

## IS IT POSSIBLE TO HAVE HIGH QUALITY OF EDUCATION IF LEVEL OF INDUSTRIAL DEVELOPMENT IS LOW?

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**Abstract** *¼ Introduction of modern CAD-CAP-CAM technologies shortened the product development cycle and lowered production costs. To deliver new product faster and cheaper, engineers are forced to learn faster and more efficiently. Rapid development of information and communication technologies (ICT) enabled new tools for education and boosted distance learning tools. The goal of this paper is to give some ideas and results on how can ICT are used efficiently in engineering education, based on the experiences and international cooperation from Italy, Norway, Germany and Spain, as well as from Bosnia and Herzegovina, a country with undeveloped industry. On one side, we have industry on the level of fifties and on the opposite side we have ICT technologies, which can not be as slow as local industry development. The paper is based on experiences gathered through international project "Establishment of Phare Open and Distance Learning Centers in Bosnia and Herzegovina" and treats the development activities in the ODL Center at the Faculty of Mechanical Engineering in Zenica.*

**Index Terms** *¼ Distance learning, Engineering education, Level of development, Education quality.*

### BACKGROUND

The Phare Multi-Country Programme for Distance Education was launched in 1994. Today more than 150 organisations in the Phare countries are co-operating on the development of their ODL infrastructures, the establishment of 50 ODL Study Centres and the development of numerous ODL courses.

One of these centres is ODL Study Centre built and developed at the Faculty of Mechanical Engineering in Zenica, University of Sarajevo, Bosnia and Herzegovina. Today this ODL Study Centre (ODL-SC) is separate unit inside the organisation structure of Faculty with tendency to become Cantonese Centre for ODL with (50:50)% of interest of Faculty of Mechanical Engineering and Ministry of Science of Canton Government. Our Faculty is situated in town Zenica, about 70 km far from Sarajevo, and it is part of the University of Sarajevo. The University of Sarajevo has

been an active participant in Tempus program after 1996. and Bosnia took part in the Phare Multi-country Programme for Distance Education since 1999. First activities in the ODL direction at our Faculty started in November 1999. Three years before that date, after the war in Bosnia, the Faculty of Mechanical Engineering in Zenica constituted and built one of the first local area computer networks at universities in Bosnia. Present layout of this network is shown on the figure 1. The LAN consists of more than 150 personal computers interconnected to Bosnian academic and research network Biharnet.

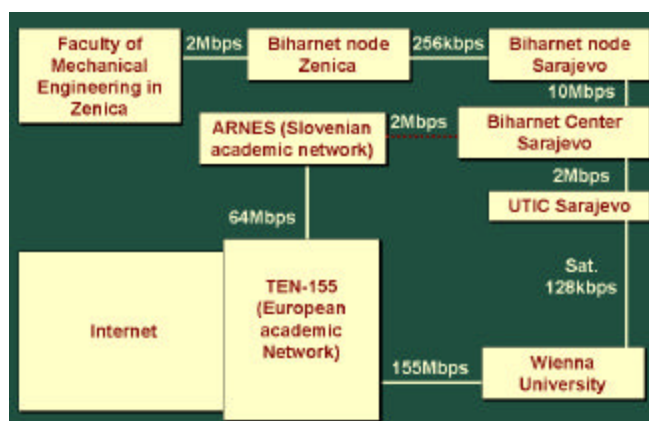


FIGURE. 1  
WAN CONNECTIVITY OF LAN AT THE FACULTY OF MECHANICAL ENGINEERING IN ZENICA.

To better understand present situation in Bosnia and working conditions for ODL Centres, some important facts are given. All data is given for Zenica-Doboj Canton, where our faculty and ODL Centre are situated, but without a great error these figures are valid for all Bosnia. The second reason for observing the Canton is educational regulation, which is totally in authority of Canton Government according to the Dayton Peace Agreement.

