfully a demanding reform like that launched by Bologna process without a considerable increase of financial means necessary for the improvement of basic conditions necessary for such endeavour.

What is in front of us?

Some important ingredients of Bologna system, like internal and external mobility, new research-based system of doctoral studies, system of life long learning, etc, are still waiting for more serious treatment. Solutions to all these open questions are, as a rule, all related to the further integration of the university at both functional and organizational levels.

Existing ECTS system needs to be revaluated and adjusted according to feedback that will be collected from students. Most likely, at least in some cases, major changes will be needed, which could have an impact on the whole structure of programmes as well.

This fall first master cycle students will start and we are still facing many unanswered questions. We need to prepare a package of information for students as soon as possible. Accordingly, as University, which declares to be a research university, we need to develop mechanisms and to attract the best students in order to broaden the scope of our master and doctoral students. To do that, we need to develop clear strategy how to become an attractive learning environment, both for our national students and for international students.

Further, it is necessary to establish research-based doctoral system. Doctoral candidates must be provided with adequate research conditions and good mentoring system, which will be reflected in doctoral thesis within the time framework (preferably not more than 4 years) and productive publishing.

When talking about life long learning (LLL) there is still remarking vacancy. This should be changed as soon as possible, on the faculty level as well as on the university level as a whole. This is an aspect of HE functioning in which on the national level we are lagging behind significantly when compared to other European countries.
In time that is in front of us, a special attention needs to be paid to existing (and accredited) bachelor programmes – they need revaluation and redefinition, at least in some cases. It is important to work on intra-program mobility. Mobility in general is an issue that University considers as very important for further development of university. At the Moment University prepared Action Plan for Mobility approved by the Senate, however, real work is actually in front of us – to put it in action. Of course, significant work needs to be performed by the University, but actual results will not be achieved without adequate support by the government and relevant Ministry. And finally, the issue of exam system as well as grading system needs to be discussed and rechecked by the whole academic environment. It seems that this aspect of Bologna process has been neglected up to now, but slowly it is becoming evident that this could be also an obstacle in successful implementation of the Bologna process.

**General obstacles** are both internal and external: human resources are still insufficient (there is unequal distribution at the university level); there is a need for better and more equipment and facilities in general; better funding; but also readiness for change; as well as recognition of new degrees and/or competencies changes outside academia.

**Instead of conclusion**

By 2010 we will have first generation of graduates of two cycles. This fact will definitely change our map and will have an impact on market, regardless the fact how quickly the outside world is ready and willing to change. University is and will be the generator of those changes. However, this imposes additional responsibility on us to produce changes marked with good quality. University is part of the social environment and we cannot dissociate us from that fact neither we can close ourselves. As much as university can influence the changes and it has the strength and power to generate them, it also must be tuned to the needs of the world outside academia. All the programmes (end ECTS) should be reviewed, but, at the same time there is a clear need for governmental and academic incentives. Nowadays, the role of all participants of higher education changed. Both students and teachers need to become more proactive, and due to bigger demands here is a clearly identified need for better support and better structured higher education in general.
Some European Experiences with the Bologna Process –
Results of an Euro-CASE Questionnaire

Abstract

The present report firstly gives an outline over the relevance of the worldwide educational market and the requirements on a modern study of engineering. Due to the importance of the worldwide educational market the Bologna process – which is so crucial for Europe – plays a prominent role. A questionnaire initiated by Euro-CASE shall shed light on what progress was made and which differences still exist in the respective countries, particularly in regard to the division in FH and TU-formation, the final degree, the professional qualification of the bachelor degree and the mobility of the students.

Concluding, a few suggestions concerning the Bachelor/Master degree formation are presented which were elaborated by the German academy of science and technology (acatech).
Some introductory remarks on the future of Engineering Education in Europe

The education of the oncoming generation plays a key-role in global competition. This perception by now has widely spread which can be evidenced by the dynamic development of the educational market. In (1) instructive reports and numerical data are published of which only a few are singled out here:

- The total market in the world today is 13 Billion US $ and is growing to 225 Billion in 2020!
- 2.5 Million students study overseas each year and the number growing!
- 2025: 7.5 Million students are expected to seek education outside their home countries
- English courses are available worldwide increasingly
- Netherlands: more than 50% of master courses are in English
- New Zealand: international students in 1997: 4,000, in 2004: 21,000
- Japan: 1/4 of the students are foreign students
- The market increases rapid by, particularly in Asia and the developing market
- Market analysts predict: global market for e-learning will increase form 8 Billion (2005) to 26 Billion US $ in 2010!
- In the USA: 65% of graduate schools offer online courses available to students worldwide

One important point in the future engineering education is a change of education philosophy. In (1) there are many contributions concerning this matter, like:

- Engineering education today based mainly on the profitability in the global market magnifies deficiencies as irrationality, parochialism, haste, sloppiness and selfishness
- We need to favour an education that cultivates the critical capacities and fosters a complex understanding of the world and its people and that educates and refines the capacity for sympathy cultivating human beings, not only producing useful machines
- Teaching not only technical issues. Teaching humanity should not be neglected!
- The ability to think critically, to transcend local loyalties and to approach international problems as a ‘citizen of the world’
- To be intelligent readers of other people’s stories and to understand their emotions and wishes
– To cultivate our students ‘inner eyes’ we need carefully crafted instructions in the arts and humanities, which will bring students into contact with issues of gender, race, ethnicity and cross-cultural experience.

Europe will have a big chance including this education philosophy into the curricula to attract students from all over the world. Particularly students from Middle East and Africa should be educated in Europe to support poor regions by knowledge in order to contribute more stability and scientific growth in these areas.

The European Bologna Process can be a big chance to meet this challenge if the design of the future Bachelor and Master courses are based on the above mentioned new philosophy and the intended goals of the Bologna Process are reached.

Euro-CASE has therefore started a questionnaire in 2007 to analyse the state of implementation of the new Bachelor and Master System.

In the next chapter the results of this questionnaire which was initiated by Claude Maury (Secretary General at CEFI – Comité d’Etudes sur les Formations d’Ingénieurs) and which was supported by 13 European countries are presented.

**Euro-CASE Questionnaire and Results**

In 1999, 29 European countries signed the declaration of Bologna which requires all European universities to establish a Bachelor / Master System for their curricula until 2010. Within three years, all students in Europe should have a unique degree and an optimum of mobility should be realised. Here are the questions and the answers:

**a. Distinction between scientific-oriented and technology-oriented courses**

- In a majority of European countries a distinction was made before the Bologna process between scientific-oriented courses and technically-oriented courses (as in Germany between TU-TH and FH)

**How to characterize, today, the situation in your country:**

– this distinction did not exist: **Czech, UK, France**
– this distinction has been kept with clearly different degrees (BSc and BEng): **Belgium, Hungary, Netherlands, Norway, Portugal, Sweden, Swiss**

– this distinction has been dropped out: **Germany (partly)**

- **Do you see this evolution as:**
  - positive: **Czech, Netherlands, Portugal, Swiss**
  - negative: **England, Germany, Spain**
  - no clear opinion or no evolution: **Belgium, France, Hungary, Norway, Sweden**

b. **Reference to a professional title of “engineer”**

In the older times, most European engineering courses were leading to a title of Engineer (having a professional touch) at the end of the engineering studies.

– it was not the case in my country: **England, Portugal**

– it was the case and the title of engineer has been dropped out: –

– it was the case and the title of engineer will be given at the bachelor and at the master level: **Belgium, Germany partly, Hungary, Sweden**

– it was the case and the title of engineer will be granted at one unique level

– either at the first level: **Netherlands, Norway, Spain**

– or at the second level: **Czech, France, Netherlands**

c. **How will the new two tier system work?**

- The new scheme of studies which has been introduced according to the Bologna declaration may be used (and understood) in three ways: **Which one is the most likely to come in your country?**

  – the first level (bachelor) should be (or become) the reference level, as it is around the world in most countries: **Germany (only for FH)**

  – the second level (master) should remain the reference level, the bachelor level being mainly a mobility point: **Belgium, Czech, England, France, Germany (only for universities), Hungary, Portugal, Sweden**

– our practice should stay more open, avoiding any model as it is allowed by the Bologna Declaration: **Netherlands, Norway, Spain, Swiss**
Are the three year graduates actually acceptable by the market?
- Yes: England, France (but not engineers)
- With (some) difficulties: Czech, Hungary, Norway, Spain, Sweden
- Not really and decisions were made to set up: Belgium, Netherlands
- 3 1/2 years bachelors: Germany
- 4 years bachelors: Portugal

d. About mobility
- Is there any concern around a decreasing international mobility during the bachelor studies?
  - Yes: –
  - A little: France, Hungary, Norway, Portugal, Sweden
  - Not at all: Belgium, Czech, England, Germany, Netherlands, Spain
- Is there any concern around a too strong mobility after the first cycle (students changing institutions after getting their bachelor)?
  - Yes (already now): –
  - A little or could come in the future: Hungary, Portugal
  - Not at all: Belgium, Czech, England, France, Germany, Netherlands, Norway, Spain, Sweden

e. Information about Bologna elsewhere what do you know about Bologna in other countries?
- we don’t know much: Hungary, Norway
- we are rather well informed: Belgium, Czech, England, France, Germany, Netherlands, Portugal, Spain, Sweden, Swiss

Recommendations from acatech German Academy of Sciences and Humanities

In the following a list of recommendations concerning the Bachelor / Master courses is presented. This recommendations were worked out by a working group of acatech (2).
Differentiated course profiles at institutes, universities and universities of applied science

Differentiated course profiles at institutes of technology, universities and universities of applied science are meeting the requirements of industry and should remain in place for future Bachelor’s and Master’s degree courses.

Attract teachers with industry experience

To preserve the special focus on application in the training of engineers, and on scientific research at institutes of technology and universities, any proposals that would enhance opportunities to produce excellent university teachers with industry experience have to be supported.

Co-operation between academic institutions and industry in engineering education. The culture of co-operation between academic institutions and industry is the backbone of successful engineering education in Germany. It therefore deserves continued support and must be extended even further.

System of quotas

Restrictions to the transition to a Master’s degree course should be determined by no other party than the academic institutions themselves. Prescribed quotas, of any shape or form, are counterproductive and, consequently, must be rejected.

Duration of Bachelor study

For Bachelor courses, the recommended length of basic and specialist studies is six semesters, plus additional time for practical modules and three months for preparing a Bachelor thesis to obtain professional qualification.

Master as the paramount objective of Engineering courses at institutes and universities

The paramount objective of Engineering courses at universities should be to produce highly, scientifically qualified Masters of Engineering. University financing must meet the requirements to achieve this goal.
Consideration of the suitability of applicants for a course and students

To take better account of the suitability of individual applicants for a course, and of actual students, it is strongly recommended to implement measures such as aptitude assessment at the beginning of the course, selection processes or orientation exams, as well as study progress control with obligatory interviews.

Flexible transition between Bachelor and Master courses

To avoid unwelcome effects on the duration of study, legislation should provide for flexible transition between Bachelor and Master courses, to allow provisional admission, for a limited time, to the Master course before the Bachelor’s degree is completed.

International recognition of the degree holders

As one of its core tasks, the Accreditation Council and the agencies it co-ordinates have to ensure that the accreditation of degree courses, as practiced in Germany, must directly result in Europe-wide recognition of the respective degrees.

To ensure global recognition of degrees awarded in Germany, it is also essential that the Accreditation Council provides the conditions for Germany’s full membership of the Washington Accord.

The Dipl.-Ing. degree

The Master’s degree awarded by institutes of technology and universities is equivalent to the internationally recognized Dipl.-Ing. degree. This equivalence should be highlighted by an appropriate notice on the degree certificate and/or diploma supplement.

Conclusion

Engineering Education in Europe plays a strategic role in the global competition and must be one of the best of the world. The Bologna Process has to be optimised in the next few years. But the specialities of a University / Curriculum should be conserved. The goal of future curricula
must be considered increasingly the combining of technical, natural sciences and part of human sciences. The global problems cannot be solved only by technical solutions. We need engineers with sensitive eyes for the need of the society. Euro-CASE can play an important role in this process by analysing this progress, by discussing the problems and by developing solution within the Euro-CASE network and with partner institutions.

**Literature**

(1) “Newsweek” – August 21, 2006/ August 28, 2006

(2) “Bachelor- und Masterstudiengänge in den Ingenieurwissenschaften”, acatech BERICHTET UND EMPFIEHLT – Nr. 2, 2006
Engineering Education in CAETS countries

Abstract

At first, the mission of CAETS (International Council of Academies in Engineering and Technological Sciences) is clearly stated and the major issues of concern of the member engineering academies are summarized.

One of the major concerns is promoting R&D and education for engineers as is clear from a recent INAE-CAETS Conference on International Engineering Education (Indian Institute of Technology Madras, 1-2 March 2007). A summary is given of the main presentations and some general conclusions are put forward.

Mission of CAETS

The mission of CAETS is clear from its mission statement: “to foster effective engineering and technological progress for the benefit of societies of all countries” through:

a. The exchange of information e.g. identify the main issues of concern (CAETS Convocation, Tokyo, 2007) of the member engineering academies:
– climate change due to human activities,
– sustainable energy: prepare the exit of the carbon-fuel based era by
  i. energy saving
  ii. more renewable energy (wind, solar, hydro, biomass)
  iii. CCS (carbon capture and storage)
  iv. nuclear power (3rd and 4th generation nuclear reactors),
– modification of social infrastructures (more public transportation …),
– development of Global Climate/Earth/Ocean Observation Systems,
– clean (drinking) water supply.

b. Promoting R&D and education for engineers.
   In this respect the following subjects are of major interest:
– shortage of engineers (except in China, Korea, Russia, …) will hamper
  the economy,
– more female engineering students are needed,
– more hands-on experience (exp’l teaching) needed in primary and sec-
  ondary schools, using e.g. renewable energy or other socially motivating
  topics as a subject,
– more inspiring information is needed for the press and for the second-
  ary school teachers.

Several conferences, dealing with these problems, have been organized or
(co)sponsored by CAETS. The latest was held this year in Madras and
was organized by the Indian National Academy of Engineering (INAE),
jointly with the Indian Institute of Technology Madras. A digest of the
major contributions is given in the next chapter.

About the INAE – IITM – CAETS Conference on International
Engineering Education; Madras; March 1-2,2007

**Major objectives** of the Conference were:

• exchange of information on individual National Engineering Education
  systems of CAETS Member Academies,
• compilation of “Fact Files” on the engineering systems of Member
  Academies,
• promotion of interaction between Fellows of CAETS Member Academies,
• sharing of experiences and learning of Best Practices from each other,
exploring the potential for bilateral / multilateral collaboration, 
• focussing attention on Engineering Education as an important concern of Engineering Academies.

The Conference was attended by Fellows from the following eight CAETS Member Academies: Australia, China, Germany, India, Japan, South Africa, United Kingdom, United States.

Summary of presentations

1. Engineering Education needs to be re-engineered taking into account the emerging trends in the inputs, the output requirements, the environment or ambience, and the strategic goals.
   • The new millennium paradigm for Engineering Education is emerging as a multi-disciplinary, multi-media, and multiple – partner enterprise.

2. Some of the major challenges facing Engineering Education for the XXIst century are :
   • broad-based university graduate programs for easy mobility (e.g. interdisciplinary Erasmus exchange program in the European Union),
   • flexibility to adapt to new and changing technologies,
   • curricula have to be dynamic and flexible, due to the fast development of technology.

3. A recent UK industry survey revealed that:
   • university courses need to provide more experience in applying theoretical understanding to real industrial problems,
   • they need to recognise the changing requirements of industry, to attract and maintain the motivation of students,
   • practical application, theoretical understanding, and creativity and innovation are seen as the top priorities for future graduate skills.

4. China has made huge investments in Engineering Education:
   • it has a large engineering workforce, 
   • some of the challenges facing engineering technology in China are: 
      – high energy consumption in production, 
      – inadequate investments in R&D,
– high dependence on imported technology,
– lack of innovative products,

• some of the emerging trends in engineering education in China are:
  – turning theory into practice,
  – promoting inter- and cross-disciplinary research,
  – intensifying research-based education,
  – emphasising on continuing lifelong education, and
  – internationalisation.

5. The recent economic development in India has its roots in the large and rapid expansion of higher technical education, combined with widespread non-formal education in the area of information technology.

• On the negative side, the quality of Engineering Education has suffered grievously on account of a severe shortage of faculty as well as Ph.Ds.

• Research is non-existent in most of the Engineering Colleges.

6. Industry perspectives for Technical Education in India include the following:

• engineering curricula should include considerations of cost, productivity, quality, safety, problem-solving, management, etc.,
• increase in number of postgraduates employed in industry,
• practical research in tune with industry requirements,
• upgrading the skills of unemployed and under-employed engineers to make them useful.

7. Europe is a relatively small and densely populated continent with rather limited natural resources.

• It is therefore necessary, in order to maintain global competitiveness, to exploit the only resource that increases while we use it viz., education and creativity of its people.

• The Bologna Treaties have opened up opportunities for students to study in different universities and different countries, thus providing them international work experience, as well as necessary language skills and acquaintance with different cultures.

8. Technology-Enhanced Learning, which exploits the developments in information and communication technology (ICT) over the past few decades, appears to be the only way to enhance the quality, and in-
creases the reach of engineering education in India and many other countries.

- The goal is to develop web- and video-based learning resources for University Science and Engineering courses, in order to enhance the reach and quality of technical education in the country (cfr. more than 1800 MIT open courses, free available on the web).
- In India it is intended to launch a Virtual University in the near future, taking advantage of the experience of some other countries (open university, distance university).

9. The role and significance of higher technical education is increasing in the emerging Knowledge Economy.

- Meaningful collaborations with international institutions involve: study abroad programs, academic exchanges, internships abroad, university partnerships, re-modelled curricula including foreign languages and cultures (cfr. Erasmus exchange program as well as the Bologna process for higher education in Europe aiming at improving student mobility).

10. The lack of sufficient numbers of engineers trained in South Africa is a potential limiting factor in the technological development of the country.

- Increasing the number of engineering graduates is, however, not a simple matter, given the history of the country, and the poor base in science and mathematics teaching at school level.
- The University of Pretoria has put in place initiatives to overcome these problems by broadcasting Open University courses.

11. Engineering supports the sustainable development of the society.

- Prevention of injury, accidents and disasters caused by technology, as well as prevention of destruction of a social order by technology, are important social subjects for “technology-oriented global society” in the XXIst century.
- Key issues in this regard include: Engineering Ethics, cultural analysis of Code of Engineering Ethics, international collaboration for solving problems for our sustainable future, etc.
- From discussions it became evident that the cultural outlook on ethics may be different: “Autonomy” is the basis of the US model of Code of Ethics, while “harmony” is the basis for the Japanese model.
12. Unwise and unethical application of Science and Technology can lead to several adverse impacts.

- Engineering Education, in addition to imparting technical knowledge and skills, must educate engineers on their ethical responsibilities.
- Professional societies across the world should endeavour to develop an internationally accepted code of ethics for engineers, for incorporating in the Engineering Curricula.

General Conclusions

The world is facing huge problems, mainly due to the increase of its population. All resources (natural resources, water, air, energy, …) are finite and depletion or pollution is threatening. Major developments of technology can alleviate the problems. Therefore, more well-educated scientists and engineers are needed.

Unfortunately, a severe shortage of engineers is threatening in most countries. This will hamper further expansion of the economy as well as easy adaptation to a changing environment. Raising interest of the youth (particular of female students) in technical sciences is at premium.
Globalization of Continuing Engineering Education and the Bologna Process

Summary

The evaluation of the consequences of the Bologna Declaration in Hungary and also in other countries is possible only, if we take into account the present surrounding, which is today our globalized world.

Our lecture deals – among others – with the different aspects of globalization, with the “half-life” of an engineering degree, and also with a very positive consequence of the Bologna process: with the increasing mobility of engineering students and engineers worldwide.

Our experiences underline the new role and importance of continuing engineering education and the continuing professional development (CPD) as a demand of all increasing economies. This demand is continuously increasing in Hungary.

The Bologna Declaration led fundamental changes of the architecture of European higher education.

From one side more and more engineers will work across national boundaries, from the other side it is not clear yet – at least in Hungary – the ef-
fect of the introduction of two-tier structure in engineering education for the labour market.

Most of our Universities introduced – but not at the same time – the B.Sc.-M.Sc.-PhD system, based on the Bologna Declaration, but general feedbacks are to be waited only within the next 3-5 years.

Seneca: No age is too late to begin learning

Globalization is a reality today

The quick development of computer science and the modern telecommunication has changed our world, and the Continuing Engineering Education found itself in the centre of GLOBALIZATION.

When we look to engineering of the next decade, we have to ask basic questions about future engineers – who they will be, what they will do, where they will do it, why they will do it, and what this implies for continuing engineering education. To compete in world market in the “knowledge age”, we can only thrive on brainpower, organization and innovation (1).

Different aspects of globalization

– Globalization of the world market
– Development of global communication systems
– Globalization of international institutions in the field of higher education, environmental protection, security policy, etc.
– Globalization of political systems.

The half-life on an engineering degree

The half-life of an engineering degree is approximately 3-7 years depending on the types of different professions. Therefore the continuing engineering education is essential in all engineering profession.
Increasing mobility

One of the aims of the Bologna process is to facilitate convergence of the various higher education systems in Europe towards a more transparent system using a common framework based on three cycles: Bachelor, Master and Doctorate(2). As one of the consequences of the Bologna agreement, an increasing mobility of engineers is to be seen worldwide.

The role of engineers in the interest of increasing welfare of the societies

It is more and more evident, that a new approach to characterize the power of a nation is the knowledge to be found in the minds of engineers, medical doctors, scientists, industrial and agricultural workers, managers and administrators, etc.

The engineering profession represents worldwide an essential bridge between the science and technology, and therefore also between the science and society.

Response of the engineers in a globalized world

Engineers see themselves as and integral part of a global society. The well-known slogan “think global, act local” is part of their philosophy of life. Engineers have the will and ability to work across all political, cultural and ethnic boundaries.

The necessity of updating of engineering teachers

With the fast technological changes engineering professors will be forced to develop and update their knowledge and improve also their pedagogical skills. They have to differ clearly the difference between the contents of the B.Sc. and M.Sc. curricula.
The new role and importance of continuing engineering education

As a consequence of the fast technological changes, all engineers have to follow the quick changes, not only in the field of engineering, but also in the field of connecting areas like economy, law, standardization, etc.

Social impacts of continuing engineering education

Continuing engineering educational programs can often be effected by collaboration at the international levels, particularly in developing countries. Collaborations between developed and developing countries, engineering schools can be effective.

Africa – usually – does not have the entrepreneurial spirit we may find in China and in India, and there is a wide gap between science and practical applications. Through proper continuing engineering education courses this gap can be decreased.

The impact of globalization on sustainability

The continuing engineering educational courses must deal also with methods and technologies, which are suitable and beneficial for decreasing the harmful effects of globalization on sustainability, for example like how to avoid global warming. This is one of those areas, which has to be integral part of the continuing professional development, because in many B.Sc. and M.Sc. courses this most important area is missing today.

Strengthening academic/industry cooperation

It is very important to strengthen cooperation among engineering schools and industry for mutual benefit. Quite a few European countries today also offer a more application-oriented engineering education as well, typically of 3 or 3.5 years’ duration. Continuing engineering educational pro-
grams must in all cases satisfy the industrial demands and must take into account the educational background of the audience.

The role of internationalized engineering education in the age of globalization

The study abroad programs are very useful for the engineering students first of all in the postgraduate programs.

More and more engineers will work across national boundaries, and therefore they must understand the cultures, traditions and languages of countries where they will work or where their products will be utilized.

Driving force for globalization of R+D+I (innovation) in our decade

The key driving force for globalization of R+D in the last decade has been increasing demand for skilled scientists and engineers. The existence of international market for research and education investments is leading the firms to direct their investments to those geographical areas which can meet their up-to-date research and manpower needs. In our days the innovation ability of individuals and firms becomes more and more important, so the R+D+I activity of a local or an international company is essential today.

Continuing engineering education in developing countries

It is fact, that the existence of Bologna agreement accelerated the mobility of creative engineers. In those cases, when engineers from developing countries come and stay in advanced scientific and technological centres of developed countries, they may collect high-level knowledge and take back into their home countries.

When foreign engineers come to work and teach in developing countries, their continuing engineering courses contain advanced knowledge and technological solutions.
Summary

The Hungarian Academy of Engineering promotes the development in Hungary in every scientific professional field which is in connection with the development of technologies, using the multidisciplinary knowledge of its members as well as their international acknowledgement and experience.

The Bologna Declaration led fundamental changes of the architecture of European higher education.

The effect of the introduction of two-tier structure in engineering education for the labour-market is not clear yet. How the application-oriented shorter engineering education should fit into the Bologna scheme remains an open question (3).

This question is open in Hungary also today. Most of our universities introduced – but not at the same time – the B.Sc-M.Sc-PhD system, based on the Bologna Declaration, but general feed-backs are to be waited only within the next 3-5 years.

It is evident, that as a consequence of the Bologna Declaration the importance of the continuing professional development (CPD) has significantly increased, the interest towards the different up-to-date postgraduate courses have also increased in Hungary, and the Hungarian Academy of Engineering will support all initiatives, which promotes the CPD activities in the country.

References


Bologna Process – Quo vadis?

Abstract

In the first part a historical overview is given over the development leading to the Bologna declaration and the follow up decisions in political meetings and/or discussions leading to the initiation of the Bologna Process. This process together with other issues in the Bologna Declaration finally has led to the implementation of the new structure of higher education consisting of undergraduate (bachelor-), postgraduate (master-), and PhD (doctorate-) studies.

The basis of the implementation was laid by specific laws from the legislative bodies in the respective countries who signed the declaration. Unfortunately, very often representatives from academia were not sufficiently involved in the discussions before some of the political decisions were made. Therefore, most universities were not very much in favour of the new structure substituting existing educational programmes which were developed more or less homogeneously over a century. Sometimes the flexibility was reduced by laws much more restrictive than the recommendations suggested in the Bologna Declaration.

A review will be given of the state of art of the Bologna Process in particular with respect to the major engineering programmes in Austria.

Finally the plus and minus will be weighed against each other from the author’s personal point of view.
**Introduction**

The Bologna Declaration from 1999 initiated a process of changes of the educational systems at university level in all European countries as never seen before. Sooner or later the countries who signed the declaration and those who joined the process at a later date issued laws which forced the university to change their educational systems even when the former system was considered as successful. During the preceding discussions and disputes the Bologna process was supported by politicians and industry while the academic community was rather sceptic and sometimes heavily opposing the changes. While Industry was interested in employing young engineers as early as possible the academic community was afraid that the level in education would be reduced and would not be appropriate in particular for engineers.

Today the process has started in almost all European countries. Discussions and disputes will fade out sooner or later since, based on political decisions, the respective laws have set the issue in concrete and made the Bologna Declaration undisputable.

However this conference offers an opportunity to evaluate the progress of the Bologna Process and to learn from other universities about the best practice they use implementing the Bologna Declaration.

**History**

The Bologna Process started in May 1998 in Paris at the 800th anniversary of the Sorbonne in Paris when the ministers of Germany, France, Italy, and the United Kingdom signed the so called Sorbonne Declaration. This declaration and in particular the phrase “Harmonisation of University Systems” initiated heavy discussions.

After a working group meeting in Baden near Vienna in 1998 a conference was prepared to take place in Bologna. At this conference to which all EU-, EFTA and EF-TA/EWR states were invited a study was worked out concerning the *Trends in Higher Education in the EU and EFTA/EWR states*.

As a result of the minister conference in Bologna the so called **Bologna Declaration** was signed by 31 ministers from 29 states. The goal is to
create a European University Space whereby the objectives of the Bologna declaration are as follows:
– adoption of a common framework of readable and comparable degrees, "also through the implementation of the Diploma Supplement";
– introduction of undergraduate and postgraduate levels in all countries, with first degrees studies not shorter than 3 years and relevant to the labour market;
– credit systems compatible to the European Credit Transfer System (ECTS) also comprising lifelong learning activities;
– generation of a European dimension in quality assurance, with comparable criteria and methods;
– elimination of remaining obstacles concerning the free mobility of students (as well as trainees and graduates) and teachers (as well as researchers and higher education administrators).

After the Bologna minister conferences had taken place more or less every second year a further minister conference was organized dealing with higher educational issues which can be seen in Table 1 (1).

Table 1. Bologna Follow up Conferences

**Prague** (2001)
– Promotion of Life Long Learning
– Participation of universities and students
– Promotion of the Attractiveness of the European University Space

**Berlin** (2003)
– PhD studies as 3rd module
– Review for the 2005 Minister Conference
– medium term goals (2005): Quality assurance, 2-stage studies, recognition

**Bergen** (2005)
– Framework for Qualifications in European Higher Education
– graduation and recognition of joint degrees
– flexible combination study including the recognition of earlier studies
– Synergies between European university space and European research space

**London** (2007)
The Bologna Process at Technical Universities and “Fachhochschulen” in Austria

In Austria the transition from the old Diploma studies (5 years) to the 3 years undergraduate (Bachelor-) studies and the 2 years postgraduate Masters studies is almost completed for most curricula at the Universities of Technology in Graz and Vienna according to probably most restrictive laws within the European countries.

Table 2 shows the continuous transition of the programmes to Bachelor and Master Programmes from 2000 to 2006.

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<th>2006</th>
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<td>MSC</td>
<td>0</td>
<td>27</td>
<td>42</td>
</tr>
<tr>
<td>Dr.</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PhD</td>
<td>n.a.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TU-Graz</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diploma</td>
<td>12</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>BSc</td>
<td>0</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>MSC</td>
<td>0</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Dr.</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PhD</td>
<td>n.a.</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

According to the University Law 2002 executed in 2004 the Bachelor study is a 3-years study whereby the curricula have to comprise the equivalent of 180 credits according to the European Credit Transfer System (ECTS) while the Master study is scheduled for 2 years and the equivalent of 120 ECTS credits. With few exceptions this law is the same for all universities leaving not much flexibility with respect to the differences in the requirements for different programmes. Only few exemptions are made as for instance in medicine.
Since the traditional title “Dipl.-Ing.” (diploma engineer) stands for highly qualified graduates both Austrian Universities of Technology in Vienna and Graz decided to keep this title. Therefore the new formula is:

\[ \text{BSc} + \text{MSc} = \text{Dipl.-Ing.} \]

This formula shows that the idea of comparability of the degrees as demanded by the Bologna Declaration will be still difficult to achieve. Nevertheless, very often titles still will differ from country to country.

As far as the 3 + 2 years structure is concerned it should be mentioned that according to information received from students it can be expected that more than 90% of them intend to continue their studies in master programmes after they have graduated as Bachelors. This in fact makes the transition from 5 to 3+2 years programmes more than questionable.

One particular problem in Austria is that among of the Technical Middle Schools we have the Fachhochschulen which educate engineers who are very much practice oriented. Like the bachelors at the universities their students graduate (also with the degree of a bachelor) after 3 or 3.5 years (3, 4). The questions which arise are:

- Is the bachelor graduated from a universities a duplication of the bachelor graduated from a Fachhochschule?
- If not what is the bachelor from the university prepared for research and development in industry or
- are the universities aware of this dilemma preparing the students for the master courses which, however, is not within the interest of industry?

According to a study of the German VDE fig. 1 shows the requirements of industry with respect to Diploma Engineers (MSC) versus Fachhochschul- and University Bachelors.

The ratio between the two groups in various departments of industry is

\[ \text{MSc (Dipl.-Ing.)} : \text{BSc (+ FH)} = 43.6 : 56.4 \]

Can these requirement be satisfied by the universities and Fachhochschulen?
In Austria the answer is: Not at the present stage for the reasons given below.

Due to the *numerus clausus* and the entrance examinations the number of graduates from the Fachhochschulen is limited. The universities could provide the bachelors needed since there are no *numerus clauses* and no entrance examinations necessary to start to study at the university. However, if most of the graduated bachelors continue to study for the master degree the number of bachelors leaving the university also will be limited. Even if the bachelor programmes at the universities are appropriate for industry requirements.

In my opinion the only chances to get more bachelors from the universities to industry are either

- To introduce entrance examinations for the Master Programmes
- To select the best bachelors for the Master programmes or
- Industry is paying reasonable salaries attractive for graduates to leave the university voluntarily.

The future will show what has to be changed in the system.

**Figure 1.** Engineers in industry
Mobility

If the remaining obstacles to the free mobility of students are eliminated by the Bologna process, seems not quite clear to me yet, since in separate discussions with a Vice Dean for Education and a Vice Rector for Education of the same university two inconsistent answers were received. The one stated that after the change of the programme structure a remarkable increase of incoming students from abroad could be recognized while according to the information received by the other the increase was because of a very active staff member of the faculty. Unfortunately, at the present state the author could not perform a satisfying analysis since no data before 2005 were available as can be seen in Table 3

Table 3. Mobility of students (2)

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TU-Vienna</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students</td>
<td>19.250</td>
<td>16.536</td>
<td>17.559</td>
</tr>
<tr>
<td>Outgoing</td>
<td>1.6%</td>
<td>1.5%</td>
<td></td>
</tr>
<tr>
<td>Incoming</td>
<td>1.9%</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td><strong>TU-Graz</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students</td>
<td>10.831</td>
<td>8.937</td>
<td>9.397</td>
</tr>
<tr>
<td>Outgoing</td>
<td>1.9%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>Incoming</td>
<td>1.9%</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td><strong>All Univ.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students</td>
<td>242.598</td>
<td>217.651</td>
<td>224.119</td>
</tr>
<tr>
<td>Outgoing</td>
<td>1.5%</td>
<td>1.5%</td>
<td></td>
</tr>
<tr>
<td>Incoming</td>
<td>1.5%</td>
<td>1.5%</td>
<td></td>
</tr>
</tbody>
</table>

Some information, however, can be extracted from Table 4 showing the statistics concerning the number of non-Austrian Students. In this table an increase from 18% to 22% for the University of Technology in Vienna and from 11% to 16% for that from Graz can be seen within the time span from 2000 to 2006.
Quality Assurance

In 2004 an Austrian Quality Agency (AQA) was established with the following objectives (5, 6):

- Support and coordination of evaluation of the universities with respect to education and organisation
- Development of quality standards and certification of quality management concepts

I personally believe that a critical self-evaluation is necessary. However, the real evaluation of engineering education programmes is done by industry employing our students and integrating them in the development and production process. This kind of evaluation happened anyway since engineering programmes have existed. Industry ranks the universities and their programmes according to the quality of their students. Unfortunately, the delay time of the feed back is very long (6 years minimum). This delay plus the time necessary to provide appropriate changes will add up to at least 10 years.

Accreditation

Another concept to keep a high quality standard is to have an appropriate accreditation system. Such a system as the Accreditation Board for Engineering and Technology (ABET) in the United States would be ideal on a European level. These evaluations or accreditations of universities, however, are very costly and mostly can not be afforded.

Table 4. Percentage of non-Austrian students (2)

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2005</th>
<th>2006</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>TU-Vienne</td>
<td>18,0%</td>
<td>21,4%</td>
<td>21,7%</td>
<td>27,3%</td>
</tr>
<tr>
<td>TU-Graz</td>
<td>10,5%</td>
<td>15,6%</td>
<td>15,6%</td>
<td>20,4%</td>
</tr>
<tr>
<td>All Univ.</td>
<td>14,7%</td>
<td>19,9%</td>
<td>20,4%</td>
<td>20,1%</td>
</tr>
<tr>
<td>FH-Vienna</td>
<td>6,9%</td>
<td>6,1%</td>
<td>6,4%</td>
<td>10,9%</td>
</tr>
<tr>
<td>FH-Graz</td>
<td>1,3%</td>
<td>3,7%</td>
<td>4,1%</td>
<td>5%</td>
</tr>
<tr>
<td>All Fhs</td>
<td>3,5%</td>
<td>6,9%</td>
<td>8,8%</td>
<td>9%</td>
</tr>
</tbody>
</table>
Another problem for such a centralized accreditation system is that very often the various governments who administer the governmental universities want to be independent and autonomous without too much interference from outside.

**Accreditation bodies in Austria**

In Austria for **federal universities** there exists no accreditation board. The programs are developed by the universities themselves and finally approved or accepted by the Federal Ministry of Science and Research.

For **private universities** the Austrian Accreditation Council is in charge. This council provides the institutional accreditation, including the accreditation of programmes.

The third type is the “Fachhochschul-Council” for **Fachhochschulen**. The council consists of three Austrian and 5 international experts. The council approves new programmes and courses and evaluates them periodically as well.

