DEREC – Development of Environmental and Resources Engineering Curriculum

Towards a new curriculum

The DEREC Experience

edited by
Enrica Caporali
Atanasko Tuneski

Firenze University Press

DEREC - DEVELOPMENT OF ENVIRONMENTAL AND RESOURCES ENGINEERING CURRICULUM
Tempus Joint European Project

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Tempus

DEREC – DEVELOPMENT OF ENVIRONMENTAL AND RESOURCES ENGINEERING CURRICULUM
Tempus Joint European Project

Progetto grafico di Alberto Pizarro Fernández

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A WORD FROM THE DEAN

The School of Engineering is a relatively young faculty of the University of Florence. It was founded in 1971 and actually consists of more than 200 professors and researchers and, every year, has about 1000 new in-coming students. The School offers 7 first level Degree Courses (three years) and 12 second level Degree Courses (two years) distributed among the areas of Architecture and Building Science Engineering, Civil and Environmental Engineering, Industrial Engineering and Information Engineering. Second-level graduated students have the opportunity to attend the 14 PhD Degree Courses which are organized together with the six Departments forming the School. The Departments cover all the research fields in the engineering area and have strong international activity in the context of the European Community programs.

Since the very beginning, the School has always paid a lot of attention to international cooperation in the area of Engineering Education. It has supported several projects contributing to the development and the enrichment of the European dimension in Engineering Education. The DEREC TEMPUS Project described in this publication perfectly fits into this line of activity of the School. This Project explores, for the first time, the practicability of offering a Joint Degree Title on the basis of an agreement between the University of Florence and a foreign university, namely the Ss. Cyril and Methodius University of Skopje.

Finally, I would like to thank all the partners for their work in the project. In particular, let me thank the Ss. Cyril and Methodius University of Skopje for their fundamental contribution to the project and let me encourage all the School colleagues involved in the project to continue this successful cooperation, which is highly valuable for both the School of Engineering and the University of Florence.

Prof. Alberto Tesi
Dean of the School of Engineering
University of Florence

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FOREWORD

INTERNATIONAL DIMENSION IN ENGINEERING EDUCATION

Claudio Borri
School of Engineering, University of Florence

1. The origin of the University in Europe

The development of the University in Europe (east and west) from its origins to the present day, played a crucial role against a backdrop of changing conditions, ideas and values. The modernization, differentiation and expansion of higher education led to the triumph of modern science, changing the relations between universities and national states, teachers and students, their ambitions and political activities. Special attention was focused on the fundamental advances in «learning» – the content of what was taught at the universities.

1.1 The University was not only born in Europe, it was born to be European

Starting from the origins of University, young people belonging to the most important European families, performed mobilities to the major Higher Education Institutions in Europe (*peregrinatio academica*) and this constituted the basis of the wish to learn from prestigious teachers.

During Middle ages, the Benedectine Monasteries became centres for the diffusion of *Christianity* in the «Old World», but were also *excellent examples of civil living* and made a decisive contribution to the *moral and cultural rebirth* of the continent after the barbarian invasions. As true communities, the monasteries were like miniature societies, in which time was spent not just on spiritual and meditative activities, but also cultural, administrative and productive work. Within their walls, on the one hand, there was *prayer and study*, the pursuit of culture and knowledge and the collection and organisation of manuscripts and documents.

Great innovation was introduced by the Benedectine Monasticism in the Middle Ages with the training of Novices. Novices were not admitted to vows until they had successfully completed the prescribed period of training and proving, called the novitiate. This can be considered as forerunner of the European mobility of knowledge. The figure of *St.*

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Benedict came to represent an element of unification in a Europe that had always struggled to build a sense of civil, cultural and spiritual identity. His message, which was spread by the many Benedictine communities from the VII century onwards, sustained the «old continent» during the darkest periods in history, and offered a decisive contribution to the construction of modern society.

In later times, mobility has characterized both University teachers and students. From one side, teachers moved to the most prestigious Universities where they could obtain higher wages, on the other hand students moved to the most accredited Universities where prestigious teachers worked.

2. Mobility within University Co-operation Programmes

2.1 Erasmus Programme

From the late 80s, the EU policy recognized the fundamental importance of the integration of cultures through the mobility of students and teachers. The most important mobility programme for Higher Education is Erasmus.

Erasmus is the EU's flagship education and training programme, enabling two hundred thousand students to study and work abroad each year, as well as supporting co-operation actions between higher education institutions across Europe. It caters not only for students, but also for professors and business staff who want to teach abroad and for university staff who want to be trained abroad.

The Programme is named after the humanist and theologian Desiderius Erasmus of Rotterdam (1465-1536) whose travels for work and study took in the era's great centres of learning, including Paris, Leuven and Cambridge. Like the man, the Erasmus programme places great importance on mobility and furthering career prospects through learning. By leaving his fortune to the University of Basel, he became a pioneer of the mobility grants which now bear his name.

Studies show that a period spent abroad not only enriches students' lives in the academic field but also in the acquisition of intercultural skills and self-reliance. Staff exchanges have similar beneficial effects, both for the people participating and for the home and host institutions. In addition to mobility actions, the Programme supports higher education institutions to work together through intensive programmes, networks and multilateral projects. Few, if any, programmes launched by the European Union have had a similar Europe-wide reach. Around 90% of European universities take part in Erasmus and 1.9 million students have participated since it started in 1987. The annual budget is in excess of €

400million, more than 3,100 higher education institutions in 31 countries participate, and even more are waiting to join.

Erasmus has become a driver in the modernisation of higher education in Europe and inspired the establishment of the Bologna Process. The general aim of the Programme is to create a European Higher Education Area and foster innovation throughout Europe. Erasmus became part of the EU's Lifelong Learning Programme in 2007 and expanded to cover new areas such as student placements in enterprises (transferred from the Leonardo da Vinci programme), university staff training and teaching for enterprise staff. The Programme seeks to expand its mobility actions even further in coming years, with the target of 3 million Erasmus students by 2012.

Actions include support:

For students mobility (SM):
- studying abroad
- working abroad
- linguistic preparation

For university/higher education institute teaching staff mobility (TS):
- teaching abroad
- receiving training abroad

For universities/ higher education institutes:
- intensive programmes (IP)
- academic and structural networks (TN)
- multilateral projects (MP)
- Curriculum Development (CD)

For enterprises:
- student placements
- teaching abroad
- university cooperation

Higher education institutions which want to participate in Erasmus actions must have an Erasmus University Charter. The Charter aims to guarantee a high level of quality in mobility and cooperation by setting out fundamental principles for all Erasmus actions that participating institutes must follow.

The European Commission is responsible for the Erasmus programme's overall implementation and its Directorate-General for Education and Culture coordinates its different actions. So called «decentralised actions» regarding individual mobility are run by national agencies in the 31 participating countries. Centralised actions such as networks, multilateral projects and the award of the Erasmus University Charter are managed by the Executive Agency for Education, Audiovisual and Culture based in Brussels.

2.2 TEMPUS Programme

The Tempus Programme (Trans-European Mobility Scheme for University Studies) supports the modernisation of higher education and creates an area of co-operation in countries surrounding the EU. Established in 1990 after the fall of the Berlin Wall, the scheme now covers 27 countries in the Western Balkans, Eastern Europe and Central Asia, North Africa and the Middle East (going beyond the «iron curtain».

TEMPUS Joint European Projects (JEP) aim at increasing cooperation and network-building between actors in higher education in EU Member States and partner countries, and help the higher education sector propagate its knowledge outside academic institutions. Projects can support universities in applying the principles of the «Bologna Process», for example by implementing the new two-level education system, and the European Credit Transfer System. *JEPs for Curriculum Development* help to create new or update existing courses and enhance the skills of teaching staff; develop updated modern teaching and learning materials; provide material aid in purchasing computers and other teaching material.

3. Mobility in a Global context

Mobility constitutes a primary element in the internationalization of Engineering Education and Erasmus represented one of the main factors of the Bologna process.

At the moment in Europe there are different societies for Engineering Education aiming at the *development* and the *improvement* of the Engineering Education in Europe such as SEFI, IGIP, CESAEER.

A future step of this internationalization process is represented by IFEES (the International Federation of Engineering Education Societies) founded in Rio de Janeiro in 2006 aiming at establishing effective engineering education processes of high quality around the world to assure a global supply of well-prepared engineering graduates. IFEES will strengthen member organizations and their capacity to support faculty and students. It will attract corporate participation, helping to connect engineering graduates with international corporations that have a pressing need for well-trained engineers who can work in a global environment. IFEES will also enhance the ability of engineering faculty, students and practitioners to understand the varied cultures of the world and work effectively in them.

INTRODUCTION

DEVELOPMENT OF ENVIRONMENTAL AND RESOURCES ENGINEERING CURRICULUM 2005-2008: PRESENTATION OF THE RESULTS

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The TEMPUS DEREC Development of Environmental and Resources Engineering Curriculum was a three-year TEMPUS JEP (Joint European Project) whose Grantholder was the University of Florence, Italy and whose Grant Co-ordinator was the University Ss. Cyril and Methodius in Skopje, FYR of Macedonia.

The specific objectives obtained by the project were the development of a new, up-to-date, three-year undergraduate curriculum in Environmental and Resources Engineering at the University Ss. Cyril and Methodius in Skopje, based on the European Credit Transfer System and in accordance with the Bologna Declaration, aimed to establish the European Higher Education Area and the fulfilment of the conditions necessary for offering a joint degree title in Environmental and Resources Engineering implemented jointly on the basis of an agreement between the University Ss. Cyril and Methodius in Skopje and the University of Florence.

The project has led to the development of a new Environmental and Resources Engineering Curriculum focused on the achievement of the six main goals of the Bologna Declaration, as a contribution to the realization of the European Higher Education Area (EHEA). In order to fulfil the Bologna Declaration goals, in addition to the new curriculum, the following DEREC outcomes were achieved: the co-operation among the DEREC Consortium Libraries, the design and elaboration of a new Environmental and Resources Engineering Curriculum based on the European Credit Transfer System (ECTS), the acquirement for the beneficiary University of the basic equipment for the development of the curriculum, the development and implementation of online learning courses, the work on the sustainability of the new curriculum. The

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project activities were managed, monitored, controlled and disseminated in accordance with the rules of the TEMPUS programme.

This publication represents the concluding part of the project, a book in which all project actions and outcomes are explained and the approach of the different partners towards the achievement of the different goals is described.

The volume is divided into two main parts: the first part describes the European Consortium approach (including papers from all representatives of Consortium Member institutions in the European Union and the project external experts) and the second part describes the approach from the different faculty representatives of the Ss. Cyril and Methodius University in Skopje and the South East University of Tetovo. This book describes some specific project activities, the methodology, the instruments and the process to the Curriculum Development and it is targeted to act as an updated, coherent and concrete set of instruments for the achievement of similar project objectives.

Through the co-operation of all project consortium members (four Universities in the European Union, two in the partner Country represented by different involved Faculties and two external experts) the project contributed to the extablishment of methods for strengthening the regional scientific cooperation and network-building between actors in higher education in EU Member States and partner countries, and helped the higher education sector to propagate its knowledge outside academic institutions.

The DEREC JEP helped the Ss. Cyril and Methodius University in Skopje in applying the principles of the «Bologna Process» by implementing the new two-level education system, and the European Credit Transfer System. Particularly, DEREC created a new course in Environmental and Resources Engineering and enhanced the skills of the partner country University teaching staff; developed updated modern teaching and learning materials and provided material aid in purchasing computers, fields and laboratory equipment.

Great enthusiasm was expressed by the European Commission on the Project activities. Particularly it was «highly appreciated that the accreditation process has been completed». It was also noted «the progress on the delivery of a joint degree with the University of Florence» and congratulations were expressed for «extensive cooperation between the two universities which has been fundamental for these developments». Comments from the European Commission on the Project reports were discussed and shared with all Project Partners on the occasion of the Quality Control Meetings of the Project held at the Ruhr University Bochum in November 2006, at the Aristotle University Thessaloniki in September 2007 and at the Vienna University of Technology in July 2008.

The new course followed all accreditation procedures and in September 2008 was opened to students. At the moment, different students are

enrolled at the Environmental and Resources Engineering degree course at the Ss. Cyril and Methodius University in Skopje. Enrolled students will spend part of their final year at the University of Florence and at the end of the course will be awarded with a degree in Environmental and Resources Engineering which is fully legally equivalent to the degree in Environmental, Resources and Territory Engineering awarded by the University of Florence on the basis of the existing bilateral agreement between the two institutions.

The activities of the DEREC project will be additionally developed in a new project to be launched in the frame of the TEMPUS IV second call of proposal which will be centered on the students mobility (allowing sustainability and exploitation of results to the DEREC project) and will include possible spin offs on a possible second level of the DEREC course and on Higher Education and Research.

Acknowledgments

The authors acknowledge with gratitude the European Commission, DG Education and Culture who funded the DEREC Project under the TEMPUS III Programme, all Project Consortium Partners (Aristotle University Thessaloniki, Ruhr University Bochum, Vienna University of Technology), the two project external experts (Prof. G. Schmid and Prof. R. Zaharieva), all staff of the Ss. Cyril and Methodius University in Skopje (Faculties of Mechanical Engineering, Civil Engineering, Electrical Engineering and Information Technology, Agriculture and Food, Technology and Metallurgy), the South East European University, Tetovo, who devoted their work and expertise with the greatest enthusiasm for the good implementation of the project.

In addition, the authors also acknowledge with gratitude the library of the Faculty of Mechanical Engineering and the Faculty of Electrical Engineering and Information Technologies of the Ss. Cyril and Methodius University in Skopje and the library of the University of Florence, all teching staff of the University of Florence, the legal representative of the Project Prof. C. Borri, all the staff of the Financial Office and the staff of the International Relations Office of the School of Engineering of the University of Florence.

THE EDITORS' DEREC EXPERIENCE

TEMPUS DEREC PROJECT: EXPECTED OUTCOMES, ACHIEVED OBJECTIVES AND FUTURE PERSPECTIVE

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Abstract. The paper presents the expected outcomes and the achieved objectives, as well as the future perspective of the TEMPUS CD_JEP_19028_2004 titled as DEREC (Development of Environmental and Resources Engineering Curriculum). The main project activities performed in the three-year project duration (2005-2008) are listed, with the experiences, milestones and the key-steps of the project realization. Special focus is put on the future possibilities for improvement and enlargement of the DEREC project results. The ways of collaboration in the educational process between the universities in one EU Partner Country (Republic of Macedonia) and European Universities in the framework of the European Higher Education Area (EHEA) are expecially emphasized. The final objective of all these activities should be establishment of the necessary and sufficient conditions for offering a Joint (or Double) Degree Title which is to be implemented jointly on the basis of an agreement between the EU and EU Partner Country universities.

1. *Introduction*

The paper presents the expected outcomes and the achieved objectives, as well as the future perspective of the Joint European Project (JEP) TEMPUS DEREC (Development of Environmental and Resources Engineering Curriculum), with a TEMPUS reference number CD_JEP_19028_2004.

The DEREC project started on September 1st, 2005, ended on December 31st, 2008, and was financed by the European Commission, Directorate-General Education and Culture, with a TEMPUS Grant amount of 469,400.00 EUR and amount of 24,900.00 EUR co-financed by the Grant Beneficiary Institution – University Ss. Cyril and Methodius, Skopje, Macedonia. DEREC Grant Applicant Higher Education Institution was the University of Florence, Italy, represented by prof. Claudio Borri as a Legal Representative of the University of Florence and prof. Enrica Caporali as a DEREC Grant Applicant. Prof. Atanasko Tuneski from the University Ss. Cyril and Methodius, Skopje was a DEREC Grant Coor-

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dinator. There were two universities from the Republic of Macedonia, as EU Partner country, involved the DEREC project: University Ss. Cyril and Methodius, Skopje and South-East European University in Tetovo. There were four EU universities involved in the DEREC Consortium: University of Florence, Italy, Ruhr University Bochum, Germany, Aristotle University of Thessaloniki, Greece and Vienna University of Technology, Austria. Finally there were two individual external experts who monitored and assessed the DEREC project activities – prof. Günther Schmid from Germany and prof. Roumiana Zaharieva from Bulgaria.

This paper is divided in three sections:

- Section 2 where the DEREC expected outcomes are listed;
- Section 3 where the DEREC achieved objectives are listed; and
- Section 4 where the DEREC project future perspective is presented.

2. *DEREC expected outcomes*

The DEREC project had two specific objectives:

- To develop a new, up-to-date, three-year undergraduate curriculum in Environmental and Resources Engineering at the University Ss. Cyril and Methodius in Skopje, based on the European Credit Transfer System and in accordance with the Bologna Declaration, aimed to establish the European Higher Education Area
- To fulfil the conditions necessary for offering a Joint Degree Title in Environmental and Resources Engineering which is to be implemented jointly on the basis of an agreement between the University Ss. Cyril and Methodius in Skopje and the University of Florence.

The above cited two specific objectives were supposed to be realized through achievement of the following project outcomes:

1 Co-operation among the DEREC Consortium Libraries, which should have been achieved through the following activities:
  1.1 Agreements for 3-years cooperation among the DEREC Consortium Libraries;
  1.2 Share the DEREC Libraries Services;
2 ECTS based three years Environmental and Resources Engineering Curriculum establishment, which should be achieved through the following activities:
  2.1. Academic visits from the Partner Country to the EU DEREC Universities;

2.2. Survey of the Partner Country Macedonian educational and Labour Market;
2.3. Workshop for defining the Curriculum courses and the DEREC academic staff;
2.4. Macedonian academic staff training and retraining at EU DEREC Universities;
2.5. Work out the DEREC educational materials;
2.6. Produce and deliver the DEREC educational materials;
2.7. Open the new Curriculum at University Ss. Cyril and Methodius;

3 DEREC Equipment Establishment, which should have been achieved through the following activities:
3.1. Specify the DEREC equipment;
3.2. Prepare the tender documentation;
3.3. Perform the open call procedure;
3.4. Select the Equipment Suppliers;
3.5. Deliver and Install the equipment;

4 Development and implemention of Online Learning courses, which should have been achieved through the following activities:
4.1. Adapt the DEREC curriculum courses for web-based access;
4.2. Develop blended learning courses methodology;

5 Dissemination of project outcomes, which should have been achieved through the following activities:
5.1. DEREC web-site, informative sessions and annual reports;
5.2. DEREC Workshops;

6 Assessment of the new Curriculum sustainability, which should have been achieved through the following activities:
6.1. Financial sustainability analysis;
6.2. Institutional sustainability assessment;

7 Project Quality Control and Monitoring, which should have been achieved through the following activities:
7.1. External reports, peer reviews and questionnaires;
7.2. Yearly quality control meetings;

8 Definition of the main project Management Structure, which should been achieved through the following activities:
8.1. Project representatives meeting;
8.2. Start-up meeting;
8.3. Administrative coordination;

3. DEREC achieved objectives

DEREC project has fulfilled all expected outcomes listed in Section 2, through the activities explained in the text to follow.

1. The cooperation among the libraries of the Universities included in the DEREC Consortium began in spring 2006, when the first Macedonian academic staff visits to the EU DEREC Universities started to be performed. During the academic visits, the libraries of all DEREC universities were presented, information about the libraries were collected and administrative activities to establish agreements for cooperation among the DEREC consortium libraries, started. The working groups at the DEREC Consortium Member Institutions finalized the Agreement among the Library of the University of Florence (as a DEREC Grantholder Institution) and the Library of the Faculty of Mechanical Engineering at the University Ss. Cyril and Methodius in Skopje (as a DEREC Coordinating Institution). The Agreement was signed in March 2008, stating that «....the DEREC project includes among its activities the settlement of co-operative actions between the library systems at the two Universities, and with the purpose of pursuing this declared goal and increasing the exchange of information and documents, the library systems of the University of Florence and of the University SS. Cyril and Methodius of Skopje will put in action the service of document delivery and inter-library loan in terms of mutual free exchange in the eligibility period of the project».
2. ECTS based 3 years Environmental and Resources Engineering Curriculum was established and opened at the University Ss. Cyril and Methodius in Skopje, Macedonia in October 2008. This final objective was achieved following the procedure scheduled in the DEREC project application: (a) the academic staff (12 persons) from the Macedonian Universities performed one-week academic visits to the DEREC EU Universities in spring 2006 in order to be informed directly about all aspects of the EU educational system, learning methods, courses, etc.; (b) On the base of the academic visits from the Macedonian Universities to the EU DEREC Universities, the expertise of the DEREC academic staff, the guidelines from the corresponding Reports of the Macedonian Ministry of Environment and Urban Planning, as well as the questionnaries filled in by relevant industry and non-governmental organizations, the DEREC Consortium prepared precise and detailed Survey of the Macedonian Needs Analysis, identifying the specific problems and needs on which the DEREC project should focus; (c) On the base of the academic visits from the Macedonian Universities to the EU DEREC Universities, the expertise of the EU DEREC professors, as well as the Macedonian needs analysis, a workshop for defining the precise list of the DEREC courses and the DEREC academic staff was held in Skopje in May 2006; (d) In order to be able to prepare modern, up-to-date curriculum in environmental and resources engineering, the Macedonian academic staff (27 professors) had one-week training and retraining

at DEREC EU Universities performed by the DEREC EU professors, up to the end of year 2006; (e) The Macedonian academic staff prepared the complete English courses content (theory and exercises) of 27 courses related to the DEREC Curriculum aimed to establish modern, up-to-date education in environmental and resource engineering. The EU DEREC Consortium academic staff ensured tutorial, expertise and consultancy services in preparation of the DEREC courses educational materials; (f) The prepared complete educational materials for the DEREC Curriculum courses was printed (in paper and CD version); (g) In spring 2008 the DEREC Curriculum was established into the educational system covered by the University Ss. Cyril and Methodius. According to the Decision of the National Inter-University Conference in Macedonia (March 2003), DEREC studies are organized on the university level on the base of the Decision for their organizing made by the corresponding Ss. Cyril and Methodius University Rector Board. The University Ss. Cyril and Methodius required accreditaton of the DEREC studies in environmental and resources engineering from the National Accreditation Board, and the National Accreditation Board gave accreditation to these studies. Moreover, the DEREC project ensured fulfilllment of the conditions necessary for offering a Joint Degree Title in Environmental and Resources Engineering which is to be implemented on the basis of an agreement between the University Ss. Cyril and Methodius and the University of Florence.

3. The equipment for the development of the DEREC Curriculum was acquired through an open call procedure which ended in November 2007. The Open call winner has been the company: ECM ECO Monitoring, a.s. in Bratislava, Slovak Republic and all procedures for the signature of the Contract were performed by the relevant offices of the University of Florence. The official signature of the contract took place at the University of Florence on April 28th, 2008. Delivery of the equipment was done at the end of September 2008, and the testing and acceptance of the DEREC equipment finished in November 2008. The following equipment was acquired (with a budget of 118.440,00 EUR): Handheld Water Quality Meters for Field Work, Ultrasonic Flowmeter, Hyperspectral Process Photometer, Data Acquisition System, Laboratory Measurement Equipment (for water quality parameters conductivity, conductivity, temperature, resistivity, conductance, salinity, resistance, total dissolved solids, dissolved oxygen), Soil Analysis Kits, GPS – Global Positioning Unit, Zeta-Meter, Informatics Equipment.
4. Development and implementation of the on-line learning environment related to the DEREC Curriculum established by the Professors of the Faculty of Electrical Engineering and Information Technologies

of the University Ss. Cyril and Methodius in Skopje. DEREC distance education system enables different forms of interaction among the participants of the learning process and supports different active learning forms. The implementation of such a distance education system represents the attempt for transferring the infrastructure of traditional educational systems (classroom, library, laboratory, project work) into digital world. DEREC Distance Education support System (DES) supports different forms of active learning. DEREC DES keeps track of student history, usage of educational materials and enable easy access to all educational modules. Clear mapping with traditional educational system is enabled where possible. The users of DEREC DES need only to have internet connection and internet browser installed on their machines. The system is developed modularly and different system modules can be used. There are two general groups of the activities that are supported by DEREC DES: student service activities and student academic activities. Student service activities (for example, lecture scheduling, general information about the subjects, course enrolling, exam enrolling, etc.) are related to educational process by supporting it. Student academic activities are represented through access to educational materials, consultation activities, discussion activities, etc. Although not directly related to student activities, instructor supported activities (for example, publishing of the exams' results, different kinds of student notifications, educational material creation guide, etc.) are included in the DEREC distance education support system. The forum module developed within DEREC can be used independently from different modules of the DEREC DES, and can be also used from other modules of the system in order to increase their functionality.

5. Dissemination of the DEREC project on the Macedonian National Level included informative sessions in April each project year, Annual DEREC Progress Reports for each project year, as well as continuously presentation of the project activities and outputs/outcomes on the DEREC web site. Also, three DEREC workshops for dissemination of the project results were performed in Macedonia (in May 2006 and May 2007 in Skopje, and in April 2008 in Ohrid) with participation of the DEREC universities, Macedonian Universities authorities, the state authorities and the non-consortium policy-makers. Four visits to the Macedonian neighboring universities (University of Belgrade, University of Nis and University of Novi Sad in Serbia, University of Architecture, Civil Engineering and Geodesy in Sofia, Bulgaria and Polytechnic University of Tirana, Albania) were performed at the end of the project in order to disseminate the project results and to establish regional cooperation in the environmental and resources engineering scientific field. In order to attract new students in the

DEREC Curriculum opened in October 2008, DEREC booklets' were printed and distributed throughout the secondary schools in Macedonia, DEREC leaflets are distributed in the Macedonian daily newspapers, DEREC advertisment was printed in the Macedonian daily newspapers, the Macedonian Engineering Journal and the Macedonian Mathemathical Journal.