Zenica-Doboj Canton population today is 545000, with 70308 employees (12,90%). About 4804 (6,80%) persons of all employees work in education sector as teachers in

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primary and secondary schools and faculties. The average annual salary in education sector is about 2500 EUR (net) and other sectors about 18500 EUR (net). In our Canton there are 54940 unemployed persons (10% of all population) which are evidenced in "Agency for unemployment". The structure of unemployed people is: 227 with university diploma, 246 with high-school diploma, 8375 with secondary school and others have lower level of education. Concerning industrial development, we may say that before the war this region was the centre of ex-Yugoslavia for metallurgy, mining, wood industry and metalworking (with production of about 2 million tons of steel, 5 mil. tons of coal, 1000 MW of installed electric power sources and about 2000 machine tools). At the field of information technologies, we might present fact that there are 7 personal computers per 1000 citizens, and in the schools there are 12 computers per 1000 students. For better comparison, we give the data for Norway, the host country of this conference and example of European country which quality of life is ideal for all countries in Eastern and Southern Europe. Norway has population of about 4450000, with 1496300 employees. 21781 employees work in educational sector (1,46%). The average annual salary in education sector is about 33000 EUR (net) and in other sectors about 18500 EUR (net). The comparison data is presented at the figures 2 to 5.

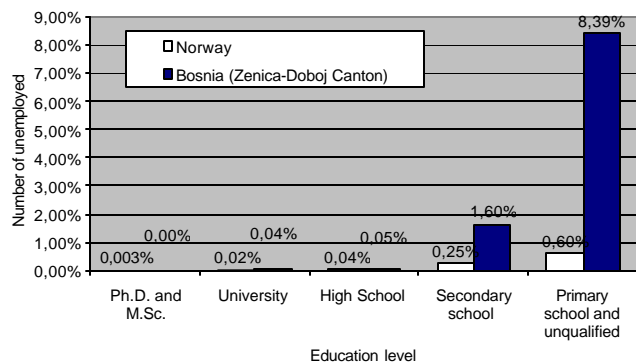


FIGURE. 2

STRUCTURE OF UNEMPLOYED POPULATION IN NORWAY AND BOSNIA.

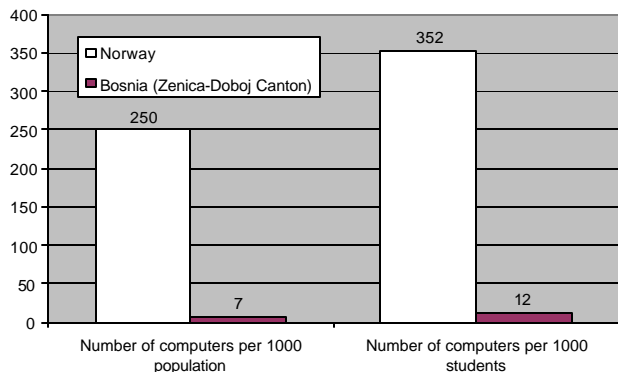


FIGURE. 3

NUMBER OF COMPUTERS IN NORWAY AND BOSNIA.

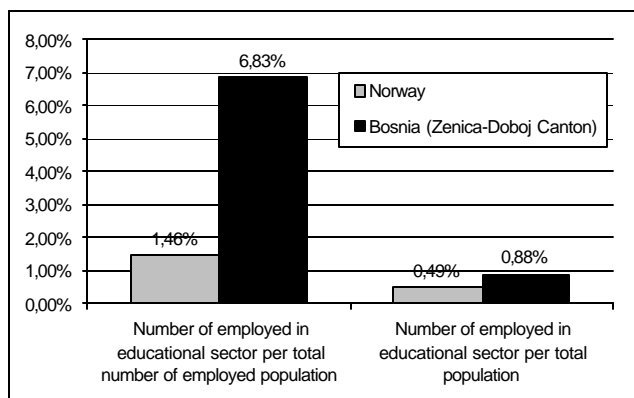


FIGURE. 4

NUMBER OF EMPLOYED IN EDUCATIONAL SECTOR IN NORWAY AND BOSNIA.

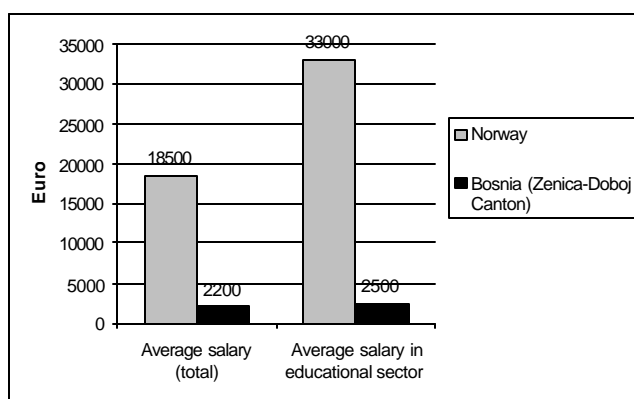


FIGURE. 5

AVERAGE ANNUAL SALARY IN NORWAY AND BOSNIA.