**Questions not answered yet**

Three years ago I presented a paper at the HATZ Colloquium in Zagreb in which I raised the following questions (7):

- Were the former educational systems as bad as sometimes stated?
- What are the industry requirements?
- Do our universities educate engineers to meet the requirements of industry and/or small and middle sized companies?
- Is the 3+2 structure the proper system for engineering education?
- Would the majority of graduates leave the universities after 3 years or continue for the Master?

Some of the questions I tried to answer in this presentation. However, I am afraid most of them can not be answered yet. It is still too early for it since neither the universities nor industry have enough experience yet. Let’s hope the future will show the improvement and deficiencies of the new structure as soon as possible so that the system can be improved and optimized.
Conclusions

In the conclusion I will try to underline some positive and/or promising aspects initiated by the Bologna Declaration.

- In the course of restructuring the educational programs rigid structures were broken, new courses were introduced and outdated were updated or eliminated. Unfortunately, sometimes programmes were straightened at the costs of basic and fundamental courses.
- New programs were organized and implemented
- BSc may decrease the “drop out” rate which in Austria still is rather high. However, most of the student drop out within the first two years of the curriculum.
- In Austria the number of examination units was reduced remarkably at least for the engineering education programmes
- Quality Assurance by self evaluation is a good start. It is a first step on the way to a European system of Quality Assurance and Accreditation.

I wish the Croatian universities much success in their own Bologna process and let us see in 2010 if our goals are achieved as codified in the Bologna Declaration.

References and used Resources


Richter, K. R., Bologna Process – Quo vadis?
Bologna Process – ICT Industry Expectations

Abstract

Today’s ICT (Information and Communication Technology) industry is a very propulsive and challenging area, with constantly increasing expectations related to business performance, high quality of products and innovation. To enable a sustainable ecosystem that can support such expectations we require competent employees ready for a life-long learning and capable of dealing with continuous change. The article analyzes the current business environment and trends with respect to the need of constant knowledge development and adopting new ways of working. It points out the main human, business and professional/technical competences that are needed to support a development environment within ICT industry. The competence development is analyzed taking into consideration what an employee who starts working brings from a university and what steps need to be taken in order to make a newcomer operative in an ICT working environment. A particular emphasis is put on the shortest possible timeframe within which this has to be accomplished. The technical competence is the essence of what students gain during the study programs at technical universities and the Bologna Process opens additional skill and knowledge requirements that can support a faster involvement of newcomers in an industrial working environment. The article also touches upon some ongoing activities undertaken in the Research and Development Center in Ericsson Nikola Tesla in cooperation with local
technical universities at building a more competitive and competent workforce and taking into consideration the concepts on which the Bologna Process is based.

**Key words:** ICT industry, Bologna Process, competence

### INTRODUCTION

The purpose of the Bologna Process is to facilitate the Europe-wide implementation of comparable and compatible quality standards related to higher education and academic degrees. This initiative was named after the city in which it was proposed – Bologna, actually after the University of Bologna, where the Bologna Declaration was signed by ministers of education from 29 European countries in 1999. In the meantime the initiative was opened to other countries that are signatories to the European Cultural Convention of the Council of Europe. The basic idea is to enable EU to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion (European Council, Lisbon, March 2000) (1, 2). This idea promotes ICT industry as the driver of economic prosperity and establishes the need of ICT industry’s strong cooperation with education and academic organizations in a struggle for better prospects for all. The possibility to gain relevant education is an essence of economic success, both on the individual and collective level. It is quite obvious that education is a long-term investment. A well-positioned economy will utilize relevant professional knowledge and transfer it to profit that can enable general social growth.

Through different historical periods (the era of individual work, the era of manufacture, the industry era) we find new paradigms to enable the streaming and usage of our knowledge for the production of additional values enabling new products and services and better standards of living. The today’s process of globalization requests from all of us a new way of thinking and different skills that can enable us to provide a part of that additional value and face the global time and profit pressure. The globalization brings to all of us daily concern about efficiency and the value of our results. Meeting the growing time and quality expectation in the global race for profits puts forward new requirements. One answer to them is to work more, but we are limited by our physical capabilities – our intellectual and bodily energy can take us forward in a sustainable
and productive way for a limited period of time. Another option is to work smart, not hard. The “smartness” we refer to here is contained in relevant knowledge that can drive us faster to solutions and to adopting an innovative approach when a solution to a problem is needed. This is the only way to survive in the global business arena. A very important element in enforcing innovative thinking is the ability to accept and lead change. Today there is an abundance of different sources of information and via Internet technology everyone can benefit from that, provided that the information are put to use in the right time and with the right purpose. This can make the difference between business success and business failure. We are living in the age of information that drive today’s global economy. Therefore the ICT industry is the driving force in the race for profits: it helps other industrial branches to produce added value leading to growth of profits.

Having relevant knowledge helps us differentiate really valuable data from the randomly accessed information. This is the key to success. There lies the essence of the need of collaboration between the business organizations and education institutions. In general, education institutions have an important role – to produce proper mindset for potential workforce and to direct them along the path of life-long learning. That is why an industrial view on the ongoing changes in high education is important. It can help new employees to fulfill the expectations imposed on them within their business environment and enable them to generate wealth.

This article is organized in five chapters, the first one being the introductory one that you have nearly read through. Chapter two deals with the global status of ICT industry and ICT trends regarding the industry’s expectations for the absorption of new knowledge. The third chapter discusses the global labor market and building of global and local highly educated workforce. The fourth chapter analyses the best practices in Ericsson Nikola Tesla, the leading Croatian ICT exporter, with reference to collaboration with the local education and academic community. The fifth chapter gives a detailed overview of working conditions in ICT industry and expectations that the newly employed need to meet in order to be successful. The article ends with conclusion remarks.
ICT INDUSTRY STATUS AND TRENDS

In a nutshell, the ICT industry of today is characterized by globalization, time and profit pressure. Understanding the principles on which modern organizations base their operation and fostering innovativeness are crucial traits of all involved in ICT industry. The omnipresence in all vital industrial sectors is another prominent feature related to ICT industry. Every industrial sector today depends on communications because having the needed information at the right time makes business decision making process more efficient. ICT industry is under constant pressure to secure comprehensive communications services with high requirements regarding bandwidth (the amount of data transferred between communications entities over a time period) and availability of different services (voice, data, video), both topped up with guaranteed quality. This requires a proper network infrastructure (fixed, mobile, ad-hoc, etc.) for interconnection of end-users around the globe and appropriate terminal equipment. Here the today’s trends are aimed at making the user personality visible in the communication environment and full mobility for same services.

Ericsson’s Role

Ericsson is the global technology leader in ICT industry. Ericsson’s local companies are located in 140 countries around the world, which makes a powerful global network of ICT experts committed to innovation. The corporation’s international operations span more than 125 years. Today the Ericsson brand is in particular strong within the area of mobile infrastructure and in setting the industry’s standards in the mobile communications area. Ericsson is listed on all main stock exchanges in the world as an industry entity with high potential. Today it is very important to have the right product at the right time and very often innovativeness has to be secured through strategic partnerships to enable broader portfolio. However, Ericsson builds its own innovative R&D community and, to enable its market success and sustainable development, the corporation has industry’s highest R&D investments. The corporate R&D centers worldwide are shown on Figure 1.
Ericsson in Croatia and its R&D Center

One of the biggest R&D centers in the corporation outside Sweden is located in Croatia. The R&D center in Croatia has about 600 people working in Zagreb (400 experts) and in Split (200 experts). The main activities of this Center are related to software development and testing for signaling products, but the organization is also involved in the software integration and verification projects and packet platform development. Over a few past years R&D Centre in Croatia has grown in responsibilities and, consequently, in headcount: 350 graduates from the university have been taken on over the past three years.

The Figure 2 illustrates the employee statistics for R&D Center in Croatia in correlation with overall data for Ericsson Nikola Tesla, the Croatian company in which it is a hosted function.

As shown in Figure 2, the high education is the main prerequisite for getting employment in R&D Center in Ericsson Nikola Tesla. The message that also comes across from the Figure 2. is about a balance of years of service and relatively young average age of employees. This fact positions R&D Center in Croatia among organizations with the highest potential in Ericsson’s R&D community. R&D Centre in Croatia makes almost a half of total headcount of Ericsson Nikola Tesla (43%).

Fig. 1. Ericsson’s R&D centers around the world
Ericsson Nikola Tesla is the leading ICT company in the region and is perceived as an employer of choice. For ICT experts it is very important to have an opportunity to deal with the cutting edge technologies because, we have to admit, for most of them this was a decisive factor in the choice of a career. This is precisely what Ericsson Nikola Tesla provides its employees with: an opportunity to work with the exciting state-of-the-arts ICT solutions and services. It is a company enabling them to make the most of their knowledge and to be a part of the global professional scene.

The general trend in ICT industry is the increasing need of modern ICT companies to get on board more people with university education. Ericsson Nikola Tesla, and its R&D Center in particular, exploits all the advantages of a solid Croatian education system teamed up with a favorable price-performance ratio. This has opened a possibility for the company to lead the regional ICT market.

Figure 2. R&D employee statistics
ICT companies insist on having the educated workforce because it has greater potential for production of new ideas, concepts and products for ICT solutions. At the same time highly competent ICT experts can support other industrial segments that use ICT solutions. Namely, the application of ICT elements in business changes business behavior and that requires educated personnel to accept and drive the changes. The education systems therefore have to produce available resources to support such demanding trends. It is a well-known fact that in the economically developed countries around the world the study of engineering is not generally popular and the technological companies often resort to the educated workforce from the less developed countries but with good technical education system. Another trend is to start development activities in the less developed countries because it is easier to find competent technical staff and, as a rule, due to the circumstances on the local labor market they cost less. Thus companies spent less money for development of new product. As a result in developing countries ICT is strongly perceived as a driving force of the prosperity. The world’s biggest developing countries today are India and China.

The boom in engineering studies in India is catching up with the same trend China (3). China is today the largest producer of engineering graduates in the world, with some 600,000 who graduated from their colleges and universities in 2006. India, it seems, isn’t far behind. According to the All India Council for Technical Education, India produced 401,791 engineers in 2003-04, 35 percent being computer engineers. In 2004-05, the number of engineering graduates increased to 464,743, among whom 31 per cent were computer engineers.

Compared to India and China, the United States produces only 70,000 engineering graduates every year. All of Europe produces just 100,000. India currently has 113 universities and 2,088 colleges, many of which teach various engineering disciplines. Engineering colleges in the country have been growing at the rate of 20 percent a year, continuously taking on more and more students, while business schools have grown by 60 percent.

If we take in the consideration that today the largest hardware production in the IT (Information Technology) sector is placed in China, it is clear why they have to produce so many educated engineers. A very important thing regarding the building of technical workforce through a
high education system is that it has to be planned and it takes a long period of time. One cycle in this process takes at least four (4) years and to double the output it will take at least 10-12 years because the employment trends have to become visible before starting to encourage young people to study engineering. Another important factor is the market: we have markets that have high technical competence potential, like China and India, and we have mature markets, like is US and developed European countries, with high investment potential and readiness to buy the best workforce around the world and secure needed technological growth.

Croatia is a relatively small country with a middle range of development of ICT sector. We have four main universities that develop workforce for ICT sector (in Zagreb, Split, Osijek and Rijeka). Yearly production of industrial newcomers in the ICT sector is in total about 800 persons. There is no unemployment in that sector as the companies that operate in the Croatian ICT sector are growing in number and business scope. Croatia cannot produce technical staff in numbers with global relevance but it can produce top-quality engineers. The records show that the Croatian education system has been recognized abroad for its production of highly skilled technical personnel.

<table>
<thead>
<tr>
<th>Table 1. The main trends in the Croatian ICT sector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
</tr>
<tr>
<td>growing market</td>
</tr>
<tr>
<td>all main industrial players are present</td>
</tr>
<tr>
<td>good education system</td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
</tr>
<tr>
<td>growing investments</td>
</tr>
<tr>
<td>global needs for ICT solutions</td>
</tr>
<tr>
<td>interest of young persons for engineering studying</td>
</tr>
</tbody>
</table>
This SWOT table indicates the main trends in the Croatian ICT sector. It is very important that on all levels of decision-making ICT is in focus, which is in line with the European Commission directives and the practice in all European Union countries. It is important to continue to build quality of technical education and to continuously enhance the quantity of new technical workforce. Continuous development and growth of ICT sector can be ensured via substantial support to research and development activities.

In Croatia young people are still interested in technical studies. To sustain this interest and to even make it stronger, investments in education must be followed by clear governmental focus directed at R&D activities. Such support could encourage forming of new companies and enforce processes leading to increased market competitiveness. An additional benefit is creating associations of business interests or clusters that can be included in the regional or global set up. This is a good way to secure better salaries in the sector and enable educated people to work in their own country.

ICT WORKING ENVIRONMENT

ICT industry is a very dynamic and progressive sector with constant technological changes and new requirements. Setting up relevant organizational form that can support the job execution implies following a project based model. In the ICT industry this model has been present for a long period of time and with constant improvements. Today, the basic framework for job execution in ICT industrial environment is project based and is applied from the phase of an early study of customer requirements through development and testing to the customer installation and execution support. In essence, the project is a temporary organization for dedicated job execution, defined by the project scope and within a defined time frame, as well as with the approved budget. The human resources are planned in line with all these parameters. The only way to survive and successfully run business in such environment is to have highly educated employees that accept constant learning as a routine way of working. Since projects provide people with temporary assignments, it is important that a line organization supports the project set up with continuous care of employees’ competence development and a balanced resource utilization over a longer period of time and between projects.
In ICT industry there are three basic career paths that every newcomer can choose (Figure 3.): standard technical development (from a trainee to technical expert for specific area, which the most employees choose), project management and line management.

![Figure 3. Basic career model](image)

It is important to emphasize that taking one of three possible tracks doesn’t mean that one has to stick to it throughout the career. In fact, the changes are stimulated and sometimes are unavoidable due to changed market and business conditions. This, for eg., means that an employee can start developing as a technical expert and after a period of time one can decide to go for project management. If this decision is supported by circumstances within this particular working environment, the employee can start developing competencies and responsibilities in a new direction. This spiral exchange of career tracks enable employees to grow professionally, to be able to take on more complex jobs and thus to contribute more in the creation of added values.

Figure 4. presents basic technical areas that are supported in the Ericsson’s technical career path related to R&D activities.

The main technical competencies are divided in six main categories: design, test, integration & verification (I&V), system management, test configuration management (TCM), and support activities that cover configuration management (CM), methods and tools (M&T) and quality as-
surance (QA) activities. Competence profiles are further aligned with the way Ericsson’s main switching platform, called AXE and another platform, called CPP (Core Packet Platform) are set up. The numbers on Figure 4. are related to the number of employees in each competence profile.

4.1. What ICT company expects from a newcomer?

To support the expectations related to development of technology and business growth it is not enough to have employees with a university degree. Enabling them to understand and accept corporate culture is also vital. Therefore we can put it that there are four parameters that describe an ICT company’s expectations from newcomers:

– technical knowledge,
– understanding of business,
– good communication skills,
– good working environment awareness.

Good technical knowledge is the crucial prerequisite in ICT environment. Having knowledge about (tele)communications systems and protocols, fully understanding new IP trends and their applications, fully understanding network elements and protocols for voice and data communica-
tions and the potential of Voice over IP technological elements is the starting point. Together with understanding programming techniques and software languages this technical knowledge forms a platform for strong conceptual understanding of today’s ICT product paradigms and development environment.

Another important element of today’s education of future ICT experts is understanding of contemporary business environment. The main aim is to gain understanding of the basics of economy and trends of economical scale in a business environment. For any of three basic career directions (Figure 3.) it is important to understand the business context and to have basic skills for tracking budget concepts. According to new study programs on technical faculties aligned with the Bologna Process such subjects have been included in the technical universities’ curriculum. It is also useful to understand different organizational processes and business changes, especially those regarding recognition of main drivers for business changes. Finally, understanding a project environment and the principles of teamwork is also what matters very much.

Without having good communication skills it is impossible to work in teams and to be a project member. Today’s projects in ICT domain are very often staffed so that they gain an international and multicultural aspect. It is very important to have very good command of English language which has generally been accepted as a common language for ICT domain. Another expectation is to have good skills in technical writing to be available for the preparation of technical documents and transfer of ideas and professional knowledge.

It is very useful for students to gain some working experience prior to employment to make it easier to bridge a students’ and a workers’ lifestyle. The best way to collect initial working experience during the study is by participation in industrial research and development teams.

To sum up, the industry expectations from the education system is to produce technically well-educated employees ready to step into the world of ICT business. Broadly the industry’s expectations can be summarized in two categories: what students after graduating from a technical university must have (solid technical knowledge and understanding of business) and what the graduates are very welcome with (good communication skills and awareness of working environment). of the ratio of these elements is 80% : 20% and 20% : 80%. It means that it is expected that a student after having finished a technical study has 80% of “must have” knowledge and the company has to invest in the rest 20%. In the cate-
gory of “welcome skills” the situation is the opposite: company has to invest 80% to leverage expected knowledge of a newcomer and a university has to give the basic 20% of knowledge.

The success factors related to competence development in ICT industry can be divided in two groups: tangible and intangible. The main tangible aspects in ICT projects can be summarized as follows:

– clear and realistic goals,
– stable customer and system requirements,
– right resources with right competence,
– total quality in the design.

Clear and realistic goals are very important for final success of any project. Only projects with clear goals can follow three basic project principles: scope, budget and time. Although it is useful to include a challenge when making a decision about project goals, it is crucial to propose realistic goals, especially in case of young teams. The stability of requirements is the main prerequisite for having the right project scope. It is true that requirements are never fully stable, because either the customer doesn’t know exactly what he wants, or the system starts performing in an unusual or unexpected way and the like. The key to success of any project is to have right resources with right competence and it is the job for line organization to secure and prepare successful resource configuration. To secure efficiency it is important to implement quality standards in the design phase of the project to avoid high expenses in the product maintenance phase. Competent designers and efficient development process environment can enable the execution of job in line with “the first time right” principle.

The main intangible aspects in ICT projects can be summarized as follows:

– engagement and commitment in teams,
– clear authority and responsibility among different roles,
– keeping customer expectations in focus,
– communication.

Every project member has to understand and follow the principles of team work. The essence of team work is self-commitment to creating and following team goals that are aligned with the project scope. In the project members can play different roles and it is very important to have a very clear definition of roles and general acceptance of all project members towards authority and responsibility among members. Constant and
open communication among project members and project stakeholders also ensures project success. As every project is executed for a customer it is very important that every project member has knowledge about customer expectations.

In another words, the university gives the basic knowledge that has to be fine polished in industrial environment to make competitive workforce.

**A case study: the cooperation of Ericsson Nikola Tesla with Zagreb and Split Universities**

A university will find it very difficult or even impossible to fulfill all specific requirements of the high dynamics of industrial changes. High education process has to stay independent. Nevertheless, industrial requirements have to be acknowledged and followed to secure competitiveness of students and to give them a good push into the labor market competition. One way to ensure industrial impact and transfer of business culture to the academic environment is to have ICT experts teaching at universities. This has for many years been a practice in cooperation between Ericsson Nikola Tesla and universities in Zagreb and Split. Another way is to establish common research projects with participation of experts (and/or students) from industry and from universities. The topics for research projects have to be carefully selected to cover interests of both sides and the results of the research have to find application in industry environment.

The competence flow within cooperation of a business organization with a university is presented on the Figure 5.

![Figure 5. Competence flow within cooperation of a business organization and a university](image-url)
In this partnership the business organization is responsible for business achievements based on common project results and the university partner is more focused on the scientific presentation. Both sides must follow strict agreements about the intellectual property rights. Very often the business organization is the owner of all intellectual property rights because it also has the role of investor. This, too, has been a mode of cooperation of Ericsson Nikola Tesla with the Faculty of Electrical Engineering and Computing, University of Zagreb, and with the Faculty of Electrical and Mechanical Engineering and Naval Architecture, University of Split.

The cooperation between Ericsson Nikola Tesla and Croatian technical universities also takes form of The Summer Camp, a summer school with active involvement of students and their professors in research projects. This practice was started in 2001. The idea is to select best senior students, usually 4-5 per project, and to have them work for 5 weeks during the summer vacation period (July, August, and September) on issues related to the company’s research projects. At the end, each student prepares a technical report to document his/her results and software, and gives a brief oral presentation thereof in a one-day workshop. The outstanding results are further prepared for publication as conference papers. The benefits of this form of collaboration include enhancing the education process by giving students a chance to spend some time working in a real industry environment. For the company, this is also an opportunity to try to attract top talent for future employment in the company.

Since 2001 seven Summer Camps were organized which involved about 150 students. The mentors came both from the company from universities. In 2007 there were 21 students who participated in the Camp and they dealt with IP systems (4). The results of these research projects made a valuable input for some ongoing Ericsson Nikola Tesla’s prototyping and development projects.

CONCLUSION

The new economy trends require a substantial number of competent professionals in all areas, ICT industry in particular. In telecom segment and in general in the whole ICT industry we observe a continuous high rate of available and flexible competent people coming from Eastern Europe, China and India. In order to be successful professionally, besides good technical knowledge, these experts are required to have solid business
skills, a strong sense of leadership and human skills. With respect to these steep requirements a close cooperation of business organizations with education and academic institutions is vital. As the practice of Ericsson Nikola Tesla and its Research and Development Center shows the cooperation with universities and academic institutions brings added value to all stakeholders in these partnerships. It is a way towards a more efficient, innovative and fruitful way of working and learning that has a positive impact on development of the community.

**Literature**


What does PLIVA expect from Masters of Engineering?

The undergraduate study programmes according to the Bologna process should generate Masters of Engineering capable of acquiring the knowledge of various work processes more easily and quickly. We expect this method of education to compensate for those gaps in knowledge, skills and competencies we noticed in the case of graduate engineers who studied under the old system.

Masters of Engineering should definitely have a solid theoretical background in their fields of expertise in order to be able to keep abreast of and continuously acquire new scientific knowledge.

The improvement in practical skills is also important, i.e. they have to know how to use instruments and equipment and be familiar with production processes and machines. Of course, they cannot be expected to know all processes or instruments they will have to use in their work, but training in the use of at least several modern technologies and instruments is of utmost importance because it will facilitate and accelerate the adoption of other technologies in their future work. Moreover, we believe that they should acquire such knowledge and skills already at the bachelor’s level.

In addition to the above mentioned knowledge and skills, we expect Masters of Engineering to acquire other requisite competencies, namely:
• problem solving skills
• strategic thinking
• ability to rapidly adjust to changes.

To acquire these competencies, Masters of Engineering should learn more about the methodology of scientific work, including statistical methods. They should also have the knowledge of their business environment, understand business operations, and have a clear picture of their role. They also have to learn to quickly find quality and important information, rather than acquire a large body of facts.
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## Bologna Process and Education of Engineers at Josip Juraj Strossmayer University of Osijek

### Abstract

Josip Juraj Strossmayer University of Osijek started with implementation of the Bologna reform in the academic year 2005/2006. New study system is based on three cycles of higher education; credit transfer system (ECTS) was implemented and a basic scheme was made for realization of mobility within Croatian and European higher education area. This paper presents an overview of new study programs at the University of Osijek, with emphasis put on study programs provided by the University constituents that educate engineers in technical and biotechnical scientific fields.

University of Osijek has undertaken numerous measures in order to increase successfulness and efficiency of studying and assurance of quality as one of the main principles of the Bologna Process. One of the most important documents of the University of Osijek defines strategic measures and activity plan in assuring quality of studying for the period 2007 – 2010. The paper presents measures and activities undertaken in the aim to improve teaching process and education quality at the University of Osijek. This overview of the Bologna Process implementation at the University of Osijek proves that all University constituents make great ef-
forts despite of many problems and restrictions that occurred in the course of implementation.

Analysis of the Bologna Process implementation at the University of Osijek shows that significant steps have been made in improving education quality and studying successfulness, however, there are also numerous problems that need to be solved. Some of these problems are specifically related to education of engineers and to implementation of new degrees.

The conclusion of this paper presents necessary measures and activities that are to be realized at the University of Osijek in order to proceed with successful reform of higher education system, especially related to education of engineers according to Bologna Declaration principles.

Introduction

Modern University of Osijek was founded on May 31, 1975. History of higher education in Osijek dates back to 1707 when the first higher education institution was founded as Higher Theological School Studium Philosophicum Esseki. In 1990, the University of Osijek was named after Josip Juraj Strossmayer, famous bishop and one of the most influential Croatian politicians from the beginning of the 20th century.

Since its foundation to the present times, the University of Osijek has an important role in development and economic revival of Eastern Croatia. Over the past 30 years, there were over 27000 graduates from the University of Osijek, which is seen as a great contribution to Eastern Croatian social and economic development. Nowadays, University of Osijek is of middle size according to European standards and is of great significance for the area of Eastern Croatia, which has a population of 900 000 (1).

In the academic year 2005/2006, almost all constituents of the University of Osijek started with implementation of the Bologna Process (for the time being, Bologna Process has not been started with only at the Catholic Faculty of Theology in Đakovo). Overview of activities within the Bologna Process proves that all University constituents made great efforts to complete higher education reform, in spite of numerous problems and restrictions that occur in the course of implementation.
The most important measures and activities undertaken with the aim to improve teaching process and quality at the University of Osijek are the following:

- Organization of mentor system of student guidance,
- Supervision of reform by the Committee for Monitoring of the Bologna Process,
- Continuous monitoring, assessment and evaluation of student activities and
- Evaluation of teaching and teachers through student questionnaires.

Within implementation of the Bologna Process, activities were realized in order to assure harmonization of our University with the European Higher Education Area. Based on the first outcomes of implementation, it can be concluded that the reform of the University of Osijek according to Bologna principles is heading in good direction and that significant results are obtained regarding quality and successfulness of studying (2).

**Bologna Process at the University of Osijek**

Preparation for the Bologna Process at the University of Osijek started with passing of the new Law on Scientific Activities and Higher Education, thematic sessions of the University Senate in the academic year 2004/2005, and with approval of the new University Statute. During the academic year 2004/2005, the University Senate appointed committees for undergraduate and graduate studies, and in the same academic year the project “Studies from student perspectives: Analysis of studying from the viewpoint of students at Josip Juraj Strossmayer University of Osijek” was realized. Results obtained from this project provided an insight into students’ needs, which served as useful guidelines in reform and adjustment of study programs at University constituents.

**New Study Programs in Line with the Bologna Process**

In the academic year 2004/2005, University constituents have completed new study programs at undergraduate and graduate level, all of which are in line with the Bologna Process. New study programs are based on two cycles – undergraduate and graduate. Credit transfer system (ECTS) has been established and basic requirements have been fulfilled for stu-
dent and teacher mobility within Croatian and European higher education area. At the same time, the University started with the process of its overall integration, completing firstly so called functional integration.

Teaching activity at Josip Juraj Strossmayer University of Osijek in the academic year 2005/2006 refers to 36 university studies, 13 professional studies and 7 satellite studies, all of which are in line with the Bologna process and approved by the Ministry as complying with the Law on Scientific Activity and Higher Education (1).

**Quality Assurance System at the University of Osijek**

Quality assurance is one of the issues dealt with within the Bologna Process. It is justified mainly by the fact that the institutional autonomy creates and presupposes responsibility and that a university itself must be a stakeholder in the process of intern quality culture creation. Therefore, it is of importance to assess and improve quality of study programs within all three education cycles: undergraduate, graduate and postgraduate.

The project “Establishment of Quality Assurance System at Josip Juraj Strossmayer University of Osijek” contributed significantly to quality assurance system development. The project was financed by the National Foundation for Science, Higher Education and Technological Development of the Republic of Croatia and lasted from January 3, 2006 until December 1, 2006 (3).

With the support of all University constituents, the project team completed all activities foreseen within the project, which referred to definition and establishment of quality assurance system and quality promotion. Main project activities were the following:

- Analysis of the existing state
- Definition of strategy of quality assurance system
- Definition of structure of quality assurance system
- Definition of administrative procedure of quality assurance system
- Student survey
- Education of academic staff
- Information dissemination
- Project evaluation
- Publications elaborating quality assurance system.
Strategic plan defined the structure, organization and management of the quality assurance system at the University of Osijek.

Structure of the quality assurance system at the University of Osijek consists of: The University Board for Quality Promotion and Assurance, established by the Rector’s Office on January 9, 2006, and committees for quality assurance at all university constituents established in January 2006. Its members are: vice-dean for teaching, academic secretary, representatives of teachers, young researchers and students. The University Board consists of 13 members (2 of them are students) and its role is to coordinate activities of the Commission for Monitoring and Assurance of Higher Education at all university constituents.

Basic documents for the quality assurance system are the following: Regulations on Establishment and Activities of the Quality Assurance System at Josip Juraj Strossmayer University of Osijek (approved by the University Senate on September 30, 2006) and Procedure for Systematic Quality Assurance at University Level (procedure for recording indicators of quality, procedure for student evaluation of teaching, procedure for self-assessment, procedure for implementation of self-assessment, procedure for evaluation of student achievements). Regulation document determines authorities and responsibilities of each University body involved in monitoring and promoting of education quality. There is a plan to establish University Centre for Quality Assurance, which would act as a central university institution dealing with promotion of education quality. According to the Regulation, this centre should employ administrative staff and be headed by a director. Furthermore, it is recommended that each University constituent should establish its own office for quality assurance, which would meet their specific needs (3).

Important outcome of the project activities is development of strategic plan for quality promotion at the University of Osijek for the period 2007-2010. This plan is defining steps for continuous monitoring and quality assurance at the University.

**Student Survey**

One of the main duties of the University Board for Quality Promotion and Assurance and of the project team within the project “Establishment of the Quality Assurance System at Josip Juraj Strossmayer University of Osijek” in the academic year 2005/2006 was to carry out and analyze the student survey. Student survey was related to courses and modules real
ized within the 1st semester of study programs that are organized in line with the Bologna Process. The survey was aimed at problem solving and assessing of efficiency of measures over specific period of time. The survey was carried out at 15 University constituents, involving 284 courses, 254 teachers and 114 young researchers. Student participation in the survey was relatively high (around 47%), thus making a representative sample within the student population.

The survey included a set of questions that are relevant to the evaluation of success rate for certain courses and teachers. According to its outcomes, there is a positive attitude among students regarding the quality of study.

Average outcomes of the survey show that there is a high percentage of attendance of taught courses during the 1st study year at the University of Osijek (ca. 80%), while the percentage of attendance of practices is somewhat lower (ca. 70%). However, the motivation of students for attending lectures can and must be improved – the most of responding students attend lectures for the purpose of preparing for exams (49,6%), while smaller percentage of students do that because of their interest in lectures (2).

Education of Engineers at the University of Osijek

Education of engineers at the University of Osijek is taking up significant role in University development. Education of engineers at the University of Osijek is being realized in the field of technical and biotechnical sciences. Faculties that educate engineers in the field of technical sciences are: Faculty of Electrical Engineering, Faculty of Civil Engineering, Faculty of Mechanical Engineering in Slavonski Brod. Within biotechnical sciences, the faculties are: Faculty of Agriculture and Faculty of Food Technology in Osijek.

Share of Engineer Studies at the University of Osijek

The largest number of students at the University of Osijek is enrolled in the area of the following studies: Humanities and Social sciences (Faculty of Economics, Faculty of Law, Faculty of Philosophy...), while the lowest number of students are enrolled in studies in the field of Natural sciences and Arts.
In a total number of enrolled students the average share of students enrolled within the field of technical sciences amounts to 18% (at national level ca. 23%) (4).

The average share of students enrolled in studies within Biotechnical sciences amounts to 12% (at national level ca. 4%) (4). Table 1 presents an overview of number of students enrolled in studies within technical and biotechnical sciences in the academic year 2006/2007 at the University of Osijek. The largest number of students was enrolled at the Faculty of Electrical Engineering, and the smallest number was enrolled at the Faculty of Mechanical Engineering in Slavonski Brod.

Table 1. Number and Share of Students enrolled in Studies within Technical and Biotechnical Sciences in the Academic Year 2006-2007

<table>
<thead>
<tr>
<th>Total number of enrolled students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. TECHNICAL SCIENCES</strong></td>
<td></td>
</tr>
<tr>
<td>Faculty of Electrical Engineering</td>
<td>1651</td>
</tr>
<tr>
<td>Faculty of Civil Engineering</td>
<td>1050</td>
</tr>
<tr>
<td>Faculty of Mechanical Engineering</td>
<td>589</td>
</tr>
<tr>
<td>Total a</td>
<td>3290</td>
</tr>
<tr>
<td><strong>b. BIOTECHNICAL SCIENCES</strong></td>
<td></td>
</tr>
<tr>
<td>Faculty of Agriculture</td>
<td>1595</td>
</tr>
<tr>
<td>Faculty of Food Technology</td>
<td>619</td>
</tr>
<tr>
<td>Total b</td>
<td>2214</td>
</tr>
<tr>
<td>Grand total a+b</td>
<td>5504</td>
</tr>
<tr>
<td>University of Osijek</td>
<td>18093</td>
</tr>
</tbody>
</table>

Table 2 shows the structure of graduate engineers at the University of Osijek in the period 2001-2006. Table 2 and Figure 1 show that total absolute number of graduate engineers was increasing (except for stagnation period in 2003 and 2004), while relative number, i.e. share of graduate engineers in a total number of graduate students at the University...
was decreasing (from more than 25% to around 18%). The highest increase in the number of graduate students was reported by the Faculty of Electrical Engineering and Faculty of Civil Engineering, while other faculties marked oscillations in numbers.

Table 2 presents the structure of engineers graduating in professional studies from the University of Osijek within technical and biotechnical sciences in the period 2001-2006. Based on the data presented in the Table and Figure 2, it is visible that number of engineers in professional studies at almost all University constituents increased significantly, however, relative share in a total number of graduate professionals decreased in the period 2001-2005. Slight increase in numbers was marked in the year 2006. In a total number of graduates in professional studies at the University of Osijek in the last six years, share of engineers takes up less than 31%.

<table>
<thead>
<tr>
<th>Scientific Area</th>
<th>Faculty</th>
<th>Year 2001</th>
<th>Year 2002</th>
<th>Year 2003</th>
<th>Year 2004</th>
<th>Year 2005</th>
<th>Year 2006</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Sciences</td>
<td>Faculty of Electrical Engineering</td>
<td>34</td>
<td>40</td>
<td>48</td>
<td>32</td>
<td>51</td>
<td>84</td>
<td>289</td>
</tr>
<tr>
<td></td>
<td>Faculty of Civil Engineering</td>
<td>18</td>
<td>20</td>
<td>14</td>
<td>14</td>
<td>44</td>
<td>38</td>
<td>148</td>
</tr>
<tr>
<td></td>
<td>Faculty of Mechanical Engineering</td>
<td>21</td>
<td>16</td>
<td>11</td>
<td>18</td>
<td>13</td>
<td>31</td>
<td>110</td>
</tr>
<tr>
<td>Biotechnical Sciences</td>
<td>Faculty of Agriculture</td>
<td>66</td>
<td>77</td>
<td>51</td>
<td>49</td>
<td>67</td>
<td>58</td>
<td>368</td>
</tr>
<tr>
<td></td>
<td>Faculty of Food Technology</td>
<td>32</td>
<td>37</td>
<td>30</td>
<td>40</td>
<td>42</td>
<td>39</td>
<td>220</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>171</td>
<td>190</td>
<td>154</td>
<td>153</td>
<td>217</td>
<td>250</td>
<td>1135</td>
</tr>
<tr>
<td>University Grand Total</td>
<td></td>
<td>676</td>
<td>771</td>
<td>741</td>
<td>809</td>
<td>1230</td>
<td>1358</td>
<td>5585</td>
</tr>
<tr>
<td>Share of Graduate Engineers [%]</td>
<td></td>
<td>25.30</td>
<td>24.64</td>
<td>20.78</td>
<td>18.91</td>
<td>17.64</td>
<td>18.41</td>
<td>20.32</td>
</tr>
</tbody>
</table>

Table 3 presents the structure of engineers graduating in professional studies from the University of Osijek within technical and biotechnical sciences in the period 2001-2006. Based on the data presented in the Table and Figure 2, it is visible that number of engineers in professional studies at almost all University constituents increased significantly, however, relative share in a total number of graduate professionals decreased in the period 2001-2005. Slight increase in numbers was marked in the year 2006. In a total number of graduates in professional studies at the University of Osijek in the last six years, share of engineers takes up less than 31%.
Figure 1. Share of Graduate Engineers in the Field of Technical and Biotechnical Sciences in the Period 2001-2006

Table 3. Number and Share of Engineers in Professional Studies in the Field of Technical and Biotechnical Sciences in the Period 2001-2006

<table>
<thead>
<tr>
<th>Scientific Area</th>
<th>Faculty</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Sciences</td>
<td>Faculty of Electrical Engineering</td>
<td>31</td>
<td>38</td>
<td>27</td>
<td>37</td>
<td>29</td>
<td>61</td>
<td>223</td>
</tr>
<tr>
<td></td>
<td>Faculty of Civil Engineering</td>
<td>14</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>11</td>
<td>23</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>Faculty of Mechanical Engineering</td>
<td>14</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>11</td>
<td>47</td>
</tr>
<tr>
<td>Biotechnical Sciences</td>
<td>Faculty of Agriculture</td>
<td>7</td>
<td>14</td>
<td>10</td>
<td>13</td>
<td>9</td>
<td>39</td>
<td>92</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>66</td>
<td>70</td>
<td>48</td>
<td>58</td>
<td>53</td>
<td>134</td>
<td>429</td>
</tr>
<tr>
<td>University Grand Total</td>
<td></td>
<td>142</td>
<td>197</td>
<td>153</td>
<td>204</td>
<td>282</td>
<td>411</td>
<td>1389</td>
</tr>
<tr>
<td>Share of Engineers [%]</td>
<td></td>
<td>46.48</td>
<td>35.53</td>
<td>31.37</td>
<td>28.43</td>
<td>18.79</td>
<td>32.60</td>
<td>30.89</td>
</tr>
</tbody>
</table>
As presented in Figure 3, total share of engineers graduating within university and professional studies offered by the University of Osijek was significantly decreasing in the period 2001-2005, and slightly growing in 2006.
Activities of Engineering Studies Referring to Implementation of Bologna Process at the University of Osijek

Faculty of Electrical Engineering in Osijek offers two studies within undergraduate cycle (undergraduate study of Electrical Engineering and undergraduate study of Information Science), as well as professional study in Electrical Engineering, and from the next academic year it will be offering graduate study in Electrical Engineering, and graduate study in Information Science. Some of activities related to implementation of the Bologna Process at the Faculty of Electrical Engineering are the following:

- In order to improve teaching process and to increase teaching quality, the number of groups for auditory exercises is significantly increased. These exercises are important in knowledge transfer (especially Technical sciences).