6. The new DEREC Curriculum sustainability processes include financial sustainability and institutional sustainability at the University Ss. Cyril and Methodius in Skopje. The financial sustainability is ensured by student's self financing, and the educational process is organized in the classrooms and premises of the faculties that are members of the University Ss. Cyril and Methodius in Skopje, with academic and administrative staff employed at the University. The student mobility between the University of Florence and the University Ss. Cyril and Methodius in Skopje is foreseen to be self financed.
7. The DEREC project quality control and monitoring was an integral part of all DEREC project activities and results. The project was easily monitored and assessed since its outcomes and activities were realistic and reachable, as well as specific and time-based. The DEREC project quality control and monitoring was performed through internal assessment on the DEREC quality control meetings (in October 2006 in Bochum, Germany, in September 2007 in Thessaloniki, Greece and in July 2008 in Vienna, Austria), and through external quality assessment reports provided by two external assessors: prof. Günther Schmid from Germany and prof. Roumiana Zaharieva from Bulgaria.
8. The DEREC Management Board established at the project beginning lead all project activities and was responsible for achievement of the project outcomes. The DEREC Project leadership was ensured by Professors Claudio Borri and Enrica Caporali from the University of Florence – the Grant Applicant Institution.

4. DEREC Project Future Perspective

The most important DEREC project result is that it fulfilled the conditions necessary for offering a Double Degree Title in Environmental and Resources Engineering which is to be implemented jointly on the basis of an agreement between the University Ss. Cyril and Methodius in Skopje and the University of Florence. The Rectors of these universities signed such an agreement in November 2008, establishing a legal framework which allows the selected students, from Macedonia and Italy, involved in the mobility activity at the third studying year, to obtain a mutual recognition of the two degree titles. There is an equiva-

lence between the DEREC Curriculum at the University Ss. Cyril and Methodius in Skopje and the Curriculum at the University of Florence on Environmental Engineering field titled as «Engineering for the Environment, Resources and Territory» (IART), established through satisfaction of the following conditions:

- the DEREC Course is compatible with the minimum European Credit Transfer System (ECTS) number required for the Italian Discipline Scientific Sectors (SSD);
- The first two years in the two curricula are similar enough to allow equivalence;
- The third year in the curricula is significantly compatible, in order to allow student exchange in the respect of the Italian regulation and obtain the equivalence for the *selected students* involved in the mobility activity.

There are precisely defined educational paths for the selected students involved in the mobility activity in the third studying year.

The cooperation between the University Ss. Cyril and Methodius in Skopje and the University of Florence will continue in the future 3-year period (2008-2011) through the TEMPUS IV project titled as «Video Conferencing Educational Services» (ETF-JP-00142-2008)

5. Conclusion

The paper presents the expected outcomes and the achieved objectives, as well as the future perspective of the TEMPUS CD_JEP_19028_2004 titled as DEREC (Development of Environmental and Resources Engineering Curriculum). The Double Degree Title offered as a DEREC project result is in a full accordance with the Bologna Declaration, aimed to establish the European Higher Education Area (EHEA). The DEREC project contributes to the enhancement of the world-wide attractiveness and international competitiveness of the European Higher Education, as well as strengthening of the universities cooperation based on partnership.

HOW TO DESIGN AN ENVIRONMENTAL AND RESOURCES ENGINEERING CURRICULUM: THE DEREC PROJECT EXPERIENCE

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Abstract. In the framework of the European Higher Education Area (EHEA) this paper presents the experience in developing a new undergraduate curriculum in «Environmental and Resources Engineering» at the Ss. Cyril and Methodius University of Skopje in FYR Macedonia. The implementation of a multidisciplinary and interdisciplinary approach to achieve the main goals of the Bologna Declaration of educational systems based on the European Credit Transfer System – ECTS is emphasized. The relevance of environment protection and natural resources enhancement is highlighted. The development of an integrated study programme, based on international co-operation at academic level, reinforced by the mobility of students and teachers, is also analysed.

1. *Introduction*

Higher Education plays a central role in the development of both human beings and modern societies as it enhances social, cultural and economic development, as well as active citizenship, ethical values and expertises for a sustainable growth. The sustainability of development has, as relevant key factors, environment protection and natural resources enhancement.

In this framework takes its place the here described experience, dedicated to the joint development of a curriculum in the field of environmental and resources engineering at the Ss. Cyril and Methodius University, of Skopje, FYR (Former Yugoslavian Republic) of Macedonia.

Higher Education includes teaching, research and social services activities of universities. Particularly, it refers to a level of education provided by universities, colleges, institutes of technology and other collegiate level institutions awarding academic degrees or professional certifications. Since 1950, article 2 of the first Protocol to the European Convention on Human Rights [4] obliges all signatory parties to guarantee the right to education. World-wide, the United Nations' International Covenant on Economic, Social and Cultural Rights of 1966 [9] guarantees this right under its Article 13, which states that «higher educa-

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tion shall be made equally accessible to all, on the basis of capacity, by every appropriate means, and in particular by the progressive introduction of free education».

The European Higher Education Area is the objective of the Bologna Process [3], devoted, since 1999, to create more comparable, compatible and coherent education systems throughout Europe, based, among others, on the European Credit Transfer System – ECTS. In the EHEA frame, as an important instrument of the Bologna Process, the EU member states and the European Commission have in more recent years strengthened their political cooperation through the «Education and Training 2010» work programme [6]. The programme integrates previous actions including vocational education and training under the Copenhagen Process [7] and links up to the Bologna Process and contribute actively to the achievement of the Lisbon objectives [8].

The Higher Education institutions, to achieve the objectives above and to encourage cooperation between countries, may take part in a wide range of programmes, such as TEMPUS (Trans-European Mobility scheme for University Studies) programme [10], which supports the modernisation of higher education and creates an area of co-operation in countries surrounding the EU. Among the actions financed by the Tempus programme are the Joint Projects based on multilateral partnerships between higher education institutions in the EU and the partner countries. They can develop, modernise and disseminate new curricula, teaching methods or materials, boost a quality assurance culture, and modernise the management and governance of higher education institutions.

In the framework above, the technical and methodological aspects related to protect environment and to enhance natural resources, i.e. the sustainability of development and human presence in the environment, are of paramount importance.

Already in 1992 at the United Nations Conference on Environment and Development (UNCED), informally known as the «Earth Summit», held in Rio de Janeiro, Brazil, an international environment treaty was defined [11]. The UN sought to help Governments rethinking economic development and finding ways to halt the destruction of irreplaceable natural resources and pollution of the planet. Governments recognized the need to redirect international and national plans and policies to ensure that all economic decisions fully took into account any environmental impact. Among the highlighted guidance principles are the investigation of alternative sources of energy to replace the use of fossil fuels which are linked to global climate change and the greater awareness of and concern over the growing scarcity of water. The international environment treaty is nowadays known as the «Kyoto Protocol», initially adopted for use on 11 December 1997 in Kyoto, Japan but entered into force on 16

February 2005. It is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), and it is intended to achieve «stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system».

Environment is in brief, becoming a more and more relevant subject both at European and global level. Environmental policy is object of discussions, in different conferences and prime minister summits, and constitutes a priority of policy in an increasing number of countries.

The necessity to develop a new, modern, integral interdisciplinary undergraduate curriculum in environmental and natural resources engineering within the Higher Education System in FYR Macedonia has its starting point from the conditions described above.

2. The DEREC – TEMPUS Joint European Project

The TEMPUS Project JEP_19028_2004, entitled DEREC – *Development of Environmental and Resources Engineering Curriculum* [5] was aimed to establish a European Higher Education Area, i.e. to achieve the following objectives: (i) to develop a new three-years undergraduate curriculum in Environmental and Resources Engineering at the Ss. Cyril and Methodius University in Skopje, FYR Macedonia, based on the European Credit Transfer System and in accordance with the Bologna Declaration; (ii) to fulfil the necessary conditions for offering a Joint Degree Title in Environmental and Resources Engineering which is to be implemented on the basis of an agreement between the University Ss. Cyril and Methodius and the University of Florence [1][2].

In order to create an adequate support towards the fulfillment of the relevant objectives to the realisation of a coeherent European Higher Education Area and the achievement of expected outcomes, a Consortium was created. Within the «Education and Training 2010» TEMPUS Joint European Project, the Consortium is composed by six Universities, the Macedonian Ministry of Education and Science, and two individual experts, one from Bulgaria and one from Germany. Two Universities are from FYR Macedonia: Ss. Cyril and Methodius University, of Skopje, Grant Coordinator Institution, and South-East European University, of Tetovo. Four Universities are from the European Union: the University of Florence, Grantholder Institution, Aristotle University of Thessaloniki, Greece, Ruhr University Bochum, Germany, and Vienna University of Technology, Austria.

The implemented project, based on the Bologna Declaration, has contributed, to the reform of contents, teaching methodologies and the structure of the University studies in Environmental and Resources En-

gineering at the Ss. Cyril and Methodius University in Skopje, FYR Macedonia. Given, in fact, the background situation of FYR Macedonia, the introduction of a new curriculum in environmental and resources engineering has been relevant towards the discussion of important topics of the engineering education field. From one side, the project is relevant for the needs of reforms of FYR Macedonia being the first national project implemented according to the new necessities of the law for Higher Education in terms of multidisciplinary studies. From the other side, the environment and nature protection is a constitution category in FYR Macedonia, as the Government in this country recognizes their significance. The macedonian law on «Environment and Nature Protection and Improvement» (adopted in 1996), is the crucial frame, based on the right of each citizen to a healthy environment, as well as on the obligation to protect everything that exists in the environment.

In spite of the Governament efforts, to enhance the significance of the environmental issues, in 2004, at the beginning of the project [1], the higher education institutions in FYR Macedonia did not offer any integral environmental and resources engineering curriculum. Taking into account the environmental policy established and led by the corresponding Ministries in FYR Macedonia, in addition to the intentions to follow the guidelines of European Union in terms of higher education as well as environmental policy, the necessity of development of a new multidiscplinary and interdisciplinary undergraduate curriculum in environmental and resources engineering was highlihted.

3. Approach and Methodology

3.1 The school of engineering experience

At the School of Engineering of University of Florence exists since many years a group of researchers and teachers, committed to improve the environmental sustainability of projects, processes and services related to the different characteristics of engineering activities.

The education and training programmes are based on the definition of study paths, to answer to the necessity of specific competences dealing with the complexity of environment and anthropogenic activities interactions, devoted to analyze and evaluate the effects of these interactions, to understand the physical phenomena, to predict the consequences and to plan control, protection and mitigation interventions. Also environmental risks assessment, i.e. floods, droughts, earthquakes, wind, fire, and pollution, as well as a suitable exploitation of natural resources, i.e. water, air and soil, are the aspects that most influence the process of sustainable development of a modern society.

In the same field, research activity aims at developing new methods and technologies, in order to reduce the environmental impact of human activities and protect the environment, to deal with the sustainability of development. This includes, for example, water and soil protection expertises, waste treatment technologies, built environment assessment, mitigation and adaptation to climate change effects.

Since the academic year 1991-92, a unique cycle degree course of five years in *Environment and Territory Engineering*, was introduced. Two years later, in the academic year 1993-94, at the Prato campus (15-20 *km* from Florence), the University Diploma in *Environment and Resources Engineering* was activated.

In the framework of the Bologna Process, some years later, the Italian Ministry of Education gave indications to settle up a two cycles degree courses, a first cycle of three years and a second cycle of two years. With the academic year 2000-2001 and the entry into force of the Italian ministerial decree, D.M. 509/1999, a new first cycle degree course, three years long, in *Environment and Territory Engineering* was introduced in Florence and the Diploma active at the Prato campus, was transformed in a first cycle degree course in *Environment and Resources Engineering*. In natural connection to the two three-year degrees, a second cycle degree course of two years in *Engineering for the Environment and Territory Protection* was also established.

Afterwards, a new revision of the curricula (first and second cycle degree) started in 2007 due to important changes in the Italian law which regulates University Degree Courses, D.M. 270/2004, based on the experience of the first application of the Bologna process. According to this new law, the two first cycle degree courses above, in «Environmental Engineering», were merged in a single course, called *Engineering for the Environment, Resources and Territory* (IART – *Ingegneria per l'Ambiente, le Risorse ed il Territorio*).

The DEREC project implementation coincided with the revision of the educational offer at the School of Engineering of the University of Florence. Particularly, the minimum requirements of the Italian Ministry of Education, University and Research as well as the internal requirements of the School of Engineering – University of Florence and of the Degree Course Council, have been considered as landmarks also for the DEREC project (Tab. 1).

The revision of the curriculum was also attended by representatives of the labour market. Suggestions and guidance have been taken into account in the design of the new study programme.

3.2 The Environmental, Resources and Territory curriculum

The study curriculum in *Environmental, Resources and Territory Engineering*, running at the School of Engineering in Florence, has the objec-

Table 1. Minimum reference ECTS according to the Italian Minister Decree (DM270/2004) and ECTS range of the *Environmental, Resources and Territory Engineering* curriculum at the School of Engineering – University of Florence

EDUCATIONAL DISCIPLINES	Minimum reference ECTS	ECTS range
Basic knowledge activities:	*36*	*39-72*
Mathematics, Informatics and Statistics		21-39
Chemistry & Physics		18-33
Characteristic skills:	*45*	*57-90*
Civil Engineering		24-36
Environment and Territory Engineering		24-36
Security, Civil, Environmental and Territory Protection		9-18
Integrative activities	*18*	*18-42*
Student autonomous activities	*12*	*12-12*
Foreign language assessment		*3-3*
Final exam		*6-6*
Others (Stage, etc.)		*1-24*

tive to educate and train technicians, professional figures with specific competences on the sustainability of human presence on the territory. The graduate is a civil and environmental engineer with specific competences in evaluating the compatibility of resources management, productive processes and human activities development with natural resources enhancement and environment protection.

The graduates have suitable scientific basic knowledge and an adequate preparation on technical and scientific methods and contents of engineering. The engineer has specific capability of civil engineering, as well as of environmental and territory engineering. The most characteristic planning and design competences are integrated with the environment monitoring and protection, natural resources assessment and enhancement. The skills acquired are markedly interdisciplinary. The engineer is able to contain the impact of the designed interventions, processes and services. The expertise is focused on environmental sustainability and on developing specific knowledge about modern methods and technologies for monitoring and managing environmental systems, for analysis, assessment and management of interaction between human activities and natural resources. The curriculum also provides knowledge regarding legislative aspects and expected behaviour from a technician capable of undertaking responsibilities.

The professional is able to adequately answer the demand of technical innovative competences. The technician has specific synthetic capacity

and problem solving in the environmental field and is able to cooperate and coordinate with experts in specific fields. The engineer for the Environment, Resources and Territory, is responsible for analyzing and evaluating the effects of interactions between human activities and the environment, understand the key physical phenomena, predict the consequences and plan interventions dedicated to environment protection and impacts mitigation.

The educational programme is organized as follows. In the first year basic scientific disciplines, such as mathematics, physics and chemistry, and engineering oriented basic principles, i.e. informatics and statistics, and English language, are taught.

At the second year, characteristic civil and environmental engineering competences, such as fluid, solid and soil mechanics, as well as specific competences for physical phenomena identification, monitoring, description and analysis, are taught. During the second year the student can choose between a technical scientific (TS) programme and a technical professional (TP) programme. In the first one basic disciplines as mathematics and physics are deeply developed and it is aimed to students wishing to continue their studies towards a second cycle degree course. The second programme is intended for students who want to acquire technical skills and to directly participate in the labour market.

In the third year the programme is directly linked to specific learning objectives in the field of environmental protection and resources enhancement. It also provides a preparation aimed at acquiring technical competences to exploit the resources and ensure maximum compatibility with the environment. In addition, it allows students to use their expertise in a perspective of global environmental sustainable development.

For the students of the TP programme, a stage within public or private bodies is required and an amount of ECTS ranging from 6 up to 18 is devoted to the activities which can help the student entry the labour market. In this case the contribution from academic tutors and mainly external experts is foreseen and strongly necessary. The TS programme instead provides knowledge in assessment and modelling of environmental systems and elective courses aimed at providing interdisciplinary competences, with specific applications in the environmental field. In both the programmes, elective courses are foreseen to develop some specific environmental themes connected to the environmental conditions of the country, i.e. land degradation and conservation, air pollution control, management of natural resources, etc.

The engineer of the «technical professional profile» is in particular trained for a wide range of employment within public and private corporations and professional offices.

The graduate of the «technical scientific profile» has strong basic knowledge to continue the studies in the second cycle degree in *Engineering for the Environment and Territory Protection*, as well as other similar second cycle degrees in the same field. The graduates can complete their training with a master course.

3.3 The mutual recognition of degree titles

In the frame of the DEREC Project, the School of Engineering, University of Florence, presented the general requirements, i.e. minimum ECTS of the Italian Ministry of University and Research and local conditions of the School of Engineering and the Degree Course Council, to be met in order to fulfil the necessary conditions for offering a Joint Degree Title. This constituted the second main objective of the DEREC project, and had to be implemented on the basis of a specific agreement between the University of Florence and the Ss. Cyril and Methodius University, in Skopje.

For the mutual recognition of degree titles between the new IART curriculum in Florence and the curriculum designed in the frame of the DEREC project, some conditions have been fulfilled aimed:

- to ensure for the DEREC curriculum the compatibility with the minimum amount of ECTS required by the School of Engineering and the Degree Course Council;
- to make the first two years in the two curricula similar enough to allow equivalence, i.e. «aequipollentia»;
- to make the third year in the curricula significantly compatible, in order to allow student exchange in the respect of the Italian regulation and obtain the equivalence, i.e. «aequipollentia», for the selected students involved in the mobility activities.

Following the minimum requirements above, an agreement between the University of Florence and the Ss. Cyril and Methodius University in Skopje, for the definition of shared educational paths in study courses in the field of environmental, resources and territory engineering and for the mutual recognition of degree titles was defined and signed.

Beyond the administrative and sustainability issues, the agreement foresees that students involved in the mobility activities will acquire at the partner University at least 48 ECTS, previously approved by the relevant Degree Course of their home Institution. A further maximum of 12 ECTS may also be acquired for stage and/or final exam activities, on the basis of a study plan foreseeing also the remaining ECTS that students will acquire at their home Institution (Tab. 2).

Table 2. DEREC project student mobility programme

Year	University of Florence, Italy	University Ss. Cyril and Methodius, Skopje FYR Macedonia
1	Developed at local level – 60 ECTS	Developed at local level – 60 ECTS
2	Developed at local level – 60 ECTS	Developed at local level – 60 ECTS
3	1. The two lectures semester are spent in Skopje for at least 48 ECTS 2. The remaining part of the academic year (12 ECTS) will be dedicated to the stage period and final exam either in Florence or Skopje	1. The two lectures semester are spent in Florence for at least 48 ECTS 2. The remaining part of the academic year (12 ECTS) will be dedicated to the stage period and final exam either in Skopje or in Florence

4. Conclusions

In the framework of the European Higher Education Area (EHEA) a new undergraduate curriculum in «Environmental and Resources Engineering» at the Ss. Cyril and Methodius University of Skopje in FYR Macedonia has been developed.

The DEREC project implementation coincided with the revision of the educational offer at the School of Engineering of the University of Florence. In this framework the conditions for offering a joint degree title in the field of Environmental, Resources and Territory Engineering have been fulfilled. In particular at the moment being a shared educational programme has been defined between the two universities that led to the mutual recognition of degree titles.

The development of an integrated study programme, based on international cooperation at academic level, reinforced by the mobility of students and teachers, carried out through a multidisciplinary and interdisciplinary approach based on the Bologna process implementation was characterized by a reciprocal enrichment, in terms of innovative educational methods and opening of the international dimension of engineering education.

The European Commission welcomed this initiative with a very positive feedback considering it highly relevant for the reform needs of FYR Macedonia and high expectations were posed in the project since it is the first national project implemented according to the new requirements of the Higher Education.

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EUROPEAN CONSORTIUM APPROACH TO DEREC

THE CONTRIBUTION OF TEMPUS PROJECTS TO MUTUAL RECOGNITION OF ENGINEERING STUDY PROGRAMMES ACROSS EUROPE

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Abstract. Mutual recognition of the respective study programs is of paramount importance for the development of the European Higher Education Area, in particular in Engineering, given the relevance of this field for European economy. The TEMPUS Programme has been, and still is, instrumental to this goal, by studying the many challenges facing Higher Education institutions in this times of globalisation and strengthening cooperation in higher education between the EU and its partner countries. Politicians at European level have recognised that education and training are essential to the development and success of today's knowledge society and economy. The EU's strategy emphasises countries working together and learning from each other. This paper aims at presenting the main challenges the project Tempus DEREC had to face in the framework of the TEMPUS programme and how it contributed to promote mutual recognition of engineering study programmes within the partner countries universities.

1. *Background*

Tempus (Trans-European Mobility Scheme for University Studies) is one of a number of European Community programmes designed to help the process of social and economic reform and/or development in the EU partner countries. The partner countries currently included are the western Balkan Countries, the Eastern European and Central Asian countries and the Mediterranean Partners.

The Tempus Programme focuses on the development of the higher education systems in these countries through cooperation with institutions from the EU Member States.

The first Tempus Programme lasted from 1990 until 1994. The programme was consolidated and renewed for the 1994-1998 and 1998-2000 periods and, again, for the 2000-2006 period.

It has become customary to refer to these periods of the programme as «Tempus I», «Tempus II», «Tempus II bis» and «Tempus III» respectively.

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The new Member States, Bulgaria and Romania were amongst the first countries targeted by the programme and participated until 2000.

The first country to be involved in TEMPUS and which is still involved in TEMPUS III was Albania in 1992 as a Phare country, followed by the so-called Tacis region (Russian Federation, Western NIS, Caucasus and Central Asia) in 1994, the Former Yugoslav Republic of Macedonia and Bosnia-Herzegovina respectively in 1996 and 1997, the remaining Western Balkan, so-called CARDS8, countries in 2000 and 2001 and finally the Mediterranean (MEDA) partner countries joined in 2002.

TEMPUS is essentially a bottom-up programme, relying on responses to calls for proposals from Higher Education Institutions and their staff, and is also directed towards the achievement of concrete political goals. In broader terms, these are laid down in the agreements established between the Commission and the Partner Countries (Common Strategies, Partnership and Cooperation Agreements, Multi-annual Indicative Programmes, Annual Action Programmes).

In more specific terms, national priorities for projects are agreed between the Commission and each of the TEMPUS Partner Countries normally each year so that the programme can serve partner countries' higher education policy strategies. In addition, in the Western Balkan region in 2000 and 2001, regional Tempus priorities were also agreed upon in the framework of the Stability Pact and Graz Process.

This setting has lead to variations between the priorities of the CARDS, MEDA and TACIS regions, but certain common themes have nevertheless emerged clearly from the dialogue with the Partner Countries. The broader reform of higher education aiming at a knowledge based society, quality assurance, accreditation, the need to adapt Higher Education better to labour market needs and the Bologna Process are important across the board.The paper presents the expected outcomes and the achieved objectives, as well as the future perspective of the Joint European Project (JEP) TEMPUS DEREC (Development of Environmental and Resources Engineering Curriculum), with a TEMPUS reference number CD_JEP_19028_2004.

2. *The Framework: European strategy and co-operation in education and training*

EU education and training policy has been given added impetus since the adoption of the Lisbon Strategy[1] in 2000, the EU's overarching pro-

[1] The Lisbon Strategy, also known as the Lisbon Agenda or Lisbon Process, is an action and development plan for the European Union. Its aim is to make the EU «the

gramme focusing on growth and jobs. It underlines that knowledge, and the innovation it sparks, are the EU's most valuable assets, particularly as global competition becomes more intense in all sectors.

High quality pre-primary, primary, secondary, higher and vocational education and training remain as important as ever. But initial learning is not enough. People's skills must be constantly renewed to enable them to meet the challenges of ever-evolving technologies, increasing internationalisation and demographic changes. Nowadays, lifelong learning is key to jobs and growth, as well as to allow everyone the chance to participate fully in society.

EU member states and the European Commission have in recent years strengthened their political cooperation through the Education and Training 2010 work programme. The programme integrates previous actions in the fields of education and training at the European level, including vocational education and training under the Copenhagen Process, and links up to the Bologna Process, which is crucial in the development of the European Higher Education Area.

While vocational training had already been identified as an area of Community action in the Treaty of Rome in 1957, education was formally recognised as an area of European Union competency in the Maastricht Treaty establishing the European Community in 1992. The treaty states: «The Community shall contribute to the development of quality education by encouraging cooperation between member states and, if necessary, by supporting and supplementing their action, while fully respecting the responsibility of the member states for the content of teaching and the organisation of education systems and their cultural and linguistic diversity.»

Integrated study programmes have become a feature of European universities only in very recent times. Indeed, they date back to the action plan and measures adopted by the European Community in 1976. The Community granted financial aid to joint study programmes (JSP), whose objective was to strengthen collaboration among universities in different countries. From 1976 to 1984 the European Community financed 409 JSP. Italian universities participated in 73 projects, accounting for 18% of the total. In order to facilitate full participation of Italian universities, the national law in Italy was changed in 1980 opening the doors to integrated study programmes for universities and stimulating international bilateral and multilateral cooperation. With the implementation of the Bologna Process, from 1999 in Italy further international

most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010». It was set out by the European Council in Lisbon in March 2000.

agreements foreseeing also joint degrees (Agreement on University co-operation between Italy and France, Socrates/Erasmus Programme, Co supervision of doctoral theses, Italo-French University, Italo-German University) were established. Meanwhile, the Italian Government took some necessary steps for the internationalisation of the Italian University System and a significant number for integrated courses leading to joint or double degrees were funded.