The presented facts in figure 2 show a very difficult situation in all sectors, especially in education sector. The normal question which follows after this conclusion is: **Is it possible to have high quality of education if level of industrial development is low?**

Normally, the exact answer is very difficult to present. Surely, in this moment, we have a great gap between industrial development and other industrial facts and educational sector. Why? On the first place, because the industry is very static with great enterprises, with many unemployed people, with old technology and old and conservative management. And all that in today turbulence environmental conditions. On the opposite side is the education sector with great influence of outside experts, program study exchange, teacher personnel and students training etc. As a illustration of these facts we might say that about 250 from 700 students who graduated at our universities in previous 25 years, today work in companies and universities in EU, U.S. and Canada with a recognised level of education.

One of the main tools, which can be used to resolve this great gap, is distance education. In this article we will try to express and explain why.

### ODL - OBJECTIVES

Distance education and training are highly practical instruments that can play a major role in the challenges that face the reform of education and training systems. When based on careful market research, distance learning is a particularly cost-effective instrument that respond to the issues facing the education and training sectors undergoing reform. It does this through providing wider and simpler access; offering flexibility and diversity in course content; and making continuing education more responsive to the needs of the economy.

The results of our pilot stage consists of:

- Establishment of ODL network and procurement of basic equipment relevant to distance education and training,
- Core group of educators and planners trained in distance education and training methods,
- Core group of educators and planners trained in selected areas of European Studies and on the EU faculties.
- Establishment of a special library based on the ODL experiences, knowledge, and modern information technologies.

Today, the education system in Bosnia is at the crossroads. On the one side, we have changes in political environment with regulation for educational system responsibilities for cantons government. On the opposite side, we have old education programme, very broad and hyperbolically deep in some aspects, in all levels of our education system. Moreover, the study courses programmes are designed unnecessary broad, and they produce feeling of frustration to persons who know the programmes in developed EU countries. Mainly, that is the main characteristic in study programmes for many small countries and poorly developed countries.

What is the best way for changing these negative characteristics and reform our education? How do we increase the capacity of our education and training system? How do we achieve flexibility? How do we meet continuously changing and diverse needs for education and studying? How do we support lifelong and continuing education? How do we strengthen the European and global dimension in our education, studying and training programmes? These questions are crucially important.

With concept of open and distance education for our educational system were obtained objectives:

- To support multi-country co-operation in the area of ODL and promote this concept in all aspects of education and training and in all institutions of primary, secondary and faculty level,
- To support the further reconstructing, re-engineering and development the education system with special attention for lifelong and continuous education,
- To support co-operation between countries in EU and other European countries in the field of distance education and training.

If we look at these facts, we can see that lifelong education becomes the natural necessity, which cannot be ignored by anybody who supports the development of education in Bosnia. In the contents of this axiom is the fact that "Distance education approach" is basic stone for building this structure. Clearly, that brings a great possibilities for faculties and other educational institutions to widen their services and start offering continuing education programmes for the new target groups - adults and unemployment.

### THE PROGRAM DEVELOPMENT

On the first place ODL method for our faculty staff, provides integration into education system of EU countries through wide co-operation in education and training. In our area the wider objectives of the ODL programme are:

- To develop the distance and training course modules in subject areas of special relevance to preaccession (industrial development, high technologies, information and communication technologies, environmental protection, production management, TQM and standard series ISO 9000 and 14000 etc.),
- To develop the distance and training course modules in special areas of interesting for graduated and postgraduate students (e.g. special topics of design, quality, maintenance, etc.),
- To establish a trans-regional infrastructure (between cantons inside in Bosnia) and the necessary human resources to further distance education and training, with particular references to the 50 Phare distance education study centres,
- To establish an infrastructure between faculties and public and private companies in Bosnia as one target group for ODL continuous education and knowledge improvement.