- Evaluation of students is performed through evaluation of all student activities during the semester (laboratory exercises, preliminary exams, seminars, homework) that helps teacher in deciding upon final grades.

- Special attention is paid to professional training of engineers within the Life Long Learning concept.

- Problems to be solved in near future encompass necessary increase of the number of teachers and assistants and completion of laboratory facilities.

Faculty of Civil Engineering in Osijek educates engineers within undergraduate studies of Civil Engineering and professional study of Civil Engineering, and from the next academic year it will start with realization of the graduate study in Civil Engineering. Activities related to the Bologna Process at the Faculty of Civil Engineering are:

- Participation in several international projects (TEMPUS project dealing with university education of civil engineers) and in CARDS (CBC issues).

- Mutual diploma recognition with other faculties of civil engineering in Croatia has been agreed upon.

- Special attention is paid to student and teacher awareness on content and progress of Bologna process implementation at the Faculty and in broader academic community.

- Certificate ISO 9001 (teaching, scientific and professional activities) is acquired.
Faculty of Mechanical Engineering in Slavonski Brod educates engineers within undergraduate study of Mechanical Engineering, and in the academic year 2008/2009 it will offer graduate study of Mechanical Engineering. The Faculty also undertakes many activities in order to improve teaching process. Some of these activities are:

- Within the student guidance system, mentors are at disposal to students. Their duty is to assist students in dealing with all issues related to the teaching process.
- Coordinators for mentors for group of students have been appointed; their task is to coordinate activities and make reports on implementation of the teaching process as well as to react if problems occur.
- Passing of exam through continuous work (preliminary exams, seminars,...) is made possible.
- Measures directed towards facilitation of studying are being applied in order to make each student an active partner in teaching process.

Faculty of Agriculture in Osijek educates engineers within undergraduate study of Agriculture and four professional studies (Agroeconomics, Plant Production, Mechanization, and Zootechnology). From the next academic year, the Faculty will offer five graduate studies (Agroeconomics, Plant Production, Mechanization, Zootechnology, and Ecological Agriculture). Activities related to implementation of the Bologna Process are the following:

- Teaching is organized in modules; more teachers are assigned to each module.
- There is a possibility of module choice – possibility of the knowledge expanding through combining of study programs.
- There is less ex cathedra teaching, and more individual and practical student engagement.
- Special attention is paid to student awareness on the progress of Bologna process implementation.
- Continuous monitoring and evaluation of students are implemented during the teaching process.

Faculty of Food Technology in Osijek educates engineers within undergraduate study of Food Technology, and from the next academic year it will offer three graduate studies (Food Engineering, Food Science and Nutrition, and Process Engineering). Within the Bologna reform, there are the following activities undertaken:
Great importance has been given to student and teacher awareness regarding objectives and results of the Bologna process implementation.

Mentor system of student guidance has been established.

Student work is continuously monitored through preliminary exams.

Problems accompanying enhanced activity in the scope of Bologna Process involve: the increase of material costs in laboratory and construction exercises, increased teacher workload and problems with the lack of facilities for carrying out of teaching.

Analysis of the First Phase of the Bologna Process Implementation at the University of Osijek

Analysis is performed during the academic year 2006/2007. Starting point were analyses of the 1st year study programs. These programs were used as good comparative indicator of the successfulness in the implementation of the new study system. The main objective of the analysis was to determine successfully implemented reform components and to define possible weaknesses in the implementation process. Exact indicators of the study success serves as a basis for the evaluation of reform implementation, for example: level of success in exam passing per subject/modul, number of students that successfully cope with study program and enroll the next study year, percentage of passed exams, etc.

Although there are no comparable study programs that were realized before the study reform according to Bologna Process, programs realized within first study years of the old study system were taken as a starting point, as they can serve as a good basis for comparison and assessment of new study system efficiency. The academic year 2004/2005 was taken as a year for comparison, as this year preceded the starting up with the Bologna Process implementation (2).

First Outcomes of the Bologna Process Implementation at the University of Osijek

One of the indicators of the studying successfulness is assessing the 1st year students’ success in passing of exams, i.e. assessing the number of exams passed. The Figure 4 presents exam passing successfulness at all
University constituents comparing academic years 2005/2006 (referring to new study system) and 2004/2005 (referring to old study system). Average percentage of passed exams of all enrolled students at the University level is approx. 57%, and successfulness of studying has been significantly increased at almost all university constituents by more than 10% (2).

**Successfullness of Exam Passing – Engineering Studies**

There is an overall increase marked in successfulness of exam passing within engineering studies at the University of Osijek. The highest increase was reported by the Faculty of Agriculture. If comparing average exam passing rate at the whole University, engineering studies have somewhat lower rate. Only the Faculty of Electrical Engineering and Faculty of Civil Engineering are at the average level, while other faculties are below the average, however, there is a tendency to eliminate existing differences – Figure 5).

**Figure 4.** Successfulness of Exam Passing at the University of Osijek comparing academic years 2005/2006 and 2004/2005
Conclusion and Future Activities in Bologna Process Implementation

Based on the assessment of Bologna Process implementation at Josip Juraj Strossmayer University of Osijek, it can be concluded that activities completed at the University level, as well as at university constituents lead the implementation process and study reform in good direction, and that it will finally facilitate harmonization of University education system with European higher education area.

Education of engineers at University of Osijek has long tradition. Analyses that were carried out with the aim to assess successfulness of the Bologna reform show positive trends. New education system provides a good basis for education of engineers at the University of Osijek.

Although it started successfully, further steps need to be undertaken in order to complete the Bologna Process at the Josip Juraj Strossmayer University of Osijek. Some of measures and activities that should be undertaken are:

**Figure 5.** Successfulness of Exam Passing within Engineering Studies at the University of Osijek comparing academic years 2005/2006 and 2004/2005
In order to ensure work in small student groups and to lower teacher and assistant workload, the number of teachers and assistants should be significantly increased. These weaknesses should be eliminated through creation of new job positions and employment of staff;

In order to provide for work with smaller student groups, additional university premises are needed. Construction of new lecture halls, classrooms and laboratories is of importance. Spatial problems will be permanently solved within the University campus project;

Further integration of the University should be achieved, in order to assure overall teaching quality at the University;

Quality assurance system at the University should be further developed. It refers also to establishment of a university center for quality assurance. Furthermore, it is recommended that each University constituent should establish its own office for quality assurance which would meet their specific needs.

The University should enhance activities aimed at creating preconditions for student and teacher mobility.

Efficiency of above mentioned measures will greatly influence further promotion of higher education system at Josip Juraj Strossmayer University of Osijek and its successful integration in the European Higher Education Area.

References


Abstract

This paper summarizes the results of the introduction of new study scheme according to the Bologna principles. Education of engineers in Dubrovnik has a tradition lasting for more than 50 years. However, University of Dubrovnik is one of the youngest universities in Croatia. Nevertheless, the University of Dubrovnik started with the studies according to the Bologna scheme already in the academic year 2004/2005. Undergraduate, graduate and postgraduate studies follow well known (3+2+5) model, and credit system ECTS (180+120+180) has also been accepted. The graduate studies started in the academic year 2007/2008.

To adapt to this new model of the study, many fundamental changes were undertaken regarding study programs and in particular the organization of the studies. All subjects are changed and taught for one semester. The teaching progress is continuously monitored for most of the subjects. The study process is more personalized, contacts of students and professors are direct, and every effort was made to put the students in the center of attention. The changes introduced, in some cases, resulted in the
resistances among some teachers, because traditional ways are still deeply incorporated.

Much attention was paid to the improvement of quality of the study. A committee was established, responsible for monitoring of quality of study, regular assessments, and certification through domestic and foreign accreditation agencies. It should be noted, however, that the University of Dubrovnik obtained ISO certificate on quality ten years ago as the first among Croatian high educational institutions (Bureau VERITAS Quality London, Croatian Register of Shipping Split). In the following years we expect to receive the evaluations by Croatian and international accreditation institutions.

University of Dubrovnik and its technical department in particular, must build the future based on the cooperation with well known domestic and foreign universities by developing joint studies, for which there is interest of business subjects and students, offering double awards, organizing joint research programs, etc. To enable continuous improvement in the quality of the studies, the University must devote special care to its staff development. Through cooperation with other universities we wish to attract students in offering them a very “special” and high level standard of study at the University of Dubrovnik.

INTRODUCTION

Education of engineers in Dubrovnik has a tradition lasting for more than 50 years. This started in former Higher Maritime School, continued on Maritime Faculty and Polytechnic of Dubrovnik, and now it is organized in different departments of the University of Dubrovnik.

Studying according to the Bologna scheme started at the University of Dubrovnik from its beginnings. Thus, from the academic year 2004/2005 this process was introduced for the first time in Croatian higher educational institutions. Undergraduate, graduate and postgraduate studies follow well known (3+2+5) model, and credit system ECTS (180+120+180) was accepted, which in a convenient way propagates mobility of students and professors. It also enables that every stage of the education process ends with suitable professional titles: bachelor, master of engineering and doctor of science. It should be stressed, however, that at the University there were lot of discussions about profes-
sional titles, particularly concerning the undergraduate studies, where it was asked to retain more traditional and understandable title graduated engineer.

Studies are organized in small teaching groups to facilitate more student centered approach. This is particularly case with the studies in fields of engineering, where traditionally small studied groups of about 30 students are applied. But, it is also realized on other studies, with more or less success, where much greater number of students is enrolled.

IMPLEMENTING THE BOLOGNA PROCESS

Undergraduate Studies

In table 1, the number of students starting the studies in 2004/2005 according to the Bologna scheme is shown. There is overall seven departments with eighteen different studies. The total number of students was 567.

Allocation of ECTS points was done according to the following principles:

- ECTS points are based on the student workload
- 60 credits measure the workload of full-time students during one academic year
- Credits are allocated to all education components of a study program

The total number of ECTS points per study cycle is as follows:

- Undergraduate studies 180 points
- Graduated studies 120 points
- PhD studies 180 points

There are also some specifics for students of Navigation and Marine Engineering in comparison to all other students. Students of Marine Engineering and Navigation after successfully finishing two years of undergraduate studies (120 points) receive certificates, which enable them to get accreditation for commercial ships.
Table 1. Number of students studying at the University according to the Bologna scheme in 2004/2005.

<table>
<thead>
<tr>
<th>Departments and studies</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics</td>
<td>70</td>
</tr>
<tr>
<td>Business Economics</td>
<td>209</td>
</tr>
<tr>
<td>Tourism</td>
<td></td>
</tr>
<tr>
<td>International Trade</td>
<td></td>
</tr>
<tr>
<td>Marketing Management</td>
<td></td>
</tr>
<tr>
<td>Financial Management</td>
<td></td>
</tr>
<tr>
<td>Applied and Business Computing</td>
<td>43</td>
</tr>
<tr>
<td>Aquaculture</td>
<td>26</td>
</tr>
<tr>
<td>Media and Social Culture</td>
<td>58</td>
</tr>
<tr>
<td>Maritime Studies</td>
<td>136</td>
</tr>
<tr>
<td>Nautics</td>
<td></td>
</tr>
<tr>
<td>Marine Engineering</td>
<td></td>
</tr>
<tr>
<td>Yachts and Marina Technologies</td>
<td></td>
</tr>
<tr>
<td>Marine Electro Engineering Communications</td>
<td></td>
</tr>
<tr>
<td>Restoration of Arts</td>
<td>25</td>
</tr>
<tr>
<td>Paper</td>
<td></td>
</tr>
<tr>
<td>Textile</td>
<td></td>
</tr>
<tr>
<td>Wood</td>
<td></td>
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<tr>
<td>Metal</td>
<td></td>
</tr>
<tr>
<td>Ceramics</td>
<td></td>
</tr>
<tr>
<td>In total</td>
<td>567</td>
</tr>
</tbody>
</table>
Entry requirements for the next year of undergraduate studies differ between departments. In engineering studies, to enroll to the next year it is necessary to get a minimum of:

- First year  48 ECTS
- Second year  60 ECTS
- Third year  72 ECTS

To complete the study, it is of course necessary to achieve total of 180 ECTS points.

Same specifics of the undergraduate studies
- Teaching in small groups (25 to 40 students per study)
- Intensive work with students (lectures, seminars, home work, laboratory work, projects, etc.)
- Continuous assessment
- Exams at the end of semesters (two terms at most)

The first experiences regarding implementation of the Bologna scheme in undergraduate studies could be summarized as follows:
- Progress was made regarding to the participation of students in the teaching process, student-teacher relationships, the active roles of both sides
- Students that actively participate in the study from the start successfully complete the subjects during the semesters
- However, some students are not active enough and do not satisfy requirements during the semesters and try to complete the subjects by taking the final exams at the end of the semesters
- By these first applications of the Bologna scheme approach used regarding students participation were more flexible. However, this will gradually upgrade

- Number of students that finished undergraduate studies by 30.09.2007:
  - Economics  8 or 11,4 %
  - Business Economics  44 or 21,1 %
  - Applied and Business Computing  26 or 60,5 %
  - Aquaculture  16 or 61,5 %
  - Media and Social Culture  35 or 60,3 %
Maritime and Restoration of Arts studies finished the second year of undergraduate studies. The passing rate from 1st to 2nd year was approximately equal to 35%.

**Graduate studies**

At the University of Dubrovnik, the following graduate studies started in the academic year 2007/2008:

- Economics
- Tourism
- International Trade
- Marine Electrical Engineering and Communication Technologies
- Mariculture
- Public Relations
- Media

It was planned to enroll 120 students on the graduate studies. There was some delay in starting the graduated studies because the undergraduate studies finished by 30th September and some time was necessary for the public announcement of the graduate studies and enrolment of the new students. The studies will start on 15th November, 2007.

**ORGANIZATION OF STUDIES AND PROBLEMS ENCOUNTERED**

To adapt to this new model of study at the University, many fundamental changes were undertaken regarding existing studies programs. All subjects are changed and were organized to last for one semester. On most of the subjects, the teaching progress is monitored continuously by making evidence of participating students, continuous assessment through individual exercises, colloquiums and seminar works, which enable students to satisfy the study requirements during the semester without the need for separate formal exam. It should be noted that in this way the study process is made more personalized, contacts of students and professors are direct, and the goal of having students in the center of attention is achieved. In addition to normal studies, the training courses were organized for different professions, as a part of live long learning. We plan to
find out how such activities could be valued in ECTS points and what is real teaching load to people participating in such courses.

The changes introduced in some cases resulted in the resistances of teachers, because traditional ways are still deeply incorporated. The professors were reluctant to change the study programs and direct working with students, and mobility has not yet started. The first steps in this direction have already been made with respect to maritime studies where all studies are already agreed with other Croatian Universities. As one of the reasons why mobility was missing, the students often mention that it is quite difficult for students that studied according to the “old model”, and inferior support for the mobility on level of Europe (Croatia is not part of Erasmus).

Much attention was paid to the improvement of quality of the study. A committee was established, responsible for monitoring of quality of study, regular assessments, and certification through domestic and foreign accreditation agencies. It should be noted, however, that this institution obtained ISO certificate on quality ten years ago as the first among Croatian high educational institutions (Bureau VERITAS Quality London, Croatian Register of Shipping Split). The quality of the study is continuously monitored and improved respecting the requirements of the new study scheme. In the following years we expect evaluations by Croatian and international accreditation institutions.

Currently, the main problem at the University of Dubrovnik is the insufficient number of the teaching staff with academic titles. Also the change of students’ attitudes from more traditional studies, such as maritime and technical toward economic and social studies, influences the development. The area is dominantly oriented to tourism and there is less development in other fields.

In order to improve the quality of study at the University of Dubrovnik and to ensure further development it is necessary to:

- Increase the number of academic staff employed at the University. Several PhD studies were started in cooperation with other Croatian Universities:
  - History of Population
  - Molecular Biology
  - Cancer Biology
  - Maritime Studies
  - Applied Research of Sea
Develop joint studies in cooperation with respectable foreign universities. This will upgrade quality of the studies offered and also attract foreign students to study in Dubrovnik.

More actively participate in joint European research programs, particularly in the field of sustainable energy, environment issues, marine- and bio- engineering.

Insure the development of high quality resources (new buildings, laboratories, modern teaching and research equipments).

CONCLUSION

Initial results indicate that:

• Necessary time to finish the studies is reduced (for about 20%)
• Number of students breaking the study after the first year is reduced
• Students of engineering studies wish to retain title graduate engineer
• The students decide to continue study at graduate levels, but not necessary as a continuation of the same study from the undergraduate level.

Some important points that also need changes and further attention are:

• At an undergraduate level, it is necessary to prepare students for employment
• After finished undergraduate studies it is not necessary to continue with the same graduate study, but this number should be smaller
• Postgraduate PhD studies need to be interdisciplinary and organized in cooperation of several universities
• Continue with implementation of the Bologna process gradually, making necessary changes to overcome problems encountered in this stage.
Adaptation to the Bologna Process at the Faculty of Engineering of the University of Rijeka

Abstract

In addition to implementing the ECTS (European Credit Transfer System), the adaptation to the reform of higher education in Europe implies for the Faculty of Engineering of the University of Rijeka also the modification of study programs, being organised now as three-cycle system study according to the scheme 3+2+3, i.e. 3 years undergraduate study, 2 years graduate study and 3 years postgraduate study. In this paper, the new Faculty establishment is described; some problems in Bologna Process application are pointed out, especially in teaching. Also, the considerations about finishing the undergraduate study and continuation on graduate study for the first generation of Bologna students after 2 years study are given. Finally, the additional trends in further implementing of the Bologna Declaration in which the Faculty wants to make a step forward, especially in various lifelong learning models, are pointed out.
Introduction

The Faculty of Mechanical Engineering in Rijeka was founded in 1960. Since 1973, it has been operating under the name of the Faculty of Engineering. Its basic units are departments, chairs, laboratories, a computer centre and a library. Through these divisions, the Faculty provides educational and teaching activities and develops cooperation with industry.

Since the foundation of the Faculty up until the present, the curricula and programs have, several times, been updated always with the aim of keeping abreast of the real needs of the industries. Every streamlining of study programs has meant not only the content completion of singular courses of study but also the implementation of new ones as a result of scientific achievements in the scientific field of mechanical engineering, naval architecture and electrical engineering and similar engineering fields.

The Bologna Process is a term pertaining to the reform of higher education in Europe aiming at the main objective of establishing a European Higher Education Area by 2010. The Bologna Declaration, a joint declaration by the ministers of European education from June 19th, 1999, has been signed by Croatian minister upon the event of the Ministerial Conference in Prague in 2001. With the coming into effect of the new Law on Scientific Activity and Higher Education in August 2003 a statutory provision was made to adjust study programs to the Bologna Declaration using the common credit point system evaluation – ECTS (“European Credit Transfer System”). Actual study programs at the Faculty completely comply with these requirements.

In the following, the experience with the Bologna Process – three years later on the Faculty of Engineering of the University of Rijeka is discussed.

Three phases of implementation

The implementation of the Bologna Process at the University of Rijeka, and hence at the Faculty of Engineering can be divided in three phases:

I. the curricula adaptation and the implementation of ECTS,
II. the adequate organization of teaching (effectiveness) and accompanying,
III. the redefinition of learning outcomes and re-adaptation of the curricula in accordance with the qualification frame.

The description of each is given bellow.
The first phase covered the cycle system of the study, the length of duration for each program together with the belonging manner of organization and ECTS structure.

The adaptation to the reform of higher education in Europe implied for the Faculty also the modification of study programs, being organized now as three-cycle system study according to the scheme 3+2+3, i.e. a 3 years undergraduate study, 2 years graduate study and 3 years postgraduate study, as shown in Figure 1. Upon conclusion of the first cycle, lasting 6 semesters (undergraduate university or vocational study) students earn a Baccalaureus Engineer or a vocational Baccalaureus Engineer degree of Mechanical Engineering, Naval Architecture and Electrical Engineering. After concluding the second cycle, lasting 4 semesters (graduate university studies) students earn the Master Engineer degree of Mechanical Engineering, Naval Architecture and Electrical Engineering. The postgraduate study, which provides the Doctor of Science degree in scientific fields of Mechanical Engineering, Naval Architecture or Other Fundamental Engineering Sciences, represents the last (third) cycle of the formal education, denoting in the first place the beginning of a career as scientists and researchers.

Figure 1. The scheme for the new Faculty establishment
Study programs comprise compulsory and elective courses of study, which are made up from all courses of study at the University. The minimum quota of compulsory courses of study must be defined in order to satisfy the standards for particular profession. Compulsory courses of study amount to 65% to 75% of the study program. Also, in view of better student professional training and the application of acquired knowledge, study programs include the performing of practical industry work.

Permeability is one of the significant, ambitious, and also attractive goals of transformation of the curricula and programs. The aim of vertical permeability is to create opportunities for students to go on with their studies at the same or another institution after obtaining their Baccalaureus level. As far as vertical permeability is concerned bottom-up permeability is enabled not only for university undergraduate students from other institutions but also for the vocational students both from the Faculty and from the other related institutions. It means that the finished vocational students can enrol in the graduate university study by taking an offer of supplemental compulsory subjects at the Faculty. As far as horizontal permeability (i.e. switching between individual programmes) is concerned, it is also implemented by development of an offer of recommended elective subjects.

The specialization on the graduate university study of Mechanical Engineering is possible in the following fields: Marine Engineering, Industrial Engineering and Management, Material Engineering, Computational Analysis of Structures and Engines, Construction and Mechatronics, Process Energy Engineering, Computational Engineering and Thermotechnics.

The specialization on the graduate university study of Naval Architecture is possible in the following fields: Ship Design and Construction or Organization of Naval Architecture.

The specialization on the graduate university study of Electrical Engineering is possible in the following fields: Electric Power Systems or Automation.

The curriculum of the postgraduate study guides towards specialization in the field, with the choice of one among seven courses of study: Production Mechanical Engineering, Thermal Energy Engineering, Computational Mechanics, Design and Building of Vessels, Mechanical Engineering Design, Quality Assurance and Engineering Systems Control and Ecology Engineering and Environmental Protection.

The programmes of all studies are accessible at the Faculty’s website [1]. There one can find the curriculum for the current academic year (with a
list of lecturers and co-workers, time-table of teaching activities, examination terms, and other important information related to the studies or students’ life.

It should be pointed out the manner of rearrangement of the previous programs. A mistake which was very common – a cosmetic change “old program copy, new program paste” depicted in Figure 2 – has been avoided very successfully. The approach implemented on the Faculty is shown in Figure 3.

The ECTS evaluates the student class load, comprised of the total hours which are to be spent for successful mastering of teaching material. One academic year has the value of 60 credits, whereas one semester 30 credits. The credits of single subject are not to be ascribed only to the time spent in lectures, seminars, terrain work and tutorials but also to the time spent in studying e.g. independent study, and on data processing after work in laboratory, examining and other knowledge evaluation. Credits can be assigned only after the student has successfully passed the compulsory final exam.

The total student load throughout the year can amount from 38 to 44 weeks (full time commitment) or 1500 to 1800 working hours yearly. Hence, this entails a weekly load, i.e. number of working hours that the
student is to be engaged weekly: in lectures, in working on seminar essays, preparations for seminars and tutorials, studying for exams, etc. Consequently, the previous definitions convey the value of one ECTS point that varies from 25 to 30 working hours per point. At the Faculty the student lecture load throughout the academic year is 42 weeks, along with 40 working hours per week, of which 25 are lectures, which amounts to 1680 working hours per year. The value of one ECTS point thus amounts to 28 working hours per point.

Nowadays the Faculty is confronted to the second phase through the implementation of new Study Regulations of the University of Rijeka [2]. The main concern is oriented to the following items:

- fixing the up to date conditions (standardization of teaching process, flexible profiles and mobility);
- determining the real working load of students (crucial);
- manner of students’ progression through course of study;
- exams and their number;
- ECTS grading and passing through – responsibility of participant;
- final success and the introduction of Diploma Supplement.

It should be pointed out that the introduction of Diploma Supplement is crucial in order to improve the transparency of education and contribute
to recognition of qualifications and better employability. All related preliminary work will be finished on time for the first generation of Bologna students since the University Committee for drafting of the Diploma Supplement held several meetings in 2007 and made a proposal of the Diploma Supplement. Final appearance will be based on the suggestions and amendments to the Diploma Supplement model for the University of Rijeka made by the Ministry of Science, Education and Sport.

The next step or **the third phase** will come very soon into focus. It covers:

- introducing the measurable learning outcomes in accordance with the qualification frame;
- appropriate redefinition of the study programs;
- real implementation of lifelong learning;
- realization of real students’ mobility.

**Development of quality culture on the Faculty**

The importance of quality maintenance and transparency is acknowledged by the Bologna Process. In accordance with this, a big step forward in comparison with the previous situation is made by establishing the institutional system for quality assurance which along accepted lines of quality assurance and quality improvement covers all activities of the Faculty. Also, the Committee for Control and Promotion of the Quality System with defined tasks and ways of action has been established. Quality assurance system not only satisfied specific qualities of the Faculty but at the same time is fully integrated at the level of the University of Rijeka, Figure 4.

![Figure 4. Faculty QA organization](image-url)
The following common documents were made:

- Book of Rules on Constitution and Working Manner of the Committee for Control and Promotion of the Quality System of the Faculty of Engineering of the University of Rijeka [3];
- Text-book for Quality Assurance on the Faculty of Engineering of the University of Rijeka;
- Institutional Development Plan.

Also, the following activities are performed on the yearly bases:

- questionnaire for the students enrolling the first year of study;
- evaluation of teacher’s work and quality of subject from the students’ points of view;
- investigation of studying efficiency and causes of non-quality, un-efficient and to long study;
- qualifying of students and stuff (orientation-motivation practicum).

Some problems in Bologna Process implementation

In the first year of the Bologna Programme implementation there were certain problems due to the students’ insufficient level of information. To avoid any misunderstandings the orientation-motivation practicum is introduced to explain the students, amongst the other, their duties and conditions of taking the exams.

When related to study programs, ECTS should be based on the student’s involvement in the study, measured by the working time necessary to accomplish given parts of the program. Although present from the beginning, this principle is often ignored by the teachers, and the students are still swamped with loads of dull facts presented in the same way. The consequence is that presently, firstly students, and then others, recognize disproportions which often directly affect efficiency in studies, and are a source of many discontents. To improve this situation, it is necessary to make a systematic survey of students’ working load and to put in order disproportions. This is exactly what the Faculty is planning to do without any postponing since all experiences show that few years is needed in order to achieve balance.

After two years of practising more demanding standards inherent to the principles of Bologna Process, lack of material resources and particularly
lack of teaching and research staff are now much more evident than before. Also, there is an urgent need to revise the teachers’ loads since, now it is obvious, the overloads are the bottle neck in implementing successfully “true” Bologna Process. In close relation to the above considerations, a considerable increase of financial means is necessary.

It should be pointed out the problem with the academic year based enrolment. The solution of the problem is expected after transferring to semester based enrolment.

Last but not the least, some important ingredients of Bologna Process like internal and external students’ mobility, system of lifelong learning etc., are still waiting for more serious treatment.

**Some considerations about finishing the undergraduate study**

The first generation of students studying after the Bologna Programme has just started the third year of the study. All the lecturers and mentors have to propose the topics for the diploma works before the beginning of the VI. semester.

To ensure enrolling the graduate studies on time, the end of the VI. semester is planned to be no late than June 6th. The problems are not anticipated for the vocational students since they have only 2-3 subjects + diploma work in the VI. semester. However, the university students have 5-6 subjects + diploma work in the VI. semester, so some problems may arise. Hence, the Faculty is developing now the testing option of performing the aggregate three by three subjects in block lessons. It means that the students will attend only 3 subjects for 5-6 weeks. After that they will have 2 weeks for the final exams. Then, the students will attend another combination of 2-3 subjects for 5-6 weeks and again have 2 weeks for the final exams. By this approach, the present situation of listening one subject, preparing for the other and taking the exam of the third will be successfully avoided.

**Evaluation of the quality achieved**

Lecturers have prepared a lot of teaching materials for the students as a supplement for their lectures and put them on the Faculty’s website. Ma-
jority of lecturers use modern teaching aids (computers, projectors and power-point presentations). They put the examples of examination tasks on the website, announce the examination results and also communicate with students by the e-mail.

There is continual observation of the students’ progress in all courses. Their knowledge is being tested during the term (partial exams, elaboration of seminar works and smaller project tasks, individual solving of tasks, etc.).

All relevant segments of education process including the work of lecturers were analysed via prepared questionnaires for students. Positively assessed questionnaire is necessary when lecturers apply for promotion. Questionnaires are planned to be taken at the end of academic year and analysed by the Committee for Control and Promotion of the Quality System which member is Vice-Dean for academic affairs by default. The aim is to improve and advance the teaching procedure.

According to evaluation of students’ experience one can say that the positive steps and results are evident in the new approach to education process (for instance better lessons attendance, good level of interaction between teachers and students etc.). Moreover, first analysis show better passing rate for all studies in comparison to former “traditional” studies which confirmed that the Faculty goes in right direction. But, the most important for the Faculty and to be proud of is the fact that, according to analysed questionnaires, students are very satisfied with their studies.

Lifelong learning

Except above mentioned it should be pointed out additional direction in further implementation of Bologna Declaration in which the Faculty wants to make a step forward, i.e. realization of various lifelong learning models. Namely, CISCO Academy which is intended for education in the field of information technology is already operating inside the Faculty constitution. Also, the Faculty is ECDL testing centre for acquiring European recognized diploma of information literacy. The special Edulab classroom with multifunctional contents for tuition and working by attending courses and using variety of software, books and journals is founded. Finally, the Academy of Information Technology which will operate on the basis of partnership between the University and Microsoft is in the state of development.
Conclusion

The Bologna process is nothing else but pointing to purposefulness and effectiveness of learning, studying and acting during the education – both of students and teachers. These are thoroughly worked out principles of more quality and more effective education. Correction of that in which we entered all together with the presumption that all is important and that we must all and at once. But still, there are some questions and challenges that need to be answered in order to fulfil the expectations.

References


Abstract

The new reform of the educational and teaching procedure at the Faculty of Civil Engineering was started when the first generation of students was enrolled in the first year of undergraduate study of civil engineering in the school year 2005/06. From the very beginning there have been occasional comments, criticism and suggestions by the students, associates and teaching staff. Since it is a complex and delicate pedagogical and didactical process, objective evaluation requires systematic monitoring and analysis of the teaching procedure from the very beginning of the undergraduate study implementation. For this purpose a system of monitoring student success rate, relevant to the needs of our faculty, has been established. The views of all the participants in the teaching procedure (students and teaching staff) stated in questionnaires must be taken into account for thorough analysis of the student success rate. For this purpose the Quality Control Committee was set up immediately after the teaching procedure according to the Bologna Declaration had been introduced at our faculty.

The important element of student success rate is the rate of enrolment into higher years of study. The Faculty Council accepted the manner of
data collection and execution of the analysis. Students are divided into categories according to the ECTS credits they have collected. Those groups have been monitored in relation to enrolment period, enrolment ranking list, high school graduated from, residence, study status and the examination pass rate. Additionally, at the end of each semester, the student success in particular courses is monitored through collecting data on signature collection, partial exam taking through pre-exams, homework and seminar papers.

Although the statistical sample is not big, a systematic analysis, which will be further elaborated in the paper, has resulted in bringing decisions which have contributed to the improvement of the organisation of the teaching procedure and motivated the teaching staff, associates and students.

Introduction

The reform of higher education, which was started in Europe a couple of years ago, in Croatia, is well underway. In July, 2003, the Croatian Parliament passed the Act on Science and Higher Education [1], prescribing that Croatian higher education is reorganised pursuant to the Bologna Declaration [2] guidelines as of school year 2005/06.

The Faculty of Civil Engineering in Zagreb joined the process and adjusted its curricula in accordance to the type, level and duration of study, introduced the ECTS credit system and academic titles. At the proposal of the National Council for Higher Education, the minister of education issued the accreditation to the Faculty of Civil Engineering in June, 2005 for the implementation of a three year undergraduate study consisting of 180 ECTS credits and a two year graduate study in the fields of geotechnics, hydrotechnics, structures, construction management, materials, transportation engineering and theory of construction modelling consisting of 120 ECTS credits [3]. Students who have successfully completed graduate study may continue their education at postgraduate civil engineering studies: doctoral studies which offer specialisations in 7 fields (consisting of 180 ECTS credits) and specialised studies which offer specialisations in 8 fields (consisting of 60 ECTS credits).

The reformed undergraduate instruction at the Faculty of Civil Engineering was started, simultaneously with other faculties of Zagreb University,
in academic year 2005/06. Due to the traditionally slow higher educational system, the changes that were introduced met with frequent and extensive opposition. Today, two years later, things have improved, but not sufficiently.

For the purpose of monitoring the process, noting drawbacks and introducing improvements specific actions have been undertaken.

**Student success rate**

The first days of implementation of reformed curricula saw comments, suggestions by students, associates and teaching staff. Since the assessment of the educational reform is a sensitive and complex pedagogical and didactic issue, the objective evaluation requires constant monitoring and analysis of teaching process from the very start of the undergraduate study instruction. For this reason the student success rate monitoring system was introduced. It takes into account the specific features of the studies offered by the Faculty of Civil Engineering.

Since the overall analysis of the student success rate must consider the perspective of all the participants in the teaching process, the practice started by the Zagreb University with the Quality Management Committee, the Faculty of Civil Engineering set up the Quality Guarantee Committee in 2006. We would like to emphasise that since 2004 the Faculty of Civil Engineering has had the bodies that have taken care of this segment. This very Committee helped the Teaching Committee to generate further positive changes and improvements.

One of the Quality Guarantee Committee’s duties is to survey students. The Faculty of Civil Engineering abandoned its own student survey after the university survey system had been introduced.

Further student success rate monitoring activities have been introduced for the purpose of monitoring student enrolment rate into higher study years.

Pursuant to its Statute, the instruction at the Faculty of Civil Engineering [4] lasts 44 working weeks, divided into 2 semesters with 15 teaching weeks each, and 14 weeks for consultations, exam preparation and exams.
There are three examination periods: winter, summer and autumn, each lasting 4 weeks. Every examination period offers 4 examination dates for each course, with the minimum 14 day interval between the re-taken exams for the same course.

**The analysis of the university student survey**

Three student surveys have been conducted at the Faculty of Civil Engineering, in summer semester of school year 2005/06, and winter and summer semesters of school year 2006/07.

The Quality Guarantee Committee reported on the results of the first survey [5] to the Faculty Council. The survey was filled out by 30% of enrolled students (filling out surveys is optional for students) for 8 members of teaching staff and 7 courses. 75.2% surveyed students stated that they have attended more than 70% of lectures, and only 6% attended less than 30% of lectures. At the beginning of instruction 53.3% expressed mild, 36% high and 10.7% low interest in the contents of the course. Their dominant grade was good (3), which were expected. Tables 1 and 2 show other parameters (student evaluation of teaching staff and instruction) of the survey.