3. The DEREC project

The DEREC project («Development of environmental and resources engineering curriculum», JEP_19028_2004) active in the period 2005-08 has surely contributed to the reform of content, teaching methodologies and the structure of the University studies in Environmental and Resources Engineering at the University Ss. Cyril and Methodius in Skopje, FYR Macedonia, in accordance with the Bologna Declaration. The main project result is in fact the development of a new, up-to-date, three-year undergraduate curriculum in Environmental and Resources Engineering at the University Ss. Cyril and Methodius in Skopje, based on the European Credit Transfer System and in accordance with the Bologna Declaration, aimed to establish a European Higher Education Area. This project has also explored the possibility to fulfil the conditions necessary for offering a Joint Degree Title in Environmental and Resources Engineering which is to be implemented jointly on the basis of an agreement between the Ss. Cyril and Methodius University and the University of Florence. In the partners' opinion this is to be considered among the most ambitious outcomes of the project and consquently great efforts have been devoted to this aspect.

It must be noted that significance of accreditation and the procedures for achieving it vary greatly from one European country to the other and joint titles are surely a useful tool to overcome difficulties related to the recognition of study programmes. Such differences lead to confusion in the mutual recognition of academic and professional qualifications: consequently, difficulties still remain in the mobility and trans-national acceptance of engineers (and other professionals), notwithstanding that since 1989 a European Directive should guarantee them, at least within the EU. To solve the aforementioned difficulties, it is necessary to reach a European-wide consensus on standards required for engineering educational programmes and on establishing a system for accrediting programmes, higher education institutions and graduates when such standards are achieved. Finally, given the background situation of FYR of Macedonia, it appears evident that the introduction of a new curriculum in environmental and resources engineering

could be considered relevant towards the discussion of hot topics with reference to the engineering education field.

4. Trends

The TEMPUS programme, with the support of the DG EAC of the European Commission, has contributed during all these years in many aspects of general interest for tertiary education: harmonising the studies, the development of life-long learning, the effective use of ICT, appraisal of the quality, accreditation, innovation of the learning methods, and last but not least, the birth of a network of institutions trusting each other. Such a solid cooperation framework is surely among the main outcomes of the DEREC project.

It is the firm opinion of the authors of this contribution that such a precious set of results must be exploited as fully as possible in the near future, by promoting new projects and/or the birth of European associations actively involving all stakeholders of EE, and committed to the enhancement of the European Higher Education Area, in particular in technology oriented fields. In fact, even if a lot has been achieved, the rapid evolution of our globalised economy presents new challenges continuously to European EE institutions, to be tackled with better and better tools.

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AUSTRIAN CONTRIBUTIONS TO THE WATER SECTOR AND THE ENVIRONMENTAL EDUCATION IN FYR MACEDONIA

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Abstract. The natural landscapes and the water sectors in Macedonia and in Austria comprise resemblance in many terms. Macedonia can benefit from the Austrian experience. Thus, and with regard to foreign investments in the country, the development of the environmental sector could be remarkably faster in Macedonia than it was the case in Middle Europe, if an adequate number of well-trained environmental experts make use of their knowledge in the country. Austrian experts in the water sector took part in projects which aimed to improve the environmental sector in Macedonia in terms of infrastructure and environmental education. The universities can play a key role as a platform for expertise in this field, as is shown with an Austrian example.

1. *Introduction*

The water sector in the FYR Macedonia can be compared to the situation in Austria, in various terms. Macedonia is a landlocked country; there are mountainous regions with rich and good quality water resources from springs and rivers, and lowlands with dry summer and rainy winter. The main part of the country contributes to one river basin, namely the Vardar River, which flows south into the Thermaic Gulf, a gulf of the Aegean Sea. The western part of the country contributes to the River Drim, which flows west through Albania and into the Adriatic Sea.

A remarkable part of the country is in the catchment of lakes situated on the boundary with neighboring countries, namely the shallow Lake Dojran in the southeastern part of the country, which is shared with Greece, the deep Lake Prespa, which is shared with Albania and Greece, and Lake Ohrid, which is shared with Albania. These lakes and the connected water bodies require special protection.

As compared to Austria, most of the country contributes to the River Danube basin. There is the shallow Lake Neusiedl in the dry eastern part of the country, which is shared with Hungary, the deep inland lakes in the Salzkammergut and Carinthia, and deep Lake Constance, which

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is shared with Switzerland and Germany. Also, there are Alpine regions in the western part of the country, rich with natural springs, and comparatively dry lowland in the eastern part of Austria.

But it is not only the natural landscapes and the characteristics of the water balances, which comprise resemblance between these two countries. Water supply is sufficient in terms of quantity and quality. This is especially the case for Skopje, which has a similar water supply like Vienna, namely karstic springs that can directly be fed to the distribution system with only safety chlorination but no additional treatment. Other parts of the country with less favorable water abundance are connected to drinking water mains which come from the mountains in the west. This applies for example for the area of Makedonski Brod and Prilep.

The development of the wastewater sector in Macedonia is quite similar to the situation in Austria, 30 to 40 years ago. There are a number of wastewater treatment plants, but the main cities like Skopje and Bitola still have no adequate wastewater treatment. There are some treatment plants in sensitive areas that were already built under the Yugoslav government. This applies for the treatment plants of Resen in the catchment of Lake Prespa, Ohrid-Struga for the Lake Ohrid area, Dojran for the catchment of Lake Dojran and Sveti Nikole as example for the dry eastern region of Macedonia with small receiving streams.

In Austria, only few biological wastewater treatment plants were operative in the 1960s. A high number of treatment plants with only carbon removal were built in the 1970s-1980s. It was only until the Water Law was amended in 1990, and new regulations for the quality of municipal and industrial effluents were decreed in the following years, that a practically full coverage of the country with state-of-the-art waste water treatment was achieved. However, a good water quality could only be reached, because enough well-trained water experts have been educated and made use of their professional knowledge. This refers to scientists, public officers, water board professionals, design and construction engineers, employees of construction companies and equipment suppliers, as well as the operating personnel of treatment plants themselves.

For the ongoing development of the water sector in Macedonia it makes sense to make use of the Austrian experiences in order to shift the environmental standards to the EU level. Thus, and with regard to foreign investments in the country, the development in Macedonia could be remarkably faster than it was the case in Middle Europe.

The treatment plant of Makedonski Brod can serve as an example for this development. The design and funding was a donation by the Austrian Development Agency (ADA), a legal body of the Republic of Austria. The construction of both, sewer and treatment plant, was performed by Macedonian companies under Austrian supervision. The training of the operators was in accordance with the Austrian practice, and the

operation was supported by Austrian experts physically and professionally, during the first years of operation. As a result of this approach, the treatment plant has been exhibiting an excellent performance for several years, which fully complies with the legal demands for sensitive areas in the European Union.

2. Transfer of the Austrian experience in the Water Sector to Macedonia – Successful Cooperations

2.1 Scenario for the development of the water sector in Macedonia

As described above there is a number of treatment plants existing in Macedonia, and many more will be constructed in the future. For the appropriate operation of those treatment plants skilled operators are essential in order to obtain optimal operation for the improvement of the water quality and to maintain these investments in the water sector in good condition. For this reason, an appropriate training program is necessary, in which academic staff and practical engineers should be involved.

For the improvement of the water sector in Macedonia, it is of utmost importance that both, the transfer of knowledge and engineering skills, are available in the country. This enables the development of an autonomous management of the water affairs, which is embedded in the local systems of natural resources, economical facilities and regional development.

An academic career in Environmental and Resources Engineering can provide the skills for the future demands of Macedonia in this respect. The university can serve as supplier for the academic training of the engineers as well as a platform for the knowledge transfer and exchange of experience for practitioners and public administrators.

2.2 DEREC – Development of Environmental and Resources Engineering Curriculum

The initiative taken by the University of Ss. Cyril and Methodius together with the Universities of Florence and Thessaloniki for the establishment of an academic curriculum for Environmental and Resources Engineering was an excellent step towards the above mentioned development scenario of the water sector in Macedonia.

In order to include the experience from other European countries in this respect, the Vienna University of Technology (VUT) was approached to participate in the development of this curriculum in the framework of the DEREC Tempus Project, especially because the Bologna process for university studies was already implemented in the curricula at VUT.

The Institute for Water Quality, Waste and Resources Management (IWAG) at VUT was asked to represent Austria in this project. The institute was founded in 1964 by the Faculty of Civil Engineering, and since then it has been participating in the civil engineering curriculum and in post graduate courses of environmental engineering, as well as in the development of the water sector in Austria.

The field of activity of the institute includes wastewater treatment of both, domestic and industrial sources, ranging from lab-scale experiments to one of the largest plants in Europe, namely the Main Treatment Plant of Vienna. With respect to industrial waste water, most industrial sectors important for Austria (pulp and paper, beet sugar, food, chemical industry, tannery, winery, etc.) were dealt with in research, design and consulting in practical operation.

Water pollution control has always been a main goal of the institute's activities, with a focus on river basin management in connection with the European Water Framework Directive during the last couple of years [1, 2]. The experience in the field of wastewater treatment was also used in the cooperation with the Austrian government in the development of legal requirements for domestic and industrial applications.

The transfer of knowledge is not only limited to the academic lectures, but ranges from the training of treatment plant operators [3] to the continuous knowledge transfer for practicing engineers and administrative staff from government, local authorities and water enterprises [4]. All these activities were the basis for the contributions to the DEREC curriculum, especially in the field of water & wastewater engineering and waste & resources management.

Documents could be handed over for the preparation of DEREC courses, which cover lectures at VUT as well as other material on:

- Ecology
- Chemistry and Biology of Water
- Water quality management
- Wastewater treatment
- Industrial wastewater treatment
- Sewerage and urban water management
- Course of WWTP operation (in Macedonian language) [5]
- Presentations for courses for treatment plant design and operation (in Macedonian language)
- Practical Handbook of Material Flow Analysis [6]

Visitors from University of Ss. Cyril & Methodius, Skopje, were invited to use the local library facilities, and to discuss with Austrian experts at the University of Technology, the University of Agriculture, and the Ministry of Agriculture, Forestry, Environment and Water Management.

Technical visits were arranged to:

- Vienna Main Wastewater Treatment Plant (4 million population equivalent)
- Moosbrunn water works (advanced oxidation with ozone, 80,000 m^3/d)
- Fernwärme Wien (hazardous waste and sludge incineration, 400,000 t/year)
- Freudenau Danube Hydraulic Power Plant (170 MW)
- Laboratories of VUT (Hydraulic Engineering, Construction materials, Technical Mechanics, Waste & Water Technology)

The project team met in Vienna in July 2008 on occasion of the final Quality Control Meeting of DEREC.

Figure 1. DEREC team at the Vienna Main Wastewater Treatment Plant, July 2008.

2.3 PISTUM – Consolidation of the Wastewater Sector in Macedonia

For the development of the water sector in Macedonia, the Austrian government financed the project «PISTUM» (1998-2007), a joint project between the Austrian engineering company BDL and IWAG. In the course of this project sewers and wastewater treatment plants were constructed and put into operation, namely Makedonski Brod Wastewater Treatment Plant (WWTP) and Krivogastani WWTP.

In addition, existing treatment plants with insufficient treatment performance were investigated and suggestions for improvement have been elaborated (WWTPs Sv. Nikole, Resen, Struga) and carried out in one of the plants.

Until 2003, there was no training program for treatment plant operation available in Macedonia and many of the existing treatment plants did not obtain their full treatment efficiency. The chief operator of Makedonski Brod WWTP, which was put into operation in 2000, was trained in Austria.

Figure 2. Aeration and sedimentation tanks at Makedonski Brod WWTP.

Figure 3. Announcement board at Krivogastani WWTP.

In the course of the PISTUM project, training courses for treatment plant operators and seminars on the technology of wastewater treatment were held by IWAG in Macedonia. A number of training courses were performed, and operators from all the operative treatment plants in Macedonia have been trained within the last years.

The following courses were held:

- 1st Basic Training of WWTP Operators. Makedonski Brod, June 2003.
- 2nd Basic Training of WWTP Operators. Makedonski Brod, March 2004.
- 1st Advanced Training Course for WWTP Operators. Dojran, June 2004.
- 2nd Advanced Training Course for WWTP Operators. Struga, November 2004.
- Basic Laboratory Course for WWTP Operators. Makedonski Brod, November 2007.

The intention of this program was not only to provide training for the operative personnel right now, but also to transfer the well established Austrian training program to be taken over by Macedonian wastewater professionals. However, the second aim has not been achieved yet since the cooperation between the Ministry of Environment and the prospective teaching personnel from the universities for such courses was not well established.

Figure 4. Practical teaching at Dojran WWTP, June 2004.

Figure 5. Participants of a Basic Training Course at an excursion to Struga WWTP, June 2003.

Figure 6. Distribution of the course certificates to the participants, June 2004.

Transfer of knowledge on a higher level was the aim of «Design Seminars» for practicing engineers, scientists, public officers, water board professionals, design and construction engineers, employees of construction companies and equipment suppliers. In the course of the PISTUM project, two design seminars were held in Skopje, under the auspices of the Ministry of Environment and Physical Planning:

- 1st Seminar on Principles of WWTP Design, May 2004, Skopje.
- 2nd Seminar on Principles of WWTP Design, September 2007, Skopje.

The intention of these seminars was to present the design principles for wastewater treatment plants, and also to create a platform for interdisciplinary cooperation and exchange of experiences between all the parties involved in the water sector.

Figure 7. Opening of the 1st «Design Seminar» in Skopje, May 2004. (From left to right: B. Nikolavcic/IWAG, interpreter, N. Matsché/IWAG, G. Wandl/IWAG, D. Matovski/ Deputy Minister of Environment and Physical Planning, interpreter, M. Tagasovska/ Fund for Environment)

3. Bringing together Universities, Ministry and Practice

From the experience in Austria it can be shown that with a rapid transfer of technological knowledge from the universities into practical solutions for environmental protection, like wastewater and waste treatment facilities, a fast improvement of the environment could be achieved. For the success of this transfer the cooperation with an efficient administrative agency was necessary to create the essential contacts. In Austria, the Austrian Water and Waste Association (ÖWAV) took over this task, during the PISTUM project this task was performed by the Macedonian Fund for Environment as part of the Ministry of Environment and Physical Planning.

With the installation of the university study in Environmental Engineering, both, the professors and the future graduates of this study, are invited to take over the technical knowledge transfer and serve as an in-

dependent source of expertise in the active cooperation between all the stakeholders in the environmental sector in Macedonia.

4. Summary

The successful procedure in solving the environmental problems in Austria can serve as an example for the approach to handle these problems in Macedonia. An essential prerequisite for this task is the existence of experts in environmental and resources technologies on all levels of responsibility. This ranges from the university professors to the on-site operators of environmental facilities.

With the installation of a university study in «Environmental and Resources Engineering» (DEREC) an important step was made towards this aim and to improve the expertise in this field in Macedonia.

Acknowledgments

The authors acknowledge with gratitude the Austrian Development Agency ADA for funding the project PISTUM, and the European Union for funding the project DEREC.

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MAPPING CURRENT AND FUTURE DEMANDS FOR MANAGEMENT OF NATURAL RESOURCES AND ENVIRONMENTAL ENGINEERING IN A COURSE CURRICULUM

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Abstract. Environmental protection and management of natural resources can be considered now – after a long debate – a top priority at the global level. Current environmental problems and modern approaches for growth and wealth have placed the environment in a central position. In this context, the approach to the education of environmental engineers has shifted to include more scientific fields than the traditional ones. This paper proposes a curriculum for a department of environmental engineering and natural resources management that corresponds to contemporary demands and requirements. The proposal was formalized during the project under the title «DEREC Tempus JEP – Development of Environmental and Resources Engineering Curriculum», where the authors have participated as members of a European research team with the task to develop such a curriculum. The paper presents the drivers and the requirements towards developing a modern curriculum concerning the environment, as well as, a specific proposal for a respective course. The aim is to identify and focus on the new perspectives in environmental engineering and management to address the modifications required in the traditional curricula towards educating a new generation of environmental engineers and managers.

1. *Introduction*

Sustainable development is, currently, the dominant framework of promoting growth and wealth in the globe. This framework consists of three pillars, namely the environment, the society, and the economy. All three of them are equally important and significant; hence, in the framework of planning development, a comprehensive and simultaneous consideration of the impact of proposed actions on these three fields is required. The notion of sustainable development has, particularly, changed the perception of the environment in the modern world. Traditionally, the environment has been perceived as an individual parameter of planning

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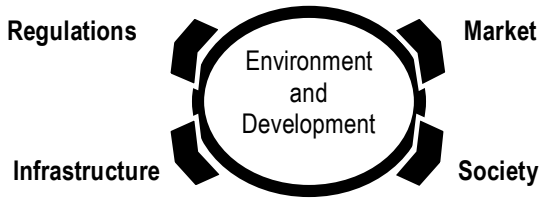
or a background of human activity that requires some treatment based on regulations. Under the sustainable development framework, the environment has become a basic constituent of growth and wealth. This new perception has raised a number of issues and complex dependencies that should be considered in environmental and natural resources management. Therefore, the next generation of environmental engineers should be capable of dealing with more tasks than assessing the environmental impact of certain human activities or technical projects. In the following sections, the environmental constituent of development is regarded in relation with the society and the economy and the new aspects in environmental engineering and management are highlighted. A proposal of a specific curriculum for environmental engineering is presented based on certain requirements, which are thoroughly explained.

2. The Environmental Dimension in Development

Fig. 1 presents graphically the interconnections of environment as a constituent for development with other important aspects of growth and wealth such as the society, the market, the infrastructure, and the regulatory and legal framework.

Figure 1. Major interconnections between the environment and other constituents of development and growth



The subsections that follow analyze these interconnections in more detail.

2.1 Environment and Regulations

Environmental regulations are now more or less incorporated in all national legal and regulatory frameworks. However, it is evident that the level of the sustainable development achieved is far from being satisfactory. Human activities, especially those related to the economy, involve excessive use of natural resources, which are critical for future develop-

ment, thus jeopardizing the ecological reserves and the strengths of the economy and the society. Remedial costs are often huge and therefore difficult for the society to afford. Therefore, there are strategies and policies at the international and global level that produce regulations aiming to prevent from unbalanced exploitation of natural resources and environmental reserves. Examples of such regulations are the principle of subsidiarity, the «polluters pay» principle and the regulations guiding the environmental impact assessments. These regulations:

- Form in a synergistic and comprehensive way a framework of environmental and natural resources protection.
- Set the bases to perceive the environment as a natural heritage that every human has rights on as well as responsibilities to preserve it for the next generations.
- Set the bases for coordinated action at national, international and global level between governments, industries, lobbies, non-governmental organizations (NGOs), and citizens as well.
- Describe the mechanisms with which responsibility for environmental protection is directly assigned to well-defined entities. Furthermore, they set the rules under which an entity that fails to fulfill its duty for environmental protection undertakes the cost for restoration of the natural environment and prevention from future damage.

The above prove that the environmental dimension is more and more incorporated in a more decisive and inclusive way in the regulatory framework that guides the development and the economy. Therefore, it is undoubted, that an environmental engineer needs to acquire a certain level of knowledge of the basic environmental principles, policies and strategies that guide the present and future environmental protection actions.

2.2 Environment and Infrastructure

Design, build and operation of infrastructure that responds to environmental concerns have a history of almost 40 years in the USA and Japan and 20 years in Europe. All types of infrastructure are subjected to an environmental impact assessment, which covers a long range of issues, e.g. from emissions to sound conditions. However, the interrelationship between infrastructure and the environment is increasingly becoming more firmly established. The significant difference is the incorporation of the holistic planning into the delivery of infrastructure. The «serial model» of infrastructure delivering, i.e. the construction of technical projects, which could act synergistically with already existing

infrastructure (e.g. a highway connection between a city and an airport), was actually putting limitations to environmental protection; the existing conditions had a drastic influence on the future steps. For example, the options for the construction of a highway connecting a city and an airport were actually limited due to morphological and other limitations. The environmental parameter was confined to the assessment of the environmental impact of the highway. Contrary, a holistic planning approach is one where all required technical works are seen from the planning phase as modules of a complex system; in this system the natural environment is an inherent feature that interacts with the infrastructure, which is now more than just a parameter of design. Perfect examples of this approach are the eco-cities that grow in several parts of the world (e.g. the eco-cities of Dongtan close to Shanghai, China and of Masdar in the United Arab Emirates). The approach of the holistic planning is also applicable to more conventional situations. For example, flood protection was traditionally treated by increasing the flow capacity of sewage networks; through the holistic planning approach the physical environment is used to preserve certain quantities of rainfall to the ground for plants irrigation, soil enrichment, etc. Therefore, an environmental engineer needs to get acquainted with the principles and tools of holistic planning and appraisal to be able to integrate environmental concerns and infrastructure delivery in a sustainable development framework.

2.3 Environment and Market

The increasing incorporation of the environmental concerns into the development and growth policies has led to a new economy sector, the environmental market. This sector is, currently, governed by regulations and not by demand, i.e. it is not the consumers that buy environmental products or services, but the regulatory system that dictates them on the industry and other economic activities. While, this is the major feature of the environmental market, it is not the only one. The environmental market presents:

1. Transitivity. Due to changing environmental regulations and technological evolution there is a wide field for economic activities that allows a transition between different fields through innovation and change of methodologies.
2. Dynamic competition. Business units with activity in the environmental market sector are mostly branches of larger organizations with main fields of interest, which are directly related to the environment (e.g. construction, chemical, energy companies). Therefore, the environmental market is dynamically linked to other market sectors and its evolution is governed by dependencies formed between markets.

3. Internationalization. The trend to decide and adopt environmental policies and tools at a global level and gradually apply them at the local level has enabled the establishment of international organizations that provide particular services internationally (e.g. collection and disposal of toxic wastes).

The environmental market includes services on the fields of remediation, pollution control, waste management (disposal, recycle and reuse), industrial and toxic waste management (collection and disposal), and control of sources of pollution (green technology).

The environmental market is expected to become a major driver of the economy in the near future. Traditional approaches to everyday leaving will be gradually replaced by environmental ones due to the existing environmental problems (e.g. climate change, less energy reserves, degradation, etc.) that have a direct and negative impact on the economy. Therefore, the definite demand for environmental solutions will lead to new innovative products and services, new employment opportunities, new technologies, etc. A modern environmental engineer must understand the environmental market and get as much as possible of an insight to it, in order to be able to produce services and products for a future that will be much different than the past.

2.4 Environment and Society

The natural environment and its protection and preservation are, also, an issue of social awareness and consciousness. However, both of them are hard to achieve. For a large part of the globe, environmental protection and preservation is not yet considered as fundamental and significant as human life, protection of property, or right to education. Unfortunately, it is only recently and after the obvious and adverse effects due to the climate change that there is a growing motivation of the people with regard to environmental issues. Social awareness and consciousness require:

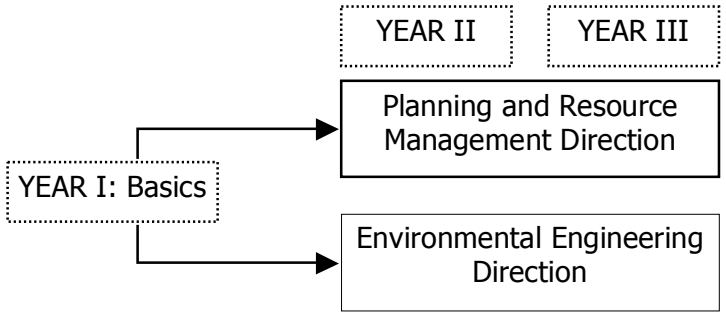
1. Interventions in the regulatory framework. Imposing new rules and regulations and monitoring their implementation and effect are such interventions.
2. Motivation and persuasion. Attracting interest of the people on environmental problems and provoke reactions are essential for a shifting towards a more environmentally friendly society.
3. Environmentally oriented education. Education at all levels should incorporate in an emphatic way the importance of the environment to the human growth and propose and analyze strategies, policies, and tools for environmental protection and preservation.

Environmental engineers can be major contributors to the raising of social awareness and consciousness on environmental issues and problems.

3. *Structure of a curriculum for environmental engineering and natural resources management*

A curriculum that can provide an environmental engineer with the necessary knowledge background to be able to cope with traditional and modern environmental issues consists of many courses. Therefore, with regard to the structure of such a curriculum there is an important limitation that needs to be confronted, i.e the inclusion of a large number of courses in a time period of three years, which is the first cycle of higher education based on the «Bologna process». To address this limitation and provide with an effective solution, an internal split of the curriculum into two distinct parts is proposed. As presented in Fig. 2, a first year is required for basic knowledge that is necessary prior to dealing with more specific environmental issues. For the second and third year the curriculum splits into two directions, namely the «Planning and Resource Management Direction» and the «Environmental Engineering Direction». In this way the same curriculum provides environmental engineers with different skills and capabilities; on one hand there are the planners, the policy makers and the consultants, while on the other hand there are the technical experts and the on site practitioners.

Figure 2. A proposal for the structure of a curriculum for environmental engineering and natural resources management



The curriculum in more details is presented in Tab. 1. This table presents all the courses considered as necessary to address satisfactorily

both, the traditional, as well as, those environmental issues discussed in Section 2. The total number of the courses leading to a degree of environmental engineering is 35, while a semester of practical training and another one for the preparation of a degree thesis are also included. The titles of the proposed courses provide with an indication of the expected content, while an analytical presentation of the latter is beyond the scope of this paper.

Table 1. A detailed proposal for a curriculum for environmental engineering and natural resources management.