However, from our point of view this is only the beginning of our work. We have changed regulations with these aspects of studying inside the basic rules, which regulated university studying process in segment of obligation for face-to-face method. We will try to incorporate this aspect of studying inside the Canton education legislative. We have to pay much more attention to the human resource development and to provide the education for the ODL course team members (professors, assistants, researchers, mentors etc.). The successful use of distance education and the participation from other institutions, faculties, professors and others, significantly changed our way of thinking and our knowledge. As the result, we want to believe that ODL can significantly contribute the speeding up of the process of the EU accession process for the Bosnia. And, to stop rapid process of "brain drain", specially of young population from our country.

For the future, the main target group will be students for lectures in module design, students on the postgraduate courses, students from Pedagogical academy in Zenica,

university lecturers, teachers from primary and secondary school and last but not least group, unemployed persons, for special educational programmes. In addition, better co-operation should be developed with target groups in industry as managers, technologists, planners and designers. The target courses in these fields need to cover topics such as advanced technologies, modern information technologies, environmental protection, quality and risk management, project management, and many others.

### THE CASE STUDIES

The educational, scientific, investigation and skill programmes in our ODL centre were structured and divided into main groups as:

- Long-term programmes (e.g. CAD/CAM technologies, The Design of Production System, Flexible Manufacturing, LabView in teaching, Auto CAD 2000 for mechanical engineers, etc),
- Short-term programmes (courses focused on the subjects related to the information technology literacy and include courses on Internet/Intranet, MS Word, Power Point etc.)
- Seminars (courses on the topics of Technical diagnostic; Statistical methods in engineering practice; Environmental management; Numerical and experimental methods of stress and strain determination)
- International co-operation through scientific research and educational topics which covered academic staff from other universities and EU.

#### Case 1. Course on Open Distance Learning

This course was organised by EU-Phare Project team and was organised for one group of faculty teachers. The whole topics were available on the network. It consisted of following topics:

- Strategy in the ODL Business - Review of Cases on ODL;
- The Concept of Learning;
- ICT - Information Communication Technology and Learning Approach;
- The Learning Organisation - A concept in ODL?
- Communication on the NET;
- Marketing the Courses;
- Delivery of Courses;
- Preparing the Assignment;

After this course which was organised at our Faculty, one group of new constituted ODL Centre staff had study visit to Denmark and visited ITAI-Institute in Tonder, where they attended seminar with following topics:

- Providing of total packages of continuing education;
- Gap analysis of qualification needs;
- Design and implementation of flexible distance education systems;

- Training of trainers in the use of multimedia and flexible distance education;
- Development of GUI's and distributed database solutions;
- Running Computer Mediated Conferences and Email systems;
- Supplying E-mail services to flexible distance education;
- Internet service Provider, WEB hotel facilities.

The third group of teachers obtained educational training in the field of the topics and practical implementation of ODL at the universities in Aachen, Barcelona, Turin, Hamburg and London. Main activities in this course were focused on the education of the academic staff in the field of distance education, development and delivery of the long-term and short-term distance education courses in different topics.

#### Case 2. Course "CIM Factories and Flexible Manufacturing"

This course was developed together Prof. Vivancos from Spain and Prof. Petkovic from Bosnia for Faculty of Mechanical Engineering in Zenica and for educational program at the Universidad Politecnica de Catalunya from Barcelona, Spain. This course includes topics from interest for the graduate and postgraduate students and for technical and management personal in the factories. This course includes 12 topics, 1 videotape of practical illustration of treated problems, and it is designed for 1 semester as distance learning courses and with possibilities to face-to-face tutorials. The contents of this course are topics about Flexible production, Computer integrated manufacturing, Group Technology, The apply methods in CIM factories, FMS, The flexibility of CIM systems, The design optimisation of FMS, Assembly and flexibility, CIM and expert systems, Practical examples, CIM centre at the UPC and Future manufacturing systems.

#### Case 3. Course "3D Modelling of Mechanical Parts and Assemblies"

This was the pilot course during the Phare project. The course harnesses ODL methods to computer-aided design technology. It utilises dedicated software that allows for 3D digital modelling and the integrated drafting and analysis of mechanical components. Students learn to work flexibly in project teams geared to overall product design. Thereby the course makes a direct contribution to the required changes of the disciplinary curriculum. While not having general appeal, this course has made a big impact on the way that the subject "Computer Aided Design – CAD" is taught within the Faculty and can be deployed in professional training in engineering circles in the local community. The course was meant to be the starting point for a number of foregoing courses, since 3D CAD models can be used as a basis for further engineering analysis.