<table>
<thead>
<tr>
<th>Question</th>
<th>Faculty of Civil Engineering</th>
<th>University of Zagreb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expertise</td>
<td>3,86</td>
<td>4,14</td>
</tr>
<tr>
<td>Quality of instruction</td>
<td>3,1</td>
<td>3,68</td>
</tr>
<tr>
<td>Rapport with students</td>
<td>4,13</td>
<td>4,23</td>
</tr>
</tbody>
</table>

**Table 1.** Student evaluation of teaching staff

<table>
<thead>
<tr>
<th>Faculty of Civil Engineering</th>
<th>University of Zagreb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average grade</td>
<td>3,59</td>
</tr>
</tbody>
</table>

**Table 2.** Student evaluation of instruction
The report states that the teaching staff at the Faculty of Civil Engineering has been given highest grades for the rapport with students and motivation for work, and the lowest grades for the quality of instruction. The reason for this is clear. Instruction of most courses should be conducted in smaller groups especially for design, construction and laboratory exercises. It is, unfortunately, impossible (Figure 2) because the premises and the teaching staff are limited, despite the fact that teaching is conducted in all the lecture rooms, morning and afternoon, as well as on Saturdays (Figure 1). The student timetable in Figure 1, compared to others, is an example of a well-organised one. Some students have much longer breaks. The study room at the faculty library is too small for all the students wishing to study during long breaks.

**Figure 1. Timetable for group 2A**
The timetable was organised so that a group of students should not attend lectures for more than 6 hours without an hour lunch break. Pre-examinations are conducted on Saturdays free of lectures.

Besides, lecture and drawing rooms are not adequately equipped with computers for the number of students attending courses. Highly qualified engineers today should be educated in specialised laboratories. Fast progress and development of civil engineering should be incorporated into the curricula, which require extensive investment in laboratory equipment. In this respect the laboratories are either not on a sufficient level or the instruction is not of high quality due to large student groups.

The Faculty of Civil Engineering does not generally vary from the average grades of the University of Zagreb that is from the general state of the University.

**Monitoring student success rate**

The number of students who have successfully passed exams is an important element in monitoring student success rate.

The number of students passing exams for the “clean” enrolment generation includes the following:

- Meeting signature requirements and partly sitting exams through active participation during semester,
- Pass rate in tests (pre-exams) during semester,
- Pass rate into higher year of study – exams passed.
At the beginning of every semester the Faculty Council brings Execution Plan defining the requirements for courses. The same body brought the Decree which prescribes the study system of undergraduate study. In order to qualify for lecturers’ signatures students have to attend and actively participate in minimum 75% of lectures and 100% of exercises which is checked through pre-exams or written programs for exercises.

There is minimum one and maximum three pre-exams per course. There are also makeup pre-exams. Lecturers are required to organise makeup pre-exams following every regular pre-exam or minimum one makeup pre-exam regardless of the number of regular pre-exams. Students, who have collected 25% points in a pre-exam, qualify for the signature, and the ones who have collected 60% are exempt from an exam segment.

Monitoring student success rate during semester includes the following:
- Verification of student attendance,
- Analysis of pass rate in pre-exams.

**Verification of student attendance**

In the absence of electronic control system, verification is conducted in various manners. Some lecturers conduct occasional “blitz” checks with attendance lists, or with cards which are returned to assistant lecturers at the end of a lecture after being signed by students, or they do not check the attendance at all due to the lack of time, Figure 2.

The attendance at exercises, which are carried out in smaller groups (the number of students is rarely higher than the specified maximum number) is strictly controlled.

The significant increase in students attending lectures has been caused by the regulation which requires students to attend lectures which they have previously failed.

It is the main cause for difficult conditions under which instruction is carried out, Figures 1 and 2. For that reason some courses have a 50% more students than the course attended for the first time. It resulted in instruction carried out in two shifts for all study years, in contrast to former undergraduate study where only first year instruction was con-
ducted in two shifts. In school year 2006/07 some courses of the first year of study were conducted in three shifts, which were repeated in the second year of study.

The cause for these conditions of instruction is not only the increased number of students enrolling courses. There has been no improvement in the number of lecturers and larger space that would result from a larger number of students. The space has remained the same, as well as the number of teaching staff, the number of assistant lecturers increased slightly only in spring 2007 when the Ministry of Science, Education and Sport (MZOS) authorised the recruitment of a significantly smaller number of junior researchers than required. By the start of school year 2007/08 the Faculty has been authorised to employ a number of new junior researchers. On the other hand, the question arises: “How many hours should junior researchers teach? “ Will they be able to meet all the requirements imposed on them? Do they have the same conditions as junior researchers in institutes where they do not teach? And so on. But, this issue should be addressed in another paper.

**Analysis of pass rate in pre-exams**

Analysis of pass rate in pre-exams was carried out twice for the first year courses and once for the second year courses. The results are in Table 3.

On one hand, a high percentage of students have qualified for lecturers’ signatures. On the other, there have been significant differences in exam taking exemption. General basic courses have had the lowest pass rates. Regardless of this, pass rates in courses vary significantly, depending on the type of the course. The pass rates vary from 10% to 97% in general basic courses, 30% to 91% in specialised basic courses, 60% to 80% in specialised courses (the sample has been small due to the lack of data for the third study year), and a high percentage (over 69%) in other courses.

We have noticed a very high pass rate (which qualifies for exemption from taking a part of an exam) in a few courses which award overall student activities (pre-exam results, attendance, active participation in lectures, homework etc.). It is difficult to work in this way in majority of courses due to the limited number of teaching staff, space and equipment. Some lecturers with good results have reported that it is impossible to achieve long term good results because of tremendously hard work and effort demanded.
There have been other efforts to improve student success rates. Two bodies were established at the beginning of summer semester in school year 2006/07: First Year Council and Second Year Council. This year a Third Year Council will be established. They consist of all the lecturers teaching students in respective study years and of one student representative for each course of a respective study year. They are counselling bodies to the Teaching Committee and through contact between students and lecturers they try to draw attention to problems and better organise instruction at specific courses.

Following suggestions of these bodies, The Teaching Committee has proposed, and the Faculty Council authorised the guidelines for pre-exam setting which are as follows: more demanding pre-exams should not be taken within the same week, there shouldn’t be more than two pre-ex-

<table>
<thead>
<tr>
<th>Courses</th>
<th>Study year/number of courses</th>
<th>Signature collected</th>
<th>Part of exam exemption</th>
</tr>
</thead>
<tbody>
<tr>
<td>General basic</td>
<td>I / 8</td>
<td>91.8</td>
<td>26.4</td>
</tr>
<tr>
<td>(Mathematics, physics, geometry, information science etc.)</td>
<td>II / 1</td>
<td>85.0</td>
<td>47.0</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Specialised basic (2 elective courses)</td>
<td>I / 2</td>
<td>83.5</td>
<td>42.5</td>
</tr>
<tr>
<td>(building construction, geodesy, materials etc.)</td>
<td>II / 12</td>
<td>80.4</td>
<td>47.6</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Specialised (2 elective courses)</td>
<td>I</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>(structures, transportation engineering, geotechnics etc.)</td>
<td>II / 2</td>
<td>95.5</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other (elective courses)</td>
<td>I/6</td>
<td>96.7</td>
<td>69.3</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
ams during a week, pre-exams should not be taken in late afternoon, pre-exams can be taken on free Saturdays. Since pre-exams are part of the timetable two pre-exams should not be taken on the same day. It is very hard to coordinate the timetable because in a 15 week winter semester of undergraduate study there are 56 regular pre-exams and 28 makeup exams and they cannot always be part of the course timetable, because, unlike instruction when minimum 2 students sit together, in a pre-exam each student must sit separately.

This year the Faculty runs a four year undergraduate study for the last time. Next school year the Faculty will start with a new graduate study program offering 7 specialisations with significantly larger number of courses than before. This will further deteriorate an already bad situation.

The Student Assembly has given positive feedback to the above mentioned facts, stating that students are satisfied with the way they have been included in the discussions on this matter, which has contributed to their easier study and pre-exam preparation. The Faculty management and the teaching staff have put great efforts into achieving higher student pass rates during semesters resulting in higher enrolment rates into higher study years.

**Monitoring pass rate into higher year of study**

Monitoring pass rate into higher year of study is based on the data on the pass rate into the second study year for the students enrolling in the first year in school year 2005/06. The available is the analysis of their pass rate into the third year of study. Also is available analysis of the pass rate into the second year by the students enrolled for the first time in school year 2006/07. The analysis has not taken into account students transferring from graduate to undergraduate study, students transferring form other faculties and students enrolling pursuant to the Article 53, Act on Rights of Croatian Soldiers in the Homeland War and Their Families. One generation of enrolled students is being analysed.

They have been divided into two categories:

- Successful students – who have been awarded 60 ECTS credits in the first study year (120 ECTS credits in the second year, and 180 ECTS in the third year).
• Less successful students – who have been awarded less than 60 ECTS credits in the first study year (less than 120 ECTS credits in the second year, and less than 180 ECTS credits in the third year).

For both groups the following has been taken into account:
• Enrolment period
• Rank in the entrance examination
• Type of secondary school graduated from
• Residence
• Status (full-time student or paying student).

For less successful students the data has been collected about the courses they have failed.

The analysis of the student generation enrolled in the first year of study in school year 2005/06 (Table 4) showed that a small number of students ranked below 150th position enrol in the second year of study (60 ECTS credits). The pass rate into a higher year of study with 60 ECTS credits was 29%, which grows to 45% if students who were awarded more than 55 ECTS credits (one exam not passed) are added. Compared to the pass rate in the former 4 year graduate study it is an improvement. In the former study program students enrolled into the second year of study with one exam not passed (on condition they passed it in due time), and the pass rate was between 30 and 35%. It is clear why the number is not higher. From the above mentioned facts it is evident there are considerable organisational difficulties. Although we are aware that there is a high demand for civil engineers on the market (there are no unemployed civil engineers), in the wish to maintain high quality of instruction, the Faculty Council has decreased the enrolment quota for the school year 2007/08, from usual 250 to 185 students, which was authorised by the University of Zagreb.

The analysis of less successful students (enrolled in school year 2005/06), who have not been awarded 60 ECTS credits, that is, have not passed all the required courses by the start of the school year 2006/07, has noted the following:
• A large majority of students have passed elective courses (94-98%)
• Winter semester courses have been passed by more than 70% of students
• Three courses of summer semester have not been passed by 50-67% of students
Table 4. Pass rate into a higher study year for generation enrolled in undergraduate study in school year 2005/06

<table>
<thead>
<tr>
<th>Enrollment period</th>
<th>Rank</th>
<th>Status</th>
<th>Enrolled after entrance exam in school year 2005/06</th>
<th>Awarded 60 ECTS credits in school year 2005/06</th>
<th>Awarded 120 ECTS credits in school year 2006/07</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td>%</td>
<td>Average grade</td>
</tr>
<tr>
<td>I. summer</td>
<td>1–50</td>
<td>full-time</td>
<td>44</td>
<td>24</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>50–100</td>
<td>full-time</td>
<td>41</td>
<td>18</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>100–150</td>
<td>full-time</td>
<td>44</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>150–200</td>
<td>full-time</td>
<td>48</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>II. summer</td>
<td>1–8</td>
<td>full-time</td>
<td>8</td>
<td>5</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>9–42</td>
<td>Paying student</td>
<td>30</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>43–81</td>
<td>Paying student</td>
<td>35</td>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>
Based on this analysis it was decided to enrol students by semester, ie. students can take exams for summer courses in February re-examination period in the following school year.

If students fail the courses of previous school year summer semester by February in the following school year, they enrol in the same courses the following school year.

Besides, a number of associates and students tutors have been hired and financed by the Faculty for the courses with lower than average pass rate.

The pass rate into the second year of study by the generation 2006/07 is generally the same as the pass rate of the generation 2005/06.

Table 4 brings data on pass rate into the third year of the student generation 2005/06. It is 17% if only students who have been awarded 120 ECTS credits are taken into account that is 26% if students with more than 110 ECTS credits are taken into account.

Correlation to courses (elective, winter and summer semester) for the students who were not awarded 120 ECTS credits to enrol in the third year of study is the same as for the second year of study.

Table 5 shows the total number of awarded ECTS credits in October 2007 for the student generation which enrolled in the first year of study in school year 2005/06 and 2006/07, including the students enrolled according to Article 53, Act on Rights of Croatian Soldiers in the Homeland War and their Families. Data shows that 16.3% of students of the generation 2005/06 were denied student rights for not being awarded 35 ECTS credits in two consecutive years.

The effects of the decisions brought cannot be yet assessed because the data on the pass rate of student generation 2005/06 into the third year, and the pass rate into the second year of generation 2006/07 has not been analysed yet or the sample has been too small.

Still, we would like to emphasise that students and their representatives have given positive feedback on the measures taken at our faculty. They have recognized and approved of our numerous efforts to improve the instruction at our faculty and proved that we have been taken the right course.
3. Conclusion

Organisations of higher education in Croatia are expected to invest further work into the education system to make it feasible, and to offer students education which will qualify them for the challenges awaiting them in their workplaces.

Since the first students enrolled in the reformed higher education two years ago, in school year 2005/06, its real advantages and disadvantages will be evident in distant future. As it is the process of change, a lot of effort has to be taken to recognise its drawbacks in order to avoid larger mistakes and improve and develop its advantages. In this view, the faculty bodies and teaching staff, with the help of student representatives and students, are actively and continuously working on this segment. The positive results are impossible to achieve without the cooperation of all the participants in the process and without the understanding, support and funding of the University of Zagreb and the Croatian Ministry of Science, Education and Sport.

<table>
<thead>
<tr>
<th>ECTS CREDITS</th>
<th>enrolled in the first year in 2005/06</th>
<th>enrolled in the first year in 2006/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–34</td>
<td>46</td>
<td>114</td>
</tr>
<tr>
<td>35–54</td>
<td>43</td>
<td>59</td>
</tr>
<tr>
<td>55–59</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>60</td>
<td>8</td>
<td>94</td>
</tr>
<tr>
<td>61–109</td>
<td>111</td>
<td>-</td>
</tr>
<tr>
<td>110–119</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>120</td>
<td>48</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>281</td>
<td>292</td>
</tr>
</tbody>
</table>
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007

Reference

(1) Act on scientific activities and higher education, Official Gazette, no.123/03., 2003
(2) www.bologna-bergen2005.no/Docs/00-Main_doc/990719BOLOGNA_DECLARATION.PDF
(3) Undergraduate and graduate university study of civil engineering, Curricula, Faculty of Civil Engineering, Zagreb University, Zagreb, 2007, 174.
(4) Statute of the Faculty of Civil Engineering, University of Zagreb, Zagreb, 2006, 40
(5) Report on the results of the student survey for summer semester 2005./06, Quality Guarantee Committe, Zagreb, January 2007, 7
Monitoring of quality of studying and study success at the Faculty of Civil Engineering – University of Rijeka

Abstract

The Faculty of Civil Engineering of the University of Rijeka organises University and Vocational study programmes in Civil Engineering based on Bologna declaration principles and accepted by the Ministry of Science, Education and Sport of the Republic of Croatia during the year 2005. Monitoring of study programmes was implemented through regular activities at the Faculty level, but the assessment of quality of programme delivery was even more amplified through the project “Monitoring and improvement of quality of studying at the Faculty of Civil Engineering of the University of Rijeka” financed by the National Foundation for Science, Higher Education and Technological Development of the Republic of Croatia during year 2006. The project provided an integral overview of the quality of studying through internal and external evaluation of the studies and of the institution. The self-evaluation results were the basis for the institutional SWOT analysis and institutional strategic goals establishment. During the academic year 2006/07 research was directed at the studying success of the first two generations of so called Bologna students.
The goal of this paper is to give an overview of activities related to the monitoring of the study programmes and the activities for their improvement at Faculty of Civil Engineering of the University of Rijeka.

The faculty of civil engineering – University of Rijeka

The history of the Faculty

The establishment of College of Civil Engineering (org. Viša tehnička građevinska škola) in 1969 could be considered as the beginning of high education in the field of civil engineering in Rijeka, with the Vocational study programme in civil engineering started within this institution. After that, College of Civil Engineering was integrated with Faculty of engineering Rijeka in 1974. At last, the Faculty of Civil Engineering at the University of Rijeka was founded in year 1976 and since then around 1200 students graduated at the University study and around 1400 at the Vocational study. Today the Faculty is attending by 831 students within 5 study programmes and employs 55 teachers.

The Bologna reform of studies at the Faculty

Since Croatia signed the Bologna declaration in the year 2001, both programmes (University and Vocational) at the Faculty of Civil Engineering were reformed according to the principles of the Bologna declaration (Faculty CE Rijeka, 2005). The reformed study programmes are organized in two cycles and ECTS were introduced in the academic year of 2005/06 at all Croatian universities, including the Faculty of Civil Engineering in Rijeka. Since then great efforts are spent in trying to implement programmes and to assure implementation of all of the Bologna principles including promotion of mobility for students and teachers, promotion of European cooperation in quality assurance and promotion of the necessary European dimension in higher education.

The scheme adopted at the Faculty for the University programmes according to education cycles is “3+2+3” and for Vocational programmes “3+1,5” (Figure 1).
Reformed University Programmes

The proposed University undergraduate programme represents, in its core part, the continuation of the University graduate programme delivered till 2005. The curriculum is adapted to the standards of the Bologna process and brought up to date in terms of contents and methodology. The University undergraduate civil engineering programme is the necessary first step in the process of educating highly qualified personnel in the civil engineering and other engineering professions. The proposed University graduate study programme is organised through the modules of the particular civil engineering branches (hydraulic engineering, structural engineering, geotechnical engineering, transportation engineering, engineering modelling and urban engineering). As compared to the previous branch programmes new scientific and practical knowledge has been applied in a particular university branch programme by introducing new courses and modifying the curricula of the current courses.

The programme offers the possibility of combining the modules from two different branches of civil engineering, thus enabling students’ flexibility.
in creating their own study programmes and choosing from a large number of optional courses (Figure 2).

As specificity of the civil engineering study, the proposed interdisciplinary course of urban engineering can be pointed out. It represents a complete novelty within high education at civil engineering faculties in Croatia. This branch evolved from the necessity for education of high quality staff qualified for work in public communal services, spatial planning positions, infrastructure maintenance etc. Further, this particular region of Primorsko-goranska county and surrounding area is known not only for its karst characteristics but also for substantial number of scientific research projects regarding problems of building, water management and protection of water resources in sensitive karst area. Therefore, the concept of the Faculty’s development is directed on both, the traditional civil engineering professional and scientific disciplines and those disciplines that appreciate specificities of coastal karst area on which the faculty is functioning and educates engineering staff. In the development of such
concept the important issue represents cooperation with other high education and scientific institutions in the form of professional and scientific work, invited lectures and mutual participation in domestic and international scientific research projects.

Great number of optional courses at the level of graduate study programme gives to students the flexibility in creation of their own curricula. At the end of the graduate study students are enabled for independent designing, organizing and supervising building of different complex constructions.

Students are also enabled for broadening of accepted knowledge and skills within the next level of education that is offered to them in the frame of postgraduate doctoral study. The Faculty organises presently doctoral study programme in the fields of structural engineering, hydraulic engineering and geotechnical engineering.

Reformed Vocational Programmes

Within the Faculty of Civil Engineering the reformed 3-years Vocational undergraduate study is also organized. This study can be considered as “practical” with necessary proportion of core curricula and a great number of expert ones. This study gives students the opportunity to acquire the knowledge that would enable them for quality participation in elaboration of projects for all types of complex constructions, for managing or supervising building of smaller objects, for careers in companies trading with construction materials and equipment and other jobs that do not require high level of theoretical knowledge. This Vocational study can be continued through Vocational graduate specialist study “Civil engineering in coastal regions and communal systems” (Figure 1). The program of this professional specialist study is focused on communal systems in general, but in its elective part it is focused on civil engineering in coastal regions and managing of communal systems with particularities of coastal areas. The need for such profiled study arose with intensive building and revitalization of coastal regions (smaller towns) that need educated engineering staff to prevent further spatial devastation.
Quality assurance system at the Faculty of civil engineering in Rijeka – University of Rijeka

Development of the quality assurance system

Promotion of European cooperation in quality assurance (QA) with the view to developing comparable criteria and methodologies is one of the basic principles of the Bologna declaration (2).

At the Faculty Civil Engineering of the University of Rijeka the development of the QA system started even before the implementation of the Bologna declaration. The impulse for the organisation of the QA team came in the year 2001 from the University of Rijeka as well as other activities connected with the investigation of students experiences.

During the academic year 2005/06 the quality assurance system at the Faculty of Civil Engineering in Rijeka was completed with the great financial support from The National Foundation for Science, Higher Education and Technological Development of the Republic of Croatia. The Foundation financed the project Monitoring and improvement of quality of studying at the Faculty of Civil Engineering of the University of Rijeka. The project aimed at establishing institutional mechanisms and defining appropriate measures for the monitoring and improvement of quality and success of studying at the Faculty. The main result of the project was the publication of the Quality Assurance Rule Book and Quality Assurance Hand-book as well as an internal publication stating all the activities performed and the results obtained throughout the duration of the project (3, 4).

Quality assurance units – tasks and responsibilities

In the first phase of the project Monitoring and improvement of quality of studying at the Faculty of Civil Engineering of Rijeka a suitable quality assurance system was created through the establishment of the faculty QA units (Figure 3):

– The Quality assurance Board (QA Board),
– The Office for student affairs,
– The Office for monitoring and improvement of the quality and success of studying.
Members of these QA units are appointed from the ranks of academics, students and administrative staff.

QA Board is responsible for the implementation of self-evaluation of the institution, development of quality indicators, assuring student participation in QA of study, evaluation of the success of studying and causes of poor, ineffective and overly long studying, students evaluation of teaching process and similar tasks.

The QA Board also collaborates with the QA Board and Centre at the University level and Faculty parties (for example in planning the strategy for quality improvement at the Faculty, implementation of the assessment programme and quality improvement procedures at the Faculty etc.).

The Office for student affairs organises periodical (monthly) meetings of members, and also “student-staff” meetings once during semesters, then orientation-motivational workshops for students of 1st years and special meetings on students, QA Board or Office members demand. The Office reports monthly to the Dean and six-monthly to the QA Board.

The Office for monitoring and improvement of the quality and success of studying is responsible for: implementing activities related to monitoring and improvement of teaching and studying, presenting activities to the QA Board, suggesting activities related to study improvement and measures and methods for promoting the improvement of teaching and studying.

Figure 3. QA units at the Faculty of Civil Engineering and their relation with the QA units at the University of Rijeka
Monitoring and improvement of the quality of studying and study success at the Faculty of civil engineering – University of Rijeka

Monitoring of the quality of studying and study success

Monitoring of the quality of studying and study success at the Faculty of Civil Engineering University of Rijeka is developed in three directions:
– monitoring of the student input data,
– monitoring of the study process,
– monitoring of the output data.

Student input and output data

Due to the different reasons, among which employability after finishing civil engineering study and efforts of the Faculty to promote its study programmes are very important, in the last years studying at Faculty of Civil Engineering in Rijeka became more popular.

Every year larger number of potential students is interested in entering the study. For example, during the academic year 2006/07 for one available place 2.1 candidate applied. The number of candidates that have graduated at grammar (high) schools is increasing (cca 65%) and the numbers show that 40-50% of students come from areas outside of Primorsko-goranska County (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage of students coming from areas outside Primorsko-goranska County</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001/02</td>
<td>44%</td>
</tr>
<tr>
<td>2002/03</td>
<td>46%</td>
</tr>
<tr>
<td>2003/04</td>
<td>40%</td>
</tr>
<tr>
<td>2004/05</td>
<td>40%</td>
</tr>
<tr>
<td>2005/06</td>
<td>37%</td>
</tr>
<tr>
<td>2006/07</td>
<td>48%</td>
</tr>
<tr>
<td>Average for 6 years</td>
<td>42,5%</td>
</tr>
</tbody>
</table>

Data about the success of finishing the study are related to studies in which the last enrolment was during 2004/05 and they show that more students are finishing the study lately. The average graduation rate was, for years, about 40% (Table 2). If data about the average length of studying are taken into account it can be spotted that students that graduated during last two years are mostly those that were studying for quite long
periods or those that had long pauses during the studying period. The above mentioned is the result of defined deadlines (dates) within which the “traditional” studies will be delivered.

**Table 2.** Percentage of students that graduated

<table>
<thead>
<tr>
<th></th>
<th>2001/02</th>
<th>2002/03</th>
<th>2003/04</th>
<th>2004/05</th>
<th>2005/06</th>
<th>2006/07</th>
<th>Average for 6 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>21%</td>
<td>31%</td>
<td>42%</td>
<td>41%</td>
<td>69%</td>
<td>70%</td>
<td>46%</td>
</tr>
</tbody>
</table>

**Table 3.** The average length of studying for graduated students

<table>
<thead>
<tr>
<th></th>
<th>2001/02</th>
<th>2002/03</th>
<th>2003/04</th>
<th>2004/05</th>
<th>2005/06</th>
<th>2006/07</th>
<th>Average for 6 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td>6,6</td>
<td>6,9</td>
<td>6,7</td>
<td>7,3</td>
<td>6,6</td>
<td>7,6</td>
<td>7 years</td>
</tr>
</tbody>
</table>

**Monitoring of the study process**

The monitoring of teaching quality at the faculty level is necessary for the improvement of the study process, but also for possible changes and improvements of study programmes. Study programmes reformed during 2005 are in the phase of implementation, monitoring and corrections of recognised faults.

At the Faculty of Civil Engineering, since the delivery of Bologna programmes started, different measures for monitoring the quality of teaching process and programmes delivery success were introduced. Teachers, students and administrative staff are involved in monitoring and quality measuring procedures.

During the last three academic years students evaluated their experience in classes. Their evaluation was done on questionnaires prepared in collaboration with the QA Board of the University of Rijeka. The students had to evaluate their experience by evaluating: quality of communication with teachers, course complexity, learning support, stimulation student activity etc. The grades for all the categories were in the scale from 1 to 5 (1-not satisfactory, 5-very satisfactory).

The results of student evaluation was the basis for self-evaluation for those teachers whose classes were estimated less than the grade of 3,0.
The goal of the self-evaluation was to define measures that will be undertaken in the future in order to improve their teaching process and with that students experience in class.

The evaluation has shown that students are mostly satisfied with the availability of the information about study, regularity in course delivery, availability of teachers, regular assessment during semester and with the fact that teachers treat them with respect.

Some of negative aspects that were pointed out are: course complexity, difficulties in acquiring subjects, lack of practical examples for illustration of theories and poor clarity of presentations in classes.

In order to test the students workload in relation to ECTS contributed to courses and programme a research was conducted. In the research students were asked to estimate how many hours have they really spent for each course that they attended in the previous academic year. In the previously prepared questionnaire students had to write down the number of hours they spent for: preparations before classes, for preliminary and final exams, for writing seminar-papers and finishing projects, consultations with teachers and other activities. The research has shown that there is a disbalance between ECTS assigned to certain courses and real students obligations during those courses. In the 1st semester students evaluated their work load with 34 ECTS while the number of ECTS for each semester should be 30 ECTS.

The practice to monitor the success at exams and students enrolment in higher years of study has continued in “bologna” reformed studies also. The comparison between data about the “traditional” and the “bologna” studies has shown that there has not been a significant improvement in the studying success. The change that can be spotted is the significant increase in the number of students on certain courses and this causes problems of quite big groups of students on a large number of courses.

*Improvement of the quality of studies and study success*

Monitoring of study programmes, teaching process and study success is based on measurable indicators (see 3.1.) as well as on observations, remarks and spotted problems that come out from the direct contact with students through the activity of the Office for student affairs (see 2.2.).
Improvement of teachers’ skills for teaching

Most teachers at engineering studies through their own education usually do not acquire competences needed for teaching but they usually develop these competences in direct contact with students during their everyday work. Despite that, the results of student evaluations of teaching process (teachers) show that students mostly have positive experiences with teachers at the Faculty of Civil Engineering in Rijeka.

However, according to the fact that the reform of study programmes is based on the premise of changing the teaching and examination methodology in the way that students became the focus of the teaching process there are teachers that have a problem in adjusting to these new conditions. So workshops for teachers are organised at the Faculty. In these workshops those teachers that have implemented new methods and approaches in the teaching and examination process try to share their experience in this area with other teachers. The main goal of those workshops is to raise the quality of teaching at the institution by using new teaching (e-learning, cooperative learning, learning through project work etc.) and examination methodologies (methods how to form the final mark taking into account student activities during the whole semester).

During the year 2006 assistants have attended the program of initial preparation for teaching organised by the Faculty in collaboration with the NGO for development of higher education “Universitas”. The program included workshops of 30 working hours of theory and also practical exercises. Altogether 12 assistants have completed this initial training program for teachers.

Motivation of students

It is proven that student motivation for the study has a very important influence on the study success. To students it is significant to recognize the connections between subjects, they have to acquire, and practice in order to get a clear picture about their future profession, in this case the profession of a civil engineer. Additionally student motivation for the study can be increased by their active involvement in different student activities that are organised at the Faculty (e.g. weekly, every Friday at 14:00, workshops about science but also about teaching/studying themes are organised). Involvement of students in teaching and non-teaching activities has shown to raise student responsibility toward the institution.
and their study so it results in improvement of the study quality and study success.

At the Faculty of Civil Engineering in Rijeka, within the QA system, in January 2004 the Office for student affairs was established (see 2.2.). The Office coordinates and through direct contact between students and teachers solves different student problems and issues related to the teaching process and student every day life at the Faculty. Experiences of members of the Office are positive both from teachers’ or students’ point of view. Solving objective problems the moment they appear is motivational for students and during time increases student responsibility for the study and for the Faculty as well.

To prepare better students for the labour market and jet to increase their motivation for the study in the spring of 2007 for the first time the “Civil Engineering Faculty Student Week” was organised. During the week many interesting activities took place (for the first time at the Faculty):
– meetings between students and stakeholders,
– workshop “How to start your career after graduating?-Practical aspects”,
– presentation “What can you do after graduating at the Faculty of Civil Engineering?”,
– exhibition of stakeholders’ promotional material that stayed in the Faculty building for 3 weeks.

The meetings between students and stakeholders were organised as stakeholders’ presentations after which students asked each stakeholder things about their activities, future plans, criteria to fulfil to enter their firms, salaries etc. Stakeholders’ representatives were from firms that cover one or more different areas of civil engineering (project and design, construction and maintenance of different constructions: roads, railways, bridges, buildings, water supply and sewage systems, dams, offshore installations, etc.).

The workshop “How to start your career after graduating?-Practical aspects” was held by a stakeholder from a different area (pharmaceutics). At this workshop students from other faculties of the University of Rijeka were also invited to participate, so this was a way to discus this topic from different points of view and with future professionals in different branches.
The presentation “What can you do after graduating at the Faculty of Civil Engineering?” was held by the Faculty member–assistant professor with great experience in civil engineering design and construction. Students’ participation in the activities was very good. They were very active in communication with stakeholders trying to get specific information about their future perspective.

The Student Week has proved to be an excellent way to motivate students from the 1st, 2nd and 3rd year for the study and to establish good and direct communication between final year students and stakeholders. Students found out many specific data about job opportunities and stakeholders’ requirements which will certainly facilitate their entry in the labour market.

Students that participated in the Student Week activities were asked to evaluate the event. Results of student’s evaluations are shown in Table 4.

<table>
<thead>
<tr>
<th>Evaluate</th>
<th>Students evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The program of activities for preparing students for the work-market</td>
<td>4,12</td>
</tr>
<tr>
<td>The benefit that you gained from presentations and workshops that you participated</td>
<td>3,81</td>
</tr>
<tr>
<td>The impact of those presentations and workshops on your motivation for the study</td>
<td>3,72</td>
</tr>
<tr>
<td>How did these activities explain or help you solve any issues about the study and the future work?</td>
<td>3,84</td>
</tr>
</tbody>
</table>

**Table 4. Evaluation of the Students week activities**

External quality assurance assessment of the Faculty of civil engineering – University of Rijeka by questioning employers and former students

The external evaluation of the Faculty of Civil Engineering of the University of Rijeka included questioning employers (stakeholders) and their employees, alumni from civil engineering faculties.

Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007 141
The main goals of the research were:
- improving certain aspects of civil engineering education on the Faculty level,
- strengthening bonds with stakeholders in surrounding area,
- increasing alignment between higher education and the needs of the labour market.

The research involved 30 stakeholders from the Primorsko-Goranska County (in which University of Rijeka is situated) in order to get indicative and quality feedback information about the study quality and alumni characteristics and competences. Questioned stakeholders e.g. firms cover one or more of the different areas of civil engineering: construction, design, control/survey, maintenance, production, spatial planning and consulting.

In order to get the average evaluation of the quality of our alumni we asked the employers to estimate alumni preparation for the labour market. We also asked our former students to estimate themselves. The questionnaires for employers and their employees were the same in order to have the possibility to compare their perception of the same characteristics: engineering competences (practical knowledge and skills, informatics skills, ability for solving civil engineering problems) and generic competences (autonomy in work, team work, motivation for work and further education).

Both employers and employees were asked to give their estimation of all above mentioned characteristics in the scale of five grades (1 – very bad, 5 – excellent). The results of the evaluation are shown in Table 5 and the graphical interpretation of the results for the University study is shown on Figure 4.

The results showed some positive aspects of studies delivered at the Faculty of CE in Rijeka:
- students are very well prepared for the use of computers and informational technologies,
- students do have motivation for their work and personal improvement and for the team work.

The results also showed that students at the beginning of their career have the problem with lack of autonomy and ability to solve practical engineering problems. Possible solution to this problem can be in new-reformed programmes in which new teaching methods are implemented.
### Table 5. Results of alumni characteristics evaluation for the University study

<table>
<thead>
<tr>
<th>Alumni characteristics</th>
<th>By employers</th>
<th>By alumni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical knowledge and skills</td>
<td>3.00</td>
<td>2.52</td>
</tr>
<tr>
<td>Use of computer</td>
<td>4.09</td>
<td>3.48</td>
</tr>
<tr>
<td>Use of computer packages – software (Word, ACAD, …)</td>
<td>4.27</td>
<td>3.57</td>
</tr>
<tr>
<td>Autonomy in work</td>
<td>2.92</td>
<td>3.38</td>
</tr>
<tr>
<td>Ability for solving practical problems in the CEng domain</td>
<td>2.83</td>
<td>2.67</td>
</tr>
<tr>
<td>Ability for team-work</td>
<td>3.67</td>
<td>3.47</td>
</tr>
<tr>
<td>Motivation for work</td>
<td>3.83</td>
<td>3.47</td>
</tr>
<tr>
<td>Motivation for further education (seminars, courses, …)</td>
<td>3.75</td>
<td>4.14</td>
</tr>
<tr>
<td>Average:</td>
<td>3.55</td>
<td>3.34</td>
</tr>
</tbody>
</table>

### Figure 4. Graphical interpretation of evaluation results for the University study
Parts of courses are organized on the basis of project work where students must give their own solution for real-practical engineering problems. That kind of teaching method existed even before but their use was not of the crucial importance for acquiring knowledge and competences in the subject and now with the implementation of Bologna declaration it became so.

From the results of evaluations, on the base of defined alumni characteristics, shown in Table 5 the average estimation of the preparedness of students from University study for labour market by employers is 3,55 and by alumni 3,34. The average grades showed that employers have better perception of their employees’ competences than the employees have about themselves.

An important part of the questionnaires were the blank spaces in which employers and alumni were asked to write their own comments, thoughts, recommendations in order to improve the quality of studying at the Faculty.

Conclusion

The first three years of delivering the reformed study programmes at the Faculty of Civil Engineering in Rijeka have shown, that despite the initial problems and difficulties, the Bologna process was the driver for positive changes and initiatives related to the teaching process and studying:

– teachers have recognised the possibility to improve and modernise their courses through new study programmes;
– the quality assurance system, that assures monitoring and improvement of teaching process, was established;
– students became active participants in the teaching-studying process, it is expected from them to work continuously during semesters and they are given the possibility to be included in other activities that are not related only to the teaching process;
– new teaching methodologies have been implemented (e.g. E-learning, cooperative learning etc.) and part of the teaching staff has completed the initial training program for teaching.

All mentioned should lead to more efficient studying because the data show that the traditional study system was very non-efficient (only about 40% of students use to graduate at the Faculty, mostly studying 7 instead
of 5 years). It is not real to expect extremely significant positive results in only three years of delivering the reformed programmes because it is all a process on which we will have to work on very intensively in the years that are coming.

Some of the practical problems (e.g., lack of teaching facilities) should be resolved with the Faculty moving to the new building that is presently under construction in the complex of the University Campus in Rijeka.