Year One: Basic Knowledge		
	SEMESTER I	SEMESTER II
1	Mathematics I	Mathematics II
2	Physics I	Physics II
3	Environmental chemistry – biochemistry and microbiology	Environmental Technology
4	Statistics I	Statistics II
5	Programming and computer applications I	Programming and computer applications II
6	Global and national environmental policies and strategies	Natural resources and sustainable development
7	Global and national environmental legal framework	Acquisition, elaboration and management of environmental data
	Year Two: Planning and Resource Management Direction	Year Two: Environmental Engineering Direction
	SEMESTER III	
1	Environmental impact assessment and management	Mathematical models in environmental engineering
2	Environmental economics	Systems analysis and risk analysis
3	Acquisition of environmental data based on statistical methods	Fundamentals in soil mechanics
4	Decision making and risk analysis I	Fundamentals in fluid mechanics / hydrology
5	Water resources management	Transport phenomena and thermodynamics
6	Land resources management	Engineering economics
7	Air resources management	Construction and environmental engineering
	SEMESTER IV	
1	Environmental protection techniques	Design and construction of water treatment facilities
2	Energy design considerations in urban planning	Design and construction of waste water treatment facilities

(continued)

3	Acquisition of environmental data based on GIS/phorogrammetry	Design and construction of solid wastes treatment facilities
4	Decision making and risk analysis II	Environmental geotechnics I
5	Solid and water wastes treatment and management methods	Natural risks management
6	Environmental geology	Environmental impact measurement tools and techniques I
7	Software applications in environmental protection and design	Mechanical process engineering
	Year Three: Planning and Resource Management Direction	Year Three: Environmental Engineering Direction
	SEMESTER V	
1	Protection and use of underground water resources	Protection and use of underground water resources
2	Transportation environmental policies	Environmental roads design
3	Environmental geotechnics	Environmental geotechnics II
4	Urban planning and sustainable development	Environmental impact measurement tools and techniques II
5	Industrial wastes management	Plant safety design
6	Solar energy use in buildings	Energy process engineering
7	Renewable energy sources	Renewable energy sources
	SEMESTER VI	
1	Practical training	
2	Diploma Thesis	

4. Discussion

A modern and scientifically sustainable curriculum on environmental engineering and natural resources management must be oriented towards a holistic treatment of the environment issue. This means to:

- Integrate environmental engineering and natural resources management.
- Provide, simultaneously, the graduates with soft and hard skills.
- Generate environmental professionals with expertise either on planning or acting.

Due to the requirement of a three-year first phase of higher education according to the «Bologna process», it is not possible for a syllabus to include all the required knowledge for a modern environmental engineer. Therefore, in order to preserve coherence and achieve well-defined goals towards the generation of environmental engineers through education, it is essential to develop a mechanism that responds to criti-

cal limitations and requirements. The curriculum proposed in this paper is such an effort. It aims at preparing environmental engineers with both theoretic and practical knowledge that will be able to implement national strategies on environmental issues. Such a curriculum may also assist national environmental agencies and organizations that will be manned with the appropriate type of environmental engineer (i.e. planner or practitioner) according to needs.

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STUDY COURSES IN CIVIL AND ENVIRONMENTAL ENGINEERING AT BOCHUM: CHANCES FOR TEACHING COOPERATION AND STUDENT EXCHANGE

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Abstract. The newly installed bachelor study course «Environmental Engineering and Management of Resources» at the Ss. Cyril and Methodius University, Skopje, is embedded into the education system of equivalent study courses at many other European universities. Respective study courses at bachelor, master, or the still existing diploma levels are active since many years e.g. at the DEREC partner universities at Bochum, Florence, Thessaloniki and Vienna. The paper deals with the specific situation at the Ruhr-University Bochum, where a bachelor program in Environmental Engineering was started in 2007/2008, and an English-speaking master course «Computational Engineering» with related content is running. Topics of study are evaluated which are suitable choices to start a teaching cooperation and a student exchange. Relevant formal requirements, conditions and structures are listed and considered for a successful cooperation in future. First steps to start a possible cooperation with a student exchange are proposed.

1. Related study courses at the Ruhr-University Bochum

1.1 Environmental Engineering

Since 2000, under the responsibility of the Faculties of Civil and Mechanical Engineering, a diploma course «Environmental Engineering and Management of Resources» is running at the Ruhr-University Bochum. On 2007/2008 a bachelor program of 6 semesters including a bachelor's thesis was started with the following main subjects:

1. Water management and hydrology
2. Urban water management
3. Waste water management
4. Ecology
5. Civil Constructions
6. Constructions of traffic streets

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7. Geotechnics and soil mechanics
8. Technical Microbiology
9. Materials
10. Energy management
11. Process management
12. Management of resources
13. Plant constructions and machinery
14. Heat and material transfer
15. Measurements and control
16. Fluid energy machinery
17. Environmental chemistry

The 4 semester master course is scheduled to start in autumn 2009 focusing on:

1. Processes and products,
2. Energy and economy,
3. Infrastructure and traffic,
4. Water and soil,
5. Environmental techniques/Planning,

A registration for the diploma course is not possible anymore.

The education is organized by the Faculty of Civil and Environmental Engineering and conducted together with the Faculty of Mechanical Engineering. Basic topics are contributed by the Faculty of Mathematics and Faculty of Geography.

1.2 Computational Engineering

Since the last two decades the field of Computational Engineering is becoming of increasing importance in science and high-tech industrial applications. In many branches, e.g. software companies and development departments in the manufacturing industry there is an increasing demand for engineers who are educated in the field of engineering, computational science and mathematics. Computational Engineering enables the creation of scalable digital models to support research, development, design, construction, evaluation, production, and operation of engineering applications. It allows optimal strategies to be found, which address key issues in future technical developments for the economy and society, in the areas such as energy, health, safety, mobility and environment.

In the year 2000, the Department of Civil Engineering of the Ruhr-University Bochum initialized the Master of Science program «Computational Engineering» with English as the language of instruction. The

study is designed to educate engineers who have the capacibility of carrying out simulations and evaluating them. Furthermore they will be equipped with the necessary fundamental knowledge in natural sciences, engineering and mathematics in order to analyze results and to discover mistakes in the simulation algorithm or the mathematical model.

2. Study topics for a teaching cooperation

2.1 Short description of the «Environmental Engineering and Management of Resources» bachelor program curriculum at Bochum

In the curriculum of the bachelor program in «Environmental Engineering and Management of Resources» at Bochum, 15 compulsory and 22 optional compulsory courses are offered. In order to achieve the title «Bachelor of Science» students must complete 180 credits from the compulsory and selective courses, a bachelor thesis, and work on projects. As prerequisite for admission, 10 weeks practical work is obligatory, which has a possibility to be fulfilled also during the study period, until the 6th semester at latest.

2.2 Short description of the curriculum of the master program «Computational Engineering» at Bochum

«Computational Engineering» initiates every winter term and takes four semesters (2 years). During the first three semesters the students complete several compulsory and elective courses. Tab. 2 shows the main subjects of the curriculum of «Computational Engineering».

Students attending this course have a chance to deepen their competences in a special direction they are most interested in. In the second and third semester they have the possibility to choose subjects out of diverse selectable courses. Furthermore, the writing of two case studies is recommended in a subject the students are interested in. The compulsory optional courses can be chosen within the fields of: construction, material modeling, numerical methods, fluid and environmental engineering or dynamics. The students decide by themselves how many optional courses they will take in order to complete a minimum of 90 credit points after three semesters.

The 4th semester of the program is dedicated to the Master's thesis. Students have the possibility to either write their Master's thesis in an academic environment at various university departments or in the industry if they are supported by a tutor who is a lecturer within the master program. The contributing lecturers have numerous connections to

Table 1. Study plan of the bachelor studies «Environmental Engineering and Management of Resources», EEMR, at the Ruhr-University Bochum.

EEMR Bachelor	Semester L+E [HWS]						Semester L+E [CP]					
	1	2	3	4	5	6	1	2	3	4	5	6
Modules I												
Mathematics A	6						9					
Mathematics B		6						9				
Numerics			3						4			
Informatics in engineering		4						5				
Mechanics A	6						9					
Mechanics B		6						9				
Fluid Mechanics			4						5			
Modules II												
Chemistry	3	3					4	3				
Physics	3						3					
Urban water management				3						4		
Technical microbiology		3						4				
Environmental chemistry	1	3	4				1	4	5			
Constructions	4						5					
Economics						3						4
Laws						2						2
Work on project												
Bachelor Thesis												12
Modules III Soft Skills (Optional)												
Languages offered at RUB												
Other optional topic (after reference list)												
Stay abroad												
Reference list												
Modules IVa Sustainable process and environmental techniques												
Thermodynamics				6						9		
Materials			3	3					3	3		
Energy management				4						6		
Energy techniques					4						6	
Process techniques					4						6	
Installations and apparatus					4						6	
Heat and material transfer					4						6	
Measurements and control			2	4					3	5		
Fluid energy machines					4						6	
Elektrotechnics			3						4			
Laboratory						2						2
Modulus IVb Environmental techniques and planning												
Urban water management					6						9	

(continued)

EEMR Bachelor	Semester L+E [HWS]						Semester L+E [CP]					
	1	2	3	4	5	6	1	2	3	4	5	6
Materials			4						5			
Static and theory of structures			4	3					4	4		
Concrete structures				4						5		
Steel structures				4						5		
Physics					4						4	
Geotechnics and soil mechanics				3	3					3	5	
Planning and methods of transport					3						4	
Construction of routes of transport					2						3	
Hydrology and water management			2	3					3	4		
Environment and ecology						2						2
Building and operation methods					2						3	
Project «Water and environment»											2	

«L» – lectures, «E» -exercises / «HWS» – Hours Weekly pro Semester / «CP» – Credit Points

Table 2. Curriculum of the master program «Computational Engineering» at the Faculty of Civil and Environmental Engineering at the Ruhr-University Bochum.

Module	Type	S	CP
Mathematical Aspects of Differential Equations and Numerical Methods	C	1	6
Mechanics of Solids	C	1	6
Computer-oriented Design of Steel Structures	C	1	6
Modern Programming Concepts in Engineering	C	1	6
Finite Element Methods in Linear Structural Mechanics	C	1	6
Fluid Mechanics	C	2	6
Continuum Mechanics	C	2	6
Fundamentals of Active Structural Control	C	2	6
Tensor Theory in Mechanics and Engineering	O	1	5
Concrete Engineering and Design	O	2	6
Theory of Plasticity	O	2	5
Advanced Finite Element Methods	O	2	6
FEM for Nonlinear Analyses of Inelastic Materials and Structures	O	2	4
Numerical Simulation in Tunnelling	O	2	1
Finite Element Technology	O	2	3
Computational Elasticity and Viscoelasticity	O	3	3
Computational Modelling of Subsurface Transport Processes	O	2	5
Environmental Modelling	O	2	4

(continued)

Module	Type	S	CP
Fundamentals and Implementation of High-order Finite Element Methods	O	2	5
Object-oriented Modelling & Implementation of Structural Analysis Software	O	2	3
Computational Plasticity	O	2	3
Safety and Reliability of Engineering Structures	O	3	5
Design optimization	O	3	6
Parallel Computing	O	3	4
Computational Combustion	O	3	5
Dynamic of Structures	O	3	6
Earthquake Engineering and Engineering Seismology	O	3	4
Adaptive Finite Element Methods	O	3	6
Computational Fluid Dynamics	O	2	6
Fracture and Damage Mechanics	O	2	4
Numerical Methods in Dynamics	O	3	6
Advanced Control Methods for Adaptive Mechanical Systems	O	3	5
Training of Competences – Part 1	O	1	5
Training of Competences – Part 2	O	2	4
Case Study	O	2,3	3
Master Thesis	C	2	30

Type: «C» – compulsory, «O» optional / «S» – Semester / «CP» – Credit Points

industry and support can be offered for students to find a suitable company. After completion of the program, the Ruhr-University awards the title «Master of Science (M.Sc.)» to the successful candidates.

The master program in general is embedded into a strong research environment with an excellent international reputation. Especially in the second year students work side by side with university scientists and have the opportunity to acquire unique insight and experience concerning scientific methodology. Graduates are therefore offered positions at other academic institutions or high-tech companies on a regular basis. The scientific education provides all the requirements necessary for pursuing an academic career as well as the knowledge required for rapid advancement in an industrial environment.

2.3 Identification of topics for a student exchange

Scheduled courses at the «Environmental Engineering and Resources Management» studies at Skopje and Bochum have many connecting points. The flexibility of the selection of courses gives a good possibil-

ity for a student exchange in both directions. Although the structures of the studies are almost identical one can find subjects of interest which are not included in both programs. Good example are the courses «Geographical information systems», «Decision making and risk analysis for sustainable development» and «Land degradation and conservation» offered in Skopje and on the other side a big number of topics in Bochum which can be in the field of interest for the students from Macedonia. The subject «Fluid Mechanics» should be underlined as example, because within its program atmospheric wind is also considered, which not the case in Macedonia is, and there is an open possibility for taking part at experiments in the wind tunnel.

Students from the University Ss. Cyril and Methodius can complete the sixth semester in Bochum, collecting credits and knowledge in the special topics, improving language skills and getting practical experience. Students from Ruhr University during their stay in Macedonia can fulfill the requirement for practical experience, work on projects in the region and attend the courses in which they have interest.

Another good reason for visiting the Ruhr-University is the international master course «Computational Engineering» which contains a variety of courses in the fields of construction, material modeling, numerical methods, fluid and environmental engineering, seismicity or dynamics. Students are free to choose some of the listed topics and get precious knowledge required for innovative design and analysis of high-tech engineering systems and materials.

3. Study conditions and requirements

3.1 Entering requirements

The language of instruction at the bachelor course «Environmental Engineering and Resources Management» in Bochum is German. Even though knowledge of German language is not an entering condition, students must be able to understand the lectures and successfully pass the final examinations. The school leaving certificate which is accepted in Macedonia as adequate for entering at the University is recognized also in Germany.

All courses at the master program «Computational Engineering» are taught in English. Therefore the students need to proof that they have a sufficient knowledge of the English language. As this course is highly selective (800 applications at the year 2008 and 31 enrollments) and projected for students with bachelor degree, only well prepared students from basic studies can be recommended to attend some of the courses from the curriculum.

3.2 Study conditions

Guest students can spend one study term plus one examination period at the Ruhr-University. Case studies, at own choices, can be done simultaneously during the stay in Germany or later on, by correspondence at the home university.

Living expenses in Bochum are approximately 650€ per month in total. Guest students do not have to pay tuition fees. The Academic Support Group, AKAFÖ, offers apartments and rooms from 160€ to 300€ per month.

Students allowed to spend a period abroad have the possibility to apply for a scholarship at some of the supporting agencies as DAAD or Erasmus (in future).

3.3 Recognition of credits

In order to give a free way for going abroad and transfer the knowledge, authorities from the partner universities must find agreement about recognizing the credits obtained from other university. From the curricula it can be seen that for some courses not the same number of credits is granted. For example, the course in Fluid mechanics receives at Skopje 7 credits, at «Computational Engineering» it has 6 credits and at EEMR at Bochum it receives 5 credits. Our proposal to bridge over this difference is to conduct an additionally case study for 1 or 2 points in order to allow for 7 credits.

4. Conclusion

During the last years study programs in the area of environmental engineering have been developed and successfully installed at many European universities.

Significant parallelism e.g. between the new bachelor program at the Ss. Cyril and Methodius University and accredited running course at the Ruhr-University Bochum can be used to initiate soon a cooperation between the study programs through an exchange of teachers. Thus, specific competencies of the participating chairs can be incorporated bilaterally into the education of the courses and increase the offer for interesting study topics at relatively low costs for time and effort. One example upon many others is the occasion to implement a block course on «Environmental Wind Engineering» at the study program at Skopje. An adequate teaching contribution of the Ss. Cyril and Methodius University to the bachelor or master program at Bochum can surely be found. Evidence

of such possibilities can clearly be observed at the ongoing teaching co-operation between the master program «Computational Engineering» at Bochum and the Institute for Earthquake Engineering and Engineering Seismology, IZIIS, at Skopje from which a block course on «Earthquake Engineering and Engineering Seismology» including related examination is regularly contributed.

The embedding of the European study programs into the European Credit Transfer System, ECTS, allows as well for an international student exchange between these study programs. Initially, priority for the choices for the attendance of exchange students can be given for optional courses and projects or study cases. But also compulsory courses can be chosen, as at least at the Ruhr-University certain basic courses are also taught in English language. One example is explained in this contribution.

Further information

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MANAGING THE DEREC PROJECT

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Abstract. The management of European projects implies some duties both towards the European Commission (such as project reporting, financial and administrative management, administrative tasks) as well as towards all involved partners (scientific co-ordination of the activities, establishment of co-operation agreements, acquirement of the equipment procedure, dissemination of project results). This paper has the aim to report some of the co-ordination and management activities carried out in the frame of the TEMPUS Project «DEREC Development of Environmental and Resources Engineering Curriculum» by the Grantholder Institution, the University of Florence, School of Engineering.

1. *Introduction*

The TEMPUS Project «DEREC-Development of Resources Engineering Curriculum» allowed the achievement of important goals.

In this paper, starting from the framework of the TEMPUS Programme, the role of the University of Florence as DEREC Grantholder Institution in some project activities, has been described. Particularly, the co-ordination of scientific activities, the legal and administrative procedure followed by the University of Florence to acquire the DEREC Equipment, the project reporting to the European Commission and the project dissemination have been analysed.

2. *The TEMPUS programme and the DEREC Project*

The Tempus Programme [3] (Trans-European Mobility Scheme for University Studies) supports the modernisation of higher education and creates an area of co-operation in countries surrounding the EU. Established in 1990 after the fall of the Berlin Wall, the scheme now covers 27 countries in the Western Balkans, Eastern Europe and Central Asia, North Africa and the Middle East.

It strengthens cooperation in higher education between the European Union and its partner countries from the Western Balkans, Eastern Europe and Central Asia, the Mediterranean region and enhances under-

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standing between cultures, it promotes the *people to people* approach: its added value lies in its promotion of international and regional co-operation, which generates better communication and new networks of personal and professional contacts between the academic world of the EU and the partner countries. The programme is designed to support the *transition and modernisation processes* in higher education through a range of interventions. It is a key instrument to consolidate the objectives pursued by the new financial instruments for the delivery of external assistance. In addition to «people to people» academic cooperation, Tempus aims at having an impact on higher education policies, and closely following national higher education priorities.

In this framework, the TEMPUS JEP DEREC Project has been launched [4]. It had the aim to increase cooperation and network-building between actors in higher education in EU Member States and partner countries, and helped the higher education sector to spread its knowledge outside academic institutions by developing an environmental and resources engineering curriculum at the Ss. Cyril and Methodius University in Skopje, FYR of Macedonia [4].

3. Co-ordination of Project Scientific Activities

The main activity carried out by the University of Florence, as Grantholder Institution of the TEMPUS DEREC Project, was the co-ordination of the project scientific activities, particularly the definition of shared educational paths in study courses in the field of environmental, resources and territory engineering.

This led to the mutual recognition of degree titles and the signature of the agreement between the University of Florence and the Ss. Cyril and Methodius University in Skopje. This agreement for the release of an «equivalent title», on the basis of a mutually acknowledged study path, will allow the selected students involved in the mobility activities of the Degree Course in Environmental and Resources Engineering at the Ss. Cyril and Methodius University in Skopje to obtain a title which is fully equivalent to the one awarded to students of the Degree Course of Environmental, Resources and Territory Engineering at the University of Florence and vice versa. This process represents a first step towards the definition of a future joint title degree.Some additional co-ordinated activities can be identified in the academic visits of professors from the University Ss. Cyril and Methodius in Skopje and the South East University in Tetovo to the European Union consortium member institutions.

Following the training and retraining visits, the DEREC courses contents have been elaborated and the educational material has been produced by the involved professors.

During the 3 years of project, 32 teaching staff (professors, assistants with teaching tasks, etc.) from the Universities in the Partner Country were trained and retrained with the tutorial and expertise of the European Union consortium member institutions (the Ruhr University Bochum in Germany, the Aristotle University Thessaloniki in Greece, the Vienna University of Technology in Austria and the University of Florence in Italy).

At the University of Florence the content of the following courses has been discussed and elaborated: Informatics and Data Engineering, Information Systems Analysis and Design, Energy and Environment, Solid Mechanics, Hydrology and Hydraulic Structures, Geographic Information Systems, Structural Engineering, Optimization Methods in Environmental Engineering.

Some contributions were also related to the on-line platform for course management and delivery (GECO system in the Prato Campus of the University of Florence) <http://www.pin.unifi.it/>.

Additional activities co-ordinated by the University of Florence were also the implementation of the procedure towards the library agreement between the University of Florence and the Ss. Cyril and Methodius University in Skopje that was signed by the relevant persons of the libraries of the two Universities and it will enable the students of the two Universities to share their Libraries Services (Bibliographic Databases: Compendex, ENGnet-BASE, Scirus, INSPEC, ICONDA, Interlibrary Loans, Document Delivery & Electronic Copy of Books, Journal Articles, Use of CD-ROM Databases, Direct Online Access to international information services, use of Gabriel- World Wide Web Service for Europe's National Libraries, etc.). The Libraries will be used as logistic support to the academic staff of the DEREC project, providing all necessary library information (books, articles, conference proceedings, workshop proceedings, seminar reports, etc.).

A survey of existing library agreements at the University of Florence and a deep consultancy with the University library staff of both Universities were carried out to establish the possible agreement conditions which have been included in the final document. The agreement among the two Universities foresees a free documents delivery and interlibrary loan.

In order to extend the library co-operation to all Consortium Member Institutions, the agreement template has been sent to all DEREC Partners, in order to establish similar agreements with the University Ss. Cyril and Methodius in Skopje in the future.

4. The Acquirement of the basic Equipment for the Curriculum

The activities foreseen to reach this goal and the work plan were set during the DEREC Workshop held in at the Ss. Cyril and Methodius University in Skopje in May 2007 and agreed among all partners.

During the DEREC Workshop in May 2007 an *ad hoc* jury made up by representatives of all Consortium Institutions as well as the external experts was nominated to evaluate the equipment specification.

The jury was made up by the following persons: A. Tuneski Faculty of Mechanical Engineering, Z. Srbinoski Faculty of Civil Engineering, D. Davcev Faculty of Electrical Engineering and Information Technologies, University Ss. Cyril and Methodius; D. Angelides Faculty of Civil Engineering, Aristotle University of Thessaloniki; N. Matsché Institute for Water Quality, Vienna University of Technology; R. Hoeffer, Aerodynamics and Fluid Mechanics, Ruhr University Bochum, E. Caporali and C. Borri School of Engineering, University of Florence.

All members of the above mentioned jury co-operated in the preparation of the specification of the DEREC Equipment.

In September 2007 the DEREC Grant Co-ordinator, after consultancy with the appointed project equipment jury, sent to the DEREC Grantholder the specification of the DEREC equipment on the basis of the partner country needs and the requisites of the Curriculum. This specification was elaborated by the Partner Country Co-ordinator and his team after different meetings and consultation with the relevant representatives of all Faculties at the Ss. Cyril and Methodius University in Skopje. The specified equipment included the following items: Handheld Water Quality Meters for Field Work, Ultrasonic Flowmeter, Hyperspectral Process Photometer, Data Acquisition System, Laboratory Measurement Equipment, Soil Analysis Kits, GPS – Global Positioning Unit, Zeta-Meter, Informatics Equipment.

The equipment was specified in one unique lot and the estimated price of each single item was included. The equipment specification process, already started at the beginning of 2007, was finalized in September 2007. The equipment specification was able to guarantee the quality and characteristic of the goods according to the needs of the new 3 year ECTS based curriculum. This enabled the Grantholder Institution to better verify and check equipment specification with all project consortium member institutions and guarantee the equipment quality and characteristics taking into account the partner country needs as well as the project aims and objectives.

The University of Florence and the University Ss. Cyril and Methodius verified the procedures to be followed to prepare the tender documentation for ordering the DEREC equipment in order to get modern, up-to-date equipment with excellent performances for the best possible price. After comparing the different procedures to prepare the tender documentation and after some consultations and meetings, it was agreed among all partners, to acquire the Equipment for the University Ss. Cyril and Methodius through an European and Italian open call for tenders published at national and European level.

This procedure was not only agreed among all partners while preparing the project proposal, but also met the financial and legal requirements of the University of Florence and the Partner Country Institution.

Tender documents (open call preparation, open call publication as well as the selection of the equipment suppliers according to the call indications) were prepared and published at European level by the International Relations Office at the University of Florence. The contract was finally awarded according to the lowest obtained discount offered from participating companies/firms/societies on the total amount of equipment set in the Grant Agreement. Costs of transportation, installation were on the suppliers own charge. According the present Italian and European regulations, the call announcement was published on 24.09.2007 on the European Official Journal at <http://ted.europa.eu/>, open call documents were available also on the DEREC official web site <http://www.derec.ukim.edu.mk/> and on the web site of the University of Florence <http://www.unifi.it/>.

All tender documents (call, application form, equipment specification) were published in Italian language (European Directive 18/2004; Italian Decree 163/06).

The call was open for suppliers until November 15th, 2007. A technical commission at the University of Florence, made up by one Full Professor and two administrative staff of the School of Engineering, University of Florence has been nominated by the Dean of the School, in order to evaluate the offers. The commission met on November 29th, 2007 to evaluate the offers from a legal and administrative point of view. The received offers were positively evaluated and the validity and regularity of administrative documents were checked.

The company «ECM Eco Monitoring a.s. (Bratislava)» was selected as awardee of the contract. Some translated documents were additionally required to the Company. After receipt of integrative documents, on January 2008 the call has been finally awarded to ECM Eco Monitoring a.s. Bratislava who offered a percentage of discount of 1,40% on the total sum of the call.

The administrative and financial offices of the University of Florence according to Italian, International and Internal procedures approved the final award of the contract. The contract was signed at the University of Florence on April 28th, 2008.

Following the signature of the contract, on September 22th, 2008 the equipment, as specified in the call and contract documents, was delivered and installed at the Ss. Cyril and Methodius University in Skopje at the Faculty of Mechanical Engineering as a coordinating institution of the DEREC project.

An *ad hoc* commission in charge to test the DEREC equipment was nominated by the Dean of the School of Mechanical Engineering at the Ss. Cyril and Methodius University in Skopje.

The equipment was checked by the representatives from the University Ss. Cyril and Methodius and the ECM ECO Monitoring a.s., Slovakia, in the period October 2nd – November 24th 2008.