**Case 4. Course "Numerical and experimental methods for stress-strain analysis "**

The short, introductory course was given to engineers from two medium-size companies. The goal of the course was to give them fresh informatin about modern trends in stress-strain analysis. It covered following topics:

- Theory of stress and strain analysis
- Mechanical similarity and rigid coverings
- Strain gauges with examples
- Photoelasticimetry
- Finite elements method
- Presentation of FEM software

The first part of the course was introductory, face-to-face course, and the second part was delivered at the distance, where engineers were given assignments which they solved within the companies.

**Case 5. Scientific research at the University for the industry through international co-operation**

Software system KBS (Knowledge Based System), developed in Norway, was tested in one Bosnian factory to show possibilities for practical implementation and improvement of maintenance management. Researchers from University in Bosnia have sent data about the vibration level collected in one Bosnian factory. Frequency analysis is then performed by means of expert system in Norway. Therefore we used both international co-operation and co-operation with local industry to perform research.

Modern ICT is used to transfer the data from the factory in Bosnia to institute in Norway, where all calculations were made. The results achieved in Norway were sent back to Bosnia for further analysis and for practical application in the factory. These results helped us to clearly understand and follow the system behaviour in one period and have possibilities to optimise maintenance activities, the number of maintenance personnel and manage with maintenance cost.

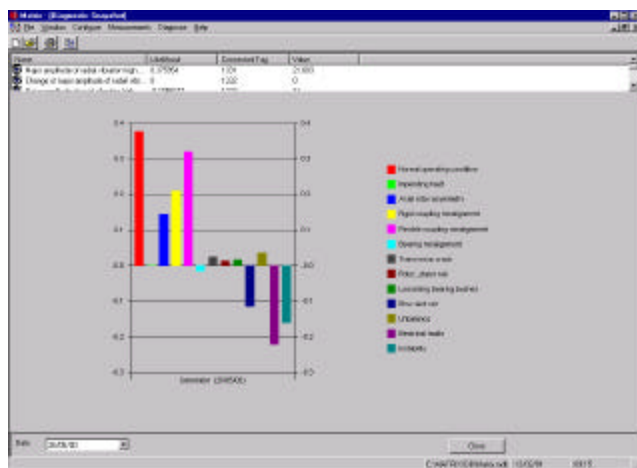


FIGURE. 6  
EXAMPLE OF DIAGNOSIS LIST MADE BY EXPERT SYSTEM IN NORWAY .

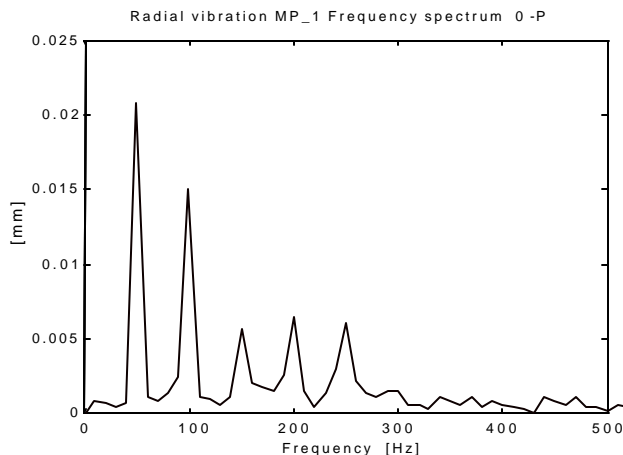


FIGURE. 7  
FREQUENCY SPECTRUM – RESULT OF CALCULATIONS.

**CONCLUSION**

Now and in the future, the distance education and training will enable to expand the capacity of our education and training systems. It will make access to education and training open to more and new target groups. The best teachers from the whole world can be available to all citizens, poor and rich, no matter where they live and where they work. It will give education and training institutions a set of tools and methods whereby they will be able to respond more in more flexible, efficient and effective ways to new skills and knowledge requirements.

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