It is very important that following development of the studies respects positive inheritance from thirty years of experience in teaching civil engineers because the research that has been done has shown that alumni from the Faculty of Civil Engineering of the University of Rijeka have always been recognised in the working market as very good professionals and this must be granted also in the future.

**References**

(1) Programmes in Civil Engineering (2005). University of Rijeka Faculty of Civil Engineering.


(4) Publication of the results of *The project of monitoring and improvement of quality of studying at the Faculty of Civil Engineering of the University of Rijeka* (2006). University of Rijeka Faculty of Civil Engineering.
“Bologna process” as trigger for changes at the Faculty of Civil Engineering in Osijek

Abstract

Changes in the academic community are slow and the “Bologna process” has been welcomed and recognized as a long needed trigger for change in the engineering education. We started by recognizing the present state-of-the-art of CE (civil engineering) education in Europe and world. A 3+2+3 educational model has been chosen, maximum work load of students has been set and the core CE and optional subjects were fitted in the frame set. As the results of this intensified work new teaching and evaluation methods were introduced, as well as innovative method of integrating specialist studies with life-long-learning of engineers. Defined is the QA/QC strategy and the Faculty has introduced HRN EN ISO 9001:2000. Encountered are also problems like: small wages that make educational jobs less attractive; academic society is closed and does not enable transfer of people to-and-from industry thus preventing experienced engineers from entering academia; applied practical sciences are taught by people that have little or no practical experience; only research results published in international journals are evaluated for promotions of teachers while their impact on our everyday life is none; teaching and research equipment are distributed based on previous research records.
which makes it impossible for small universities to advance; mobility of
students and teachers is low even within Croatia; there is a great danger
that we educate good bureaucrats instead of creative engineers and teach-
ers. We strongly feel that these problems should be recognized at the na-
tional level as they could endanger positive results of the initiated changes.

Introduction

Brief History of the Faculty

University education of civil engineers in the region of East Croatia
reaches back into the year 1967, when the department of the Technical
College Zagreb was established in Osijek. This department has been active
in the region up to 1976 when, as a part of the Educational Centre for Civil
Engineers, the Civil Engineering College Osijek was established. The Civil
Engineering College was separated from the Civil Engineering School in
1982 and in 1983 it was merged with the Department for Materials and
Constructions Osijek into the Faculty of Civil Engineering Sciences
of the Osijek University. Since than the Faculty has been active within
the Civil Engineering Institute Zagreb and after its transformation during
the Homeland War in 1991, the four independent units in Zagreb, Split,
Rijeka and Osijek were formed. With the separation of the Business centre
Osijek of the Civil Engineering Institute of Croatia, the independent Faculty of Civil Engineering Osijek was founded February 7, 1992.

Past Experiences in the Implementation of University
Educational Programs

Faculty of Civil Engineering Osijek, with its 31 years of experience in edu-
cating civil engineers in Slavonia, is today one of the prominent faculties of
Josip Juraj Strossmayer University, and of Slavonia, Croatia and Europe.
This fact has become evident in the increased interest of students for the
studies at the Faculty of Civil Engineering in Osijek and in the tendency of
shortening the time of the studying. According to the present situation at
the Faculty, the quality of curricula of the undergraduate and postgraduate
studies, the success of the scientific and teaching workers, co-workers and
other faculty members in all fields of their work, and the successful man-
aging with the revenues, the Faculty has proved its seriousness and high
position in university education and science in Croatia.
During the last 31 years of the Faculty, over **1200** students have become civil engineers, almost **400** of them have become Bachelors of Science in civil engineering, and 6 candidates have acquired their doctoral degrees in technical sciences (Ph.D.).

During 2003 and 2004 the Faculty of Civil Engineering in Osijek has initiated and realized the **CARDS project of the life-long education** of civil engineers which at once embraced more than one thousand civil engineers in the region of East Slavonia. The life-long education of civil engineers in the region is supported by regular organization of scientific and professional lectures and presentations, and by publishing of textbooks, mimeographed course materials, monographs for students and civil engineers.

**Connection with Modern Scientific Concepts**

The new study programs are based on the long-time and diverse scientific work of our employees in Croatia, as well as on the cooperation with European scientific and educational institutions. Currently five scientific-research projects are financed by the Ministry of Science, Education and Sports at our Faculty. There are also international projects which involve American, German and Slovenian partners and deal with very diverse topics of earthquake engineering, timber and concrete constructions, soil mechanics as well as different economical aspects of civil engineering. Scientists of the Faculty of Civil Engineering in Osijek took part in the three **TEMPUS** projects: one dealing with coordination of civil engineering education in Croatia with the Bologna Declaration, the second one with the application of the Bologna Declaration at the Osijek University. The Faculty was a partner in **CARDS** inter-border cooperation projects of the sustainable development of Baranya family farms, with the accent on the preservation of the landscape of Baranya villages.

**Comparison with Foreign University Study Programs**

During the making of the study programs we took part in shaping the **TEMPUS project “Restructuring and Updating of Civil Engineering Curriculum, TEMPUS JEP NO. 17062-2002”** on which all four civil engineering faculties in Croatia were engaged together with the international consortium of 10 European faculties. This cooperation, as well as the active participation in the adaptation of study programs of engineering studies in Croatia organized by the Ministry of Science, Education and Sports, led to the coordination of all the suggested programs of
civil engineering faculties in Croatia (November 2004). The differences in undergraduate study programs were less than 10%.

During the making of the programs we consulted the contents of study programs of many European and American civil engineering faculties, and used the guidelines of professional organizations which, in some countries, define engineering competencies. We mostly followed the instructions of EUCET (European Civil Engineering Education and Training) which embraces 136 scientific institutions (EUCET projects “Harmonizing Engineering Education Across Europe” 2004). We also coordinated the programs with the guidelines of SEFI (European Society for Engineering Education project: “Enhancing Engineering Education in Europe, Innovative Curricula in Engineering Education 2003), with the standards of the German institution for accreditation of university programs in civil engineering ASBau (Akkreditierung un Qualitätssicherung zeitgemäßer Studiengänge des Bauingenieurwesens an deutschen Hochschulen) from 2003, and with the criteria for accreditation of engineering programs in the USA (Engineering Accreditation Commission, Accreditation Board for Engineering and Technology (ABET) from 2003 and 2004.

Undergraduate and Graduate programs at the Faculty of Civil Engineering in Osijek

Changing Study Programs following Bologna Principles

The changes in undergraduate and graduate programs at our Faculty are based on principles of the Bologna declaration and are described as follows.

University study programs are defined as consisting of two basic cycles; three years of undergraduate studies and two years of specific graduate studies (Supporting Structures, Construction Management and Technology and Hydraulic Engineering) with a possibility of another three years of postgraduate studies. Professional study programs are defined as a one three year educational cycle. Both studies are based on ECTS and a possibility of selecting optional subjects at other faculties of the University has also been introduced. Differential year has been devised and introduced as a way to bridge a gap between professional and university study programs in civil engineering and give an option to students to transfer within both types of study, with additional effort.
Study programs are defined as comparable and easily recognizable and therefore diploma supplements of all four of Croatia’s faculties of civil engineering (Zagreb, Split, Osijek and Rijeka) are mutually recognized.

Both general and academic community has been informed on the course of the Bologna process based changes at our Faculty through lectures and debates. Faculty’s management has conducted these discussions with high school students and their parents prior to enrolment at the Faculty as well as with student and teacher population currently present.

Faculty’s management has also introduced a number of measures intended to upgrade the success ratio of our students. The first such measure is transparently informing students of their status, rights and obligations at faculty level through written materials (student guide), introductory lectures, periodical student tribunes and also with attributing a mentor for every student. Second measure is equally transparently informing students of their status, rights and obligations at subject level through written and oral presentation of required activities and defined credit structure (grading). Teachers are required to present a semestral teaching report based on uniformed report questionnaires for every subject course with defined success indicators at subject and academic year level. Possibilities for students to successfully pass an exam during the semester through colloquia have been promoted and introduced at a vast majority of subjects and will be obligatory for all subject courses starting in 2008.

Positive Trends and Comparisons in Numbers

Have all these changes and measures left a visible difference in the success ratio of our students?

A significant positive trend can be detected comparing three different types of university students at our Faculty – pre-Bologna students, first generation and second generation of Bologna students.

Only 41% of first year students that were educated following pre-Bologna programs (last generation enrolled in 2004) could successfully meet requirements needed to enter second year of study. For the first generation* all these materials are presented to students and faculty management.
tion of Bologna students (enrolled in 2005) this percentage was exactly the same 41% while the second Bologna generation (enrolled in 2006) raised these numbers to 53%.

Table 1. Comparison of success ratio of different generations of students of university studies

<table>
<thead>
<tr>
<th>Type of students</th>
<th>Year of enrolment</th>
<th>Percentage of students entering second year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre - Bologna</td>
<td>2004</td>
<td>41%</td>
</tr>
<tr>
<td>First generation Bologna</td>
<td>2005</td>
<td>41%</td>
</tr>
<tr>
<td>Second generation Bologna</td>
<td>2006</td>
<td>53%</td>
</tr>
</tbody>
</table>

Same trend can be observed in professional studies as well, while taking into account a lower overall quality of students entering these studies. Only 25% of first year pre-Bologna students enrolled in 2004 entered second year of study and the same was with the first generation of Bologna students enrolled in 2005. The second Bologna generation enrolled in 2006 raised these numbers to 34%.

Table 2. Comparison of success ratio of different generations of students of professional studies

<table>
<thead>
<tr>
<th>Type of students</th>
<th>Year of enrolment</th>
<th>Percentage of students entering second year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre - Bologna</td>
<td>2004</td>
<td>25%</td>
</tr>
<tr>
<td>First generation Bologna</td>
<td>2005</td>
<td>25%</td>
</tr>
<tr>
<td>Second generation Bologna</td>
<td>2006</td>
<td>34%</td>
</tr>
</tbody>
</table>

**Introducing and Promoting Quality Assurance**

Quality assurance at our Faculty is currently supervised by the quality assurance manager and it is present on two levels; through a quality assurance structure coordinated on University of Osijek’s level as well as through the HRN EN ISO 9001:2000 certificate.
University of Osijek has introduced a comprehensive quality assurance system following a National Science Foundation project in 2006. Its most important aspects are a firm QA structure at the University (QA Board and Office, QA advisor, QA committees at faculties) yearly student evaluations of teachers (since 2006) and staff (starting in 2008), collecting and analysing data on eight chosen education quality indicators (since 2006) and conducting continuing workshops for students, teachers and staff in the field of quality assurance.

Faculty of Civil Engineering in Osijek has been issued a HRN EN ISO 9001:2000 certificate by TÜV in September 2007. This certificate concerns all administrative, educational and research activities* at the Faculty and it follows a long tradition of enhancing quality of education of civil engineers in Osijek.

Our Faculty has also been chosen as the first and representative institution at the University of Osijek to undergo a process of outside evaluation and accreditation conducted by the Agency for science and higher education (January 2008).

**Potential Problems**

Some of the potential problems encountered in the Bologna process based undergraduate and graduate education at our Faculty are:

- labour market has inadequate information on competencies of our graduates,
- employers are currently not included in the process of defining learning outcomes for professional profiles,
- the differences in competencies and responsibilities of different types of graduates have to be tested on the labour market,
- knowledge acquired outside the higher education system is hard to measure and accept,
- the mobility of students and teachers is at a very low level, practically nonexistent,
- the number of students is constantly increasing thus stretching our resources and

* Except accounting which is subject to specific law regulation.
University of Osijek has defined a 24 ECTS minimum per academic year (that is necessary for a student to acquire in order to continue studies) which can lure students to other universities.

Post-graduate programs in CE

The postgraduate programs in civil engineering aim at training students to solve problems in civil engineering by enlarging and deepening their knowledge base as well as encouraging the intellectual pursuit of creative ideas to improve human and natural environments. Students engaging in postgraduate studies at the University of Osijek, Faculty of Civil Engineering, may concentrate on structural, environmental, geotechnical, water resources, construction engineering and management or infrastructure development.

The postgraduate programs lead to the degree of Doctor of Philosophy in Civil Engineering or to the degree of Specialist in one of the field of Civil Engineering. The specialist’s degree program focus on strengthening students’ knowledge on certain areas of civil and structural engineering and exposing them to the issues involved in the conception, design, construction, maintenance and use of structures and facilities. The PhD program aims at developing the skills needed to identify issues related to civil engineering and the ability to formulate and propose solutions to a problem in an independent manner.

University postgraduate doctoral studies of Civil Engineering

Doctoral studies have a modular system of teaching, so that a student can choose the modules from three scientific branches: Supporting Structures, Construction Management and Technology and Hydraulic Engineering. The study consists of three elements: regular classes, independent research work and a doctoral thesis. Research work for the doctoral thesis is the mainstay of the students’ scientific work. The doctoral thesis should not only be the proof of the successful study completion, but it should also represent a real and important global contribution to science.

Applicants for admission should normally have completed a bachelor’s or master’s degree in civil engineering or related engineering field, and
should have a proven record of good performance. A PhD student must make satisfactory progress in the research to obtain approval for annual re-enrolment in the program.

Table 3. Structure of the studies with corresponding ECTS credits and a timetable

<table>
<thead>
<tr>
<th>Optional</th>
<th>Course List of courses</th>
<th>ECTS credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of all courses (6 to 8 courses)</td>
<td></td>
<td>36 – 48</td>
</tr>
<tr>
<td>Independent research work</td>
<td></td>
<td>42 – 54</td>
</tr>
<tr>
<td>Specialist thesis</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>180</strong></td>
</tr>
</tbody>
</table>

*University postgraduate specialist studies of Civil Engineering*

Applicants for admission to the specialist studies are required to have completed university graduate or undergraduate studies in the domain of technical sciences, achieving at least 60 ECTS credits in the field of civil engineering. The study consists of three elements: regular classes, independent research work and specialist thesis. All the courses are compatible with courses in long life education of civil engineers. Specialist thesis, which carries the last 20 ECTS credits, is necessary for study competition, earning the following academic degree: *specialist of earthquake engineering, specialist of project management, specialist of environment protection in civil engineering.*

Table 4. Structure of the studies with corresponding ECTS credits and a timetable

<table>
<thead>
<tr>
<th>Optional</th>
<th>Course List of courses</th>
<th>Hours (lecture + seminars)</th>
<th>ECTS credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of all courses (min)</td>
<td></td>
<td>66 + 134 = 200</td>
<td>36 – 48</td>
</tr>
<tr>
<td>Specialist thesis</td>
<td></td>
<td>200</td>
<td>90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>180</strong></td>
</tr>
</tbody>
</table>
Lessons learned

Reviewing the present experience in postgraduate studies (two generations), following issues can be emphasized:

- **Interest for postgraduate studies at technical faculties**
  - high interest for continuation of studies, enrolment quota has been achieved
- **The actual study**
  - regular classes seem to be the main interest of students while independent research work must be encouraged constantly
  - as opposed to former doctoral studies, study progress necessary on a year by year basis; doctoral thesis must be presented within a seven year period
- **Study completion**
  - problems with specialization field for doctoral thesis, lack of employer’s support, employment of a future doctor of technical sciences

Problems that need to be recognized on the national basis

Despite the enormous efforts of the whole Faculty in introducing the “Bologna” process there are still many obstacles that need to be recognized and solved on the national basis. They cause problems at the present but could cause irreparable damages in the future, if not solved.

If we take a look at the most prosperous countries that have made a big leap forward (Ireland, Finland) and their universities (for instance Helsinki University of Technology) there they have:

- Teaching with focus on entrepreneurship education in growth oriented international entrepreneurship with strong combination of theory and practice. These in return bring continuously growing popularity of entrepreneurship. Teaching courses starts of new ventures initiated by students and endowments from the venturing community and alumni.

- Research has a strong combination of practical relevance and scientific vigor. It brings strong collaboration with leading international scholars and centers of excellence that makes them an internationally recog-
nized center of excellence in entrepreneurship. That results with nu-
merous best papers awards in leading international scientific journals.

– Outreach of the University is seen on several initiatives to develop
entrepreneurship with expert roles in entrepreneurship and innovation
policy, new successful growth-oriented ventures, contributions to de-
veloping entrepreneurship and innovation policy in Finland.

At the area of technical sciences, particularly in the field of Civil En-
gineering in Croatia, we feel that there is not enough interaction
between science, technology, economy and society. It could be attributed
to various reasons, such as:

– Croatia is a transitional society with the industry that lacks behind;

– our scientific research capacity, at all 4 CE faculties, is rather limited so
that industry has not seen any practical application of it;

– poor motivation of our scientists that find it much easier to earn money
on some practical design jobs instead on the poorly paid research jobs;

– Universities are government owned and industry is mostly private! Pri-
ivate firms in Croatia invest only in the minimal tests required by law
(standard tests and certificates), and for these jobs faculties are not pre-
pared! Our industry is not motivated for innovation and is not ready to
invest money into something which results cannot be guaranteed.

– There has been large investment in the Croatian infrastructure in the
past years! Logical question is: Which part of it is invested in the funda-
mental or applied research through the universities and how many new
materials, technologies and inventions were made? We believe that no
big mistake is done when we say that we are talking about insignificant
amount of money.

Private institutes are here in much better position and are advancing in
bigger steps collecting all of the applied research jobs and leaving only
fundamental research to the University. If we acknowledge that our situa-
tion is such than we have to make some crucial steps in order to bring
up the university competitiveness.

Engineering is a technical activity that creates systems in the form of ar-
tifacts in which science and art meet. Therefore, technical faculties must
have better links with industry. That enables academic & professional
mobility that is of vital importance for proper education of good engineers. Such interaction is one of the fundamental conditions of being a modern university that brings progress to the society. In comparison with the best schools in the most advanced countries, we have problems:

– in the way how we promote our teacher;
– in the way how we support our research;
– in the way how to improve university outreach and make it a guiding force of the society.

**Promotion of teachers**

Engineering faculties and industry need the interaction on which they both earn which is achieved only if the professor has been working for the industry (or if faculties are better equipped and are gaining more applied research projects). Industry and technical faculties need to work in close cooperation and students should be taught on real problems by doing (project based learning, student associations, practical trainings, with feedback & coaching).

There is probably no dispute regarding the fact that engineering faculties should teach students to be good engineers. Then the logical questions are: Is a teacher without engineering experience capable of educating engineers? Does a teacher without practical experience broaden the gap between the university and industry?

If we want to improve our situation we should enable mobility between the university and industry. It has to be possible to work at the university, get out and work for industry (collect some invaluable experience) and come back and work at the university again. Here we strongly feel that a system should be more flexible in order to bring the best minds into universities, at least at some time of their career! If we want to maintain the connection with industry we should value the practical experience as advantageous for teacher’s reelection!

Here, the critical questions for promotion of the teachers at technical faculties are asked:

– Why the experience at industry (even patented inventions, designs of the biggest bridges, design of the most complicated structures, etc.) is not valued?
– Can we, in Croatia, have the only relevant criteria for a good teacher—publication of CC or SCI paper in some internationally recognized paper (as we have none in the field of CE), thus probably stimulating the industry abroad and giving valued ideas, free of charge?

– What are director and indirect benefits of the published papers in USA or Japan for Croatia and its industry when we have none internationally recognized journals (in CE)?

Maybe a better way would be to try to stimulate our industry in using our best knowledge in making itself more competitive in the international market.

Teacher at the university is promoted on the basis of his scientific achievements, in the same way as scientists at research institutes whose only job is research! Initiation of Bologna process requires more work with students that are not valued for teacher’s promotion. Applied technical sciences (namely Civil Engineering) and our industry are placed in unfavorable position as the promotional criteria for teachers are developed for fundamental and biomedical sciences and for the people working at research institutes! This situation has come at the same time when “bologna process” started. The twelve technical faculties have tried to change this by writing a common letter to the Ministry indicating the problem and proposing better solutions for the advancements in the field of technical sciences, but we have found no understanding for our requests. The promotion in the field of technical sciences has become almost impossible and than the Ministry opened a small door that enabled re-election to the same scientific level.

**Funding of the scientific research projects and equipment**

The situation at the technical faculties became more complicated as the same criteria for advancement were used for choice of the scientific project leaders. Scientific research projects are required for education of research novices, for buying the new equipment and for the renewal of schools. In order to become eligible for a project, primary weight is given to the previous scientific achievement of the main researcher. Thus, even the projects that we evaluated as excellent, received no support. So the younger universities are brought into very unfavorable position. If you have no previous research record, you are not going to get a support, you cannot buy the new research equipment and without equipment you cannot improve your record which closes the circle. Fundamental and ap-
plied research (industry supported) at universities is impossible without modern equipment and without funding and support for the new universities (or badly equipped ones) should be made possible in some other way!

**Mobility of teachers and students**

We have some particular problems, that are probably non-existent in bigger markets (USA, Europe), but are almost impossible to solve in Croatia.

The first one is associated with the technical faculties where we have problem of attracting the best students to work at the university when their income in industry is bigger through their whole working life. For that reason we have more and more women working at the university as they prefer secure job position and flexible working time, even poorly paid, to market fight.

As the mobility of teachers, between industry and university, is made almost impossible we, in Croatia, have problems that each our faculty educates its own professors (for instance: student at Uni-OS, Ph.D. at Uni-Os, teacher at Uni-Os). Due to various reasons, there is an inherent immobility of our teachers and therefore we have strongly to promote or request mobility at least at post-graduate studies!

Today’s situation is such that a scientific novice, who has started to work at the university, already sees himself on a particular position of one of the older full professor. He/she collects papers (formal requests) and has rather limited practical experience! In the present situation we promote bureaucrats instead of innovation driven researchers!

**Future Outlook**

At the university we should be devising strategies to be at the forefront of knowledge creation, if not now than in the future. And for that great aim we, at the University J.J.Strossmayer in Osijek and particulary at the Faculty of Civil Engineering in Osijek are developing a multi-tier mechanism for monitoring quality on a continuous basis:

- **Tier 1**: International benchmarking through accreditation. Community of self-motivated high-caliber constituents is the core element of the de-
sign but monitoring quality is essential for benchmarking the results and preventing digressions at every level,

- **Tier 2**: Discipline of the marketplace as measured by ability to attract best students, faculty, entrepreneurs, and international partners. Transparency as a disciplining device. Market demand to gauge its quality. Generating the metrics for measuring market assessment of quality is a key policy,

- **Tier 3**: Faculty administration as the last resort supervisor of quality. Administration itself is responsible for monitoring the quality of education, research and services provided within the university and to the outside world.

**Literature**

(1) Cesaeer, Conference of European schools for advanced engineering education and research, Istanbul, 2004

(2) Cesaeer, Meeting of European schools for advanced engineering education and research, Lisbon, Portugal, 2005

(3) Tempus-Ruce project, Workshops held at Osijek, Rijeka, Split, Zagreb, 2002-2005.
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Experiences in Bologna Process implementation at the Faculty of Chemistry and Technology of Split

Abstract

The Faculty of Chemistry and Technology (FCT) has been organizing and performing the teaching procedure in the scientific fields of chemistry and chemical engineering since 1960. The teaching programmes have been constantly changed. The last adjustment of the programmes was made in 2005 in accordance with the Bologna Declaration propositions. 5 study programmes of chemistry and chemical technology were established: 2 undergraduate, 2 graduate (will start in 2008/09) and one professional. A new programme for the postgraduate doctoral study is in procedure of reviewing. The students’ load has been standardized and measured by ECTS credits. All the courses are organized as one-semester courses with average weekly timetable of 20-25 periods. A number of optional courses have been introduced in all programmes. Teaching procedure is organized and carried out through various forms of lectures. Most lecturers use modern teaching aids. The lecturers have prepared a lot of teaching materials for the students and put them on the internet site of the Faculty, which regularly announces the plan of lectures for the current academic year. For all courses there is permanent observation of students’ progress during semester through the tests of knowledge. The passing rate at particular courses has increased, as well as the passing
from the first to the second year. After the first year of studying after the Bologna Programme, analysis of success in studying was made, and it has shown that 30% students have realized 100% credits but 25% of them have zero credits. This year, for the first time, systematic students’ evaluation has been introduced through the students’ surveys at the end of each semester. Among other Bologna process propositions, mobility scheme remains to be realized for lecturers and for students. For the beginning, the students of the last year will be encouraged to mobility. At this point, mobility scheme is being realized so that the students go to do the practice.

The long-term targets are: to reinforce the scientific-teaching personnel, to get adequate space on Campus, to improve the quality of equipment of all Departments, to update permanently the teaching programmes, to introduce life-long education, and better cooperation with industries primarily by organizing the postgraduate specialist studies.

Introduction

The Faculty of Chemistry and Technology (FCT) was founded and started to work in 1960. Since then it has been organizing and performing the teaching procedure and scientific-research work from the area of technical sciences, scientific field of chemical engineering, and since 2005/06 also from the area of natural sciences, scientific field of chemistry. So far the teaching programmes of the Faculty have been constantly updated so that they can be comparable with the programmes worldwide. The last adjustment of the programmes was made in 2005 in accordance with the Bologna Declaration propositions implemented in the new Scientific Activity and Higher Education Law (the Law). The main propositions of the Declaration are:

The system of studying is based on two educational cycles, the first of which consists of two degrees, the undergraduate and graduate study; while the second cycle is the postgraduate study; introduction of ECTS credit system; introduction of a supplementary document concerning the study (supplement diploma); promotion of the students’, lecturers’, researchers’ and clerical workers’ mobility; promotion of cooperation in quality ensuring and promotion of necessary European dimension in higher education.
Most of technical faculties in Croatia, among which is the Faculty of Chemistry and Technology, have organized their programmes to be carried out in two educational cycles according to the study model \((3+2) + 3\). In this adjustment of teaching programmes each semester has 30 ECTS credits due to easier recognition of the programmes and possibility to realize the students' mobility. 1 ECTS represents the student's total working load of 30 periods.

The state and results of the implementation of Bologna process at Faculty

In accordance with the stated, since the academic year 2005/06 and after the review was carried out, 5 study programmes have been organized at the FCT, and these are:

1. University undergraduate study of chemistry (UC)
2. University undergraduate study of chemical technology (UCT)
3. University graduate study of chemistry with the courses:
   - Organic chemistry and biochemistry
   - Environmental chemistry
4. University graduate study of chemical technology with the courses:
   - Materials
   - Environmental protection
   - Mediterranean cultures
5. Professional study (PS) of chemical technology with the courses:
   - Chemical technology and materials
   - Food technology

Undergraduate studies last 3 years and when completed one gets 180 credits. The study is completed when the final work is finished, then the certificate is obtained and the academic title of Bachelor of Chemistry, or Bachelor Engineer of Chemical Technology (According to the Academic and Professional Titles and Academic Grade Law, NN 107/207, 19th 10. 2007).
Graduate studies (to be carried out in the academic year 2008/09) last 2 years and when completed one gets 120 ECTS credits. The study is completed when the final work is finished and defended, then the diploma is obtained and the academic title of Master of Chemistry, or Master Engineer of Chemical Technology.

Professional studies last 5 semesters, when completed one gets 150 ECTS credits. The study is completed when the final work is finished, then the certificate is obtained and the professional title Engineer of Chemical Technology.

With certificates and diplomas it is obligatory to issue the student a supplementary document about the study, which contains a list of all the exams passed and the marks pertaining to, as well as the data on the teaching load and teaching matter. The University Senate determines the form of this document.

At the FCT the program for the postgraduate doctoral study “Chemical engineering in materials development and environmental protection” has been made and it is now in procedure of reviewing. The study lasts 3 years (180 ECTS), and it is completed with the elaboration and defense of doctoral thesis, the diploma is obtained and the academic title of Doctor of Sciences in Chemical Engineering.

In elaboration of the above-mentioned study programmes the propositions for the organization and performance of the study proposed by the Law were obeyed:

All the courses last one semester (one semester is 15 weeks) with weekly teaching load of 25-26 periods at university undergraduate and graduate studies, 20-22 periods at professional study and 8-12 periods at university postgraduate study. ECTS credits are attached to each course and they represent the real student’s load for a particular course in the semester in which the course is listened to. The credits are realized after the exam has been passed.

To meet the students’ personal interests, a number of optional courses have been introduced. Total amount of ECTS credits accounts for 15 % of optional courses at undergraduate studies, 20 % at graduate studies, and 50 % at postgraduate studies.

Faculty lecturers carry out the mentioned study programmes at the FCT (of which 31 in scientific-teaching vocation and 3 in teaching) together
with the assistants (23) and laboratory technicians (12). Apart from
them, outside lecturers from the universities of Split and Zagreb and
from the institutes, or economy professionals, also take part in carrying
out the teaching of the courses that are not fundamental for the study
(English language, physical education, courses in economy and sociology,
various courses in biology) or they are specialist courses of the profession.

At the Faculty there are about 500 students and 94 permanently em-
ployed workers, and the FCT is one of medium-size faculties. Since the
establishment of the Faculty 1310 students graduated, 33 students got
their Master’s Degree and 35 got Doctor’s Degree.

The programmes of all studies carried out at the Faculty are accessible at
the Faculty’s Internet sites (www.ktf-split.hr). There one can find the
curriculum for the current academic year (with a list of lecturers and
coworkers, time-table of teaching activities, examination terms, and
other important information related to the studies or students’ life an-
nounced by the Students Association on their Internet sites. The plan is
announced before the beginning of the academic year.

In the last period the lecturers have prepared a lot of teaching materials for
the students as a supplement for their lectures and put them on the Fac-
ulty’s Internet sites. Majority of lecturers use modern teaching aids (com-
puters, projectors and power-point presentations); they put the examples of
examination tasks on the web sites, announce the examination terms and
examination results, and also communicate with students by the e-mail.

Teaching procedure is organized and carried out through lectures (L),
seminars (S), laboratory exercises, professional practice and field teach-
ing, scientific and professional work. The student is obliged to attend
80% of periods of the direct forms of teaching (L+S) and 100% of labora-
tory exercises. At the beginning of the academic year a mentor is ap-
pointed for each student (8-10 students/mentor) and he/she observes the
student’s work during semester.

The most important problems during implementation

At the implementation of the Bologna Process some new problems have
appeared or the existing problems have become more prominent, like the
permanent lack of space. By setting up a greater number of courses and
modules, more optional courses, work above the norm for some lecturers and assistants and engagement of outside lecturers, that problem has generated difficulties in setting the timetable. The Faculty disposes of about 4000 m² at two locations, in Split and in Kaštel Sućurac (about 10 km far from Split), of which there are 6 lecture rooms and a computer room, along with other rooms: library, lecturers’ study rooms, laboratories, social rooms, etc. Teaching procedure is going on all day long from 8 to 20 o’clock, but in spite of it the timetable outline is a great problem, as the students who take again the courses that they have not passed should be enabled to listen to them again. The solution of the problems is expected after the new premises are built on the Campus, where the FCT is going to have around 7300 m².

There is continual observation of the students’ progress in all courses. Their knowledge is being tested during the term (partial exams, elaboration of seminar works and smaller project tasks, individual solving of tasks, etc.). In the first year of the Bologna Programme implementation there were certain problems due to the students’ insufficient level of information, especially about the way of passing the exams by partial examining. To avoid any misunderstandings all the lecturers have to explain to the students their duties and conditions of taking the exams and to announce it on the students board or on the web sites of their departments.

The student has opportunity for taking exams in all the courses during the semester in which the course is being listened to through the system of partial exams (written and/or oral). Depending on the number of periods, the course matter is divided in minimally 2 and maximally 4 partial exams. ECTS credits related to a particular course are realized after all the duties are completed. The student’s weekly load is 40 working hours.

Examination periods are in winter, summer and autumn. The examination period lasts at least 4 weeks and has four examination terms. The student can take two terms with an interval of at least 15 days. The examination in one course can be taken 4 times at the most, of which the fourth time is taken before the Commission. If the student fails to pass at four times, he/she has to take that course again in the next academic year. He/she can sit it again 4 times, but if he/she does not pass it he/she loses the right of studying at that study. The way of taking exams is determined by the Book of Regulations on the studies at the FCT. (This Book of Regulations is in the final phase of elaboration. Otherwise, the University Book of Regulations was adopted and came into force on 1st October 2007).
The finishing undergraduate study and continuing studying on diploma study

The first generation of students studying after the Bologna Programme has just started the third year of the study. As they are expected to take the final work, in the third year they have to take one optional course relevant to the topic of their final work, and in agreement with the mentor. All the lecturers and mentors have to propose the topics for the final works before the beginning of the academic year.

In the next academic year 2008/09 the realization of graduate studies begins. The right of enrolment on graduate studies have the persons who have completed the undergraduate study at the FCT and also the students of related faculties (Food Technology, Textile Technology, Pharmaceutical-Biochemical and others). There is also interest to enrol the graduate study among those who have graduated from a professional study (after the old programme) or they will finish it this year after the Bologna. The way and conditions of enrolment are just being prepared and will be incorporated in the Book of Regulations on studies and studying. For these persons attending and taking exams of the differential year will be proposed.

Assessment of the first generation quality level achieved after two years of studying

Regarding the analysis of successfulness of studying after the Bologna the following has been done:
– Analysis of passing rate achieved at particular courses after the first semester (Fig. 1).
– Analysis of realized ECTS credits after the first study year (Table 1).

Analysis of successfulness after the second year is still being processed.

From the Enclosure 1 and comparison of data from earlier years of the first semester, the study rate at particular courses (especially Mathematics) has risen, and quality of studying has also risen (better average marks have been achieved).

This analysis of successfulness of studying can be connected with the candidates’ success at classification exam and with the profession of
Figure 1. Analysis of successfulness of taking exams after the first semester (1st March 2006)
secondary schools the candidates came from. The undergraduate study can be enrolled by the candidates who completed a four-year secondary school, and professional study who completed a three or four-year secondary school. Because of reduced interest in studying at technical faculties, students can enrol the FCT without taking the classification exam but have to achieve the minimum entrance score, which responds to the average mark good and a little bit lower mark to enrol the professional study. The candidates are ranked on the basis of success achieved in secondary schools and marks of the subjects relevant for the study (Croatian language, Mathematics, Physics and Chemistry).

This year for the first time the students’ evaluation of teaching was carried out by the survey that the University made many years ago. Earlier some lecturers carried out their own surveys, but there has not been a systematic unified survey yet. Such a survey is expected to be prepared by the University for all constituents, because a positively assessed survey is necessary when lecturers apply for vocations. Surveys are planned to be taken at the end of each semester, i.e. two times a year. Vice-Dean for academic affairs carries out the survey. The aim is to improve and advance the teaching procedure. This year the Centre for Quality Improvement has been established (at the University) and also Commissions for Quality Improvement (with the University constituents). At the FCT the Commission has 5 members.

### Table 1. Analysis of successfulness of studying after the first year of studying

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of students who have realized the stated number of ECTS credits expressed in %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Undergraduate study of chemical technology</td>
<td>32</td>
</tr>
<tr>
<td>Undergraduate study of chemistry</td>
<td>23</td>
</tr>
<tr>
<td>Professional study of chemical technology</td>
<td>27</td>
</tr>
</tbody>
</table>
Long – term prospects, goals of the process and basic propositions for the long – term goals realization

Among other Bologna Process propositions, mobility scheme remains to be realized, but the precondition for that is to open some relevant offices at the University and at the Faculty that would prepare the necessary documents. All of the University constituents have appointed the ECTS commissioner, and the University its coordinator. At the University Book of Regulations on studies and studying was made and it came into force on 1st October 2007. The Faculty’s Book of Regulations is harmonized with the University’s Book. For the beginning we are encouraging the students of the last year to mobility for the sake of elaborating their finals, diplomas and doctoral theses. So far the students have realized it so that their practice has been organized by the IASTE. This year they have also become members of FISEC and opened up new possibilities. In the last period there were two students from France at our Faculty to do their summer practice, two postgraduate students from Bosnia and Hercegovina to perform the experimental part of their doctoral theses. We have had quite many inquires, especially by the students from India, to study 1 or 2 semesters at our Faculty, but unfortunately we were not able to receive them. Anyway, there is the issue of financing these stays.

Apart from the students’ mobility, we should improve the lecturers’ mobility as well. Last year two of our trainee-assistants were in Germany for scientific improvement, and several others stayed for a short time at the faculties of Italy, France, Germany and Bulgaria. Two of our lecturers are visiting lecturers in Mostar, one was in Marseille, and this year we are expecting a visiting lecturer from France. Generally, our aim is to improve the international cooperation at all levels.