According to the testing documents delivered by the University Ss. Cyril and Methodius to the University of Florence, the equipment was complete, delivered without any damage and in accordance to the contract signed between University of Florence, Italy, and ECM ECO Monitoring a.s., Slovakia. All equipment units were started up, put into operation and verified by the staff from the University Ss. Cyril and Methodius. ECO Monitoring a.s. provided all necessary support and advice in the procedure of the DEREC equipment testing.

The open call procedure guaranteed that the contract was awarded to the bid offering best value for money and in observation of the principles of transparency and equal treatment of potential contractors avoiding any conflict of intereSs. All interested companies at international level had the possibility to participate in the call and the final delivery, installation and technical assistance on the purchased equipment were guaranteed.

These mandatory steps had to be accomplished according to the internal rules of the University of Florence and the Italian national regulations about open call procedures. The winning company has been previously informed about the procedures to be accomplished by the University of Florence in order to get the contract signed and the call awarded.

This process, although cumbersome and time demanding, played a very important role to guarantee that the delivered equipment corresponded to the specification in terms of quality, completeness and technical characteristics and to the needs of Partner Country Institution.

5. Project Reporting to the Commission

Among the activities carried out by the Grantholder of the Project, beyond the participation and co-ordination of all activities in order to reach the proposed outcomes in strict co-operation with the Co-ordinating Institution, were the project action implementation and financial reporting on activities to the European Commission according to the conditions, dates and deadlines stipulated in the grant agreement.

Reports include detailed description of action's implementation, statistics and indicators, table of achieved/planned outcomes, summary report for publication, financial statement.

The reports on the DEREC Projects, prepared by the project grantholder and grantcoordinator, with the contribution of all partners, were sent to the relevant office of the European Commission in January 2006, March 2007, October 2007 and March 2008, the final report is to be delivered in February 2009 after the end of the Project eligibility period.

The approval of the project progress reports from the European Commission was accompanied by punctual observations and suggestions as well as enthusiasm on the future activities. Particularly, the reply letter to the last progress report submitted in March 2008, states that it was «highly appreciated that the accreditation process has been completed» It was also noted «the progress on the delivery of a joint degree with the University of Florence» and congratulations were expressed for «extensive cooperation between the two universities which has been fundamental for these developments». Comments from the European Commission on the Project reports were discussed and shared with all Project Partners on the occasion of the Quality Control Meetings of the Project held at the Ruhr University Bochum in November 2006, at the Aristotle University Thessaloniki in September 2007 and at the Vienna University of Technology in July 2008.

6. Project Dissemination

The DEREC Project has been disseminated and spread among partner universities, university professors, teaching staff and students in all possible occasions.

Different meetings were held at the University of Florence during the project lifetime in the frame of the academic council of the school of engineering, of the degree courses of Environmental and Resources Engineering and Environmental and Territory Engineering to present the DEREC objectives, action implementation status, future initiatives as well as sustainability measures.

Furthermore, publications on the project activities are available in the Proceedings of the SEFI Annual conference held in Ankara (Turkey) in September 2005 [1], and SEFI IGIP Annual Conference held in Miskolc (Hungary) in July 2007 [2].

The DEREC Project was also presented and disseminated by the Academic staff of the University of Florence in a series of national and international meetings such as: the XVII AIMeTA congress on Theoretical and Applied Mechanics held at the University of Florence in September 2005; the First Dean Convention on Present and Future Challenges for Engineering Education and Research in Europe held at the University of Florence in November 2005; the AMHY FRIEND annual meetings held at University of Calabria in the years 2007 and 2008; the conference: «Education and Profession of Italian Engineers: Quality and Accreditation in Comparison with European Partners» held at the University of Florence in May 2008, the DEREC Project final event held at the University of Florence in October 2008 and opened to a large public from all over Europe, the European Geoscience General Assembly in April

2008; the «Northern Europe Friend and AMHY, joint Low Flow and Drought meeting» held in November 2008 and the University of Bratislava; the first German – South East European Conference on Civil and Environmental Engineering Sciences – SCEES Conference. held in December 2008 at the Ruhr University Bochum.

7. *Conclusion*

The Management of an European Project implies duties both towards the European Commission, the partner country institutions and all involved project partners. In this framework, a series of activities carried out by the University of Florence, School of Engineering in the frame of the TEMPUS JEP PROJECT DEREC Development of Environmental and Resources Engineering Curriculum have been analyzed and specified.

The academic co-ordination of project activities of all involved Institutions, the development of co-operation among institutions, the procedure to acquire the DEREC equipment, the project dissemination as well as the administrative and financial management and reporting are some of them.

Managing the DEREC Project revealed a very interesting and challenging experience, with the result of full achievement of objectives and outcomes thanks to a very good and fruitful co-operation and atmosphere among all project partners.

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ENVIRONMENTAL AND RESOURCES ENGINEERING: DEVELOPMENT OF A STUDY COURSE AT THE SS. CYRIL AND METHODIUS UNIVERSITY IN SKOPJE WITH UNIVERSITY PARTNERS IN TETOVO (SEE), FLORENCE, BOCHUM, THESSALONIKI AND VIENNA

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Abstract. This contribution gives a personal opinion of one of the «DEREC-experts» on the importance of the development of the study course *Environmental and Resources Engineering* obtained during the DEREC meetings (start-up meeting, workshops, quality control meetings).

1. *General remarks*

Environmental consideration and management of resources has become one of the central issues in education and production in our time. The growth of population and a life style with high consumption of a multitude of goods uses more and more of the limited resources of our earth and litters the land, intoxicates rivers, groundwater and oceans and spoils the air. The effects of the humane behavior are often a result of very complex processes and can not be seen immediately. In addition the processes are interdisciplinary in nature. In order to understand their interaction a broad and correct knowledge has to be spread not only in the societies of the industrialized countries but actually in all countries around the world.

A good example of the development of an environmental problem is the automobile. An own car creates for his owner a before unthinkable freedom. Instead of living in a crowded city one can live in thee green unspoiled country site and communicate to the job in the city. Vacation areas like mountain resorts and sea sides can be reached with the whole family in short time even if these are hundreds of kilometers away. And if we believe the advertisements of the sellers we learn that a new car on the freeway with unlimited speed gives us freedom, pleasure and, indeed, is the essence of life. And because many people believe not reflected these promises the car producers fulfill their wishes and produce world wide cars. Volkswagen alone produced 6.2 million vehicles in 2007, this

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makes about 17 000 vehicles per day. And because the car owners even for the shortest distances want to enjoy the promised pleasure the cars inundate the cities. They block the streets, they park on pedestrian side walks and the exhaust of their engines pollutes the air. This development can be seen in Skopje and in other cities around the globe.

Figure 1. Car parking in a not «defended» area, here a sidewalk in a city in South Eastern Europe.

2. *Need of Environmental and Resources Engineering*

The living standard, as we define it, is strongly connected to material goods and material production. Industrial production and consumption of natural resources increase if the living standard is to be raised. To protect the environment the best and most modern technologies should be used to reach this goal. Such a decision is often only taken reluctantly in developing countries. In the early 80- ties I had the chance to visit Shanghai. The economic growth could bee seen everywhere: high rise buildings, personal cars and lots of smoking chimneys – which made breathing tiring. It looked liked the pictures of the German city of Essen in the midst of the 19th century when the industrialization in Germany started and a high chimney with a lot of smoke was the proud of the fabric owner.

But in the more than 150 years since then new technologies have been developed. I pointed out to my colleagues from Shanghai Tong Ji University that for the health of the people and the protection of the environment the industrialization has to go hand in hand with the introduction and use of the most modern ecological and sustainable technologies. Their answer was, at that time, that firstly the investment had

to go into production. Ecological considerations could be considered later. The wrong priority of this approach could be seen by the world during the Olympic Games this summer in Beijing.

That the protection of our environment is of utmost importance we see and hear in the daily news, in the statements of far looking scientists, in the new advertisements of the producing industry. Also architects and artists, among others, are engaged in environmental and resources engineering: Not far from our venue, in Venice, the 11th Architecture Biennale, with the topic «Architecture Beyond Buildings», shows new methods of decentralized energy production and effective energy conservation. The Italian economist Jeremy Rifkin who wants to create together with architects the 3rd economic revolution states there that buildings use the most energy, before the production of meat at 2nd and traffic at 3rd place; that they are responsible for 30 to 40 per cent of the carbon dioxide emission. And the Polish artist Kobas Laksa shows in the Polish pavilion in a collage his vision of Warszawa if we continue our life unchanged.

Figure 2. Collage of the vision of Polish artist Kobas Laksa of Warszawa if we continue our life unchanged (part of a triptych: photomontage of the Marina Mokotów, exhibition Hotel Polonia, "The Alterlife of Buildings" at the Polonia Pavilion in Venice, from 11th International Architecture Exhibition in Venice, 2008, photo courtesy of Zachęta National Gallery of Art).

What a challenge for our students! What a chance for interdisciplinary teaching for us professors!

According to my understanding a study course in Environmental Engineering can not be seen isolated. The base of environmental conscious-

ness has to be laid in the family and in the primary and secondary school. There the general understanding and hard facts based on natural sciences have to be introduced. And the society and the political establishments have to show the high priority of ecology and environmental protection. The ban of the overwhelming use of plastic bags, introduced by the Macedonian Government on January 2009, is an example. If the society understands that ecology and the protection of the environment is a highly important issue then also the best students will enroll in the study courses of Environmental and Resources Engineering. And one should not be afraid if the number of enrolled students is small. Quality is important not quantity.

3. International Cooperation

The partners of the Joint European Project *Environmental and Resources Engineering* are the Ss. Cyril and Methodius University, the South-Eastern European University in Skopje and the EU-Universities in Bochum, Florence, Thessaloniki and Vienna. The university partners in Western Europe have several years of experience in developing and teaching courses in Environmental Engineering and are willing to share their knowledge and there study material with the Macedonian newcomer in this field. In addition the University of Florence offers to strive with Skopje for a common study course leading finally to a double or joint degree. The project partners agreed to develop together in English language a course which contains the best of the lecture material developed so far in the partner's courses and also are willing to share their libraries with the universities in Skopje. And the two universities in Skopje added an impressive part to the lecture material in Distance Education and Data Visualization.

4. Conclusion

With the developed study material Skopje can present to their students a first cycle of environmental studies which may get ahead of those of the contributing partners. And the contributing partners may receive back newly produced modules to incorporate them into their own courses. The joint degree with Florence and even more the quality of the course will attract students also from outside of Macedonia for an education which will be recognized in the South-Eastern and Western European countries.

I congratulate all participating partners, and specially those in Macedonia, that they succeeded to start in October 2008 – according to plan – with the study course at the Ss. Cyril and Methodius University Skopje and I wish the first dozen of students pleasure and success in their studies.

NEW ENVIRONMENTAL CURRICULUM IN A COUNTRY IN TRANSITION: CHALLENGES AND CHANCES

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Abstract. The author has been invited to participate as an individual, external expert in the DEREC TEMPUS Project CD_JEP_19028_2004 (2005-2008), aiming at 1) the development of a new, up-to-date, three-year undergraduate curriculum in Environmental and Resources Engineering at the University Ss. Cyril and Methodius in Skopje, FYROM (hereafter Republic of Macedonia) on the European Credit Transfer System and in accordance with the Bologna Process, aimed to establish a European Higher Education Area 2) the fulfillment of the conditions necessary for offering a Joint Degree Program in Environmental and Resources Engineering which is to be implemented jointly on the basis of an agreement between the University Ss. Cyril and Methodius and the University of Florence.
The author's position and high appreciations have been expressed in the external expert reports related to the DEREC Project. The purpose of this article is to emphasize the challenges and chances for the new environmental curriculum in the specific conditions of a country in transition as Republic of Macedonia can be qualified at present.

1. *Country in transition*

The term «country in transition» is usually associated to countries which economy changes from a centrally planned economy to a free market. Transition process is usually characterized by the changing and creating of institutions, particularly private enterprises; changes in the role of the state, thereby, the creation of fundamentally different governmental institutions and the promotion of private-owned enterprises, markets and independent financial institutions. It is obvious the transition in a broad sense implies:

- liberalizing economic activity, prices, and market operations, along with reallocating resources to their most efficient use;
- developing indirect, market-oriented instruments for macroeconomic stabilization;

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- achieving effective enterprise management and economic efficiency, usually through privatization;
- imposing hard budget constraints, which provides incentives to improve efficiency;
  and
- establishing an institutional and legal framework to secure property rights, the rule of law, and transparent market-entry regulations [1].

All these processes have a strong social and political impact and influence all society's aspects, including education and environmental protection. The particularities and consequences of the transition period can be observed in a full scale in the Republic of Macedonia.

2. *Legal environment and nature protection framework*

The Republic of Macedonia is a member of the UN. The commitment of the country to the United Nations Framework Convention on Climate Change is expressed on many levels: strategic, legislative, institutional, technical and, of course, under cooperation on bilateral, regional and global levels.

The country, as a candidate (since December 2005) for full membership in the EU, bases its policy in environmental protection and harmonizes it with the general policies on European Union level. The Law on Environment and Nature Protection and Promotion (adopted since 1996) has provided the basic legal framework of environmental protection and introduced the basic instruments of environment and nature protection and improvement. The Law defines the rights and responsibilities of legal entities and natural persons in the areas of environment and nature protection and improvement; the development of planning documents in the area of environment, such as the National Environmental Action Plan and Local Environmental Action Plans and stipulates the protection control mechanisms. In the last years, four more laws have been adopted: Law on Environment, Law on ambient air quality, Law on Nature Protection, Law on Waste Management [2].

As a conclusion, today, in Republic of Macedonia there is a willingness to treat environmental issues as an integral part of the overall strategy for economic and social development during the transition to a market economy.

3. *Need of qualified engineers of environmental protection and resources management*

The ambitious goals require adequate society's response. An immutable part of this response is to provide qualified professionals. Although

the country has a large number of highly educated and skilled specialists with large experience in the different fields of environmental protection, at the present moment the higher education institutions in Republic of Macedonia do not offer any integral environmental and resources engineering curriculum [2]. There are some higher education environmental and resources engineering courses covered by the corresponding Faculties, but the complexity of environmental issues demands an interdisciplinary and integral approach. The experience of other countries in transition, close to Republic of Macedonia in geographical, economical, but mostly in historical and social sense, like Bulgaria, shows a significant lack of such complex specialists – planning actors and acting experts on the field of environmental engineering and resources management. Many of the environmental projects have been hindered not because of the investments, but because of unqualified staff.

Without underestimating the role of other specialists in the environmental protection such as jurists, economists, etc., the role of engineers is the fundamental one, because engineers are professional problem-solvers. Environmental engineering is the application of science and engineering principles to improve the environment (air, water, and/or land resources), to provide healthy water, air, and land for human habitation and for other organisms, and to remediate polluted sites. Environmental engineering involves water and air pollution control, recycling, waste disposal, and public health issues as well as a knowledge of environmental engineering law. It also includes studies on the environmental impact of proposed construction projects.

Environmental engineers conduct hazardous-waste management studies to evaluate the significance of such hazards, advise on treatment and containment, and develop regulations to prevent mishaps. Environmental engineers also design municipal water supply and industrial wastewater treatment systems as well as being concerned with local and worldwide environmental issues such as the effects of acid rain, ozone depletion, water pollution and air pollution from automobile exhausts and industrial sources [3].

Taking into account the actual environmental policy established and led by the corresponding Ministries in Republic of Macedonia, as well as its intention for closer association to the EU, it can be stated that there is a necessity of development of a new, modern, integral interdisciplinary undergraduate curriculum in environmental and natural resources engineering [2].

4. Challenges and chances

In many countries of transition, the market liberalization has been pursued by a «boom» of higher education establishments. However, very

often some of these establishments were «empty» in terms of academic capabilities, but dressed in attractive denominations, for others the sustainability of education has not been ensured, and thus a kind of mistrust to the new curricula has been created.

In Republic of Macedonia the higher levels of education can be obtained at one of the four state universities: Ss. Cyril and Methodius University in Skopje, St. Clement of Ohrid University of Bitola, State University of Tetovo and Goce Delchev University of Shtip. There are a number of private university institutions, such as the European University, Slavic University in Sveti Nikole, the South East European University and others.

The chance of the new Environmental and Resources Engineering Curriculum to overcome the mistrust of the society, including future students and employers, consists in the fact it has been introduced within the highly reputed university of Republic of Macedonia – Ss. Cyril and Methodius in Skopje. During the workshop held in Ohrid in April 2008, the academic staff involved has demonstrated not only its professionalism and high quality of educational materials, but also a strong personal motivation to create a new curriculum, contributing to the sustainable development of Republic of Macedonia.

The Curriculum has successfully passed all criteria for state academic accreditation. Moreover, the Curriculum has been established in the framework of the DEREC Project, with the participation of many experts from five European Universities: University of Florence-Italy, Aristotle University of Thessaloniki- Greece, Vienna University of Technology-Austria, Ruhr University of Bochum- Germany and University of Architecture, Civil Engineering and Geodesy, Sofia- Bulgaria. The input of South-East European University, Tetovo should also be recognized. The best practices of the foreign universities have been discussed and introduced in the Curriculum. At the same time, the Curriculum is taking into consideration the particularities of the country in terms of environmental problems and labour market needs.

The new curriculum has been created in a very contemporary way, including Web based course management system and e-learning adapted education materials. The new learning environments, methods and procedures are more efficient in the educational process and they are better suited to the students' needs.

One of the advantages of the Curriculum is the existence of bilingual (English and Macedonian) educational materials for the curriculum courses. The students will be able to work in an international environment, as the majority of environmental protection projects are during the EU pre-accession period.

One of the biggest difficulties experienced by the universities in a country in transition is the lack of finance for modernization of the facilities and the equipment. Usually the government is aware of the di-

rect relation between the quality of the higher education and the quick development of the country in both economical and social aspects. However, the country in transition faces very important economical problems and although the higher education policy is well defined on papers, very few, or insufficient governmental efforts are directed to help the higher education system. The government is hidden behind the autonomy of universities.

That's why a next advantage of the Curriculum is the possibility for students to use the facilities of the main technical faculties of the University. Moreover, a new laboratory, research field instrumentation and audio-visual equipment, as well as dedicated software packages have been acquired.

Last but not least, the Environmental and Resources Engineering Curriculum is well placed in the logics of the Macedonian educational system. It creates a strong basis for master degree studies in other engineering fields, for example civil engineering.

5. Conclusions and recommendations

One condition to keep the Curriculum attractive is to keep it «alive» by giving the possibility to update and to modify in order to meet the needs of the Macedonian's labour market. During the 3rd year of studies, the students could choose some elective courses according to their interests and career's opportunities. These elective courses could be amended by some additional disciplines. As stated before, the engineers are problems solvers, and this happens when the problems appear. However, very often the problems can be avoided when some decisions/policy are taken/made at the right moment. For this option some disciplines as «Urban planning» and «Sustainable Development» could be recommended as a basis of the integral knowledge to deal with the environmental issues. Moreover, for the time being there is no higher education degree in urban planning at the Faculty of Architecture.

A systematic interaction with the labour market will also increase the possibilities of training offers for students during their education and for their future employment.

As a conclusion, in the case of the new Environmental and Resources Engineering curriculum the adjective «new» is far from describing «unfamiliar» or «unaccustomed». The new Curriculum should be considered as supplementing the existing education, as constituting a revived, different, improved, and more advanced form of answering to the Macedonian society needs in the field of environmental protection and management of resources.

The trans-disciplinary approach of the Curriculum in the field of Environmental protection and resources management could effectively

contribute to the elaboration of long-term educational programmes in FYR of Macedonia and neighbour countries.

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TOWARDS A NEW CURRICULUM: DEFINITION, APPROACH, COURSE CONTENTS AND DEGREE TITLE, EVALUATION

ACCREDITATION OF THE DEREC STUDY PROGRAM AT SS. CYRIL AND METHODIUS UNIVERSITY

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Abstract. In this paper the procedure for accreditation defined by Macedonian Low for Higher Education as a tool for assuring the quality of higher education in the country is presented. Then the University bodies and mechanisms they use for ensuring the quality of the Study Programs are described. The steps performed towards accreditation the DEREC Study Program at Ss. Cyril and Methodius University, Skopje are also given.

1. *Macedonian National Quality Assurance System*

The main feature of national quality assurance system is existence of two bodies; Accreditation and Evaluation Board (Fig. 1). Licensing/accreditation is performed by the Accreditation Board that is an independent body. The constitutive session of the Board is convened by the Minister in charge of higher education affairs. The members of the Board are independent in their work, and they adopt decisions within their jurisdiction on the basis of expertise and competency.

Within its rights and duties, the Board: determines whether, by the project on the establishing of a higher education institution and the relevant documentation submitted, requirements have been met regarding the higher education activity performing; decides on the accreditation of a scientific institution wishing to perform postgraduate and doctoral studies; determines whether the higher education institution fulfils the conditions for organizing new study programs and determines the capacity for studying at the higher education institutions; licenses study programs; keeps records on higher education institutions it has decided to have licensed and for the other licenses; and performs other tasks provided for by the Law.

The Board notifies the Minister in charge of higher education matters on licensing activities done and on other matters as well as when it considers necessary.

The Board establishes expert commissions to which it specifies the competencies in the accreditation. In particular, the work, the manner

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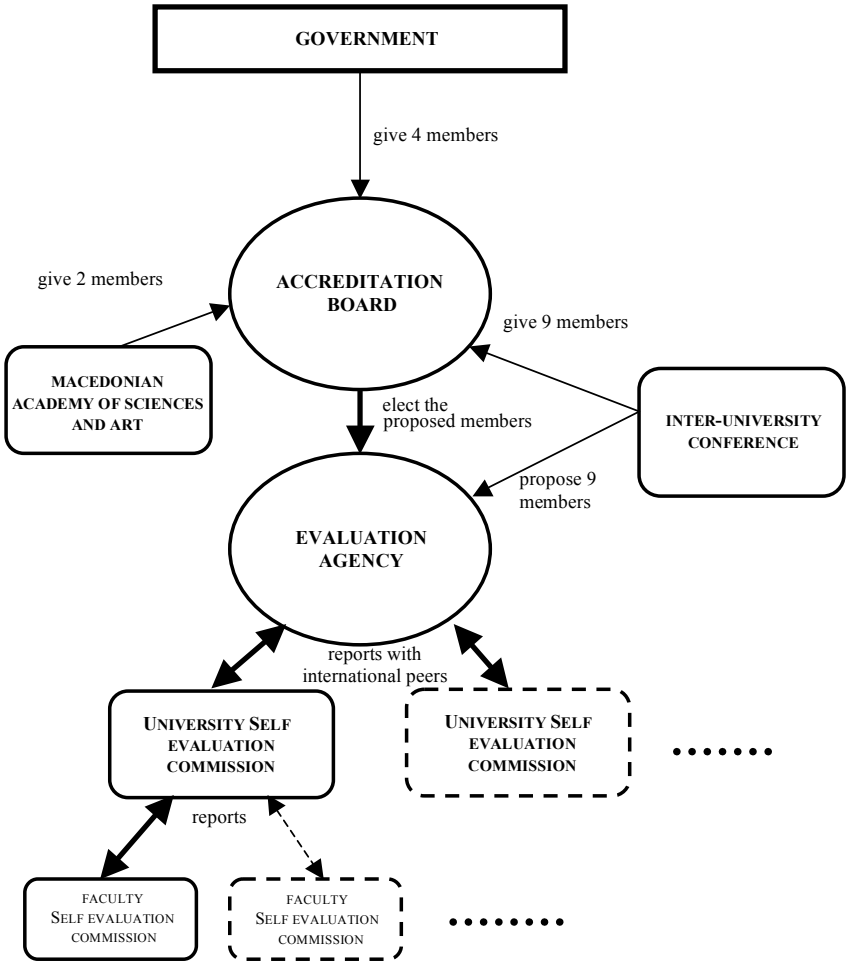
of decision-making, the accreditation and evaluation methodologies and procedures and other matters are regulated by the Rules of Procedure. The manner in which the expert, administrative and financial works are performed is regulated by an Agreement between the Board and the Ministry in charge of higher education matters.

Funds needed for the operation of the Board are provided from the Budget of the Republic of Macedonia with a special budget item.

Evaluation of Higher Education Institutions is performed by means of evaluation methods such as self evaluation, (directed towards monitoring and analysis of the HEI, study programs, study and subject courses of

Figure 1. Chart of Macedonian Quality Assurance System.



under and post graduate studies, teaching and assistant staff, teaching and learning activities, students, facilities and material resources, logistics, external co-operation, scientific and research activity and financing). After conducting of self-evaluation the Evaluation Commission writes a report. The self-evaluation report is submitted to the Evaluation Agency that shall initiate the external evaluation procedure. The expert Commission (if possible inclusion of foreign expert) create an opinion regarding the quality of HEI and the study programs, respecting the self evaluation report ant the discussions realized directly by the commission members. The External evaluation report is submitted to the HEI evaluated, and after its comments and opinions on the report, the same is adopted by the Evaluation Agency. After its adoption, the report is submitted to the Board of Accreditation, the Government and the National Assembly.

Both accreditation and evaluation bodies are members of the network of Central and Eastern European Quality Assurance Agencies in Higher Education since its establishment 2001.

2. Quality assurance system at Ss. Cyril and Methodius University

2.1 Measures for quality assurance / evaluation

Within the overall changes at the Ss. Cyril and Methodius University (UCM), special attention was dedicated to the activities for assessment, assurance and improvement of the quality in the high education, as part of the European program for institutional evaluation.

Following the directions for self-assessment and for preparation of report on self-assessment determined by the European Association of Universities, a working team has been established for its preparation and construction. The report for self-assessment of the University is a response to the legislation, and it represents a critical analysis of its work. It provides a complete picture of the state at the UCM, in its every part they are realistically and critically shown and it represents a firm basis for projecting the future strategic objectives for the development of the University. Following its verification by the University Senate Evaluation Commission, a procedure was conducted, which enabled the UCM to be included in the Program of the European Association of Universities (EAU) for external evaluation.

In accordance with the documents and the established practice of the EAU for evaluation of the universities, the external evaluation of the UCM was conducted by an expert team assigned by the European Association of Universities, and it was handled in two phases, preliminary and main visit of the team.

The main visit, as the last phase of the external evaluation, was finished with a report on the external evaluation of the UCM, performed by the

expert team, which was orally presented in front of the university staff and the general public in Macedonia, and its final version in written form was delivered after a few months. It is significant to emphasize that the expert team did not have any remarks concerning the Report on self-assessment of the UCM, which was assessed as a realistic and self-critical one.

Following the transparency principles, the Report on self-assessment and the report on the external evaluation of the UCM are available on its internet web-site, in Macedonian and in English.

In addition, in the last period, the process of self-assessment has been finished on all Faculties, whereas external evaluation organized by the Agency for evaluation has been conducted at 6 Faculties.

It is significant that in these processes a European approach towards valorization and quality accomplishment was introduced, and a personal and specific Macedonian model of evaluation was elaborated, with prepared and written documents for procedures, protocol, inquiries, conversations, creating reports on self-assessment and external evaluation. A mechanism for continuous improvement of the high education quality in Macedonia has been built and institutionalized. It remains for the Ministry of Education and Science and the academic environment to obey the established standards and criteria, and implement them in practice in all high education institutions in the country.

The external evaluation assessments up to present state that the Faculties possess well-educated academic staff, although insufficient in number; well-profiled study programs of graduate and post-graduate studies; they are open for international co-operation with presence of great enthusiasm for work, acceptance and implementation of the Bologna Declaration simultaneously with all other European Universities, etc.

In addition, it has been stated that the age structure of the academic staff is adverse, with relatively small number of young recruit, with insufficient practice in the teaching process, insufficient number of optional (facultative) subjects in the teaching plans, longer time for studying than predicted, insufficient number of computers for the students, scarce presence of research work (due to lack of finances) etc.

The processes of evaluation and accreditation accomplished in the University community, present novelty for the first time implemented in the Law on High Education and an obligation resulting from the Bologna Declaration of the European Universities, having the purpose to achieve harmonization of the high education in whole Europe.

2.2 Steps Undertaken in the Process of Accreditation of DEREC Study Program

Following are given the main steps undertaken in the process of accreditation of DEREC Study Program, as well as the dates of their fulfillment:

1. Preparation of Elaborate for the DEREC Study program – October, 2007.
2. Delivery of the Elaborate to University Education Committee for approval – November, 2007
3. Approval of the Elaborate by Rector's management board -January, 2008
4. Delivery of approved Elaborate to Accreditation Board for Higher Education – February, 2008
5. Enclosure of approved DEREC Study program in University call for enrollment of students in academic 2007/2008- February, 2008
6. Approval of University call by Macedonian Government – May, 2008

2.3 The main items from the Elaborate for DEREC Study Program

According to Macedonian positive legislation in the field of higher education, the Document which officially introduces new Study Program should consider following topics:

- Elaboration of the need for new Study Program
- Curriculum of the Study Program (name of the courses with ECTS credits)
- Learning outcomes
- Degree awarded, (Double/Joint degree)
- Short description of the courses
- List of academic staff involved
- Classrooms and laboratories, equipment
- Management and organization
- Financial issues

With the latest Macedonian Law for Environment (2005), a totally new concept for protection of the environment was introduced that enables integral managing with the environment as an integrity, which was not a case until now due to having no agreement and no coordinative of the different topics. The law is focused on the implementation of the procedure for estimation of the influence on the environment, as well as the procedure for estimation of the influence of certain strategies, plans and programs on the environment. The procedures for the integral management with the environment, through the special system of integrated ecological permissions and permissions for harmonizing of the existing contaminants with environmental norms and standards.

Review of study programs at the University of Ss. Cyril and Methodius – Skopje which treat problems of protection of the environment

was done. From the offer of the study program at the different faculties at the Ss. Cyril and Methodius University, the following programs treat problems of environmental protection:

Undergraduate study programs
- Faculty of Mechanical Engineering – *Energetic and ecology*
- Faculty of Technology and Metallurgy – *Inorganic engineering and environmental protection*
- Faculty of Mining and Geology – *Polytechnic studies – geoecology*
- Faculty of Agricultural sciences and Food – *Eco-agricultural*

Master study programs
- Faculty of Civil Engineering – *Hydro-technical department (module–water protection)*
- Faculty of Technology and Metallurgy – *Environmental engineering*
- Faculty of Natural Sciences, *Institute of biology*
  - Master
    - Ecologically – taxonomy
  - Specialist
    - Managing of protected natural objects
    - Ecology and protection of vertebrate in Macedonia
    - Structure and ecology of terrestrial ecosystems
    - Eco-physiology

The above given review of the study programs lead to the conclusion that all of them treat narrow scientific topics from the wide field of the Environment protection. Therefore, there is a clear necessity the University Ss. Cyril and Methodius, as the oldest high educational institution with the richest contents in our country, to offer an integral study program for education of highly educated cadre, who will be able to answer to the contemporary needs of the national strategy for Environmental protection and managing with the natural resources.

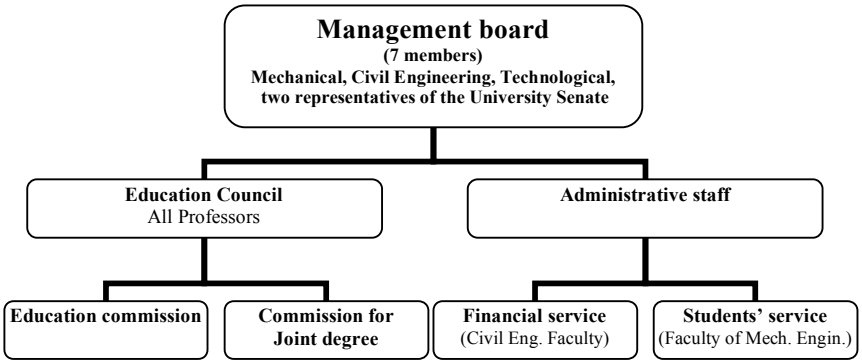
From the defined Curriculum of the Study Program the following Learning outcomes should be gained:

- treatment of the problems with soil pollution;
- treatment of the problems with water pollution;
- treatment of the problems with air pollution;
- treatment of the natural resources;
- treatment the solid waste;
- environmental policy and legislation.

Regarding the Degree awarded it is planed to organize joint studies with partner University of Florence. The details of double/joint degree should be defined in mutual University Agreement.

Since in the DEREC Study program participate three faculties from UCM the issue of management and organization was essential. Fig.2 gives the planed organization and management structure.

Figure 2. Planed organization and management structure



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DEREC DISTANCE EDUCATION CHALLENGES

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Abstract. The way that Internet «stepped» into our society implies dramatic changes in the way people learn and interact as a society. Students in the higher education are especially common with using Internet resources for their studies and research. This fact opens the possibility of creating an effective education environment, using the Internet as a medium for human interaction. The idea of creating such environment is a challenge of redesigning the user interface systems in order to mimic the classical educational environment, as much as a challenge of improving the education process by implementing options and techniques that are hard to implement in the traditional teaching systems. Though these challenges are hard to achieve, most of the assumed options and teaching characteristics are possible to implement with current technologies. DEREC distance education system enables different forms of interaction among the participants of the learning process and supports different active learning forms. The implementation of such a distance education system represents the attempt for transferring the infrastructure of traditional educational systems (classroom, library, laboratory, project work) into digital world.

1. *Introduction*

The modern educational environment is in continuous change. Classrooms and students move at rapid rate, novel educational practices stimulated by the new information and telecommunication technologies enable almost instant access to latest educational materials. That environment triggers the need for new approaches in providing both educational and administration services to the student. Learning takes place in wide range of settings, across the whole life span, and with a variety of aims. Comprehensive new approaches to valuing learning, which will students to move freely between learning settings, jobs and countries, making the most of their knowledge and competences should be always considered as very important for every community.

The need to share information among students, teachers and administrators, applies to a huge range of organizations from grade schools to

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postgraduate institutions. Over the past decade, numerous techniques have been developed [1] to use communications and computer systems to distribute knowledge, information, and instructional resources to widely disparate audiences in many different environments and contexts.

Colleges and universities are implementing various kinds of distance or e-learning systems (DES). Distance Education System's primary role is to enable and enhance educational process. It is very interesting and difficult to try to foreseen the further changes in the educational environment. For example, once the location is of no primary interest and as long the good sound system is in place, the classroom furniture might be moveable sofas, coffee tables and a boardroom table. The student might feel freer to ask the questions, and thus be more involved in the educational process, if they are anonymous [2].

The primary goal of this paper is to present a system for support of distance education that can be used within the DEREC [3]. Different internet based modules for the support of student activities and educational processes have been implemented. These implementations represent the attempt for transferring the infrastructure of traditional educational systems into digital world. The possibilities of current trends of internet based technologies were used in order to increase the efficiency and usability of developed modules.

2. DEREC Learning Environment

Learning within traditional teacher-centered education systems is based on deficit student model. The educational system tends to identify student's deficiencies and weaknesses. Based on those deficiencies, students are tracked and categorized. Teacher is an expert who broadcasts his/her knowledge. The student has passive role and the primary goal of education is to reproduce the teacher's knowledge.

Distance education is based on human behavioral educational theories. One of the basic educational theories of this type is the Constructivist educational theory. According to this theory, learning is active process, in which the students construct new ideas or concepts based on their current knowledge. The education is student centered active process. The teacher's role is to canalize and enable the learning process and thus he/she becomes a trainer or instructor. Students should take initiative in the learning process whenever possible. In that way, the general concepts which are the subject of learning become the part of students' experiences. Learning is a natural process, which can take different patterns depending on students' affinities, backgrounds and interests. The Learning is social process and thus different forms of communication and collaboration among students should be encouraged. Students should find

their own facts related to the educational subject. The knowledge is created through the real world activities rather then reproduced.

New information and communication technologies are blurring the distinction between traditional and distant teaching. When the role of a technology within learning is assessed, there are two separate criteria to consider, those or effectiveness and efficiency. Effectiveness refers to the opportunity that technology offers to improve what is obtainable with traditional methods. Efficiency refers to the opportunity that technology offers to improve the access to educational materials.

2.1 Educational Materials

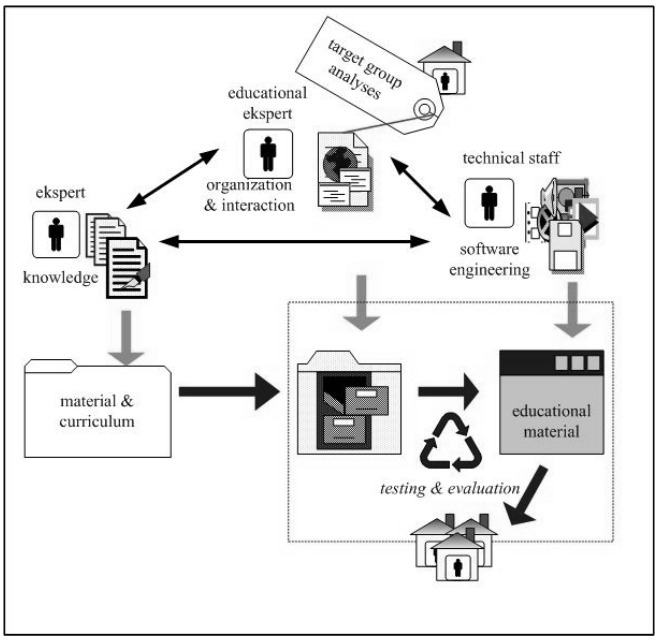
Educational process needs various educational materials organized in way that enables autonomous learning process [4]. Web based learning materials are usually used within majority of e-learning Systems. It is very appropriate but not only way of sharing educational resources. It is clear that educational information can be accessed more easily from day to day [5]. The next problem is how that information should be accessed and used.

Within the DEREC project, bilingual web based educational materials have been developed for each subject. The traditional material is enriched with searching and browsing possibilities, reference linking and community based discussions (forums, e-groups).

Similar to the educational materials aimed for traditional education, educational materials for distance education have to contain expert's knowledge. Additionally, since there might be a lack of direct communication, that knowledge has to be organized in way that enables autonomous learning process. For that purpose, educational expert has to be consulted when creating such materials. Finally, the technical staff should transfer the materials resulted from previous collaboration into a distribution medium. Educational materials for distance education are built in several phases (see Fig. 1) such are: Analyses of target students' needs, common goals and social background, creation of educational material, presentation of learning material depending on student evaluation.

Educational material should state in a very clear way «what is the main contribution for the students», what kind of students it is intended to, and what kind of examples it contains. Examples should be familiar to the student target group. Graphical symbols for different content (definition, example, related work, etc) should be defined at the beginning of the material and used within it. Cooperative work and different forms of communication between the actors of the educational process should be stimulated by providing discussion groups, chat facilities, and other more sophisticated communication support tools.

Figure 1. Process of creation of educational materials.



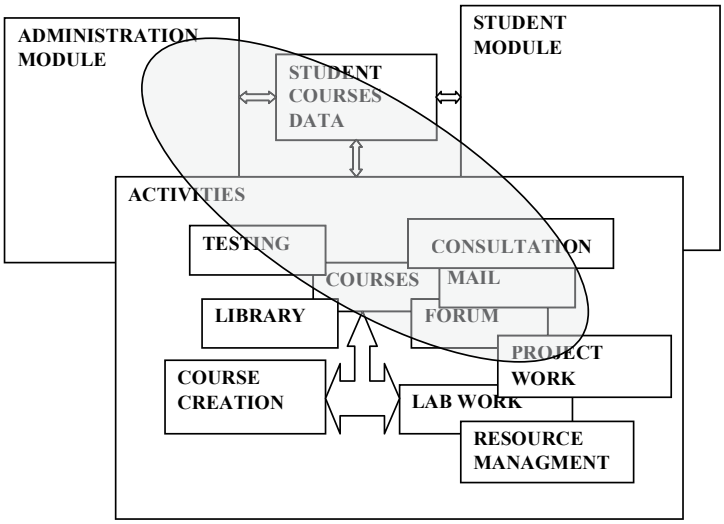
2.2 DEREC Distance Education System key features

Distance education support systems are complex systems. They should support different forms of active learning. They should keep track of student history, usage of educational materials and enable easy access to all educational modules. Clear mapping with traditional educational system should be enabled where possible. A classical example of such distance education support system was developed within DEREC. The users of this system need only to have internet connection and internet browser installed on their machines. The system is developed modularly and different system modules can be used.

There are two general groups of the activities that are supported by DEREC DES: student service activities and student academic activities. Student service activities (see Fig. 2) are related to educational process by supporting it. Examples of such activities are: lecture scheduling, general information about the subjects, course enrolling, exam enrolling, etc. Student academic activities are represented through access to educational materials, consultation activities, discussion activities, etc. Although not directly related to student activities, instructor supported activities are be included in the distance education support systems. Examples of such

activities are: publishing of the exams' results, different kinds of student notifications, educational material creation guide, etc.

Figure 2. Student activities supported by DER.EC DES.



The most common internet based communication is an electronic mail (e-mail) communication. The forum module developed within DER.EC can be used independently from different modules of the DER.EC DES. It can be also used from other modules of the system in order to increase their functionality.

3. Next Steps

Internet based synchronous communication among the educational process participants simulates «face to face» communication of traditional educational systems. Although this type of communication eliminates the distance between the communications participants, all participants have to be logged to the system at the same time.

The calendar of activities related to educational module, or individual DER.EC DES user can help in coordination of different educational activities.

The chat and calendar module can be implemented in the next interaction of development of DER.EC's DES.

3.1 Enabling Project Based Learning

Once different communication support modules are implemented, combined synchronous/asynchronous communication can be used in order to further enhance learning process. An example of such enhancement can be represented with project module. Project Module should be developed within DEREC's DES as a tool for supporting project-based learning. This will help the professors, instructors and students involved with the project to plan and monitor the project as well as to prepare particular tasks within the project. The Project Module should have completely web-based interface for the users of the system offering online access from any place and at any time.

The Project Module should support a control and coordination of the team involved in the project. The list of all logged activities should be seen using the «view activities» function. The activities should intended to provide detailed knowledge about the work on the tasks and the project as well to be a part of the project knowledge base.

3.2 Video Conferencing

Streaming technology is considered to be a very important internet based network technology that enables the deployment of video conferencing services. Streaming technology covers one way transmission of audio, video and possibly other content to an end user.

Video conferencing enhanced distance learning increases educational opportunities offered by any institution. It reduces the costs of teaching and learning, while allowing students to have more access to a variety of degree programs. Thus, an adaptation to video conferencing system within DEREC's DES should be also considered. By using such system, the mobility of students and especially instructors can be made financially acceptable even with small number of students, since the students distributed in different international locations can share the instructor.

Video conferencing service, used in combination with other distance educational services significantly eases this access to educational material and increasing the possibility to update educational materials more frequently.

The components of the learning environment that promote usage of video conferencing service can be itemized as follow: educational methodology used in the learning process, mapping of video conferencing technology onto the educational methodology, and institutional factors influencing the educational process.

In order to make video conferencing to function effectively, the instruction and course content must be interactive, and the instructor must exhibit flexibility and creativity when teaching the class.

4. Conclusion

A system for support of distance education that used within the DEREC was presented in this paper. Different internet technologies for the support of student activities and educational processes have been implemented within the system. These implementations represent the attempt for transferring the infrastructure of traditional educational systems into digital world. This paper also suggest the way in which DEREC's DES should be further developed from technological point of view.

It is clear that an understanding of the learning process and the way in which technology can best support it, are necessary for successful education. The web based learning environment itself does not guarantee that educational services will be developed and used.

There are also other factors which are also important for successful implementation of educational processes. These factors relate to the institutional needs in higher education. Examples of such factors are: the need for large scale collaboration in education technology development, the need to share resources, especially transferable courseware, and continuous staff development.

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PREPARING A DATA VISUALIZATION COURSE FOR ENVIRONMENTAL ENGINEERING CURRICULUM

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Abstract. We will describe the process of preparing a Data Visualization course for an Environmental Engineering curriculum. The curriculum has been built during the three years of duration of the DEREC (Development of Environmental and Resources Engineering Curriculum) Tempus JEP project. The work on the Data Visualization course has been realized by the author at South East European University in Tetovo, Republic of Macedonia as a completely new course. Besides following well established practices from the academic environment for proposing a new course, we have taken into consideration lot of aspects of the specific requirements of a course for an interdisciplinary curriculum and have positioned the content and delivery methods in an original and innovative way.

1. Initial Considerations

1.1 Program Context

The Environmental and Resources Engineering Curriculum as principal outcome of the DEREC Tempus project is aimed to answer to number of requirements both from institutional, administrative and academic point of view.

Institutionally, the program is positioned as interdisciplinary undergraduate program, offered by Ss. Cyril and Methodius University in Skopje with total umber of 180 ECTS planned to be earned in a three academic years composed of two semesters. Principal contributors in terms of course delivery are the main engineering faculties of the University. Administratively, the program is aimed to be managed by the Mechanical Engineering faculty at the same university with previous experience in offering interdisciplinary studies and as beneficiary country coordinator of the DEREC project.

From the academic point of view each of the Faculties members of the consortium has been working on courses that will be offered in the undergraduate curriculum. Since the curriculum itself has been build in

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the framework of the project the Faculties are contributing to the academic offer of the new program through the best of theirs expertise and teaching experience.

The overall structure and content of the curriculum is shaped in a compatible way with the correspondent academic offer from the University of Florence, a contractor of the project and a partner institution which played a major role in building the new curriculum and is expected to lead the process of follow up of the academic delivery and recognition of the program of the new-built academic offer in Ss. Cyril and Methodius University.

1.2 Curriculum Context for the Data Visualization Course

The course Data Visualization is a course in the last (third) year of studies of the Environmental and Resources Engineering Curriculum and is part of the elective block of courses in the program. South East European University and the Faculty of Communication Sciences and Technologies has been promoter of many innovative ideas of blended communications and IT founded programs and courses since its establishment in 2001. Although contributions have been done in many fields of Information and Communication Technologies area – there is no course at present from the domain of Data Visualization or related.

The technical course delivery framework for the Data Visualization course has been defined to be four ECTS credits, the week contact hours distribution – two hours of lectures per week and one hour practical and the total number of learning hours was set up to one hundred.

There are two courses giving the informatics background and preceding this course offered in the first year of study one of which is a prerequisite for enrollment in this course – Informatics and Data Engineering.

2. The Process of Building a Data Visualization Course

Data visualization as discipline aims to communicate information clearly and effectively through visual means. The main goal is to communicate the information.

The information in the context of Environmental and Resources engineering curricula is issued from the physical environment (air, water and land resources) and is aimed to serve for providing healthy supply of those resources, to remedy the polluted environments and contribute to the organization of the human activities in a sustainable and nature-friendly way. Consequently, the main purposes of the Data Visualization course will be to provide knowledge and tools for developing skills

and abilities in the domain of information visualization in a human and/or purpose suitable form for (1) the data issued from air, water and land resources measurements and (2) supporting resources management and decision support environments in the domain.

Data visualization is closely related to Information graphics (<http://en.wikipedia.org/wiki/Information_graphics/>), Information visualization (<http://en.wikipedia.org/wiki/Information_visualization/>), Scientific visualization (<http://en.wikipedia.org/wiki/Scientific_visualization/>) and Statistical graphics (<http://en.wikipedia.org/wiki/Statistical_graphics/>). The term unites the established field of scientific visualization and the more recent field of information visualization.

2.1 Structure of the Approach

Technically we can describe the process of building the Data Visualization course as being composed of the following phases:

Draining a considerable set of ideas

This phase consist of analysis of all core courses in the program curriculum from the aspect of type data and information involved, requested data manipulation skills and the expected level of knowledge that will be acquired by the students in the learning outcomes of the courses in the curriculum. Data visualization domain has been considered from purely technical and constructive till purely usability-friendly approaches. Some existent approaches for data visualization of environmental data has been estimated as inappropriate due to the extended level of mathematics knowledge on which they were based and which is not anticipated in the current curriculum of the program in question.

Selecting important conferences and resources

A list of state-of-the-art in the domain of publications, conferences and resources has been built identifying both the current topics of interest for the field of Data visualization as research topic and of the variety of approaches for defining the core content of an academic undergraduate course.

Compiling a reading list

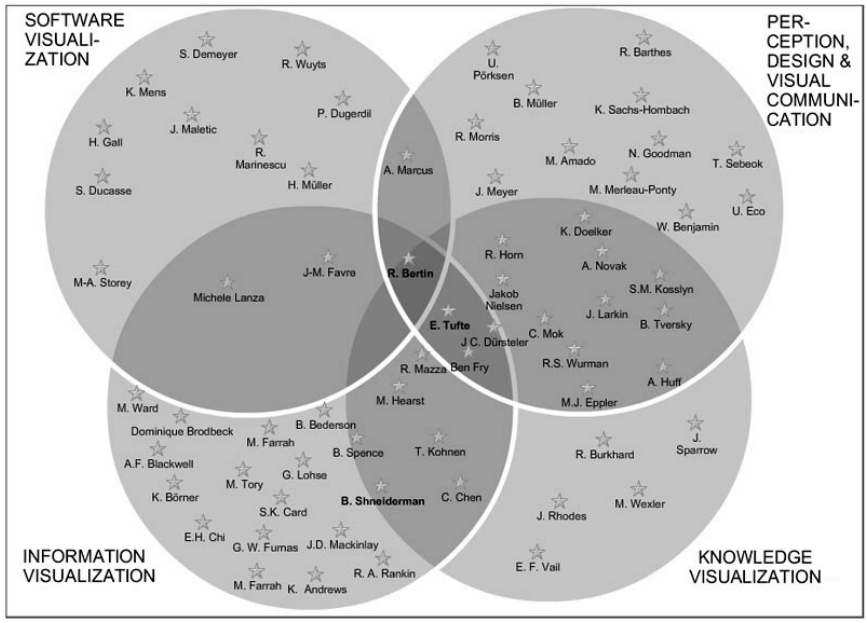
Set of core textbooks and other relevant reading sources have been compiled tracing the published work of relevant authors in the field but

also using the original way of presentation of the information in the community of Data visualization including visual presentations of the findings – in this case the reading sources as shown in Fig. 1.

Preparation of set of datasets

Although it is expected that the students in their last year of education will already dispose of relevant set of datasets suitable to be used as sample datasets for implementation of various data visualization techniques – at this stage of the course building it is useful to relay on existent and available data sets recognized internationally as reference datasets for data and information visualization. Initial list of datasets has been defined in this stage.

Figure 1. Core textbooks from the Data Visualization domain distributed by the domain of visualization [1].