The long-term targets and aims in the Bologna Process implementation at the FCT are: constantly to observe the quality of the institution and of teaching procedure for the purpose of increasing the passing rate and successfulness of studying, to perform regular self-assessment for the evaluation of one’s own quality, to introduce the ISVU system for observing the teaching procedure, to be involved in European projects for the exchange of students and lecturers, to reinforce the scientific-teaching personnel (exchange of outside lecturers), to move to the Campus and to hold theoretical and laboratory teaching at one location, which will burden the students and contribute to the quality of studying, to improve the equipment of all Departments for the purpose of better teaching and scientific-research work, to have more scientific projects, to continually
harmonize our programmes with the programmes of European universities so that we can follow scientific achievements, to carry out the surveys after the students have passed their exams for the sake of possible corrections of attributed ECTS credits, to introduce lifelong education for students and other Faculty workers and students who have completed the study as well. We plan better links between the Faculty and economy and also greater engagement and motivation of lecturers in solving their professional issues, especially through the organization of specialist postgraduate studies. Today the cooperation with economy is sporadic (TLM, AD Plastic, cement industry, Ironworks, small private businesses, and the like) and it is carried out through the elaboration of projects and studies, professional analyses, diploma works and Master and Doctor’s theses. It is necessary to collect the data about all the students who have graduated from the FCT (Alumni) so that their employment could be analysed and observed and in cooperation with them to harmonize the teaching programmes with the needs of the economy.

**Conclusion**

There are some difficulties in the Bologna Process implementation but they are not insurmountable. All the subjects, participants in the process, from students to lecturers and supporting services in the function of teaching and scientific-research work, should carry out alterations for a completely new way of work and thinking. After all, we are talking about a process that is being developed, improved and adopted. Results certainly won’t fail to come for the students who have decided to study, and time of studying will be considerably reduced.
Experience and Challenges after 3 Years of Education According to “Bologna Process” at Mechanical Engineering Faculty in Slavonski Brod

Abstract

In the introduction part of this paper, a short review of chronology of mechanical engineering study in Slavonski Brod is given. The new study programs according to “Bologna process”, that are currently active at Mechanical Engineering Faculty, are explained in brief. The most important activities, foreseen by the study programs and undertaken in the last period of time, with the main purpose being implementation of “Bologna process” and fulfillment of expectations that appeared with the new approach to education process, are stated and explained. In order to monitor and improve the education process, the Commission for improvement and quality assurance which is a part of University System for improvement of education quality, was established. The main activities of the Commission for improvement and quality assurance, as well as previous activities for improvement of education process quality, are shortly stated. The results of the survey, conducted among the pregraduate students, are presented in
detail. The survey objective was for students to review professors and assistants at relevant segments of education process. In this academic year the third generation of students is included in the new study program, so one can say that the positive steps and results are evident in the new approach to education process. But still, there are some questions and challenges that need to be answered in order to fulfill the expectations.

Introduction – general data on the academic institution and its achievements

Study courses of mechanical engineering have been conducted at the Mechanical Engineering Faculty in Slavonski Brod for 45 years (since 1962). Initially, the lectures were held within the Centre for special learning of the Engineering College in Zagreb. After its integration with the Mechanical and Maritime Engineering Faculty into the Faculty of Mechanical Engineering and Naval Architecture in Zagreb (FSB) in 1967, the Centre for special learning continued its activities as Centre for mechanical engineering studies of the Faculty of Mechanical Engineering and Naval Architecture, seated in Slavonski Brod.

When the University of Josip Juraj Strossmayer in Osijek was founded in 1975, the Centre for mechanical engineering studies became an integral part of that University. In 1979, the Faculty of Mechanical Engineering was founded as a part of the “Institute for Mechanical Engineering” of “Duro Daković” company. In 1991 it became an independent faculty within the Josip Juraj Strossmayer University of Osijek.

To the present day, 337 students have graduated from the 2 1/2-year-course (plus 377 of our students who obtained their degree at the Faculty of Mechanical Engineering and Naval Architecture in Zagreb). Another 377 students have graduated from the 4 1/2-year-course (in addition to another 94 who graduated at the Faculty of Mechanical Engineering and Naval Architecture in Zagreb).

Since 1998, postgraduate study program has been offered at the Mechanical Engineering Faculty in Slavonski Brod (so far, ten master’s theses and seven PhD theses have been successfully defended).

From 2005/2006, the lectures have been held according to the new programs (i.e. the “Bologna process”). In the academic year of 2007/2008,
the third generation of students (according to the new program) has been enrolled.

At the present, the Faculty has 52 employees (4 Departments and 2 independent Chairs):
– 10 full professors (tenure)
– 2 full professors
– 5 associate professors
– 9 assistant professors
– 4 senior lecturers
– 3 lecturers
– 2 senior assistants
– 3 assistants
– 3 research associates
– 9 scientific novices
– 1 system administrator and
– 1 laboratory technician.

Including graduates, there was a total of 434 enrolled students at the Mechanical Engineering Faculty in Slavonski Brod in the academic year of 2005/2006. There were 193 undergraduate students (level VI/1) (including undergraduate ABD) who registered for the next term.

Considering the number of available professors, the number of students indicates a very favourable ratio for study programs (according to the “Bologna process”).

Remark: From 2006/2007, the undergraduate studies (former level VI/1 of education) of mechanical engineering are part of the Polytechnic of Slavonski Brod, (still using resources of the Mechanical Engineering Faculty).

155 258 students have enrolled in Croatia in 2004/2005 – a division according to academic fields is given in Figure 1 (Uzelac, 2006). If we compare the number of freshmen in the academic field of technical sciences at the Josip Juraj Strossmayer University of Osijek given in Ref. (2) (Faculty of Electrical Engineering, Faculty of Civil Engineering and Faculty of Mechanical Engineering), we can conclude that it matches the average for Croatia (23.3 %).
The study course of Production Engineering offered at the Faculty of Mechanical Engineering in Slavonski Brod is a sub-segment of MECHANICAL ENGINEERING in the field of TECHNICAL SCIENCES.

The concept of study programs at the Faculty of Mechanical Engineering in Slavonski Brod

University study programs as offered at the Faculty of Mechanical Engineering in Slavonski Brod are based on a “3,5 + 1,5 + 3” – model (university undergraduate, university graduate and postgraduate study). In the seventh semester of the university undergraduate study, the students gradually get an insight into some courses which are offered in more detail during the graduate studies. These are:

- Design and Product Development
- Production Logistics
- Materials Engineering
- Production Technologies

Legend:
1 ... Natural Sciences 5 ... Social Sciences
2 ... Technical Sciences 6 ... the Humanities
3 ... Biomedical Sciences 7 ... the Arts

Figure 1. Ratio of freshmen per scientific field in academic year 2004/2005 (Uzelac, 2006)
The graduate study program in the eighth semester offers four possible modules:

- Design and Product Development
- Production Logistics
- Materials Engineering
- Production Technologies

The three-year postgraduate doctoral study (PhD) program begins with a basic course of lectures during the first semester, and the lectures in the second, third and fourth semester are offered in three possible modules:

- Modern Production Technologies
- Modern Production Management
- Design and Numerical Analysis of Product

The fifth and sixth semester are mainly reserved for acquisition of ECTS points by publishing scientific and research papers and through dissertation related work.

Beside the postgraduate PhD program, the Faculty of Mechanical Engineering in Slavonski Brod also offers a three semester specialist postgraduate programme under the title “PRODUCT AND TECHNOLOGY DEVELOPMENT”, offering these possible modules:

- Materials Engineering
- Structural Modelling and Numerical Analysis
- Production Technologies Application
- Production Management

Here too, after the basic 1st semester, the 2nd semester is divided into modules. The 3rd semester is foreseen for preparing and writing of the final work.

In cooperation with Polytechnic of Slavonski Brod, the lecturers from the Mechanical Engineering Faculty hold lectures for undergraduate students of mechanical engineering (three-year program) since 2006/2007.
Activities over the past three years aiming at the implementation of the “Bologna process”

In order to meet the set goals, the staff of the Faculty has used all skills and knowledge for promoting the main idea of the “Bologna process” – putting students into the centre of the educational system (4) by “tailoring” the offered courses according to individual students and demands of the job market. Beside creating new programs according to the “Bologna process”, a wide range of particular activities was initiated in order to implement the process at the Faculty. Some of the activities were:

– Preparatory seminars for future freshmen of the undergraduate program (mathematics, basics of mechanical engineering, …)
– “Mentor work” of the student group mentor who is being appointed to assist students throughout the entire study course
– The possibility of taking exams during the current semester by periodic tests (i.e. midterm quizzes, seminar papers etc.)
– The possibility of choosing a tutor with adequate title during lectures and exams
– Optional revision of segments or entire lectures if requested by students
– Elective courses (foreign languages, PT, Internet, …)
– Institutional monitoring of education quality with particular emphasis on some courses
– Other activities.

Group mentors monitor student performance and assist in solving problems when needed. They must inform their co-ordinator and the vice-dean for education of their work. Those reports are also put on the Faculty server where they are available for all interested parties.

3.1 Student Survey as analytic tool of constant quality improvement (1)

A System for Improvement of Education Quality was established at the Josip Juraj Strossmayer University of Osijek.

All members of the University, including the Faculty of Mechanical Engineering in Slavonski Brod, have formed a Commission for Quality Improvement and Assurance. The organigram of the University system as mentioned is given in Fig. 2.

Fig. 3 shows the position of the Commission for Quality Improvement and Assurance at scientific constituents of the University.
By title, the members of each Commission for Quality Improvement and Assurance are:
- Vice-dean for education
- Secretary
- a representative of Professors
- a representative of Assistants
- a representative of Students.
This Commission coordinates all activities of quality improvement and assurance at the Faculty.

During the academic year of 2006/2007, an extensive anonymous survey was conducted among the students who attended lectures according to the new study program at all faculties of the University. Among other issues, the survey was about the courses (in general), about professors and assistants. Based on their experience from lectures, the students expressed their impressions numerically for post-survey processing purposes. Survey elements were as follows:

1/ General questions about a course:
   – Frequency of attendance of lectures
   – Frequency of attendance of (laboratory) experiment sessions
   – Frequency of lectures held
   – Frequency of (laboratory) experiment sessions held
   – Midterm quizzes
   – Exam passed

2/ Questions about the lecturer:
   – Adequacy of students’ pre-knowledge
   – Simplicity and comprehensibility of lectures
   – Lecturer able to raise interest in the course
   – Lecturer considers students’ ability to follow
   – Transparent grading
   – Lecturer is approachable and helpful

3/ Questions about the assistant:
   – Assistant raises interest in the course
   – Assistant considers students’ ability to follow
   – Assistant is approachable and helpful

The feedback proved that lectures and experiment sessions were held and attended regularly. It also emphasized the key motives for attendance.

The following template shows averages for held and attended lectures and experiment sessions as sum values for all courses. Beside averages, maxima and minima are given for attendance and held sessions for all courses.
Comment:
- 0.33 % of all conducted surveys, this question remained unanswered.
- 91.91 % of the students confirmed attending most sessions. 3.71 % of the students confirmed attending half of all sessions.
- Approximately 4.05 % of all students confirmed rare attendance.
In most survey samples (92.58%) the students claimed to attend experiment sessions / seminars regularly. 3.2% of all samples indicate occasional or rare attendance respectively. Only 6 survey samples (1.02%) remained unanswered.

Table: Frequency of attendance of experiment sessions 92.6%

<table>
<thead>
<tr>
<th>Possible answer</th>
<th>Frequency</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Regularly</td>
<td>549</td>
<td>92.58</td>
</tr>
<tr>
<td>b) Occasionally</td>
<td>19</td>
<td>3.20</td>
</tr>
<tr>
<td>c) Rarely</td>
<td>19</td>
<td>3.20</td>
</tr>
<tr>
<td>No answer</td>
<td>6</td>
<td>1.02</td>
</tr>
</tbody>
</table>

Question: How many times were the lectures cancelled?

Table: Frequency of lectures 89.7%

<table>
<thead>
<tr>
<th>Possible answer</th>
<th>Frequency</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) never</td>
<td>532</td>
<td>89.71</td>
</tr>
<tr>
<td>b) once or twice</td>
<td>33</td>
<td>5.56</td>
</tr>
<tr>
<td>c) more than twice</td>
<td>25</td>
<td>4.22</td>
</tr>
<tr>
<td>No answer</td>
<td>3</td>
<td>0.51</td>
</tr>
</tbody>
</table>
Comment:
The template and histogram show that 89.71% of all students confirm that no lecture was cancelled without prior notice. 5.56% claimed that this occurred once or twice, while the percentage of claims stating that lectures were cancelled on short or no notice more than twice lies with 4.22%. 0.51% of all samples remained unanswered.

Frequency of experiment sessions 92.4%

<table>
<thead>
<tr>
<th>Possible answer</th>
<th>Frequency</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) never</td>
<td>548</td>
<td>92.41</td>
</tr>
<tr>
<td>b) once or twice</td>
<td>20</td>
<td>3.37</td>
</tr>
<tr>
<td>c) more than twice</td>
<td>19</td>
<td>3.21</td>
</tr>
<tr>
<td>No answer</td>
<td>6</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Comment:
92.41% of all samples back the answer a) (never cancelled without previous notice). 3.37% of all students chose b) (cancelled without previous notice once or twice) and 3.21% replied with c) (session cancelled without previous notice more than twice). 1.01% remained unanswered.
Exam preparation is the key motive for attendance 57%  
(out of interest 14.5%; max 22%, min 9%)

<table>
<thead>
<tr>
<th>Possible answer</th>
<th>Frequency</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) it is mandatory</td>
<td>163</td>
<td>27.49</td>
</tr>
<tr>
<td>b) to prepare for the exam</td>
<td>338</td>
<td>57.00</td>
</tr>
<tr>
<td>c) out of interest</td>
<td>86</td>
<td>14.50</td>
</tr>
<tr>
<td>No answer</td>
<td>6</td>
<td>1.01</td>
</tr>
</tbody>
</table>
Comment:
– It can be concluded that most students (57%) attend the lectures in order to prepare for exams.
– 27.49% attend the lectures because it is mandatory, 14.5% have a personal interest in the subject, and 1.01% did not answer this question.

For each course, the students had to grade the statements from 1 to 5 (1 – do not agree; 5 – completely agree).

The answers as sum values for all courses are as follows:

<table>
<thead>
<tr>
<th>Students pre-knowledge is sufficient for the complexity of the subject</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valid N</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>592</td>
</tr>
</tbody>
</table>

It can be noticed that some 50% of all replies are in agreement with the offered statement.

<table>
<thead>
<tr>
<th>Lectures were easy to follow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valid N</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>591</td>
</tr>
</tbody>
</table>

It can be noticed that some 50% of all replies are in agreement with the offered statement.

<table>
<thead>
<tr>
<th>Lecturer manages to raise interest for the subject</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valid N</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>592</td>
</tr>
</tbody>
</table>
It can be noticed that some 50% of all replies are in agreement with the offered statement.

**Lecturer does consider students’ comprehension**

<table>
<thead>
<tr>
<th>Valid N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>592</td>
<td>3.56</td>
<td>4.0</td>
<td>Multiple</td>
<td>166</td>
<td>1</td>
<td>5</td>
<td>1.23</td>
</tr>
</tbody>
</table>

It can be noticed that some 50% of all replies are in agreement with the offered statement.

**Exams procedure is transparent**

<table>
<thead>
<tr>
<th>Valid N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>590</td>
<td>3.76</td>
<td>4.0</td>
<td>4.0</td>
<td>191</td>
<td>1</td>
<td>5</td>
<td>1.06</td>
</tr>
</tbody>
</table>

It can be noticed that some 50% of all replies are in agreement with the offered statement.

**Lecturer is approachable and helpful**

<table>
<thead>
<tr>
<th>Valid N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>593</td>
<td>3.83</td>
<td>4.0</td>
<td>5.0</td>
<td>231</td>
<td>1</td>
<td>5</td>
<td>1.19</td>
</tr>
</tbody>
</table>

It can be noticed that some 50% of all replies are in agreement with the offered statement.

**Assistant raises interest in the subject**

<table>
<thead>
<tr>
<th>Valid N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>406</td>
<td>3.65</td>
<td>4.0</td>
<td>4.0</td>
<td>127</td>
<td>1</td>
<td>5</td>
<td>1.17</td>
</tr>
</tbody>
</table>
It can be noticed that some 50% of all replies are in agreement with the offered statement.

<p>| Assistant considers students’ comprehension of the subject matter |
|-----------------------|--------|---------------|-------------|----------|--------|----------|</p>
<table>
<thead>
<tr>
<th>Valid N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>406</td>
<td>3.73</td>
<td>4.0</td>
<td>5.0</td>
<td>132</td>
<td>1</td>
<td>5</td>
<td>1.20</td>
</tr>
</tbody>
</table>

It can be noticed that some 50% of all replies are in agreement with the offered statement.

<p>| Assistant is approachable and helpful |
|--------------------------------------|--------|---------------|-------------|----------|--------|----------|</p>
<table>
<thead>
<tr>
<th>Valid N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>406</td>
<td>3.90</td>
<td>4.0</td>
<td>5.0</td>
<td>165</td>
<td>1</td>
<td>5</td>
<td>1.19</td>
</tr>
</tbody>
</table>

It can be noticed that some 50% of all replies are in agreement with the offered statement.

Based on this survey, we can conclude that the students have rated their professors as very good. The analysis clearly shows ratings issued by students for every single lecturer involved in teaching at individual courses. To back the effort of improving education quality, the lecturers were informed of the survey results and specific remarks deriving from the survey. As a response to these results, the Management of the Faculty has taken the appropriate steps in order to improve the education quality.

**Difficulties experienced during the past three years of implementation of the “Bologna process”**

During the initial implementation of the new program, several difficulties occurred and can be summed up as:

- Insufficient pre-knowledge of Physics and Mathematics (demonstrated by students)
– Low motivation of young graduates to apply for the position of scientific novices who could contribute to new academic programs
– Too many students in the lectures and experiment sessions, (several additional lecture rooms are needed, as well as one bigger fully equipped laboratory)
– Laboratory technitians needed to improve the quality of lectures
– Some changes and addenda of study programs are neccessary
– It is necessary to define the preconditions for the transfer from other faculties.

A particular problem to be emphasized is the final exam and the transition from a university undergraduate program to a graduate program after the seventh semester.

References

Bologna process at the Faculty of Geotechnical Engineering

Abstract

The restructuring of the higher education system in Croatia came at the right moment for the Faculty of Geotechnical Engineering. Namely, the consideration for new, modified study programme had been present at the faculty some time before the Scientific Activity and Higher Education Act was passed in 2003. The new study programme has been based on the idea to preserve a tradition of the old programme (geotechnical engineering and water engineering) on one hand and to switch to certain segments of environmental protection on the other hand. The paper shows basic preconditions for the implementation of the new study programme and offers an analysis of results of enrolment into the Faculty of Geotechnical engineering.

The most important issues of the Bologna process at the Faculty of Geotechnical Engineering are: insufficient number of teachers employed by the faculty, low level of secondary school knowledge and insufficient general interest for the study programme “Geoengineering”.

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Vice-Dean for Teaching of the Faculty of Geotechnical Engineering
University of Zagreb
Varaždin, Croatia
dkovacic@gfv.hr
Introduction

The restructuring of higher educational system could not have come at a better time for the Faculty of Geotechnical Engineering. The thought of a new, changed study programme were present at the Faculty a considerable time before the Scientific Activity and Higher Education Act from 2003. Also, the time seemed right for financial assets in view of a credit provided by the Zagreb University to be used for modernizing the laboratory equipment and IT support. There was also a third important component to actualizing the modification of the study programme, and that is the Faculty’s initiative in introduction of certain amendments to the existing Regulations in Scientific and Artistic Areas, Fields and Branches, whereby the new programme would find its niche in scientific terms.

The concept of the new study programme presented by the Faculty of Geotechnical Engineering has attempted, on one hand, to somewhat preserve the tradition of the long-standing programme (geotechnical engineering and water engineering), and on the other, to turn to certain segments of environmental protection. Thus, the new programme contains three modules. The two modules formerly present in the programme are still here, keeping their old names, but otherwise enriched by environmental protection contents. The third, new study course is named “Environmental Engineering”, finding its contents in those segments of environmental protection mainly covering the problem of groundwater and soil pollution, and waste management. The importance of environmental protection in Croatia should not be especially emphasized, but, for the purposes of this paper, we will mention just several factors supporting this issue.

The importance of environmental protection

We should first mention the fact that this problem has been elevated to the highest level of national policy; after all, one of the ministries is named the Ministry of Environmental Protection, Physical Planning and Construction. From the regulative standpoint, we should mention the following: The Environmental Protection Act (19947), the National Environmental Protection Strategy (2002) and the National Environmental Action Plan (2002). The next significant step was the establishment of the Environmental Protection and Energy Conservation Fund (2003),
which ensured additional financing for projects, programmes and similar activities in the field of environmental protection, sustainable use, protection and improvement of the environment. Furthermore, in accordance with the Decision made by the National Science Council on the priorities of short-term and long-term strategies of science development, the short-term strategic research priorities in the Republic of Croatia are: the environment, health, energy and materials, and the Croatian identity. We should add that a new Environmental Protection Act was brought forward in 2007, existing in accordance with European Union legislation (1, 2, 3).

We can illustrate the financial scope of activities planned for environmental protection using the data from the Strategy of Waste Management of the Republic of Croatia (4) where waste management expenses for the 2005 – 2025 are estimated to be some EUR 3.2 billion. Another important piece of data is that of analytical overview (screening) of legislation for the chapter “Environment” being completed mid-2006, as one of the most difficult, most wide-spread and most expensive – as it will demand high financial investments (experts estimate them to be some EUR 10-11 billion). In addition to this, according to the Central Bureau of Statistics, total investments in environmental protection in Croatia in 2005 amounted to HRK 1.46 billion.

The above stated facts, i.e. documents unquestionably point to the importance of environmental protection. It is also clear that planned activities cannot be executed without appropriate staff, which means relying on higher education and science. Therefore, we can safely say that the new study programme of the Faculty of Geotechnical Engineering is on the right track.

General characteristics of the new study programme of the Faculty of Geotechnical Engineering

The new study programme has two levels (Fig. 1). The first level: the undergraduate study (Bachelor Programme) lasts three years. The first two years are common for all students, while third year students may choose one of the offered modules. During one semester, a student is to collect 30 ECTS points through preliminary exams, term papers and exams. After the students collect 180 ECTS points, they will attain the rank of bacalaureus/bacalaurea in Geoengineering.
Thesecondlevel:thegraduatesudy(MasterProgramme)laststatwoyears
andcontainsthreearliermentionedmodulesofstudy,wherestudents
mustcollectfurther120ECTScredits.Completingthislevel,thestu-
dentsattaintheacademictitleofMasterofGeoengineering(5).

TheFacultyofGeotechnicalEngineeringisattemptingtoalsoimplement
thepostgraduate–doctoralstudy.Thistudyshouldbeinternational,i.e.
so-calledjointstudy,incorporatingthefacultyofMining,Geologyand
PetroleumEngineeringandthefacultyofCivilEngineeringofthe
ZagrebUniversity,thefacultyofCivilEngineeringoftheMaribor
University,thefacultyofCivilEngineeringoftheGrazUniversityofTech-
nology,andthefacultyofCivilEngineeringoftheBudapestUniversity
ofTechnologyandEconomics.TheFacultyofGeotechnicalEngineering
gaveinitiativesfortheinitiationofthistudyattheendof2005,
workingontheexpansionofexistingcooperationbetweensomeof
thepreviouslymentionedhighereducationinstitutionsandon gaining
astrongregionalframework.

Figure1.Diagramofthestudyprogramme

The second level: the graduate study (Master Programme) lasts two years
and contains three aforementioned modules of study, where students
must collect further 120 ECTS credits. Completing this level, the stu-
dents attain the academic title of Master of Geoengineering (5).

The Faculty of Geotechnical Engineering is attempting to also implement
the postgraduate – doctoral study. This study should be international, i.e.
so-called joint study, incorporating the Faculty of Mining, Geology and
Petroleum Engineering and the Faculty of Civil Engineering of the
Zagreb University, the Faculty of Civil Engineering of the Maribor Uni-
versity, the Faculty of Civil Engineering of the Graz University of Tech-
nology, and the Faculty of Civil Engineering of the Budapest University
of Technology and Economics. The Faculty of Geotechnical Engineering
gave the initiative for the initiation of this study at the end of 2005,
working on the expansion of existing cooperation between some of
the previously mentioned higher education institutions and on gaining
a strong regional framework.
Preconditions for realization of the new study programme

Additional effort has been put forward during preparations for introduction of the new study programme, in view of improving levels of current teaching staff, employing new teachers and increasing the number of guest teachers from other Zagreb University institutions. This step was essential due to differences between the new and the old study programme.

However, the most important positive improvement of teaching process was the procurement of new laboratory and IT equipment, and renewal and expansion of teaching premises. Thanks to the financial injection by the Ministry of Science, Education and Sport, i.e. the credit which was approved to the Zagreb University in the amount of HRK 6.5 million, and by investing HRK 1.2 of our own income, we managed to expand the existing geotechnical laboratory and set up a new laboratory for environmental geochemistry.

Spatial conditions

As far as the necessary room for actual performing of lectures is concerned, the Faculty of Geotechnical Engineering in that respect stands on favourable ground. The recent analysis encompassing all engineering faculties of the Zagreb University has shown that in Faculty of Geotechnical Engineering, the relation faculty space/number of students is very high (16 m² per student), which places us at near the top of that particular list (most faculties have a ratio between 4 and 10 m² per student).

We should add that all lecture rooms have been outfitted with modern IT equipment and the library has been renewed. Especially impressive is the newly constructed hi-tech IT classroom (Fig. 2).

Staff

The Faculty of Geotechnical Engineering, with its seat in Varaždin, represents a removed member of the Zagreb University. The Faculty of Geotechnical Engineering employs 55 full-time staff, of which 42 are teachers and associates. The structure of teachers and associate is as follows:
1 full professor with
3 full professors
3 associate professors
10 assistant professors
3 senior lecturers
3 lecturers
10 assistants,
9 professional associates

The ratio of full-time teachers and visiting teachers for the undergraduate study (the Bachelor Programme) is shown in Table 1.

**Table 1. Participation of visiting teachers in the Bachelor Programme**

<table>
<thead>
<tr>
<th>Academic year</th>
<th>No. of visiting teachers</th>
<th>%</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>31</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>41</td>
<td>NA</td>
</tr>
<tr>
<td>Bachelor Programme</td>
<td>17</td>
<td>31</td>
<td>NA</td>
</tr>
</tbody>
</table>
The table shows that the Faculty of Geotechnical Engineering, as far as teaching staff is concerned, needs improvement. Still, it needs to be emphasized that the teaching staff necessary for the implementation of the new study programme has been ensured. Namely, the Faculty, along with its own teaching staff, also uses teachers from the Faculty of Civil Engineering, the Faculty of Mining, Geology and Petroleum Engineering, the Faculty of Textile Technology, the Faculty of Geodesy, the Faculty of Electrical Engineering and Computing, the Faculty of Mechanical Engineering and Naval Architecture and the Faculty of Transport and Traffic Engineering, as well as some other institutions. Thanks to this cooperation, a regular flow and high quality of teaching has been ensured.

The management of the Faculty of Geotechnical Engineering is constantly looking for ways to employ new teaching staff. The primary difficulty in achieving this is the separate location of the Faculty, since young, talented candidates for junior researchers and young scientists do not like to leave the seat of the University, the City of Zagreb, which secures them better scientific work conditions, and thereby possibility for faster advancement on the scientific and educational title scale.

The science component

Results of research performed within various scientific and professional projects are also being used in the realization of the study programme. This primarily pertains to projects financed by the Ministry of Science, Education and Sport: “Sensitivity of the karstic hydrogeological systems”, “Characterization of municipal solid waste” and “Sustainable utilization and protection of water resources in the National Park Plitvička jezera”, and various professional projects: “Hydrogeological researches on the location of the waste water treatment plant for NP Plitvice Lakes and Rakovica”, “Hydrogeological and geochemical investigations on the Delovi wellhead”, “Water management study of the Jadro and Žrnovnica catchments”. Certain parts of the teaching process are also being realized through cooperation on international projects: “Mountainous lakes: sustainable utilization of water in the pilot area Plitvice Lakes” and the “Mirna river basin management plan”.

Geotechnical Laboratory

Units comprising the reconstructed geotechnical laboratory are: the geotechnical practicum where students acquire basic knowledge of methods of laboratory soil testing; the soil mechanics laboratory, which will be
used, along with the educational function, for economical cooperation; and the scientific research laboratory.

Primary new apparatus acquired for the lab is the hydraulic oedometer, which has a much larger range of options for measuring parameters of soil samples than the classic oedometer. We also acquired a new device for triaxial testing.

Modern equipment was also acquired for other geotechnical research and testing. This equipment allows for continuous monitoring of tests with real-time display and includes automatic unlimited measurement data recording. All areas of geotechnical laboratory testing were encompassed by this modernization, specifically: Determination of basic physical and mechanical soil characteristics, classification tests, uniaxial compressive test and shear strength test, as well as testing of special soil characteristics. Technical capabilities of such equipment ensure a high quality of laboratory testing, not only according to HRN standards, but also according to BS or ASTM standards, which are considered among most advanced global standards in the field of geotechnical laboratory testing. Therefore, with qualified and experienced staff and the realized level of modernization, the geotechnical laboratory is surely becoming an important factor in the Faculty of Geotechnical Engineering taking part in research and professional projects, in Croatia and abroad.

The above mentioned modernization will ensure those attending the new study programme to master the new methods of geotechnical lab testing of soil and to raise the level of their competences and skills (Fig. 3).

**Figure 3.** Student exercise at the geotechnical laboratory
Environmental Geochemistry Laboratory

The Environmental Geochemistry Laboratory hosts a suite of instruments used for teaching and research in the field of Environmental Geochemistry. More precisely, it has a function within the scope of "Environmental Analytical Chemistry" and "Hydrogeochemistry" lectures as well as in surface and groundwater resources and environmental protection projects.

Analytical instruments in the Environmental Geochemical Laboratory include valuable equipment: a Perkin Elmer AAS with graphite furnace and hydride technique (Figure 4) and Luminiscence Spectrometer LS 55, High performance liquid chromatography (HPLC) instrument (KNAUER) with UV detector, HACH UV VIS Spectrophotometer, two field spectrophotometers, turbidimeter, two field laboratories for water, waste water and soil analysis, and smaller group of digital instruments for field (HACH, WTW) and bore-hole measurements (SEBA).

Figure 4. Perkin Elmer AAS with graphite furnace and hydride technique

These instruments are utilised for studies of distribution of major and trace elements, nitrogen and phosphate compounds and some organic compounds to examine geochemical processes in water and soil environment as well as effects of anthropogenic impacts on mentioned parts of
environment. Laboratory instruments support a need for groundwater tracing tests by artificial tracers, uranium and lithium chlorides and natural geochemical tracers.

Both laboratories have already began their procedures of gaining accreditation according to the ISO/IEC 17025 standard that will improve the quality of laboratory analytical procedures and ensure their competitiveness in regional and European scientific and technology projects.

**Results of enrolment for undergraduate studies**

The first undergraduate level “Bologna generation” was enrolled in the Faculty of Geotechnical Engineering in the academic year 2005/2006. Of the total 104 enrolled students, approximately one third (34) collected the necessary number of ECTS credits and enrolled in the third semester. Somewhat less than a third (32) fulfilled the required conditions partially. In accordance with the programme requirements, these students had to take the courses they failed in the first year again, as well as adding some from the second year. Unfortunately, over one third of students (38) did not continue their studies at the Faculty of Geotechnical Engineering. The enrollment in the fifth semester resulted in further reduction: only 17 students enrolled, i.e. 50% of the 2nd year students.

The second “Bologna generation” was enrolled in the academic year 2006/2007. Of the total 87 newly enrolled students, one third (29) enrolled in the third semester, while almost 60% (51 students) dropped out. A fewer number of students (74) enrolled in the Faculty as the third “Bologna generation” than in the previous academic year.

Table 2 contains a joint overview of the number of students enrolled in the new study programme at the Faculty of Geotechnical Engineering. The total number of students enrolled in undergraduate studies is 137.

After a two-year experience, we can conclude that the rate of success of attendance at the Faculty of Geotechnical Engineering is below expectations. After the analysis of the state of matters, certain conclusions were reached, which are presented in the conclusion in this paper.
Conclusion

The main reasons for low level of passing the undergraduate studies at the Faculty of Geotechnical Engineering may be divided into two basic groups: External causes and internal causes.

The first external cause is the low quality of faculty entry candidates, i.e. insufficient body of knowledge obtained by the students through their high school education. This is especially true of their knowledge of mathematics and physics, which are essential in order to successfully navigate through the faculty programme. This problem is partially present in other technical faculties as well, but it is especially emphasized at the Faculty of Geotechnical Engineering.

According to enrolment data for students entering the Faculty in the academic year 2007/2008, only 20 finished the general high school, while 53
students completed a vocational and training school. Although the final grade was satisfactory (4,2), the average grade in mathematics and physics through all four years of schooling was only approximately 3. However, this average hides some worrying data:

- **Mathematics**
  - 22 pupils have the average grade 2

- **Physics**
  - 17 pupils have the average grade 2
  - 8 pupils – duration of the subject: 3 years
  - 19 pupils – duration of the subject: 2 years

It is clear that additional effort needs to be put forward in order to have more students with better previously acquired mathematics and physics knowledge enrolled in the Faculty programme.

The second external reason has to do with insufficient interest of the students for jobs in the field of environment protection. In connection with the facts mentioned in Chapter 2 of this paper, national institutions are responsible for the change of the described state. In that respect, and pursuant to provisions of the new Environmental Protection Act, we expect forthcoming regulations on taking the professional examination for activities connected to environmental protection. Besides, by adopting the proposed modifications in the existing Regulations in Scientific and Artistic Areas, Fields and Branches, the new study programme would find its niche within the scientific system as well. It is also essential to amend the National Qualifications Classification System with appropriate names for occupations in the field of environment protection.

The primary internal reason of low number of students passing the undergraduate studies at the Faculty of Geotechnical Engineering is insufficient staff. Data under Subtitle 4.2 point to an insufficient number of full-time employed teaching staff. The solution of this problem is the primary task in further realization of the Bologna process at the Faculty of Geotechnical Engineering.

Within their abilities, the Faculty of Geotechnical Engineering will strive to improve the quality of teaching, the level of scientific research and standard of studying at the Faculty. This is surely our obligation toward the society, local community and, most of all, toward students who should be the leaders in solving important environmental protection problems in Croatia after they finish their studies.
References


Abstract

Faculty of Food Technology and Biotechnology has started intensive preparations for the Bologna process reforms in 2004 and first students enrolled new undergraduate studies in the academic year 2005/06. Therefore, the “Regulations on undergraduate and graduate studies” have been issued. During that year the new study system according to Bologna process has been built up and implemented, a very demanding task for which Quality assurance committee has been founded. The duty of the Committee was to follow the implementation of the system and solve the unforeseen problems already during the first year of studies. One of the most important novelties was the continuous knowledge examination through partial exams and/or tests during the semester which could fully replace the final exam at the end if sufficient points were collected. To enable students to fulfill the requirements of the new regime all lecturers were asked to prepare their teaching materials and they were up-loaded to the faculty web-sites. Quality assurance committee reviewed the materials and asked for revisions were required to enable students to acquire the required skills and knowledge with an engagement of 40 hours per week. The number of direct lecture hours was decreased while the extent
of seminars and practical courses was maintained. For better communication mentoring was introduced and each student got a mentor among teachers or assistants. In the academic year 2006/07. the second year of teaching according to Bologna system was organized with the help of experience of the previous year.

Why is it worth investing efforts in implementation of the Bologna reform?

Implementation of the study reforms according to the “Bologna process” started at the Faculty of Food Technology and Biotechnology in Zagreb with the academic year 2005/06, following about two years of intensive preparation. Although strategic decisions to join European high education trends were brought at the level of the state, reforms have generally been accepted among teachers at our Faculty as an opportunity to make a step towards more efficient, labor market oriented education. Major reasons for the Bologna reform and the requirements high education should be able to fulfill through its implementation have been thoroughly elaborated and documented in the recent years, thus they will not be a subject of this text. Rather, the specific opportunities the reform offers in the education of Food Technologists, Biotechnologists and Nutritionists will be described as seen from the angle of experiences gained at our Faculty in the starting years of the implementation.

Bologna reform is a process identified as a possibility to solve several problems burdening our studies in the previous study regime. First, it is the duration of the studies. Although studies at the Faculty of Food Technology and Biotechnology were declared to last 8 or 9 semesters depending on the study, even the best students were not able to graduate in this period. The average duration of studying was between 7.5 and 8 years which, in fact, was the overall average at the University of Zagreb. Second, our studies could fulfill requirements of our students’ future employers only partially. Usually, there was a rather long period of additional education taking place at their working places after their employment. This additional training was absolutely required for their adjustment to new working surrounding but it was usually run by experienced company employees, thus wasting part of their time and energy on something that should have been a part of the formal education. Finally, the very aim of the studies was to give students as much knowledge as possible, often forgetting that knowledge acquired during the high education
process should not be regarded as broadening of the general education standard of the population but rather as a tool for performing specific activities at the students future working place. As a result, our students ended their studies with appreciable knowledge but rather low skills and poor ability to use the learned facts efficiently. Therefore, the students had to invest a lot of work to achieve much lesser competences.

Naturally, the identified problems defined the expectations of the implementation of reforms, pointing out major aims as improvement of the efficiency of the education process. Studies should end in shorter time and produce students with significantly higher skills at the expense of some knowledge which may not necessarily be a part of the future profile of experts educated at our Faculty. To achieve these goals reforms have to be incorporated in all segments of academic system and basically should reflect to the resources mobilized in education, to the attitude of teachers and the way they approach their duties in teaching and research, and, finally to the attitude of students as partners in the process of acquiring competences. In the following chapters our approach and so far achievements will be discussed shortly.

Resources

Main resources involved in education are certainly funds, people, space, equipment and literature (in broader sense as a source of information). Funding of high education institutions is interconnected with other pre-requisites, it is insufficient for carrying out reforms and can only partially be supplemented with more human engagement, better organization etc. However, funding is to a great extent a result of general financial situation, determination of the state politics to identify importance of education in the further development etc. Since these factors can be influenced by high education institutions only to a very limited extent they will not be discussed here.

Human resources may represent the rate limiting factor in implementation of reforms and the problem is both quantitative and qualitative. Lack of teachers is evident at the whole University of Zagreb and is experienced at the Faculty of Food Technology and Biotechnology, as well. Particularly, it can be seen in insufficient number of assistant positions. Studies at technical and biotechnical faculties are particularly challenged in the reform process because the improvement of competences in these
fields require pronounced individual approach to students and working in smaller groups, especially during practical courses. This is not possible with the present number of assistants/PhD students and postdoctorals. Having in mind that their main task at their departments is research, the present situation represents marked overload of assistants who are neither able to perform their experiments as parts of their PhD thesis in a satisfactory manner, nor can they dedicate enough time to teaching. In qualitative terms, the competence of teachers is a problem, particularly in some surrounding, mainly due to a long tradition of underpayment, poor social acceptance and bad working conditions resulting in negative selection and loss of motivation. Such teachers are certainly not able to conform to standards brought by the reform of studies. At the level of the faculty we can fight the problem of the insufficient number of assistants by increasing the number of scientific projects financed by the Ministry of Science, Education and Sport thus bringing new positions for PhD students. The other possibility would be an increase in the number of projects in collaboration with production companies which would finance new PhD students’ positions but should find a direct interest in such collaboration. In the same time, only insisting in high scientific criteria can ensure required quality of teachers.

Educational process, particularly at technical and biotechnical faculties requires the use of sophisticated and often expensive equipment. Lack of such equipment significantly reduces final skills and competences of students. Although it is not realistic to expect educational institutions to be better equipped than production companies, students should at least be able to get acquainted with methodology comparable to that used by their future employers. To some extent this problem can be tackled by a better organization in the application of existing equipment which is often used much below their actual capacities. However, a significant investment in equipment is also required.

Finally, one of the urgent problems at the Faculty of Food Technology and Biotechnology, but probably at some other faculties, too is the lack of adequate textbooks for many courses. Some textbooks are old and outdated, some have the required quality but have been published several years ago and disappeared from the bookshops in the meantime, and for many courses, particularly newly introduced ones, there are no textbooks at all. The problem is not new but was diminished in the previous study regime by the fact that students of one generation used to take exams at different exam terms which meant that they did not prepare exams (i.e. used textbooks) simultaneously. In the present system they are expected to follow lectures and prepare exams during the semester, thus all stu-
dents need textbooks at the same time. As an auxiliary measure, all lecture presentations are accessible to students at the faculty web-site, but it would of course be a big mistake to substitute textbooks with such presentation and make them a major source of information for studying and exam preparation.

**Teachers’ attitude**

In order to bring reforms to a success teachers have to understand the changes, to accept them, and show willingness for their implementation. This requires a rather radical change in the approach to teaching, often being a significant obstacle on the way of reaching the goals of the reform. Important factor which necessarily leads to a change in the approach is a significant reduction in lecture hours. A teacher confronted with limited lecturing time has to consider a choice of facts and data he can include in the lectures forcing him to restrict to the most significant. Besides, he will try to avoid any repetition within his own lectures, but also with other courses. Finally, the teacher will try to use more advanced education means in order to save time. Altogether, shortening of lecturing time motivates teachers to increase the efficiency of their courses. In the same time it is extremely important not to decrease practical courses since this would undoubtfully lead to a decrease in competences achieved.

Another important measure leading to more logical and efficient studying is the revision of teaching materials by teachers of succeeding years or courses. This leads to modifications in topics covered by a course providing that it gives students exact and sufficient skills and knowledge to prepare them for the next courses. An ideal result would be a focused and consistent studying vertical leading to a clear, easily recognizable curriculum. Although such approach seems logical *per se* it has never before been a practice, neither at our faculty nor in many other high education institutions.

Finally, a very important role in helping teachers to adapt to the new study regime was played by the Quality Assurance Committee. The Committee’s main role was to follow the implementation of the reform at a weekly basis and suggest modifications of measures taken, sometimes in a direct communication with particular teachers, or, if broader changes had to be done, also with the faculty management, the dean or vice-deans.
Students’ attitude

Adaptation of students to a new study regime is normally much easier than the adaptation of teachers since advancing from a secondary school to a faculty represents a major change in the life of a student anyway. Students have to be regarded as partners in the education process and not, as it was often the case in the past, as its objects. In communication with students faculty managements have to define their commitments clearly and in due time. Setting clear “rules of the game” was the most important students’ expectation and their own involvement in many aspects of on-going reforms was highly appreciated in the Quality Assurance Committee as well as in other faculty bodies.

Considering the students’ attitude to the teaching process, the most important changes have been achieved by replacing classic exams with a continuous following of students’ success. Instead of one exam at the end of a course, students have to pass several partial exams during the semester. The final note is composed of all partial exams and also other course elements like practical exercises, seminars etc. The schedule of partial exams and other study obligations was created by the Quality Assurance Committee in very close collaboration with student representatives. In this way students’ engagement which previously peaked before each exam was distributed through the whole semester more evenly. Besides, the pace of studying was defined by the study program and was not in the hands of students any more. As a result, a significant decrease in the average length of studying is expected.

Experience at the Faculty of Food Technology and Biotechnology shows that students have high expectations of the reform, that they are willing to overcome problems which occur at the beginning of its implementation, and that they are ready to invest more efforts to be a part of the on-going process. Such attitude additionally points out the responsibility of the entire higher education system and all its components in the “Bologna process”.

Conclusions

Although three years are certainly not enough to evaluate changes in an educational system the experience gained so far can point out some of the most obvious strengths and weaknesses of the new study regime. A switch in the study goals from knowledge to competence certainly creates
a risk of decreasing knowledge of an average student through shortening of lecturing and the overall study duration without adequately substituting it with an increase in acquired skills through more practice, new teaching technologies, stronger involvement of students and generally, an improvement of the educational process. If this happens the only result we can expect would be a decrease in competences and the failure of the reform. Therefore, only an absolute dedication of all structures involved in implementation of the “Bologna process”, from governmental bodies coordinated by the Ministry of Science Education and Sport to every single university teacher and assistant can provide basis for a more efficient, labor market directed and Europe-wide recognized high school education system in Croatia.
Bologna reform “three years later”

Abstract

In the 2005/06 and 2006/07 academic year the new program of the undergraduate study of the Food Technology was simultaneously carried out with the previous undergraduate study. Two simultaneous programs caused an additional work in teaching for lecturers and associates and an increasing necessity for additional classroom and laboratory space both for teachers and associates. With the aim of facilitating students’ socialization into academic community, students were given all relevant information for the study during the Dean’s address and later in a 90 minute discussion. In both academic years teachers were assigned as mentors to students. At the end of semester one additional term was given to students for partially passed exams and additional terms for accomplishing other tasks and duties of the study programs, not done in due time. At the end of the 2005/06 academic year the average grade of all passed exams, after the first two semesters, was identical with the average grade that students obtained from the secondary school courses that were evaluated during the placement test procedure. After the 3rd and 4th semester the average grade of all passed exams in both academic years increased for additional 10%. The generation of 2006/07 students obtained 10% higher average grade than the previous generation. The drop out was identical. Approximately 50% of students from both generations fulfilled conditions for continuing the study at the 2nd year, while 50% of the 2nd year students fulfilled conditions for continuing the 3rd year of study. In the 2007/08 academic year a decrease of drop outs and an increase of average grades after the
1st year of study can be expected. According to the present facts it can be expected that about 75% of the student population in the 3rd study year will finish the undergraduate study on time and will choose the graduate study at Faculty of Food Technology in Osijek.

**Introduction**

In the 2005/06 and 2006/07 academic year the courses were conducted both at the current and the former undergraduate study of the Food Technology. Parallel conduction of these two studies caused additional work for the lecturers and associates resulting in the increasing necessity for additional classrooms and laboratory space including new teachers and associates.

During the Dean’s address and later in a 90 minute Vice dean’s discussion with the students, students were introduced to all information relevant for the study, in order to facilitate their adaptation to the academic society.

In both academic years teachers were assigned to students as mentors. At the end of semester students were given additional terms to pass certain parts of the exam. Besides, one additional term was given for accomplishing unfulfilled obligations from the study programmes.

At the end of 2005/06 academic year the average mark of all passed exams, after the first two semesters, was equal to the average mark that students obtained from the courses in the secondary school, which were evaluated during the entrance exam. After the 3rd and 4th semester the average mark of all passed exams in both academic years increased for additional 10%.

In the generation of 2006/07 students obtained 10% higher average marks than the former generation. Drop out was the same. About 50% of students from both generations reached conditions for study continuation in the 2nd study year, while 50% of students of the 2nd study year reached conditions for continuing the study in the 3rd year.

In the 2007/08 academic year, a decrease of dropouts and an increase of average marks after the 1st study year could be expected.

According to the present facts it could be expected that about 75% of the student population in the 3rd study year will finish undergraduate study on time and will choose graduate study at the Faculty of Food Technology in Osijek.
European Higher Education Community, Croatian Ministry of Science, Education and Sport, Croatian Universities and other relevant bodies involved in higher education have published different materials about the Bologna process for last few years. Based on these materials, different conferences about Bologna reform, ECTS system implementation and experience in conducting this process at the University of Osijek and the Faculty of Food Technology Osijek, this paper was prepared.

Faculty of Food Technology Osijek offers six different study programmes in four different levels (Table 1).

<table>
<thead>
<tr>
<th>Study programme</th>
<th>Level</th>
<th>ECTS</th>
<th>Awarded title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Technology</td>
<td>Undergraduate</td>
<td>180</td>
<td>University Baccalaureus/Baccalaurea of Food Technology</td>
</tr>
<tr>
<td>Food Engineering</td>
<td>Graduate</td>
<td>120</td>
<td>Master Engineer of Food Engineering</td>
</tr>
<tr>
<td>Process Engineering</td>
<td>Graduate</td>
<td>120</td>
<td>Master Engineer of Process Engineering</td>
</tr>
<tr>
<td>Food Science and Nutrition</td>
<td>Graduate</td>
<td>120</td>
<td>Master of Nutrition and Food Science</td>
</tr>
<tr>
<td>Food Safety and Quality</td>
<td>Postgraduate specialist</td>
<td>60</td>
<td>University Specialist of Food Safety and Quality</td>
</tr>
<tr>
<td>Food Engineering</td>
<td>Postgraduate PhD</td>
<td>180</td>
<td>Doctor of Biotechnical Sciences, Scientific Field Food Technology, Branch Engineering</td>
</tr>
</tbody>
</table>

### Conditions for admission

To be admitted to the Faculty of Food Technology students are expected to have finished a four-year secondary school and to pass the entrance exam that includes the points obtained from the testing in chemistry and mathematics and the points that are assigned on the basis of secondary school success. The applicants who had excellent marks in the secondary school can achieve sufficient points to be exempted from taking the tests in mathematics and chemistry.
By completing the undergraduate study of Food Technology at the Faculty of Food Technology in Osijek one is awarded the academic title of the University Baccalaureus/Baccalaurea of Food Technology. In addition to acquiring the knowledge from the basic natural sciences during the undergraduate study, students also acquire sufficient professional knowledge, which enables them to successfully perform all jobs in their profession in food or related industries (enhancement of product quality, process supervision etc.).

Students who either finish the undergraduate study at this Faculty or the Faculty of Food Technology and Biotechnology of the Zagreb University (profile food technology and nutrition) can be directly enrolled at the graduate studies at the Faculty of Food Technology. Students who finish undergraduate studies at the Faculty of Chemical Engineering and Technology, Chemical-Technological Faculty, Pharmaceutical-Biochemical Faculty, Agronomical Faculty in Zagreb, Agricultural Faculty in Osijek can be enrolled at some of the graduate studies at the Faculty of Food Technology provided they pass some additional exams.

Precise conditions of enrollment will be defined after comparing undergraduate studies, which will be done by the committee, appointed by the Faculty staff (2, 3, 4, 5).

**Studying**

To enroll to a senior study year students must have at least 42 ECTS credits and 24 for repeating the same study year. A student can score 30 credits during a semester.

Based on the students’ questionnaire where students have assessed themselves, the courses and the lecturers, efforts have been made for permanent improvement of the teaching process. All lecturers were given average grades in the questionnaire, while the students’ office received the highest grade at the whole University.

Courses are obligatory and elective and students can choose certain areas in which they will collect knowledge. Study programmes are designed according to demands from industry and other institutions where students will apply for job. Elective courses are designed primarily for demands in Slavonia region. In both type of courses the main goal is to make engineers ready for the European labor market.
Engineers with previous title will be recognized at the labor market as equal and based on personal demand they will obtain the title of the Master Engineer of Food Technology and Process Engineering.

Mobility is among important prerequisites for the establishment of the main goal of the Bologna Process, the joint European Area of Higher Education. Students can use CEEPUS network scholarships and go to foreign Universities while foreign students can come to the Faculty of Food Technology. In the previous years many students, young researchers and teachers visited Universities in different European countries and foreign students spent from one to three months at the Faculty of Food Technology Osijek (5).

Reform implementation

The Faculty of Food Technology started the three-year undergraduate course of Food Technology in the academic year 2005/06. The study included ten courses with 167 students, 11 lecturers, and 9 associates, which meant that one lecturer, had 15 students and one associate had 19 students. The full class load, only for the first study year, was three hours per week for professors and 16 for associates. Since most of them taught at senior study years, their class load was too big and they lacked time for proper preparation of teaching and exam materials.

The undergraduate and three graduate studies offer 136 courses and 102 of them involve Laboratory practice. This clearly shows the mainstream orientation of the Faculty of Food Technology, namely education of experts who will be competitive at the labour market due to their practical work experience.

While the undergraduate study of Food Technology offers 39 courses, three graduate programmes offer 32 courses in Food Engineering, 35 in Process Engineering and 30 in Food Science and Nutrition. Students have various elective courses at the Faculty of Food Technology, but they can also take some of the elective courses at other faculties of the Osijek University.

In the academic year 2002/03 implementation of the Bologna process already started for Mathematics at the first study year. According to the analyzed results more students are successful in passing exams now than before, which amounts to 60% now. This is an indicator of a higher edu-
cation quality. In addition to regular testing during semesters, students can also take exams within the regular exam schedule (6, 7).

In the academic year 2003/04, teaching in smaller student groups was applied for several other courses and study years, accompanied by more frequent knowledge assessment during semester. Since 2005/06 the Bologna process has been implemented for all courses of the undergraduate programme of Food Technology. In accordance with the new curriculum all courses last one semester and students have 2 to 3 qualifying exams during semester. Exams could be also taken in the winter, summer and autumn examination terms.

After several weeks of lectures and examinations, statistical analyses showed better success in exam passing, which is due to smaller student groups, intensive engagement of professors and associates, student preparation for a new work method, and less teaching material. Exams are organized upon the completion of teaching units, namely every fifth week students take four qualifying exams. Those who fail can take exams within the regular exam schedule. It was noticed that the exam results in June were similar to prior years, but by the end of the autumn exam schedule, the results were better compared to the previous years.

All exam results were presented to the students, professors and associates. Regular meetings were held for all actively involved lecturers regarding the programme realization. Implementation of the Bologna process was also presented to the other teaching staff of senior study years. All professors act as mentors for a group of students during their study.

It is occasionally difficult to organize lectures for so many small groups due to a lack of free classrooms. This problem also refers to exams simultaneously held for all study groups. Professors usually prepare exams consisting of various group types of questions, which is an additional workload.

**Improvement and quality assurance**

The Faculty of Food Technology has a young teaching staff that covers more than 80% of lectures. Admission and study conditions are very transparent. Numerous scientific papers have been published permanently. The Students’ office uses computer programmes ISVU, MOZVAG...
and others. The Faculty has also intensive student exchange programme and cooperation with institutes, companies, and other faculties (8, 9).

There is a constant lack of classroom space and financial support for a higher teaching quality. The Faculty lacks a lecture room with 150-200 seats. It also lacks premises and financial support for research work.

In the above mentioned period many activities were done, some on a regular basis, with an aim of improving and assuring quality:

– analysis of students’ data regarding their secondary school, place of living, towns and counties from which they arrive;
– presentation of the Bologna programme in 20 secondary schools via lectures, and distribution of leaflets about admission and study conditions;
– analysis of students’ success at exams for all courses of undergraduate and graduate study;
– an additional opportunity for every qualifying exam during semester;
– opportunity for partially taking exams by the end of each week as to the teaching material presented the previous week;
– analysis of diploma papers from the given courses;
– monitoring of teachers’ workload and possible help;
– appointment of professors as students’ mentors and regular meetings with students;
– involvement of senior students in discussions between mentors and the first-year students;
– organization of practical work in industry and study visits to important companies;
– discussions among the teaching staff and cooperation with an aim of removing problems and improving teaching and using the premises and equipment in an optimal way;
– organization of various students’ questionnaires;
– diploma papers written in cooperation with various firms and other University members;
– help in finding job after graduation and monitoring (un)employment upon study completion;
– permission for professional specialization abroad.

Finally, it should be emphasized that students and lecturers should ensure constant influx of experts through their partnership during the implementation of the Bologna process. These experts must be ready to respond to the challenges of the European and world market labour (10, 11, 12, 13).
Based on the previous 35 years of experience in higher education and having food technology engineers in Croatian and foreign companies, it can be said with certainty that the Faculty of Food Technology is ready for its task.

References

(1) Academic and professional titles and Academic Degree Law (2007), Official Gazette of the Republic of Croatia, N.N. No 107
(6) Regulations about Final Exam (2007), Faculty of Food Technology Osijek
(7) Regulations about studying (2005), Josip Juraj Strossmayer University of Osijek
(12) Regulations about Constitution and Acting of Quality Assurance System at Josip Juraj Strossmayer University of Osijek (2006), Josip Juraj Strossmayer University of Osijek
(13) Scientific Activity and Higher Education Law (2003), Official Gazette of the Republic of Croatia, N.N. No 123
Presentations

All the lectures with PPT from the Scientific Conference "Engineering Education – The Bologna Process – 3 Years Later", as well as complete audio and video discussions are available on the web pages of the Conference: www.hatz.hr/engineeringeducation.
Professor Željko Hutinski, Ph.D.
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University of Zagreb
Varaždin, Croatia
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Bologna process 3 years later
All the participants in Bologna-related changes:

- Ministry of science, education and sports,
- Universities,
- Educational program holders,
- Other ministries,
- Institutions of society in which or through which student acquires or realizes certain rights.
- HZZO,
- Businessmen and entrepreneurs...

Where and how to advance?

- To create the Registry of equivalence,
- To hire young(er) teachers,
- To increase (qualitatively and quantitatively) the number of program holders (there are more programmes than qualified teachers available, throughout all levels of education),
- To create formal assumptions needed to enable students' and teachers' mobility,
- To enhance material and financial support offered to program holders,
- To standardize spatial conditions of studying,
- To standardize infrastructural conditions of studying,
- To animate other subjects to follow Bologna-related changes...
Prof. Tomislav Kilić, Ph.D.
Vice-Dean for Education of the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture
University of Split
Split, Croatia

Bologna Process @ FESB
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
Professor Biljana Kovačević-Zelić, Ph.D.
Vice-Dean for Teaching of the Faculty of Mining, Geology and Petroleum Engineering
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Zagreb, Croatia
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Bologna Process at the Faculty of Mining, Geology and Petroleum Engineering

Engineering Education - The Bologna Process - "3 years later"
Zagreb, Croatia, November 8-10, 2007

Bologna Process at the Faculty of Mining, Geology and Petroleum Engineering

Biljana Kovačević Zelić & Goran Durn
Kovačević-Zelić, B.: Bologna Process at the Faculty of Mining, Geology and Petroleum ...
Kovačević-Zelić, B.: Bologna Process at the Faculty of Mining, Geology and Petroleum ...
Kovačević-Zelić, B.: Bologna Process at the Faculty of Mining, Geology and Petroleum ...
Professor Miljenko Lapaine, Ph.D.
Vice-Dean of the Faculty of Geodesy
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Geodesy and Geoinformatics Undergraduate Study in Croatia – First Experiences
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
Lapaine, M.: Geodesy and Geoinformatics Undergraduate Study in Croatia – First ...
Professor Damir Markučić, Ph.D.
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Education of Engineers before and after the Reform
Markušić, D.: Education of Engineers before and after the Reform

Figures to be presented

3 years later...

Education of engineers before reform

Education of engineers before reform

Not only teaching but education

Engineers with FSB diploma have

distinctly desirable, tested and recognized

on the market in Croatia and abroad

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Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
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Experiences of FER in the implementation of the Bologna process

Experiences of FER-a in the implementation of the Bologna process

Vedran Mornar
November 8th, 2007
Mornar, V.: Experiences of FER in the implementation of the Bologna process
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007

University of Zagreb

FER in numbers: faculty & staff

Faculty of electrical engineering and computing, University of Zagreb

FER in numbers
Mornar, V.: Experiences of FER in the implementation of the Bologna process

Additional curriculum reform goals

- Follow the advance of science and technology
- Adjust the program to labor market
- Switch from teaching to learning
- Give appropriate competencies
- Satisfy the criteria of international accreditation

Competencies

- Master
  - Analyze and solve complex engineering problems
  - Lead a team
  - Design the systems and processes in the fields of electrical engineering, information and communication technology, mathematics, physics, electrical engineering, computer science, and computing.

- Bachelor
  - Participate in the design of systems and processes in the fields of electrical engineering and communication technology, mathematics, physics, electrical engineering, computer science, and computing.

Total yearly income: 17 M€

- Up to 50% of income comes from the open market activities
- Engineering projects
- Consulting
- Life-long learning
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007


- Bachelor level (3 years)
  - Electrical engineering and information technology
  - Computing
- Master level (2 years)
  - Information and communication technology
  - Information processing and informatics
  - Wireless technologies
  - Telecommunications and informatics
  - Computer science
  - Software engineering and information systems
  - Computer engineering
  - Control and robotics
  - Electronics
  - Electrical and computer engineering
  - Power systems
  - Automation
  - Electrical engineering and information technology
  - 3 + 2 + 3
  - First year common to all students
  - Specialization in 3rd year with course modules


- Master level (2 years)
  - Power systems
  - Electronics
  - Electrical and computer engineering
  - Computer science
  - Software engineering and information systems
  - Computer engineering
  - Control and robotics
  - Automation
  - Electrical engineering and information technology
  - 3 + 2 + 3
  - First year common to all students
  - Specialization in 3rd year with course modules
Mornar, V.: Experiences of FER in the implementation of the Bologna process

Typical assessment scheme

- Activity in class: 6 points
- Homeworks: x 2 points
- Mid-term exam: 2 points
- Final exam: 2 points
- Passing grade: 60 points

Grading scale
- According to rank in the generation: 10% - 10%

Model of study

- 20 contact hours per week at the bachelor level
- 16 contact hours per week at the master level
- Merging of theory and application
- Homework / individual work
- Individual / group projects
- Continuous assessment
- 2 mid-term exams
- Final exam
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Mornar, V.: Experiences of FER in the implementation of the Bologna process
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Bioengineering education at BUTE before and after Bologna process
Salgó, A.: Bioengineering education at BUTE before and after Bologna process
Salgó, A.: Bioengineering education at BUTE before and after Bologna process
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007

- Applied Biotechnology Branch
  - Branch subject
  - Basic studies
  - Biotechnology education at BSc level 7
  - Bioengineering BSc established 2004 only
  - Biotechnology BS started 2005/autumn
- Clinical Chemistry/Healthcare Branch
  - Branch subject
  - Basic studies
  - Biomedical studies
- Food Quality Control Branch
  - Branch subject
  - Basic studies
  - Food Quality Control Education
Salgó, A.: Bioengineering education at BUTE before and after Bologna process

Recent experiences (5th semester)
- Decreased ability and knowledge in chemistry
- Strong segregation in students' population
- No real approach about the possible employment of students having BSc
- More self-managed, independent work

Established 2006
- Bioengineering MSc will start in Spring 2009
- Starting process requested at Hungarian Accreditation Committee
- 30-35% of BSc students can be involved in the qualification exam
- Structure is similar to BSc – 4 subbranches
Salgó, A.: Bioengineering education at BUTE before and after Bologna process

More Information

Please visit web site

http://biomimic.bme.hu

http://biomimic.bme.hu

salgo@bme.hu

Budapest University of Technology and Economics

BUTE, Budapest, Hungary

Conclusions

Linear education system developed (BSc-MSc PhD)

Stronger selection between students and units

Competition for students and also between universities will increase

The demands of industry has to be monitored continuously

Continuous development of curriculums and subjects needed (the bioreactors change very fast)
Assist. Prof. Damir Šljivac, Ph.D.
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Faculty of Electrical Engineering in Osijek
– 3 years after
Šljivac, D.: Faculty of Electrical Engineering in Osijek – 3 years after
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
Šljivac, D.: Faculty of Electrical Engineering in Osijek – 3 years after
Problems & Tasks
- Insufficient teaching staff resulted in larger groups of students.
- Large number of seminars - 2nd year.
- Insufficient space and insufficient laboratory problems solved.
- Some seminars were held with students.
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The experience of teaching in accordance with the Bologna processes at Polytechnic of Zagreb
Zentner Pilinsky, S.: The experience of teaching in accordance with the Bologna ...

Outline:
1. Introduction of WWS and TVZ
2. Current state of lecture process
3. Main problems and plans for next term
4. Conclusion
Zentner Pilinsky, S.: The experience of teaching in accordance with the Bologna ...
Zentner Pilinsky, S.: *The experience of teaching in accordance with the Bologna ...*
International
Acknowledgements
Technical Systems in Intelligent Clothing with Active Thermal Protection

Abstract

All technical systems of intelligent clothing with active thermal protection are presented. The whole architecture necessary to manufacture this kind of clothing is described. The practical construction of a patented intelligent article of clothing with active thermal protection, outer shell with a variable thickness, system of thermoinsulating chambers, sensors and measuring systems, microcontroller and control system, actuator system and power supply system based on hardware aspect are presented. Based on software aspect a measuring and control program with algorithm of intelligent behavior is presented. For first prototype of the intelligent clothing with active thermal protections is given 1st prize Golden Tesla’s egg, Croatian Hi-Tech award for best Croatian Hi-Tech products in 2007. year.

Keywords: clothing, intelligent clothing, active thermal protection.
1. Introduction

Clothing belongs to one of the oldest human articles of daily use which have always provided a protective function against climatic influences (primarily protection against cold, moisture, wind, heat, rain, sun’s UV radiation) and then against environmental influences (dust, mud). Later the clothing assumed a mechanical protective function to protect craftsman, farmers and warriors against mechanical injuries and blows. Afterwards it assumed additional functions to mark the social class of its wearer or his rank in hierarchy within organization groups (army, clergy, and sovereigns). Only later it assumed attributes of embellishment (adornment, self-assertion and seduction). One of the latest functions of clothing, developed during the 20th century, was the function to express opinions (moral, sociological and religious) which was called language of clothing.

At the meeting of the Thematic Expert Group, TEG no 6 Smart Textiles & Clothing within the European Technology Platform for the future of Textiles and Clothing organized by EURATEX (European Apparel and Textile Organization) and held in January 20, 2006, 37 experts coming from all the European countries accepted the definition and characteristics of the term intelligent clothing. The experts agreed that three sets of instruments should be integrated into an article of clothing: sensors for measuring and information input which collect input information, processing unit for interpreting input information and making decisions (microcomputers, microprocessors or microcontrollers with accompanying programs) and output actuators for adapting an article of clothing and provide output information. This definition is in accordance with investigations performed in the sector of developing intelligent clothing and publications in the course of two previous years at the Department of Clothing Technology of the Faculty of Textile Technology of the University of Zagreb.

The prototype of an intelligent article of clothing with active thermal protection was designed and constructed at the above-mentioned Department. At the moment it is being subjected to the first experiments of functional investigations. The first paper describes all the technical systems incorporated into the above-mentioned intelligent article of clothing.
2. Architecture of intelligent article of clothing with thermal active protection

Based on the investigations performed the whole architecture of an article of clothing with thermal protection is clear, consisting of the following technical subsystems, Figure 1:

1. System of the outer shell with a programmable variable thickness with an outer and inner protective fabric layer.
2. System of thermoinsulating chambers with possible control of conduction and convection of body heat.
   3a. Subsystem of measuring the temperature of environment and microclimate of an article of clothing
   3b. Subsystem of pressure measuring in thermoinsulating chambers

![Architecture of the intelligent article of clothing with active thermal protection](image)

**Fig. 1.** Architecture of the intelligent article of clothing with active thermal protection
4. Microcontroller measuring and control system for an intelligent article of clothing.

5. Actuator system for an intelligent article of clothing with active thermal protection with elements of micropneumatics for controlling output variables.

6. Power supply and

7. Measuring and controlling microcontroller program with algorithm of intelligent behavior of an article of clothing.

Hereinafter the architecture elements with integrated technical systems are described.

3. System of outer shell with a programmable variable thickness with an outer and inner fabric layer

To manufacture the outer shell and the lining of an intelligent article of clothing with active thermal protection the model of a men's sports jacket, Figure 2, was chosen for whose construction and modeling a special construction of the basic cut was designed. It is acceptable for model-

![Fig. 2. a) Model of a men's sports jacket b) Thermoinsulating chambers with integrated technical systems inside of jacket](image)
ing all models from which wear comfort and freedom of movement is expected [1].

A garment size of 54 was selected for the construction of the basic cut of the outer shell of an intelligent article of clothing with active thermal protection. On the basis of main body measurements construction measurements were calculated, and then the construction of the basic cut of the outer shell and lining followed.

4. System of thermoinsulating chambers with possible control of conduction and convection of body heat

By courtesy of Bayer Epurex Films GmbH, Germany, a few types of high-elastic polyurethane foils were delivered for the manufacture of thermoinsulating chambers. All foils were subjected to extreme stresses and pressures. The foil designated as Walopur 4201AU showed the best results. It is characterized by a material density of 1.15 g/cm³, a softening point from 140 to 150 °C and a very high elongation caused by breaking force, amounting to 550% [2]. Moreover, the material is highly UV resistant, hydrolytically stable, has good properties in joining by thermal and ultrasonic methods, and a good microbiological stability which is important for the incorporation into the clothes. The selected high-elastic polyurethane foil showed better properties in ultrasonic sealing than hot wedge or hot air sealing.

The Pfaff 8310-003 Seamsonic ultrasonic welding machine was used for sealing.

5. Sensors and systems of measuring input variables

Intelligent article of clothing with active thermal protection should contain sensors of so-called input variables in order to get information about the condition in its environment and the microclimate space between the intelligent article of clothing and human body as well as the information about pressures in the thermoinsulating chambers. In the case of an intelligent article of clothing with thermal protection five input variables are included:
1. Environmental temperature of the intelligent article of clothing with active thermal protection (so-called external or ambient temperature) – $t_{\text{out}}$
2. Temperature inside the intelligent article of clothing with active thermal protection (so-called internal or microclimate temperature) – $t_{\text{in}}$
3. Pressure of the shoulder thermoinsulating chamber – $p_r$
4. Pressure of the chest thermoinsulating chamber – $p_p$
5. Pressure of the waist thermoinsulating chamber – $p_b$

In accordance with the representation in Figure 3 the system of measuring input variable is composed of:
- Temperature measurement subsystem
- Pressure measurement subsystem and
- Subsystem for the stabilization of program voltage.

![Figure 3. Representation of the sensor and measurement system of the input variables of an intelligent article of clothing](image)

Air-conditioned and increased measuring voltages of input variables of environment temperatures and microclimate of the intelligent article of clothing and pressures of the air thermoinsulating chambers are led by a measuring bus to the microcontroller ports. The subsystem for the stabi-
lization of program voltage, which is necessary for the operation of the measuring system of input variables, is also used to supply the microcontroller system.

5.1 Subsystem for measuring the pressure in thermoinsulating chambers

A RS235-5784 pressure converter by RS Computers was used to measure pressure in the thermoinsulating chambers. The pressure converter dimensions are comparatively small. It was selected because of its good properties and a comparatively small thickness of only 8 mm, which made it possible to integrate the converter successfully into the intelligent article of clothing. According to the production specification [3] the pressure converter in question can measure pressures up to 1 PSI according to the English system of measurement, i.e. up to 68.95 bar. It permits a 20-fold overloading up to about 1.4 bar. The pressure sensor in the converter is a thin diaphragm which is deformed with increasing pressure. Four piezo-resistors, which change their electric resistance according to diaphragm deformation, are attached to it. Piezo-resistors are connected to a Wheatstone bridge. Inlet bridge resistance amounts to 5 kΩ, and the recommended input terminal voltage amounts to 10 V. A higher input terminal voltage would cause the heating up of measuring piezo-resistive elements and measuring faults. Therefore, a voltage stabilizer of the input terminal voltage with Whitestone bridge of 5 V was selected for experiments whereby, the supply current amounted to 1 mA. The highest declared voltage output from the converter is 45 mV at the highest pressure of 68.95 mbar when supplying the measuring bridge with a voltage of 10V. Therefore, the highest sensitivity of the converter amounts to 0.653 mV/mbar. Due to a reduced input terminal voltage, in the experiments conducted a sensitivity of 0.327 mV/mbar was reached and the highest output voltage from the measuring bridge of 22.55 mV respectively, at the highest pressure connected to the measuring converter.

5.2 Subsystem for measuring the environment temperature and the microclimate of the article of clothing

An intelligent article of clothing with active thermal protection is devised in such a way that it can measure two significant temperature parameters: external temperature (or environment temperature) or microclimate temperature inside the garment. A measuring converter of the 3rd generation with digital processing measurement data designed DS18B20 by Dallas Maxim Semiconductors was selected for temperature measure-
ments. Its measurement accuracy is better than 0.2 °C, and the measuring range lies between 55 °C do + 125 °C. The resolution of an incorporated A/D converter can be adjusted between a 9 and 12 bit resolution, depending on the user needs. Each DS18B20 temperature converter has a unique and unchangeable mark integrated into a 64-bit serial number in the ROM memory of the converter which serves as an address mark in the bus to which a practically unlimited number of measuring converters can be connected, each with its own address. They all can be connected to the bus which represents only one data conductor and mass (so-called “1-Wire bus”). The supply of the converter may be realized from a 3V to 5.5V local DC source or via a data conductor (so-called “parasite power”). Conversion of temperature data in the highest resolution of a 12-bit digital word lasts mostly for 750 ms, and a 9-bit one (lowest resolution) lasts for about 94 ms. Thanks to the serial data flow, the DS18B20 temperature converter needs only one data connection, and due to integrating all the components into the basic silicium plate within the converter no external additional component is necessary for its operation. This is very significant information since a remarkable complexity of the measuring sensor at internal level is reflected in a simple construction and realization of an intelligent article of clothing with active thermal protection.