Selecting Data Visualization tools

This phase resulted in a set of data visualization tools that will be used during the course delivery during lectures, but especially during the practical hours. The set of tools besides the requirement to be a complete one has to consist of suitable tools, especially of open source tolls that will enable the students to have hands-on experience in data visualization and

Figure 2. A «Periodic Table» of visualization methods – a visualization for the domain of visualization methods for Data, Information, Concept, Strategy, Metaphor and Compound visualization [1]

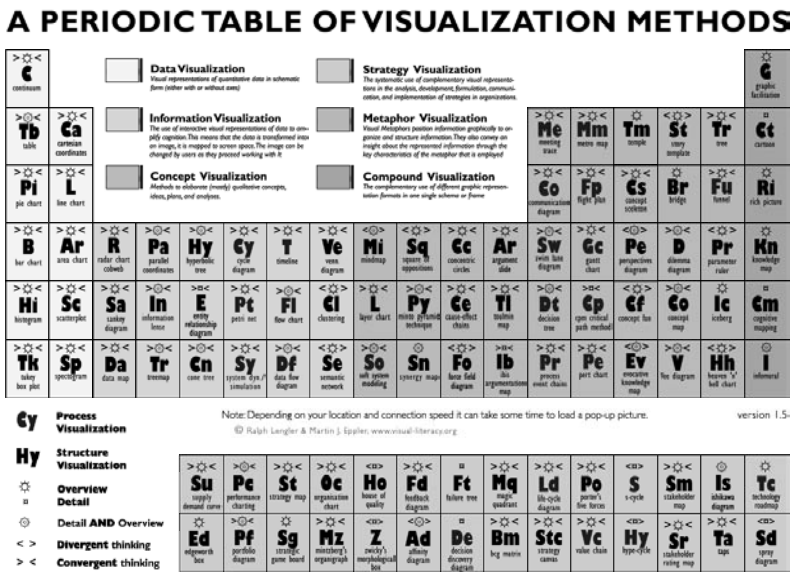
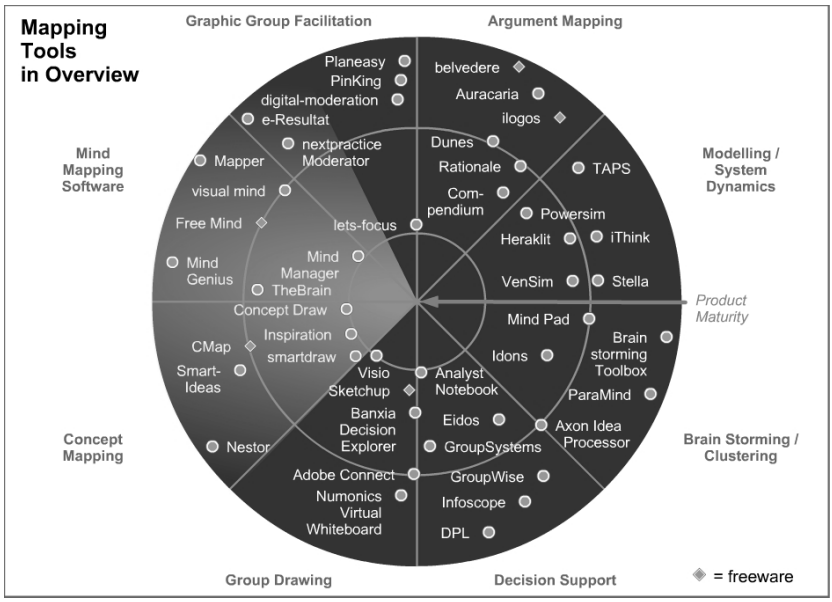


Figure 3. Data visualization tools sample representation and distribution in the sub-domain of Mapping tools [1]



provide them with tools that will initiate original approach for building visualization schema for a variety of data types that are to be considered in the field of environmental and resources engineering domains. Here again the data visualization community disposes of results available in suitable visual format as shown for Visualization methods in Fig. 2 and for a sub-domain of Mapping visualization in Fig. 3.

Composing syllabus and course delivery details

This is the final stage of the course preparation and consists of defining all elements of the course syllabus and course delivery details.

3. South East European University Institutional Context

Established in 2001 with institutional and funding support from the European and US funds, the South East European University in Tetovo, Macedonia, (<http://www.seeu.edu.mk/>), took an important place in the Macedonian higher education space.

Initially Faculty of Communication Sciences and Technologies (CST) with tracks in Communication Science and Computer Sciences (Communication Technologies) has recently been transformed and renamed into Faculty of Contemporary Sciences and Technologies and consists of three departments: Computer Engineering, Computer Sciences and Business Informatics.

The University disposes of important information technology infrastructure and specialized laboratory in Multimedia computing. The laboratory disposes of production, processing and storage servers, multimedia data capturing device, publication tools and videoconferencing Polycom equipment. The information technology capacities have recently been upgraded with state-of-the-art computer classrooms based on Sun Fire servers and 150 SunRay virtual display clients. This computing infrastructure offers a comfort computing power for running advanced data visualization tools and will be available for the students at the program that is subject to this project.

Moreover, besides the university campus based in Tetovo, from 2008 the University opened a branch in Skopje with computer laboratories and all needed facilities for course delivery using current technology for both teaching and individual students work.

4. Data Visualization Course Perspectives and Challenges

Three main tracks of Data visualization have been considered in the content of the proposed Data visualization course: Tracks in Data visu-

alization in Communications, in Business and in Engineering with emphasis of the last one.

The main elements of the Data visualization course for Engineering studies have been defined to be focused on:

- Using graphics to illustrate data and relationships;
- Visualization environments for: Presentation; Explorative analysis; Confirmative analysis;
- Transforming large multidimensional datasets into structures suitable for visualization;
- Visualization of different elementary data structures;
- Creating own visualization solutions for concrete practical problems.

The main challenges related to the positioning of a Data visualization course on undergraduate interdisciplinary level are been detected to be:

- A wide variety of environmental data types and formats;
- Unavailability of open datasets for realistic and contextualized case studies relative to the local environmental issues;
- Uncertain level of prospective students' data manipulation literacy for developing visualization environments;
- Most of the existing academic offer in the field is focused to Computer Science majors rather than to interdisciplinary studies students.

5. Data Visualization syllabus structure

As a result of all activities performed in the framework of the DER.EC project we have proposed a modern Data visualization course shaped for the environmental and resources engineering undergraduate academic curriculum. The syllabus structure of the course is built up around the following structure:

- Visualization fundamentals
- Data study and preparation
- Visualization flavors
- Scientific Visualization
- Information visualization
- Nonconventional techniques
- Analysis and visualization of environmental data
- Interactivity
- Visual communication
- Choice and evaluation

6. Conclusion

Proposing of new course in Data Visualization has been defined as a task in the early phases of building up of the Environmental and Resources Engineering undergraduate curriculum subject of the Tempus DEREC project. We described the process of conceptualization and building up the course for the given curriculum and justified the syllabus structure proposed. This activity provided new and original experience in considering a complex requirements set for establishing academic undergraduate course from the field of computer science for interdisciplinary studies in environmental and resources engineering and resulted in an innovative undergraduate course in Data visualization non-existent in the current academic offer in the beneficiary country of this project.

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THE ROLE OF MATHEMATICS IN THE ENVIRONMENTAL AND RESOURCES ENGINEERING STUDIES

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Abstract. Mathematics plays an important role in any engineering science. Here, the experiences and conclusions obtained during the academic visits within the DEREC Project about the role of mathematics in the environmental engineering are described and some specifics are pointed out. Modern trends in teaching mathematics for «non-mathematicians» are described and the content of mathematical courses for the environmental engineering studies are given.

«Book of Nature is written in the Language of Mathematics».
Galileo Galilei (1564-1642) in his well known book *Il Saggiatore*.

1. *Environmental Engineering and Mathematics Relationship*

1.1 *Basic definitions and history remarks*

In order to make comprehensive analysis of the relationship between environmental and resources engineering and mathematics some basic definitions and history remarks are needed.

How can mathematics, engineering, technology, environmental engineering be defined? There are many definitions in the literature today and some of them that are widely recognized are given below.

The word «mathematics» comes from the Greek μάθημα («máthēma») meaning learning, study, science, and μαθηματικός («mathēmatikó»s) meaning fond of learning. Mathematics is study of all conceivable abstract patterns and relationships, usually dealing with concepts as quantity, structure, space and change.

Engineering is the discipline and profession of applying technical and scientific knowledge for utilizing natural laws and physical resources in order to design and implement materials, structures, machines, devices, systems, and processes that safely realize a desired objective and meet specified criteria.

Technology is a broad concept that deals with a species' usage and knowledge of tools and crafts, and how it affects a species' ability to control

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and adapt to its environment. Technology is a term with origins in the Greek «technologia», τεχνολογία – «techne», τέχνη («craft») and «logia», λογία («saying»).

Environmental engineering is the application of science and engineering principles to improve the environment (air, water, and/or land resources), to provide healthy water, air, and land for human habitation and for other organisms, and to remediate polluted sites. Environmental engineering involves water and air pollution control, recycling, waste disposal, and public health issues as well as knowledge of environmental engineering law. It also includes studies of the environmental impact of proposed construction projects.

All of the above, mathematics, engineering, technology, environmental engineering, are human enterprises. However, according to historians, technology far precedes the others. Namely, first recorded technology dates about 2.4 million years ago, from the Koobi fora site in northern Kenya where evidences are found that humans created primitive tools using the process of chipping the ages away from stones.

In the meantime we became more than a tool makers. Humans pursue scientific knowledge since the Stone Age (5000–100000 years BC), first by pragmatic experimentation characterized as discovery by trial and error, then by the invention of the formal logical system (ancient Greek philosophers) and as a final step of the evolution of science we have the discovery of the possibility to find out casual relationship by systematic experiment (Renaissance period).

Evolution of technology is delivered through engineering. Engineering has its formal beginning about 3000 years BC with the building of many temples, tombs and pyramids along the valley of the Nile by the Egyptians. The word «engineer» was created in the Middle Ages when the builders of «engines» of war were called «ingeniators» by Latin writers.

Mathematics dates about 10000 years ago when humans began to count when the nomadic Stone Age hunters became farmers because of the retreating glaciers. Modern mathematics is based on the work of the ancient Greek philosophers and dates from the Middle Ages. Since then the development of engineering sciences goes along and is brought by with the discoveries in mathematical sciences.

Finally, youngest of all is environmental engineering born in the second half of the twentieth century when human concern for the ideas like preservation of nature, optimal usage of natural resources, etc. raised to the necessary level.

1.2 Environmental Engineering and Mathematics Synergy

As stated in the beginning of this article Galileo Galilei (1564-1642) in his well known book *Il Saggiatore* with the statement «Book of Nature

is written in the Language of Mathematics» illustrated in brilliant way the relationship between mathematics and nature which means also the relationship between mathematics and sciences studying the man made changes of nature. Further analysis is based on the following:

- Mathematics is abstract, involved with patterns and their relationships and concerned mainly with providing solutions to theoretical problems.
- Environmental and resources engineering is very specifically involved with utilizing the materials and forces of nature for the benefit of mankind, concerned with the improvement of the environment.

Lot of mathematics is «embedded» in the practice of an environmental and resources engineer (of an engineer in general). If you ask a skilled engineer «do you ever use mathematics?», a typical response might be, «no, I haven't used it for 20 years». But if you probe further, you can identify mathematical elements of their expertise which they no longer think of as mathematics, it's just «doing engineering». The question then is where does that embedded mathematics come from? It must come from doing explicit mathematics in the formation phase which becomes implicit in practice. The process of embedding depends critically on the student's experience of learning mathematics and engineering.

Main reasons why mathematics is important for engineers can be formulated as:

1. The laws of nature (e.g., Maxwell's equations for electromagnetics, Kirchhoff's Rules for circuit analysis) are mathematical expressions. Mathematics is the language of physical science and engineering.
2. Mathematics is more than a tool for solving problems; it also develops intellectual maturity. It is critical that an engineer can visualize abstract concepts.
3. Numerical simulation on a digital computer is a powerful and effective tool that is being used by an increasing number of engineers. However, computers do not make traditional mathematical analysis obsolete.

2. Teaching Mathematics for «Non-Mathematicians» – Modern Trends

Modern trends in teaching mathematics for engineers faces the following challenges:

- Mathematics education for engineers, with some exceptions, has typically been about techniques, which were needed in the past to perform practical calculations, but today, nearly all of those techniques have disappeared to be replaced by computer software. What has not

been replaced is the need to understand modeling and now days the need is shifting in that direction.
- Many students believe that the way to solve a problem is to search for the proper formula, and then substitute numbers into the formula. This may be all right for solving quadratic equations, but this is not a good general attitude.
- Helping students to understand that «doing maths» helps them to develop a logical thought process, a discipline of problem solving that is essential for solving engineering problems of many kinds.
- Few problems can be solved immediately. It is critical that engineering students develop persistence at solving problems. Often the «best» way does not come instantly or even easily; one must try various methods and see what happens. The experience of working large numbers of homework problems, of diverse kinds, seems to build a personal collection of approaches and tools, and add to an understanding of mathematics.
- Many students need more practice in how to start solving a problem, including translating «word problems» into mathematical expressions.

Extensive use of mathematical software (Maple, Mathcad, Matlab…) should be introduced since there are so many students with weak algebraic skills. Not only that: the software is also extremely powerful for exploring mathematical modeling. Never the less one should be aware that:

- Computer programs contain mathematical relations; understanding and fluency with manipulation of these relations is still necessary.
- Knowledge of traditional mathematical analysis is essential for validating computer programs. One of the best ways to validate a program is to compare the computer simulation of simple situations to the analytical solution for the same situation.
- It is relatively easy to write brute-force computer code that requires a long runtime and produces significant error, owing to accumulation of errors from the limited resolution of machine numbers. Great increases in both speed and accuracy can be obtained by using analytical solutions for parts of the problem, or by careful development of appropriate algorithms. Knowledge of traditional mathematics is highly relevant to this task.

Finally, one of the conclusions from the DEREC Tempus Project is that for three year studies in environmental and resources engineering two mathematical courses are needed. They should include: basics of linear and vector algebra, differential and integral calculus of functions of one and several variables, ordinary differential equations and basics of applied statistics and optimization.

Detailed contents of these two courses are given in Appendices A and B of this paper. Suggested literature for the courses is:

1. G. James et al. (2000)), *Modern Engineering Mathematics*, Prentice-Hall.
2. J.D. Faires and B.T. Faires (1989), *Calculus*, Random House.
3. K.A. Stroud and J.B. Dexter (2007), *Engineering Mathematics*, Palgrave Macmillan.

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Appendix A
Content of Mathematics 1 course within DEREC Curriculum.

1. Matrices and determinants.
   1.1. Manipulations with matrices.
   1.2. Evaluation of determinants.
   1.3. Finding the inverse of a non-singular square matrix.
   1.4. Solving systems of simultaneous linear equations using matrices.

2. Vector algebra and its applications.
   2.1. Operations with vectors.
   2.2. Scalar and dot product of a vectors.
   2.3. Lines and planes in space.

3. Sequences of real numbers.
   3.1. Increasing, decreasing and bounded sequences.
   3.2. Convergence of sequences.

4. Properties of functions of one variable.
   4.1. Ways of defining a function.
   4.2. Graphs of some elementary functions.
   4.3. The limit and the continuity of function.
   4.4. Horizontal, vertical and slant asymptotes.

5. The derivative of a function.
   5.1. The definition of the derivative of a function.
   5.2. Geometric and kinematical interpretation of the derivative.
   5.3. Formulas for differentiation.
   5.4. The derivative of a composite function – the chain rule.
   5.5. Maxima and minima of functions. The first derivative test.
   5.6. Higher derivatives. Concavity and the second derivative test.
   5.7. Comprehensive graphing of a function.
   5.8. Application of the derivative.

6. Integral calculus of one variable.
   6.1 The definite integral.
   6.2 The indefinite integral.
   6.3 Techniques of integration.
   6.4 Application of the definite integral.

Appendix B
Content of Mathematics 2 course within DEREC Curriculum.

1. Multivariable functions.
   1.1 Functions of two variables. Level curves.
   1.2 Functions of three variables. Level surfaces.
   1.3 Quadric surfaces.
   1.4 Cylindrical and spherical coordinates in space.

2. The differential calculus of multivariable functions.
   2.1 Limits and continuity.
   2.2 Partial derivatives.
   2.3 The chain rule.
   2.4 Application of partial derivatives.

3. The integral calculus of multivariable functions.
   3.1 Double integrals.
   3.2 Surface area.
   3.3 Triple integrals.
   3.4 Application of triple integrals.

4. Ordinary differential equations.
   4.1 Homogeneous differential equations.
   4.2 Exact differential equations.
   4.3 Linear first-order differential equations.
   4.4 Linear second-order differential equations: homogeneous and nonhomogeneous.

5. Introduction to applied statistics.
   5.1 Population. Sample. Random variables.
   5.2 Presenting and summarizing the data.
   5.3 Point and interval estimation of data parameters.
   5.4 Parametric test of hypotheses.

6. Optimization.
   6.1 Linear programming. Simplex algorithm.
   6.2 Formulation and optimization of a transportation problem.

MAN AND THE ENVIRONMENT

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Abstract. The paper presents the contents and obejctives of the courses created by the Faculty of Technology and Metallurgy in Skopje, Macedonia, and included in the Curriculum titled as «Environmental and Resources Engineering» developed in the framework of the Joint European Project (JEP) TEMPUS DEREC (Development of Environmental and Resources Engineering Curriculum), with a TEMPUS reference number CD_JEP_19028_2004. An introductionary part describing the relation between the man and the environment is also included.

1. *Man and the Environment – Introduction*

The paper presents the courses created by the Faculty of Technology and Metallurgy in Skopje, Macedonia, and included in the Curriculum titled as «Environmental and Resources Engineering» developed in the framework of the Joint European Project (JEP) TEMPUS DEREC (Development of Environmental and Resources Engineering Curriculum), with a TEMPUS reference number CD_JEP_19028_2004. The aim of the developed Environmental and Resources Engineering Curriculum is to provide professionals with the knowledge and skills necessary to contribute, directly or indirectly, to the conservation and prudent use of natural resources for the benefit of society. The students should develop the capacity to carry out technical research and assessments on environmental issues. They should also learn to analyze and assess environmental systems and problems; be able to propose sustainable solutions to environmental problems; and contribute to the development of policies and strategies for environmental planning.

The environmental and resources science is becoming more and more important with every next day. If Ecology is defined as a Science that is treating the strong and complex multiple relationship between the life beings and its inorganic Environment, then, human being as an integral part of the life being with great possibilities to modify the Planet biosphere, all in order to provide adequate conditions for surviving and better quality of life of the Mankind, caused development of a new discipline so-called Human Ecology covering much wider range of issues.

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Beside biological, human ecology is covering technological, economic, cultural, ethical, legal, political, philosophical, military-pacific and other aspects that might have an influence on the life of the contemporary human being, characterized especially for the period of the second half of the previous Century.

During the 1990s, a relatively new concept gained in importance, at least in principle, dealing with pollution and limits of natural resources. This is one of the basic ideas for development of industrial ecology, which has a tendency to treat industrial systems in a manner analogous to ecological systems in the nature, where, true waste products are very rare. Different than in the Nature, where, all materials are recycled by some organisms (Plant fix CO_2, as plant material by photosynthesis, herbivores eat plants converting it in energy and own biomass, carnivores eat herbivores and when they die, their biomass is degraded by bacteria, producing substances necessary for plants and so on, the cycle is repeated), human being with its activity in producing of the various goods, permanently is working especially on minimization of the toxic waste (gases, liquids and solid) materials and prevention of their uncontrolled releases to the environment, but, not always successfully, causing significant attack to the health of the local human and other populations.

That is why today, generally speaking, people all around the world are continually obsessed with their health. People's preoccupation with medical issues is so pervasive that most of the time we forget that we are healthier and more prosperous than at any time in human history. According to recent figures released by the National Centers for Health Statistics, in average, People live longer than ever before and the infant death rate has reached an all time low. Our children are more likely to survive into adulthood than in the past. And despite all the publicity about a range of environmental problems most of human populations enjoy a life that is far safer than before. However, it is important to note that when the future is deemed to be very threatening, it is present day society that is condemned. For if our actions are likely to have such an impact on the future, and then it is we who are responsible for what happens in the period ahead. As Luhman[1] wrote «more and more of the future apparently comes to depend on decisions taken in the present». Since our actions are likely to increase the dangers faced by people in the future – the most enlightened strategy is to minimize the risks faced by future generations. That requires that we do as little as possible of anything that is likely to have future consequences. Of course, this is opening still even today, an actual issue, i.e. should we build Nuclear Power Plants in the future with an intensity like it was in the last Century or

[1] Luhman N. (1993). *Risk: A Sociological Theory,* New York: Walter.

not, especially having in mind the consequences of the Three miles Ireland (1979) and Chernobyl (1986) accidents.

The general mood of anxiety about existence makes the public susceptible to health scares, even to the extent of a loss of judgment about risk assessment. People are designated as being «at risk» not because of their chosen behavior, but because of who they are. Thus, risk becomes an entity in its own right, only minimally subject to human intervention. The idea of risk has come to have only negative connotations.

The main reason why today's insecurity has created an intense consciousness of risk arises from the changing relationship between society and the individual. Many observers have commented on the relentless process of individuation that has occurred in recent decades in Western societies and now-a-days in southeastern European Countries. Changing economic conditions have created an insecure labor market, while the transformation of service provision has increasingly shifted responsibility from the state to the individual. The individuation of work and the provision of services have made survival much more of a private matter. But of course, the changes in the labor market alone cannot account for the process of individuation. Economic change has been paralleled by the transformation of institutions and relationships throughout society. The decline of participation in political parties and trade unions points to the erosion of traditional forms of solidarity among people. This has been most clear with the demise of traditional working class organizations, political parties etc. Many mainstream commentators have interpreted this trend through what they call the decline of community. Even a fundamental institution such as the family has not been immune to this process. That is why the concern about the environment is growing day by day. Damage to the environment is caused by our ever increasing demands which consume the world's natural resources, and by the pollution of land, water and air caused by our activities and the wastes we create. More and more companies are seeking to understand how their operations impact on the environment, and these companies then put management systems in place to keep control of the impacts. Their concern is extending from their own activities to those of their suppliers and subcontractors; «green» companies want to trade with «green» partners. An organization's commitment to the environment and good environmental practice can now be demonstrated by being registered to ISO 14001, the International Standard for environmental management systems. Working on these issues in Macedonia, all efforts related to the conservation of the Environment are directed toward the introduction of a good environmental practice based on international experience and standards. On this way, as a transitional measure (introduction of IPPC- Integrated Pollution Prevention and Control), is already practiced in Macedonia.

2. DEREC Courses Developed

As Einstein is reputed to have said: «Make science as simple as possible, but no simpler», our aim is to provide not only science simplified as far as possible, but education as well. In this sense, the Faculty of Mechanical Engineering, supported by several other Engineering Faculties from the University Ss. Cyril and Methodius in Skopje, Republic of Macedonia, has initiated the realization of the TEMPUS project (CD_JEP_19028-2004) titled as *Development of Environmental and Resources Engineering Curriculum (DEREC)*, through an intensive cooperation with the University of Florence, Italy, as a DEREC Project Grantholder and the Technical University of Vienna – Austria, Ruhr University of Bochum, Germany and Aristotle University of Thessaloniki, Greece. The DEREC Curriculum has been developed in accordance to the Bologna Declaration, and it is based on the European Credit Transfer System (ECTS). Building up of an efficient and attractive curriculum under the above mentioned title was not a simple task. A lot of discussions among the academic staff (Mathematicians, Physicists, Chemists, Information Technologists, Chemical Technologists, Civil Engineers, Process Engineers, Water Sanitary Engineers, Soil Engineers, Ecologists and others), together with academic visits, training and retraining of the Macedonian teaching staff at the Advanced DEREC European Universities, was necessary in order to develop modern, up-to-date curriculum in environmental and resources engineering.

The Faculty of Technology and Metallurgy, as a member of the DEREC Consortium, made a commitment to prepare teaching materials for the following courses:

Chemistry and Ecology

This book contains several chapters: Introduction, Ecology, Pollution and degradation of living environment, Chemistry, Prevention and protection of the environment pollution, and remediation of the polluted environment.

The textbook «Chemistry and Ecology» is intended to impose the necessity of reaching greater knowledge on chemistry and technology by pointing out all destructive effects possibly appeared as a result of the civilized living. The ultimate intention is the pollution of the living environment to be diminished, to a great extent, but if the pollution is happened, the purification to be carried out successfully. From here, the knowledge of «the Ecology» and «the Chemistry», and especially the relationship between the both separated sciences is appeared as an indispensability, if it is expected a stable development in the balanced living conditions.

Physics

The primary goal of the prepared text is to provide students with a sound understanding of how physical phenomena are analyzed, illustrated with applications to specific topics (Solved examples or questions). Special attention has been paid to the Problem-Solving Strategy, expressed in several steps listed below:

- Read *the problem carefully at least twice. Be sure you understand the nature of the problem.*
- Draw *a scheme/diagram while rereading the problem.*
- Label *all physical quantities in the diagram, using letters that remind you what the quantity is about.*
- Identify *physical principles, the known's and unknowns, and list them.*
- Choose Equations *connecting known and unknown quantities.*
- Solve *the set of equations for the unknown quantities in terms of the known.*
- Substitute *the known values.*
- Check *your answer. Do the units match?*

It is expected that when students complete the course they will be able to recognize the existence of:

- Two levels of the nature description. One is *macro* (global and phenomenological) that corresponds to the world we directly perceive. The other is *micro*, that is structural and in the domain of atoms and quantum theory.
- Two complementary descriptions of natural phenomena. The first description employs particles (balls, atoms, molecules…), and the second involves physical fields (gravitational, electromagnetic etc.).
- Two broad energy levels, low, corresponding to the world we are dealing with, and high, that is world of Einstein's relativity and nuclear forces.
- Two kinds of physical laws, fundamental (laws of gravitation, electromagnetism, entropy etc) and statistical, corresponding to the laws of friction, viscosity, gas laws, Ohm's law etc. and be prepared for facing with various everyday technical problems.

Environmental Process Engineering

The purpose of the discipline environmental process engineering is to present general economic and design principles as applied in processes for removal of industrial, municipal and hazarodous wastes. In the first part an overall analysis of the major factors involved in waste water

process design, with particular emphasis to economics in design work, is presented. In this sense an usual economical evaluations of capital investments, estimation of capital investments, estimation of total product cost, interest and investment costs, present and future worth, annuity, cash flow, depreciation and project profitability, will be debate d. In the second part will be presents an overview of physical, biological and chemical processes for sewage, sludge and waste water treatment and the basic principles of plant design. In the next parts the use of environmentally balanced industrial complex (epic) to make changes to the production process, a`uipment, or operating conditions for waste minimization will be discussed. Illustrative examples and simple problems will be used extensively to illustrate the applications of the principles to practical situations, for example fertilizer and cement plants, pulp and paper plants, tannery plants, sugarcane plants, textile mil plants, and municipal waste water treatment plants, with particular accent of already existing plants in Macedonia (Kumanovo, Sveti Nikole, Makedonski brod, Ohrid, Krivogashtani, Cucer Sandevo and Jasenovo).