6. Microcontroller measuring and control system of intelligent article of clothing

Two microcontrollers are used to control the operation of an intelligent article of clothing with active thermal protection. Most of the functions, including the performance of algorithm of intelligent behavior, are controlled by a very powerful PIC 16F877 manufactured by Microchip, and rational electric power management is controlled by a smaller PIC 16F628 microcontroller of the same manufacturer [4]. The PIC 16F877 microcontroller has 40 connections on the box where a powerful central processing unit with RISC architecture (Reduced Instruction Set Computer) is located so that it can recognize and perform 35 different computer instructions necessary for program processing. Its operation speed can be adjusted by changing the control frequency which can amount to 20 MHz whereby an instruction can be performed in only 200 ns. A FLASH program memory with 8 k capacity, RAM data memory with 368x8 byte capacity and EEPROM data memory with 256x8 byte capacity were installed into the same box. Processing requirements can be ad-
dressed from 14 possible sources; it can operate in the so-called sleep mode or in a state of nonoperation with reduced electric power consumption. It can operate with supply voltages ranging from 2 – 5.5 V, and at individual connections output current can reach up to 25 mA. Typical consumption amounts to 0.6 mA with a supply of 3 V and a work cycle of 4 MHz. If the work frequency is reduced to 32 kHz, with the same supply voltage its current consumption amounts to only 20 μA. In the sleep mode its consumption is less than 1 μA. The described microcontroller has three installed timers, two comparators, multichannel analog-to-digital converters with a 10-bit resolution and a possibility of serial and parallel communication with its environment. The smaller microcontroller responsible for a rational electric current consumption is located in the box with 20 leads into which the RISC processing unit as well as program and data memories are built in. The FLASH program memory has a capacity of 20 kbytes, RAM data memory has a capacity of 224x8 bytes and EEPROM data memory has a capacity of 128x8 bytes. The work frequency can also reach up to 20 MHz. Two analog comparators and one source of reference voltage and a communication assembly are also built in. The consumption of the microcontroller is less than 2 mA with a supply voltage of 5 V and a work frequency of 4 MHz. At a reduced work frequency of 32 kHz it consumes approximately 15 μA, and in the sleep mode the bias-current amounted to less than 1 μA. It recognizes and performs 35 program instructions whereby all instructions are performed in one cycle of 1 ns, apart from program branching which are performed in two cycles.

7. Actuator system for an intelligent article of clothing with active thermal protection with elements of micropneumatics for controlling output variables

The actuator system uses micropneumatic elements illustrated in Figure 4. Compressed air is generated by the DR-4X2PN microcompressor by the American company Clark (11). The microcompressor operates on diaphragm principle and is supplied with a direct current of 9 to 14 V consuming 200 mA. Maximum work pressure of the microcompressor may be 0.75 bar. Its dimensions are: width 25 mm, length 50 mm, height 66 mm, mass 197 g. Compressed air is led through small tubes (12) to the stop valve (14) behind which there is the pressure regulator (15). The value of the regulated pressure is measured by the sensor (16). Electrovalves (18), (19) and (20) are used to inject compressed air into the thermoinsulating
The pressure in the thermoinsulating chambers is measured via sensor (16). Electrovalves 21), (22) and (23) are used to discharge the air from the thermoinsulating chambers. The microcontroller system used in line with the decisions based on the algorithm of intelligent behavior controls the operation of the electrovalves.

The microprocessor is activated when it is necessary to inflate the thermoinsulating chambers, and it is supplied directly from the electric power supply system.

8. Electric power supply system

A pack of rechargeable NiCd batteries with a total voltage of 24 V is used to supply sensors, microcontroller system and actuators. Battery capacity is 1200 mAh. The system is supplemented by an adapter which is connected to the power supply system. The microcontroller monitors the battery state-of-charge, and measurement results are displayed.
9. Measuring and control microcontroller program with the algorithm of the intelligent behavior of the article of clothing

The operation of an intelligent article of clothing with active thermal protection is based on an abridged conceptual flow diagram illustrated in Figure 5.

![Flow diagram of the intelligent article of clothing with active thermal protection](image)

**Fig. 5.** Operation flow diagram of the intelligent article of clothing with active thermal protection
After activating the system, a self diagnosis of the state of the technical system of the garment is performed. In the mentioned procedure the proper operation of all temperature and pressure sensors in the chambers, microcompressors, all for inflating and deflating valves and the battery state are examined. After finishing the self-diagnosis procedure of the state the data are displayed, and the external and internal temperature is measured. Afterwards it is possible to select a control mode for the thermoinsulating chambers which can be manual or automatic.

Provided that the manual control mode has been selected, it is necessary to make a subjective evaluation of thermal comfort. If a feeling of thermal comfort is expressed, the system is directed to the first subprogram (SUB 1) in which the system deflates all the thermoinsulating chambers in sequence. If the subjective feeling of a severe cold is expressed, the second subprogram (SUB 2) is activated which activates the sequential inflation of all thermoinsulating chambers. By a subjective evaluation of medium cold the third program (SUB 3) is activated which starts the inflation of the shoulder and waist thermoinsulating chamber. Subjective feeling of coolness can be evaluated through two states: cooler and slightly cool. In case of a higher coolness the fourth program (SUB 4) is activated and this inflates the shoulder chamber. In case of feeling slightly cool the subprogram 5 (SUB 5) is activated to start the waist chamber. After finishing any of these five subprograms, the external and internal temperature is measured, and the program is reset, i.e. to select a control mode.

The first step in making a decision which can lead to branching in the program flow is the comparison between the internal temperature and the upper limit temperature. In the event that the measurement shows that the internal temperature is higher than the upper limit temperature a conclusion is made that the wearer of the garment is too hot, and it is necessary to activate the first subprogram (SUB 1) and to deflate all the chambers in sequence. In the event that the internal temperature is not higher than the upper limit temperature the algorithm of behavior will continue according to its basic tree. Thereupon a comparison of the value of the internal temperature and the lower limit temperature of the microclimate is made. In the event that the internal temperature is higher
than the temperature of the lower microclimate limit the system makes a conclusion that it is within the limit tolerances and hysteresis of $\pm 2^\circ C$ of the desirable microclimate temperature, and it makes a decision that the system response is not necessary so that the program is reset to the starting point of the decision-making tree. In the event that the internal temperature is not higher than the temperature of the lower microclimate limit the system makes a conclusion that the wearer of the garment is cold, and the thermal protection of the garment is to be activated. In the event that the automatic control mode is selected, it is necessary to enter data on the desirable For the system to make a decision on response intensity of thermal protection, it is necessary to calculate the difference between the desirable microclimate temperature and the measured external temperature. The response intensity of the technical system of the intelligent article of clothing and the decision on combinations of activated thermoinsulating chambers will depend on the above-mentioned difference. If the temperature difference ($\Delta t$) between the desirable microclimate temperature and the measured external temperature higher than $15 ^\circ C$, the system concludes that it is very cold and activates subprogram 2 (SUB 2) in which it inflates all the thermoinsulating chambers in sequence. If the temperature difference is lower than $15 ^\circ C$, the system finds out whether the temperature difference is higher than $10 ^\circ C$. If the difference is higher than $10 ^\circ C$, the system concludes that it is medium cold and makes a decision to inflate the shoulder and waist chamber. If the temperature difference is lower than $10 ^\circ C$, a comparison is made whether the temperature difference ($\Delta t$) is higher than $5 ^\circ C$. If the decision made is positive, the system concludes that it is cooler and activates the shoulder chamber, and if the decision made is negative, it concludes that it is slightly cool and activates the waist chamber by subprogram 5 (SUB 5). After finishing any of five subprograms, an enquiry is made of interrupting the automatic control. If there is no desire to interrupt, the program is reset to the starting point of the branching tree; if there is a desire to interrupt the automatic control, the system is switched to manual control.

10. Realization of the System for Independent Measurements of Actuator States

The system for independent measurements of actuator states is based on six groups of attenuators and filters on the experimental board shown in Fig. 6.
Each group of attenuators and filters is connected to the actuator bus of the intelligent article of clothing with active thermal protection by means of a multicore cable to be seen on the left side of the experimental board. Signals for actuator activation with amplitude of 24 V are taken from the actuator bus. As a consequence, the indicated voltage is first decreased by the attenuator to 5 V so as not to damage the ports of the A/D converter of the PMD-1208FS computer measuring system because of too high a voltage.

Since the voltage in the actuators is of pulse-type because of the PWM operation type, it is necessary to filter it using a capacitor of 0.68 μF contained in each filter. In addition, in the filter exit a diode is placed limiting the output voltage to a value of 0.8 V.

In this way it was achieved that the impulse voltage of an amplitude of 24 V is reduced to a value of 5 V, it is filtered and limited to the value of direct current of 0.7 V that is conducted to the ports of the PMD-1208 FS measurement system via a series of connections to be seen on the right side (Fig. 6).

11. PMD-1208FS Computer Measurement System

The PMD-1208 FS computer measurement system is a professional laboratory device for measurements, data acquisition and processing, representation and storage of measuring data manufactured by Meilhaus Electronic GmbH, Germany [3]. The system can acquire analog data via
8-channel A/D converter, digital data via 16-channel I/O assembly, receive data for system calibration, external synchronization with other measuring devices of the measurement system, digital counter and external synchronization master clock. At the same time the PMD-1208FS measurement system can transfer analog signals to two analog exits and 16 digital data to the same number of digital exits placed at 40 connectors (Fig. 7).

The system is controlled by an 8-bit microcontroller with a program memory of 16,384 bytes and a subsystem memory of 2,048 bytes. The measurement system has an EEPROM memory of 1,029 bytes; it is supplied by a voltage of 5 V via USB connection whereby it consumes an 80 mA current.

The A/D converter of the PD-1208 FS measurement system operates on the principle of successive approximations, and in its port it measures the voltage whose value can amount to ±10 V. The maximum input voltage should not exceed a value of ±28 V. The maximum input current for each channel is 70 μA, and the amplification of each channel can be adjusted by the program from factor 1 to 20. The measurement system can be configured in such a way that it operates with 8 single analog ports with a resolution of 11 bits or with 4 differential ports with a resolution of 12 bits.
12. Integration of the Measurement System for Independent Measurements of Temperature and Actuator State

The system for independent measurements of microclimate and environment temperature, the system for independent measurements of actuator state and the PMD-1208 FS computer measurement system are connected to one unit forming a complete measuring system for independent investigations of functional operation and properties of an article of clothing with active thermal protection. By integration a system for objective and independent measurements of states of all technical systems in an intelligent article of clothing with active thermal protection and the analysis of their operation as well as the complete investigation of an article of clothing has been created. This forms the basis for a real scientific evaluation of research results.

13. Research Results of the Functional Operation in Manual Operating Mode

According to the described independent measurement system investigations of the functional operation in manual and automatic operating mode of the intelligent article of clothing with active thermal protection were undertaken.

Thus, changes in microclimate and environment temperatures as well as actuator states are observed. They developed as a result of the algorithm development of intelligent behavior and other settings in the microcontroller program controlling the operation of an intelligent article of clothing with active thermal protection.

Fig. 8 shows the diagram of changes in microclimate temperature ($t_{\text{in}}$) and environment temperature ($t_{\text{out}}$) depending on testing time. The diagrams of signals of the electromagnetic valves for inflating (U1) and deflating (I1) the shoulder thermoinsulating chamber are beneath them.

The signal diagrams of the electromagnetic valves for inflating (U2) and deflating (I2) the chest chamber are beneath them.

The diagrams of the electromagnetic valves for inflating (U3) and deflating (I3) the waist thermoinsulating chamber are at the bottom of the rep-
Fig. 8. Diagram of the manual activation sequence (inflating) of the thermoinsulating chambers

representation. Taking into account the short time of the activation of the thermoinsulating chambers, the time representation lasting for 5 minutes was selected on the abscissa. The microclimate temperature dropped under 18 °C. According to the algorithm flow chart of intelligent behavior in the manual operational mode the activation state of the thermoinsulating chambers and the activated degree of thermal protection, respectively, does not depend on the values of microclimate and temperature, but it depends on the will and subjective feeling of the thermal comfort of the garment wearer.

The figure very well shows the sequential operating mode (first, the shoulder chamber is inflated, followed by the chest chamber and the waist chamber is the last to inflate). The same figure shows that the shoulder chamber had to be inflated three times over short intervals (D1), and the chest chamber only once (D2), but a little longer.

This proves the correctness of the program operation which takes care of constant pressure in the chambers (50 mbar) which is additionally inflated if necessary.
Figure 9 shows the sequence after the manual deactivation (deflating) of the chambers. The chambers are deflated simultaneously (designations 11, 12 and 13), which means that there is no sequential deactivation after deflating. Since the consumption of the air release electromagnetic valve is noticeably lower than the consumption of the inflating electrovalve, and as during deflating the microcompressor is not switched on, it is not necessary to rationalize the consumption of battery resources.

The diagram also shows that deflating the chambers lasts approximately 4.5 minutes, and that deflating time also depends on the chamber volume.

14. Conclusion

An intelligent article of clothing with thermal protection is a complex technical system consisting of a very complex architecture. The whole architecture includes a system of outer shell, thermoinsulating chambers, sensors, microcontroller system, actuator system and power supply sys-
tem. All the mentioned architectural elements are connected by different bus types to constitute a complex system acting synchronously and effectively. The operation of the system is controlled by the microcontroller containing the program which is based on the algorithm of the behavior of the intelligent article of clothing. The architecture described and the technical systems in the intelligent article of clothing with thermal protection presented in this paper are protected by patent [5, 6]. The technical systems described represent a suitable basis for experiments and scientific research during the introduction of intelligent clothing into human life.

References


(2) http://www.epurex.de


International Cooperation
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007

International Council of Academies of Engineering and Technological Sciences

CAETS Strategy: 2006 - 2010
Agreed July 14, 2005
Canb. Queensland, Australia

CAETS is the International Council of Academies of Engineering and Technological Sciences, Inc. It consists of those national academies of engineering and technological sciences which have satisfied an agreed set of criteria for membership. It was established in 1978 and was incorporated as a charitable non-profit corporation in the District of Columbia (US) in 2000. Its Articles of Incorporation, Bylaws and Operating Procedures set down its objectives and governance arrangements. Its membership and achievements are set down in the CAETS publication The First 25 Years: 1978-2003.
Mission

The mission of CAETS is to pursue effective engineering and technological progress for the benefit of societies of all countries. Specifically, CAETS provides the mechanism through which the engineering and applied science academies of the world work together on internationally important issues in ways that enable each academy to draw on the total global expertise and experience of all academies. In addressing issues at the national level, and that converge at the global level, that is of interest to all member academies and provide consolidated input at the highest levels of the UN System.

(1) Seeking Observer/Consultative status with key UN Agencies and Programmes with CAETS representation at the regular sessions of their governing bodies.

(2) Encouraging and assisting CAETS member academies to be involved in the preparation of their national reports and to that end, to establish a global intergovernmental institution for the benefit of all the peoples of the world.

(3) Preparing a draft of the CAETS annual report for the UN System and to be represented at CAETS Conferences and other meetings.

Vision

The vision of CAETS is a world in which national and international science and engineering, social, and environmental issues are properly informed by relevant scientific, technological and engineering considerations, and in which the peoples of all countries benefit from the full benefits of science, technology and engineering.

Priorities

Engagement with the United Nations Specialized Agencies and Related International Organizations:

Mission: Develop and implement an ongoing strategic collaborative model and framework for CAETS接口, with the relevant scientific and technological offspring of the United Nations (UN) System.
Fostering and Strengthening National Academies of Engineering and Technological Sciences:

Mission: To enhance national and international cooperation and to increase the number of academicians engaged in the advancement of science and technology.

Representatives of the Croatian Academy of Engineering (HATZ) in 2007

For many academicians, their academic contributions are limited by their institutional affiliations. In order to address these limitations, HATZ is actively seeking to establish partnerships and collaborations with other national and international academies. This will enable academicians to share their expertise and resources, thereby enhancing the scope and impact of their research.

Immediate Goals:

- Strengthening the institutional framework of HATZ
- Enhancing collaboration with other national and international academies
- Increasing the visibility and reputation of HATZ at national and international levels

Addressing Issues of Common Concern of the Member Academies

Mission: To promote a collaborative approach to addressing common challenges and opportunities.

For the biennial Conferences, efforts will be made to bring together academicians from various disciplines and institutions to discuss and address common challenges and opportunities. This will facilitate knowledge exchange and collaboration among academicians, thereby enhancing the impact of their research.

Immediate Goals:

- Organizing biennial conferences
- Facilitating knowledge exchange and collaboration among academicians
- Identifying and addressing common challenges and opportunities

With a view to increasing the efficiency and effectiveness of such initiatives, HATZ aims to establish a forum for regular communication and collaboration among academicians. A series of initiatives is underway to facilitate this, including the establishment of a comprehensive online platform for information sharing and networking.

In conclusion, HATZ is committed to enhancing the visibility and reputation of scientific and technological achievements in Croatia, fostering international collaborations, and addressing common challenges and opportunities. Through these efforts, HATZ aims to contribute to the advancement of science and technology in Croatia and beyond.
Environment and Sustainable Growth
A Statement by CAETS, International Council of Academies of Engineering and Technological Sciences, Inc.
Tokyo, Japan October 23-26, 2007

At the 17th CAETS Convocation, hosted by the Engineering Academy of Japan and held in Tokyo on 23-26 October 2007, a wide range of global energy and environmental issues was reviewed and discussed by more than 250 CAETS Academy representatives and specialists. The state-of-the-art of various technologies for improving energy efficiency, energy production with reduced carbon dioxide (CO2) emissions, carbon-free electricity generation including nuclear power, and carbon dioxide capture and storage (CCS) was reviewed and discussed.

The Convocation also considered water resources and pollution, control of noise pollution, recycling of materials and electronic devices, global environment monitoring systems and various strategies and measures for realizing sustainable growth. It recognized the need for urgent international national development and implementation of counter measures to foreseeable local and global energy and environmental challenges.

CAETS is the International Council of Academies of Engineering and Technological Sciences. It consists of the national academies of engineering and technological sciences that have established an official set of rules for membership. It was established in 1978 and is incorporated as a charitable, non-profit non-governmental organization at the Secretariat of Columbia at NYU in 2008. the Academy of Engineering and Operating Procedures set down in the oath of office and governance agreements. These documents and its membership and achievements are posted on the CAETS website, www.caets.org.
The Convocation participants noted that much progress has been made in controlling air, water and other environmental pollution in developed countries, but that air pollution remains a serious problem, especially in rapidly developing countries, that millions of the planet’s inhabitants still lack clean drinking water and sanitation, and that environmental noise is a constraining factor for sustainable development.

The Convocation focused particularly on the impacts of increasing carbon dioxide concentrations in the atmosphere resulting from human activities as the world economy grows. Greenhouse gas emissions in the newly industrializing countries are increasing rapidly to rival those of the highly developed countries. As reported by the Intergovernmental Panel on Climate Change (IPCC), most of the observed global warming since the mid-20th century is very likely due to human-produced emission of greenhouse gases and this warming will continue unabated if present anthropogenic emissions continue or, worse, expand without control.

The Convocation participants agreed that the adverse impact of global warming could be dramatic in the medium- to long-term future. The Japan Earth Simulator and other global earth system modeling centers are making many sobering predictions of the likely impacts as CO₂ concentration, global mean temperatures and sea levels continue to rise. CAETS, therefore, endorses the many recent calls to decrease and control greenhouse gas emissions to an acceptable level as quickly as possible. The Council recognized that it is the responsibility of the academies of engineering and technological sciences worldwide to alert their governments and citizens to the dangers posed by unbridled damage of the natural environment and future shortages or depletion of natural resources for fossil fuel; to work actively to apply existing solutions; and to foster new and improved technology as part of the global effort to avert dangerous human interference with the climate system.

In light of the Convocation deliberations and in order to realize sustainable growth and enhance the quality of life while reducing the use of fossil fuels for energy and curtailing greenhouse gas emissions, CAETS recommends that the following measures be urgently addressed through well planned implementation programs and research and development, including partnerships between governments and international organizations experienced with the relevant environmental issues.

1. Energy saving technologies must be greatly improved and disseminated as quickly as possible among both developed and emerging countries. Key initiatives considered most promising in the short term (in the next two decades or so) include the improvement of the efficiency of electric power generation and transmission and energy storage by batteries, effective use of heat pumps, advancement of the efficiency of internal combustion, electric and hybrid vehicles, improved energy efficiency in commercial buildings and residences, and utilization of Light Emitting Diode (LED) technology for illumination.

2. The opportunities provided by information, communication and control technologies for reducing energy consumption — for example, by reducing the need for travel and through development of optimized logistics and smart power systems — should be exploited aggressively, along with efforts to reduce energy consumption in ICT devices and systems themselves.

3. Development of renewable and alternative energy sources must be promoted and their application should be encouraged. Breakthroughs in the technologies for hydroelectric, nuclear, solar, wind, biomass and geothermal energies, and high-voltage DC power transmission in combination with high-frequency power conversion, should be explored for near- to medium-term exploitation and their appropriate use should be considered in light of the situation of each region.
Development of innovative technologies for remote exploration and enhanced extraction of oil, gas and mineral resources from the oceans must be encouraged.

4. Studies must proceed to determine under what circumstances technologies for the capture and storage of carbon dioxide are feasible and cost-effective. Other proposals to reduce emissions should be also encouraged and their effectiveness evaluated. Since, for some time to come, the use of fossil fuels will inevitably play a key role in economic growth to meet the needs of expanding populations for an acceptable quality of life, immediate attention to development of more effective (cleaner) and efficient use of coal and oil is essential.

5. The increased use of the nuclear power generation as an energy source must be addressed as a key issue for sustainable growth. CAETS recommends the promotion of studies on new generation reactors in the short and medium term and fusion research for the long term. Research to enhance safety measures, waste handling, economical performance and obstacles to non-proliferation are necessary for conventional reactors and associated fuel cycle facilities.

6. Other promising technologies warranting priority for medium- to long-term development, including hydrogen production, transport and storage, and application of fuel cells for vehicles should be explored. The discovery and environmentally sound management of gas hydrates should also be promoted.

7. Together with advances of the new technologies referenced above and the more effective and efficient use of traditional energy sources, the modification of social infrastructures, consistent with the conditions of each economy, must also be seriously considered. For example, development of well organized public transportation systems, should be
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
Part II

Who is Who in the Croatian Academy of Engineering
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The members of the Presidency of the Croatian Academy of Engineering are members of the Governing Board, Secretaries of the Departments, Chairs of the Standing Committees and Heads of the Centers.

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Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007

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\hline
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\end{center}

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\begin{center}
\textbf{Deceased Members} \\
\begin{tabular}{|c|}
\hline
\textbf{Ban, Siniša, Prof. PhD.} \\
(1914-2007) \\
Honorary Member (2000) \\
\hline
\textbf{Damjanić, Frano, Prof. PhD.} \\
(1944-1988) \\
Associate Member \\
\hline
\textbf{Džanić, Husein, Prof. PhD.} \\
(1933-1995) \\
\hline
\textbf{Filajdić, Mirko, Prof. PhD.} \\
(1920-1998) \\
Honorary Member \\
\hline
\textbf{Fleš, Dragutin, Prof. PhD.} \\
(1921-2005) \\
\hline
\textbf{Fritz, Franjo, PhD.} \\
(1932-1996) \\
Associate Member \\
\hline
\textbf{Gamulin, Antun, PhD.} \\
(1931-1998) \\
\hline
\end{tabular}
\end{center}
<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hrs, Ivo</td>
<td>Assisst. Prof. PhD.</td>
<td>(1937-1999) Collaborating Member</td>
</tr>
<tr>
<td>Johanides, Vera</td>
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<tr>
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<tr>
<td>Name</td>
<td>Title</td>
<td>Years (Years)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------</td>
<td>---------------</td>
</tr>
<tr>
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<tr>
<td>Muljević, Vladimir</td>
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Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007

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- Faculty of Civil Engineering, University of Zagreb, www.grad.hr
- Faculty of Electrical Engineering and Computing, University of Zagreb, www.fer.hr
- Faculty of Electrical Engineering, Josip Juraj Strossmayer University of Osijek, www.etfos.hr
- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, www.fesb.hr
- Faculty of Engineering, University of Rijeka, www.riteh.hr
- Faculty of Food Technology and Biotechnology, University of Zagreb, www.pbf.hr
- Faculty of Food Technology, Josip Juraj Strossmayer University of Osijek, www.ptfos.hr
- Faculty of Forestry, University of Zagreb, www.sumfak.hr
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– Faculty of Geodesy, University of Zagreb, www.geof.hr
– Faculty of Geotechnics in Varaždin, University of Zagreb, www.gtfvz.hr
– Faculty of Graphic Arts, University of Zagreb, www.grf.hr
– Faculty of Maritime Studies, University of Rijeka, www.pfri.hr
– Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, www.fsb.hr
– Faculty of Mechanical Engineering in Slavonski Brod, J. J. Stossmayer University of Osijek, www.sfsb.hr
– Faculty of Metallurgy in Sisak, University of Zagreb, www.simet.hr
– Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, www.rgn.hr
– Faculty of Textile Technology, University of Zagreb, www.ttf.hr
– Faculty of Transportation Engineering, University of Zagreb, www.fpz.hr
– Hrvatska elektroprivreda d.d. www.hep.hr
– Hrvoje Požar Institute of Energy, Zagreb, www.eihp.hr
– Institute of Geology, Zagreb, www.igi.hr
– Institute of Naval Architecture Ltd., Zagreb, www.hrbi.hr
– Institute of Transportation and Communication, Zagreb, www.fpz.hr/ipv/
– Kraš Inc., Zagreb, www.kras.hr
– Odašiljači i veze d.o.o., Zagreb, www.oiv.hr
– Pliva Croatia Ltd., Zagreb, www.pliva.hr
– The Vehicle Center of Croatia, Zagreb, www.cvh.hr
– University of Dubrovnik, www.unidu.hr
New Supporting Members in 2007 Year
AKademija tehničkih znanosti hrvatske
Croatian Academy of Engineering

SPOJAZUJ

izbore CENTRA ZA VOŽILA HRVATSKIH d.d. na
predsjednički Zbor
AKademije tehničkih znanosti Hrvatske

Clanak 1.

Na unutarnjo inicijativu pokrenutu od Centra za vožila Hrvatske d.d. (u daljnjem tekstu CENTAR) do postanka predsjedničkog Zbora AKademije tehničkih znanosti Hrvatske za dolijevanje
kartu HATZ proveden je uvjet u pravu akter CENTAR, kao i u istom odjelj vojnim predstavnikom
akademije. Vrijed sabora istaknuto je iznosi predstavnika CENTRA i HATZ. Lopata HATZ
ne ga Predstavnikov HATZ izmene za predsjedničkim HATZ pravom člana C:

Clanak 2.

CENTAR, uživao da prijavite, HATZ, s nek nekog, pravila odeljenja, da se nema
Spremama obavijestilo da se ne naiđu najmanje ovog Spremama u stjenove predstavnika.

Clanak 3.

HATZ se istoj pravaju da će se značajno najmanje na kojima se naiđu najmanje predstavnika
pravima supernaturne stjepa na ovim i tim CENTAR

Clanak 4.

CENTAR se u svakom rečenica za unije programu HATZ u 2008. godini uključi
dioci tehničkih strojeva

- za uživljenje, izvršavanje programa HATZ 10.000 kuna (sistematična kunat)
- za aktivizaciju Zavoda HATZ 10.000 kuna (sistematična kunat)
- za uživljenje zahvalne

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Sukladno čl. 2 u drugoj polovici 2008. godine CENATAR odlučio je osnovati preduzeće zajedništva za izradu HATZ. Ove akcione akvizicije odnos su izvedene u istom roku.

**Clauš 5.**

Preuzimanje HATZ i CENTRA počelo aktivnosti u petom kvartalu 2008. godine. Ove akcije su uključene u program podnoseći ciljevima i ciljima istraživanja i razvoja nuklearnih komponenti i radnih postupaka u oblasti nuklearnih inovacija.

**Clauš 6.**

Sporazum se zaključio na trci od 2 godine s početkom rada 2008. godine. Obe strane su u okviru ovog sporazuma obvezane za izvođenje programa u skladu s uslovima sporazuma.

**Clauš 7.**

Na skupštini HATZ u 2008. godini CENTRO uočio je i nekoliko nesreća o javnosti u pravilima člana HATZ-a i zaštitu javnog duha uzimajući u obzir i zahvaljujući ovim članovima.

**Clauš 8.**

U slučaju otkrivanja problema u izvođenju ovog sporazuma obveze su im na osnovu čl. 12, a za izvršenje ovog sporazuma u skladu s uslovima sporazuma.

**Clauš 9.**

Ovoj sporazum je emitiran u etakovanje protokola, od kojih svaka strana nakon pročetka protokola.
The Vehicle Center of Croatia (CVH)
Centar za vozila Hrvatske (CVH)
Ilica 15/1, 10000 Zagreb;
phone: + 385 1 4833444, fax: + 385 1 4833-610;
http://www.cvh.hr

The Vehicle Center of Croatia (CVH) is a joint-stock company, founded in 1971, authorised to organize and professionally supervise work of stations for technical inspection, to undertake compulsory periodic technical inspection and to perform activities of legal technical testing of vehicles and their trailers. Nowadays, the system comprises more than 150 stations for technical inspection, located evenly throughout Croatia, with more than 1400 professional employees. All legal matters regarding documents, registrations, technical inspection of vehicles, insurance and road-toll can be done at any single station.

Principle activities:
– organization of technical inspections and registration of vehicles
– testing of built-up, rebuilt and self-built vehicles
– checking of vehicle type approval
– organization and checking of single vehicle homologation compatibility
– organization and testing of ADR vehicles and issuance of certificates of approval
– organization and testing of CEMT vehicles and issuance of certificates of compliance.

Certain sections of CVH and its laboratories are accredited according to HRN EN ISO/IEC 17025 and HRN EN ISO/IEC 17020.

CVH is a full member of CITA and a supporting member of the Croatian Academy of Engineering.
SPORAZUM
O
IZBORU TVRTKE BELUPO d.d. ZA
PODUPIRUĆEG ČLANA
AKademije tehničkih znanosti hrvatske

ČLANAK 1
NA OSNOVI INICIATIVE POKRENUTE OD STRANE BELUPO NA POSTANE PODUPIRUĆI ČLAN HATZ, PROVEDEN JE LIVAD U HRVATNE AKTE BELUPO KAO I U IZRAZENI ODLJIVE PREDLOŽENIH BUKVARENJA. POZBINDU OBRATNIH BASTANAKA IZMEĐU PREDSTAVNIKA BELUPO I HATZ. UPRAVA HATZ NA SVOJOJ SJEDNICI USVOJILA JE PRIJEDLOG OVOG SPORAZUMA TE GA Predsjedništvo HATZ IBARE IZ BASTANCA ZA PODUPIRUĆEG ČLANA HATZ PREMA ČL. 51. STATUTA HATZ.

ČLANAK 2:
BELUPO PRIHVACA STATUT HATZ I SVE NJEGOVE PRATEĆE AKTE TE SE POTPISOM NA OVOM SPORAZUMU OBVEZLE DA ČE IH SE ZA VRIJEME TRENAJUAN OVOG SPORAZUMA U ZAJEDNOSTI HIREDJAVATI.

ČLANAK 3
HATZ SE OBVEZLJE DA ČE NA SVIM MJESTIMA NA KOJIMA SE NALAZI POSEB PODUPIRUĆI ČLANOVA BITI PRIKAZA ODREĐENIH BASTANAC NAVEĐENIH I NAZIV BELUPO.

ČLANAK 4:
BELUPO CIJE SVOGI SREDSTVA ZA IZVJEŠĆENJE PROGRAMA HATZ U 2008. GODINI

ČLANAK 5
PREDSTAVNICI HATZ I BELUPO PORED AKTIVNOSTI SPOMENUTIH ČLANAKU 4.

OVOG SOPORAZUMA BUDUKE SU DA SE USREDNJUJU I STAVLJATE NA PROGRAMU CJELOŽIVOTNO OBRAZOVANJA, IZRADE EXPERTIZA KOJE BI BELUPO KORISTIO U PROMOTIVNE NAMJENE BELUPO I HATZ, ORGANIZIRANJE ZAJEDNIČKIH SEMINARA I RADNIH BASTANAKA I OSUTE ZAJEDNIČKI DOBREVORENE PROGRAME.

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IZVRŠENJE AKTIVNOSTI IZ ČLANKA 5. NIJE OBUHVATENO ČLANKOM 4. OVOG SPORAZUMA TE SE O IZVRŠENJU TIH AKTIVNOSTI I RHKOVOM ODNOSO DONOSI POSEBNE ODLUKE KOJE ODGOVARJAJU UPRAVI HATZ I BELUPRO.

HATZ I BELUPO SU SLUŽBENE DA ČE GOSPODA BRANKA PERKOVIĆ, DIPL.UR., ČLANICA UPRAVE BELUPO I DRUGA IMENOVANA OSOBA TUGOM TRAJANJA OVOG SPORAZUMA BITI KOORDINATOR AKTIVNOSTI U PRIMJENJENOVU ČLANAK SPORAZUMA.

ČLANAK 6.

SPORAZUM SE ZAKLJUČUJE NA ROK OD 8 GODINA I POČETKOM VAŽENJA OD 1. SVEĆENJA 2008. GODINE I MOže SE UZ ODGOVARJAJU SUKLADNOST PROIZVODII IZA NAĐEGO MAZDOLJE. U BLIČAJU DVA VAŽENJA OVOG SPORAZUMA, JEDNA STRANA ĆE IZNIKEć BITI OPOZIVATI SPORAZUM, OBAVJESTAVAJU DRUGU STRANU O RASKRŠNJU SPORAZUMA TE SE B. SUKLADNO VJEĆNOM GODINI SPORAZUM SHEMAJ NAĐENJIM. ONJE STRANE SU SUKLADNE DA ČE ČE VAŽENJA OVOG SPORAZUMA IZNSIĆBITI SVE OBEVE UPRAVNE OVOVMI SPORAZUMOM.

ČLANAK 7.

NA ŠKUPŠTINI HATZ U 2008. GODINI BELUPO ĆE SE SVEČANORUČITI ODLUKE O PRIJAVOMI ZA ODUPIRANJE ČLANA HATZA A DO TADA ĆE OBNOVA ZA SUKLADNJU BITI OVAJ SPORAZUM KOJI ĆE SE POČIVATI POJEDINI SUKLADNJU NAĐEGO GODINI PREDSJEDNIŠTA HATZA.

BELUPO ĆE PRADO PREDOVIĐITI JEDNOG SVOG SLUŽBENIKA ZA ČLANA PRIJATELJICA HATZA KOJI ĆE NA GODINOSU ŠKUPŠTINA 2008. GODINI BITI UZBRAN.PREMA STATUTU HATZA.

ČLANAK 8.

U BLIČAJU MOGUĆIH PROBLEMATA IZ RUČNEH OVOG SPORAZUMA ONJE STRANE SU SUKLADNE DA ČE ČE IZNSIĆBITI MEĐUSOBNI DOGOVORI.A KOJO JO NIKO BI Bilo MOGUć PROZVUCU Mzdoljnost DJEDU NA DJEDU.

ČLANAK 9.

U ZAGREBU, 22. VELJAČE 2008. G.

ZA HATZ.

PREDSJEDNIŠTVO HATZA

BRANKA PERKOVIĆ, DIPL. U.R.

ZA BELUPO.

ČLANICA UPRAVE BELUPO

PROF. DR. SC. ZLATKO KNIEWALD
Belupo Inc.

Belupo is the second largest pharmaceutical company in the Republic of Croatia with a 36-year tradition. It is a leading pharmaceutical company in Croatia in sales of medicines for cardiovascular diseases and dermatological preparations. The company headquarters are situated in northern part of Croatia, in city of Koprivnica, some 90 km away from Zagreb. Belupo employs more than 1000 employees, 900 in Croatia and over a hundred abroad. The total consolidated sales of Belupo exceed 83 million EUR in 2006.

As a strategic partner to the Croatian health service system, Belupo continuously participate in organizing and developing of public health activities and especially supports education of patients regarding the importance of a timely and proper medical treatment and self-care in order to improve quality of life.

Belupo has a certificate for production of pharmaceuticals, issued by relevant authorities of republic of Croatia, as well as GMP certificate of European inspection PIC/S that confirms that Belupo meets all valid standards and requirements of the good production practice recommended by WHO and EC. Being aware of the fact that high quality, especially in pharmaceutical company is a key to success and a long term goal of all business activities, Belupo has implemented in its overall management procedures high quality standards with particular emphasis on production process, product development and quality control as well as human resources and services. The system of quality is founded on the Good Manufacturing Practice (GMP requirements), as it is prescribed by the Croatian and European legislation and by the guidelines and standards of the environment protection. The system of quality and its documentary evidence is being checked by domestic and international pharmaceutical inspections and license partners.

Quality system is built on GMP in a way it is prescribed by Croatian, European and American legislation and guidelines, taking into account our own experience and the best practices introduced through cooperation with our licence partners. The quality of Belupo processes are regularly checked by relevant authorities in Croatia, as well as by the representatives of the international organization Pharmaceutical Inspection Convention (PIC) and the licence partners.
Supporting Companies for the Conference Engineering Education – The Bologna Process “3 years later”
Annual Report on the Activities of the Croatian Academy of Engineering (HATZ) in 2007
Bogatstvo je kultura čuvanja zdravlja.

Zdravo budi!

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We acknowledge the assistance of Ministry of Science, Education and Sports in publishing this book.