Wastewater Environmental Engineering

This course has the following chapters:

WATER AND ENVIRONMENT – Water cycle (water storage in oceans, water storage in the atmosphere, evaporation, evapotranspiration and transpiration, sublimation, condensation, precipitation, surface runoff, snowmelt runoff, streamflows and rivers, ground-water storage, freshwater storage, human impact of the water cycle;

WATER POLLUTION – Sewage and wastewater, Industrial waste, Radioactive waste, Oil pollution, Atmospheric deposition, Global warming, Eutrophication, Sewage spills, Pesticides, Urban runoff, Population, Nitrogen and Nitrogen cycle, Phosphorous and Phosphorus cycle, Sulfur and Sulfur cycle, Water conservation;

AQUATIC CHEMISTRY – Chemical reactions in aqueous solutions, PH, Carbon Cycle, Carbon Dioxide in the water, Oxygen cycle, Photosynthesis in the water, Cellular Respiration, Decomposition;

METHODS FOR CONTROLLING OF WATER QUALITY – Conductivity and salinity, Dissolved oxygen, Biochemical Oxygen Demand (BOD), Dissolved metals and salts, Chromatography techniques, Applications, Samples preparation and collection, Data Output and Analysis, Microorganisms, Turbidity;

PHYSICAL CHEMICAL AND BIOLOGICAL OPERATIONS – Operations and processes employed in the treatment of water and waste water, Flow equalization, Neutralization, Precipitation, Coagulation and flocculation, Sedimentation, Filtration, Carbon adsorption, Disinfection, TOC, COD and BOD Removal, Sewage

PROCESS ENGINEERING DESIGN OF WASTE WATER TREATMENT SYSTEMS – Wastewater treatment, Treatment stages.

After finishing the course the students will be familiar with: Processes within the water cycle; Analysis of the physico-chemical parameters of water; Processes related to the waste water treatment; Controlling of the all stages of waste water treatment.

Industrial Waste Management

Through this course, the student will be involved in:

- Definition of waste and industrial waste management, understand chemical process that produced waste, type of waste, Best Available Technologies and chemical industries in Macedonia, Legislative in Macedonia, concerning environment and Industrial Waste Management, A- or B-integrated permits, producer responsibility and penalties.
- Waste minimization technique, such as source reduction and recycling, with their advantages and limitations. The purpose and necessity of waste audit, why it is necessary to do it, how to do it, what are the benefits of the waste audit.
- The concept and components of cleaner production, its importance and the strategy of cleaner production development. By the completion of this course students will be able to analyze an industrial process, including ability to describe and explain a particular industrial process and to identify the waste that is being produced.
- Students will learn the legal obligation of the producers, including the Regulation for A and B integrated license request, the issuing authorities, as well as the limits of the maximum pollution concentration of the air, water and soil. The students shall apply the legal regulation on the previously given assignment.
- Students shall be able to analyze the process in terms of waste reduction (the process that has been given to him/her at the beginning of the semester). Further, the students shall be able to make an analysis and to explain which option for waste reduction is most suitable according to the waste hierarchy.
- Students shall be able to report on the audit (or revision) of the waste from the industrial process that is being analyzed during the course.
- Student shall be able to apply the Cleaner Production concept on the industrial process that has been given to him/her at the beginning of the semester.

At the beginning of the semester, to each student an individual assignment that will consist of a practical example of an industrial process

will be given. Depending on their number, the students will work individually or in group of two. As the students will be acquainted with one industrial process in Macedonia, they will be given an opportunity for on-site visit before they start working on the waste management problems for each case. In this way, the students will be able to apply the received knowledge from the studied subject area. In general, after the graduation, environmental science and engineering students will have abilities for a successful facing with the problems related to the management of the Environment (detection of the environmental pollution and its adequate protection). At the end, the student will come to know that the solution to pollution is not dilution, but instead is a community-based plan of action rooted in that most Citizens of civic values, personal responsibility.

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AGRICULTURE SECTOR IN FYR MACEDONIA: IMPORTANCE, WATER DEFICIT MAPS AND IMPROVEMENT MEASURES

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Abstract. The paper presents the importance of the agriculture sector in the Republic of Macedonia, the comparative advantages of the country's agriculture, the increased water deficit maps, as well as the adaptation and mitigation actions for crop production sector in Macedonia. The vulnerability assessment is done and the vulnerable zones in the Republic of Macedonia are defined. The most vulnerable crops are determined according cropping pattern in vulnerable areas. Different measures and adaptation techniques are listed both for irrigated and rainfeed agriculture.

1. *The Importance of the Agriculture Sector in Macedonia*

The most important economic sectors in Macedonia, according to the statistical data, are: mineral extraction and metal processing industries; telecommunications; trade; agriculture and food production; and beverage production. The agriculture sector plays an important role in Macedonia's economy through its contributions to GDP (agriculture accounts for 16 percent of GDP), employment, trade and the rural economy. Macedonia's comparative advantages in agriculture lie in abundant labor, fertile soils, a range of moderate continental and Mediterranean micro-climates in the South (though with water deficiencies and occasional droughts in parts of the country) and natural upland pastures. About 49 percent of the total land area, or 1.16 million hectares (ha), is agricultural land, split evenly between cultivable land and pastures; a further 37 percent of land is forest, while the rest includes lakes and urban areas. About 80 percent of cultivated land is farmed by approximately 180,000 private family farms that are becoming increasingly commercially-oriented. The remainder is farmed by 136 agricultural enterprises. Agricultural growth is largely determined by a growing but fluctuating crop sub-sector, with livestock making a stable but smaller contribution to agricultural productivity. Despite land, agriculture is utilizing about 70% of water available in the country. Due to this agriculture is the biggest user of some of the

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natural resources (land and water) with utilization of about 50% of land resources and 70% of water resources in the country.

The environmentally friendly agricultural practices and technologies are very important for agricultural sector because there is need to utilize water and land without polluting these resources. Especially important is land degradation and desertification processes because these damages are almost nonreversible. Sustainable use of these resources is becoming essential part of environmentally friendly agricultural engineering. Despite pollution/degradation of huge portion of land and water available in the Macedonian agriculture is facing with very demanding market that is requesting safe and high quality agricultural products. In opposite population is increasing permanently and request for food and other agricultural products is bigger with every next day. Limited resources (water, land) are limiting agricultural production. There is need to increase agricultural production which create pressure to increase yield from unit area. Further intensification of agricultural production means increased pressure for further degradation of available land and water resources (trough increased use of pesticides, fertilizers, water, soil cultivation etc). Further increasing of the environmental problem is that agriculture is faced with challenge of producing bio-energy (bio diesel, bio ethanol). Same land and water should produce food for more than 6 billions inhabitants of this planet and produce bio fuels to contribute in solving of climate change problem and problem with decreasing of fossil fuels. So agriculture should produce more with same resources. Further increasing of the problem is global environmental changes. Climate change, land degradation and desertification, world water crisis are making the problem of agriculture and environment even bigger. The land degradation and desertification are decreasing available soil resources, the world water crisis is decreasing available water for agriculture and there will be problems with further increasing of water use in agriculture (50% of agricultural production is produced from 17% of agricultural land that is irrigated, rest 50% are produced from 83% nonirrigated land).

2. Agriculture and Climate Change

For the purpose of preparation of Second Macedonian National Communication to United Nations Framework Convention on Climate Change (UNFCCC) the Vulnerability assessment and Adaptation Report for Agricultural sector was prepared. The several meteorological parameters and agro ecological indices were used in order to find out if climate changes are taking part in the country and how agricultural production will be affected by these changes. For this purpose we present here only one parameter that was used – water deficit. It is very clear that this pa-

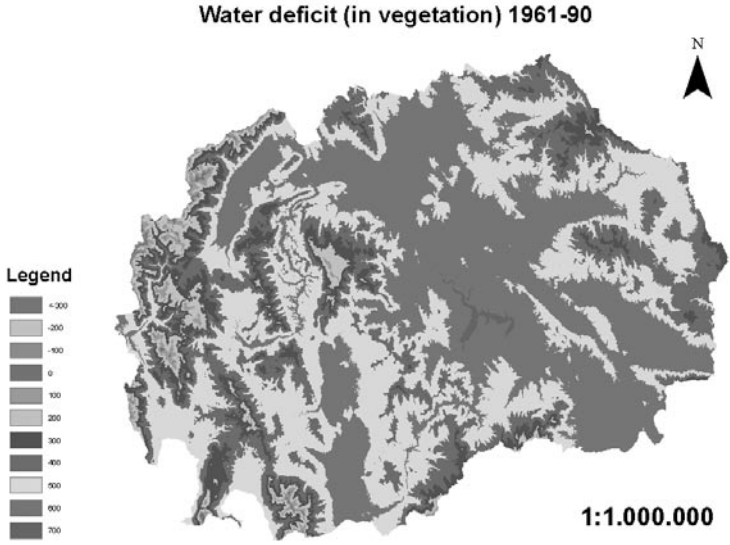
rameter is limiting agricultural production in the country. Also among other parameters this was one of the best to determine vulnerable areas of the country. The vulnerability assessment and proposed adaptation measures are for crop production sector.

2.1 Water Deficit in the Republic of Macedonia

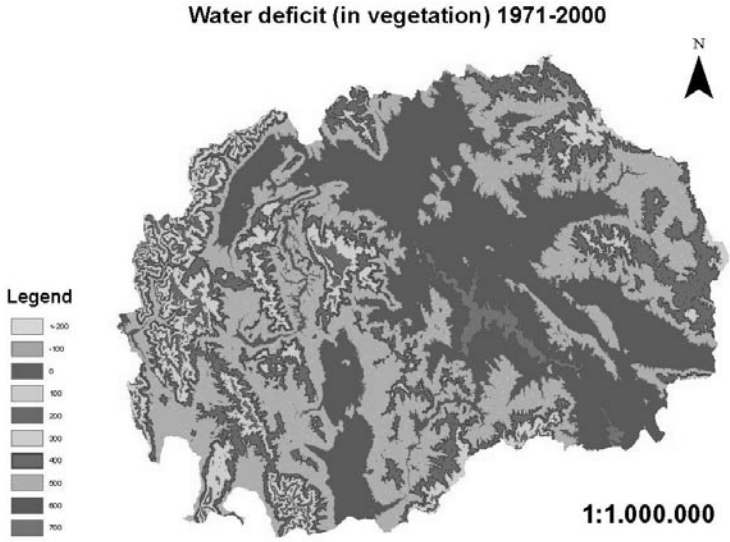
Water deficit is calculated as difference between potential evapotranspiration and effective rainfalls. Calculation was done on year basis and on growing season basis, but here only growing season will be presented. For further information check <http://www.unfccc.org.mk/>. Water deficit based on growing season clearly shows in which parts of the country there is not enough water for normal crop growing. Crop growing in such areas normally results with decreased yield as result of drought and drought stress. The results are shown in next maps created with modeling in Geographic Information Systems (GIS) technology in order to get perfect spatial distribution of water deficit in the country. Data in Map 1 and 2 present water deficits calculated as difference between potential evapotranspiration calculated by Thornthwhite and effective rainfalls calculated by the Food and Agriculture Organization of the United Nations (FAO) dependable rainfalls method for main meteorological stations Macedonia. Then mathematical model for spatial distribution of these parameters was developed for presenting spatial distribution of water deficit for period 1961-1990 (the data series used for climate change scenarios etc). Graph 2 presents same data but for period 1971-2000. Finally Map 3 is simple graphical subtraction of Graph 2 minus Graph 1 and shows in which areas water deficit was increased (the most of agricultural areas in the country).

The values for water deficit presented in Map 1 and 2 seem to be very high. It is like that because dependable rainfalls equation calculates very low values and in case of high evapotranspiration water deficit became very high. Even though, this is well recognized method and some of the studies for irrigation schemes in the country are calculated by this method. It is possible to use other method for calculation of effective rainfalls as fixed percentage or United States Department of Agriculture, Soil Conservation Service (USDA SCS) method, also recommended by FAO. We decide dependable rainfalls method because it is worst case and preparation for climate changes in agriculture should be done on worst case. Increased water deficit in growing season means higher crop water demand and higher needs for irrigation. Anyhow irrigation water is in shortage even in this moment and any further increased water amount for irrigation is big problem with utilization of present irrigation schemes (constructed in period 1950-1970 with crop water demand existed in that period). Better utilization of irrigation water and higher irrigation efficiency is

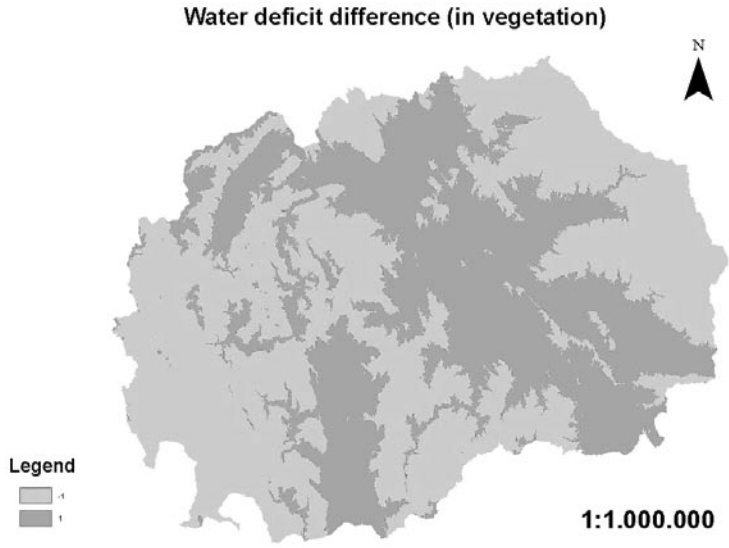
Map 1. Growing season water deficit for Republic of Macedonia in period 1961-1990



Map 2. Growing season water deficit for Republic of Macedonia in period 1971-2000.



Map. 3. Difference in growing season water deficit for Republic of Macedonia between periods 1971-2000 and 1961-1990.



imperative for solving of that problem. Maps 1 and 2 shows that highest water deficit is determined in the following Macedonian regions: North, Central and Southern Vardar Valley, area of city of Skopje, Veles, Gradsko, Kavadarci, Negotino, Valandovo and Gevgelija. These maps define very narrow strips along Vardar and Crna Rivers in the central part of the country (conjunction of these rivers) as areas with higher water deficit in growing season. It is most vulnerable area to climate change. In map 2 for period 71-2000 to this area is added area of very south part of Vardar Valley (Gevgelija). Much bigger areas are defined in second group of vulnerable area. The highest values of water deficit are distributed in all important agricultural areas in Macedonia (Pelagonija, Polog, Tikves, Skopje, Kumanovo, Ovche Pole, Kocani, Stip, Strumica, Gevgelija, Valandovo valley etc.). Map 3 shows that water deficit in growing season increase almost for all important agricultural areas in the country. Decreasing is defined in case of high elevated mountainous areas. These areas are not very important for agricultural production in the country, even though these areas cover big portion of the country.

2.2 Vulnerability assessment

According previous investigation we define that most of important agriculture areas in Republic of Macedonia are vulnerable to climate

changes. Even though we define several vulnerable zones in the Republic of Macedonia:

1. The most vulnerable zone is Povardarie region, especially area of conjunction of Crna and Bregalnica River with Vardar. The most representative meteorological station for this area is Kavadarci.
2. Very vulnerable zones are:
   - Southeastern Part of the country (Strumica)
   - Southern Vardar valley (Gevgelija)
   - Skopje-Kumanovo Valley (Skopje)
   - Ovche Pole (Stip)
3. Less vulnerable zones.
   - Pelagonija Valley (Bitola)
   - Polog (Tetovo and Gostivar – no climate scenario)
   - Big Lake Region (Resen)

The meteorological station in brackets is best fitting station for vulnerable region that was evaluated in Report for Climate Change Scenarios for Macedonia. Defining of most vulnerable crops was determined according cropping pattern in vulnerable areas. The crop that predominate (wit area or importance) in vulnerable regions was determined as vulnerable crop.

Following crops were defined as vulnerable crops:

1. Vine grape as most important crop in Povardarie Region;
2. Tomato as most important vegetable crop in predominantly vegetable growing agriculture in South Eastern part of the country (Gevgelija-Strumica);
3. Winter wheat as most important cereal in Skopje-Kumanovo and Ovche Pole area;
4. Apple in Big lakes region, especially Resen;
5. Alfalfa as crop with very high water demand and huge importance in livestock sector that is vulnerable in all agricultural regions in the country, especially for Bitola area.

3. Adaptation and Mitigation Actions for Crop Production Sector

Climate changes Macedonia will create worse condition for crop production – increased drought (water stress) and increased maximal temperature (heath stress). In order to recommend adaptation techniques, crop production in Republic of Macedonia should be divided in two parts:

- Irrigated agriculture
- Rainfeed Agriculture

Different measures and adaptation techniques should be used for irrigated and for rainfeed agriculture.

3.1 Irrigated Agriculture

Even though more than 120 000 ha of Macedonian agricultural land can be irrigated, in the Republic of Macedonia about 30 000 ha are irrigated in the last several years. Such situation is unfavorable, especially in order to adaptation to climate changes, because irrigation is best available practice for Macedonian agriculture. Building of new irrigation schemes is very expensive and attention should be on rehabilitation of existing irrigation schemes. Building of new irrigation schemes is recommended in order to increase irrigated area and to mitigate drought problem if possible.

Best adaptation strategy for irrigated areas is spreading of water saving techniques in irrigated agriculture in order to maintain same or even bigger irrigated areas with same water amount. Best available practice is application of micro irrigation (90% of WUE – Water Use Efficiency) in comparison with less than 50% WUE in furrow irrigation and about 70% WUE in sprinkler irrigation).

Despite technical rehabilitation and adaptation several important measures should be undertaken in next period. As a first of all it is to determine real price for the irrigation water. Farmers should pay real price for water in order to become more convenient for importance of water sawing techniques.

Increasing of level of knowledge for modern and efficient irrigation trough education of farmers and water users is extremely important. For this purpose UNESCO financed project for establishing of Training Center for Irrigation and Agricultural Water Management, located at Faculty for Agricultural Sciences and Food in Skopje.

Public awareness is one of important issues when changes of present irrigation techniques will take place. Framers should be aware that their yield will be higher, their income will also increase and they will pay less for water if they invest in new micro irrigation equipment.

3.2 Rainfeed Agriculture

The best available adaptation technology – irrigation – is not easily applicable in rainfeed agriculture, because there are not premises to apply irrigation (irrigation schemes, infrastructure etc.). Due to this adaptation technologies should be oriented towards mitigation of negative effects of drought and heath stress on crop development and yield.

Adaptation measures for rainfeed agriculture should be divided in 4 groups:

1. Genetic measures (new more drought tolerant crops and varieties);
2. Land reclamation measures (to increase soil water holding capacity – manure, organic matter increase, some polymers);
3. Agricultural practices (soil and water conservation soil cultivation – reduced tillage, water harvesting, mulching etc.);
4. Irrigation – building of new irrigation schemes, rational use of ground water, waste water etc.;
5. Increased level of knowledge trough education of farmers;
6. Increased public awareness for new adaptation techniques trough public campaign.

4. Conclusion

The paper presents the importance of the agriculture sector in the Republic of Macedonia, the comparative advantages of the country's agriculture, the increased water deficit, as well as the adaptation and mitigation actions for the crop production sector in Macedonia. The vulnerability assessment is done and the vulnerable zones in the Republic of Macedonia are defined. The most vulnerable crops are determined according cropping pattern in vulnerable areas. Different measures and adaptation techniques are listed both for irrigated and rainfeed agriculture.

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COOPERATION AMONG THE HIGHER EDUCATION LIBRARIES: STATUS OF ART AND TRENDS

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Abstract. The paper presents the current status of art and the trends in the collaboration among the higher education libraries. It provides a brief description of the ways of collaboration and their main characteristics. One specific example of collaboration among DEREC consortium libraries and sharing of the DEREC libraries services, as one of the outcomes of the Joint European Project (JEP) TEMPUS titled as Development of Environmental and Resources Engineering Curriculum (DEREC) is presented. Since the very beginning of this project much has been done on this particular field. The cooperation among the libraries of the Macedonian faculties included in the project was strengthened, and a free document delivery and interlibrary loan agreement was signed between the Library of the Faculty of Mechanical Engineering and the Faculty of Electrical Engineering and Information Technologies on one side, and the Library of the University of Florence as a DEREC Grantholder Institution, on the other. The paper gives a short report on the cooperation among the DEREC libraries.

1. *Introduction*

Universities are important not only because of their aim – to educate the future intelligentsia and to develop a scientific research, but also for the fact that they are amongst the rare institutions that have survived and maintained themselves in the western society from the 12th century until the present day. This was achieved thanks to their ability to change and to adapt to the local conditions and situations, without changing their basic mission. Universities are unique in their ability to resist the little and short-lasting society changes from one year's end to another [1].

In parallel with the development of the universities, the higher education institution libraries were developing. They appeared with the modern university in the early Middle Ages, but their parent institutions had generally neglected them until the 18th century and in many cases even later than that [2]. Nowadays, the academic library is known as «the

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heart of the university». It points out the undisputable importance of the academic library. This type of library is defined as an institution whose primary goal is to develop and create collections and resources in all formats in order to support the institutional teaching and research mission. They are the crucial part of scientific and educational infrastructures, because with their collections and services they contribute to the development of science and help improve the educational processes. Their services are intended primarily for the students, the teaching cadre and the researches, but they serve all the members of the wider professional community, as well [3].

Kornelia Petr in her doctoral dissertation comes to the conclusion that the libraries of the higher education institutions until the 60s of the last century reflected the development of the university – the growth of the university meant growth of the library and the stagnation of the university lead to stagnation of the library. Modern libraries, on the other hand, are faced with a lot of problems. According to Petr, not only that they receive much less money than before, but the library material itself is considerably more expensive. The prices of the periodical publications have risen up to 400% in the last 20 years, and the books nowadays have 40% higher prices than 10 years ago. At the same time, the number of publications on the market increases rapidly. This leads to the modern paradox: in the time of the richest offer on the market, the libraries purchase less than ever before. Not to mention all those expenses for space and for the modern technology.

As a result of all these factors, the great change that happened in the 1990s gives priority of providing assess to information, without necessarily owing the source: *Access not ownership*. This change gives the clear picture of the financial state and the acquisition power of the libraries, which continue to strive towards providing quality in their services, using the benefits of the information technology.

The changes in the way of lecturing and the changes in the educational process had a direct influence on academic libraries. Today universities have a lot of so-called «untraditional» students, which would say older students, who have greater demands and bigger expectations. The introduction of distance learning and the focus on the individual work contribute to the changes and the library is forced to follow the trends and the new users' needs.

2. Interlibrary cooperation

These trends and changes, which the academic libraries are faced with, lead to the enormous importance of the collaboration among the libraries.

The cooperation among the libraries is not a novelty – during the past centuries librarians collaborated by the exchange of printed catalogues in order to inform one another about the content and the size of their library collections. In the technology era this kind of cooperation is so much alleviated – new technologies are providing opportunities for further developing of the means of cooperation and today the distribution of information to the ultimate user lasts incredibly short time. With the electronic catalogues owned by almost every modern library, the user has insight into the collections, can browse the collections by certain parameters, make a reservation or order a copy of some material and receive it at his/her home address.

Even the biggest and the most modern libraries in the world are not self-sufficient. In completing the library mission and meeting the user's needs, a library works with other libraries and creates a net of cooperation. There are so many good examples of libraries work together to make information more accessible to the users. The new technologies are providing opportunities for further development of the collaboration processes. And certainly, the professionalism of the library staff and willingness to join forces in order to obtain mutual benefit or achieve common goals is the crucial part in the cooperation.

There are many different types of interlibrary cooperation:

- interlibrary loan;
- document delivery;
- planned cooperative acquisitions of resources;
- consortia acquisitions of electronic publications;
- cooperative cataloguing;
- integrated library systems;
- use of common storage space;
- ideas and knowledge exchange;
- etc.

One of the most important kinds of cooperation is, certainly, the interlibrary loan. The loan encompasses exchange of information about the collections and resources, and the lending/borrowing of materials between libraries. Another important way of cooperation is the document delivery and delivery of electronic copies of books and articles. The supply of loans and copies between libraries in different countries is especially valuable part of the cooperation process.

Planned cooperative acquisitions of resources try to solve the problem of the expenses and to avoid acquisitions of the same or very similar items in libraries which are close to one another, serve the same community or closely cooperate.

Consortia acquisitions are especially used for acquisition of electronic resources, as a result of the continuous raise of the prices and the bad conditions for access and use of electronic resources.

Integrated Library Systems (ILS), or known in the past as Library Automation Systems, are relational databases that offer a set of features including acquisitions, cataloguing, circulation, serials, OPAC etc. Modern integrated library systems represent multi-function information management systems. They help the information flow among the libraries in the system and make the interlibrary loan and document delivery easier. One of the useful and time-saving features in these systems is the possibility of cooperative cataloguing.

The exchange of ideas, knowledge and comprehensions among the colleagues from libraries of the same or different type, contributes to the development of librarianship, and that directly improves the quality of the services that a library provides for its users.

The use of communal space always helps the lack of space problem – the constant problem for nearly all the libraries in the world. Rare are those libraries that haven't had this problem so far. In this case, cooperation of this type is helpful in the way that two or more libraries could use one space for stocking their duplicates or rarely used items.

3. DEREC Libraries Cooperation

With the signing of the Bologna Declaration and the introduction of the European Credit Transfer System (ECTS), the collaboration on university level in Europe is improved, and the collaboration among libraries as well. An impressive number of projects supported this type of collaboration and has made the educational and research process in many universities easier. There are many examples of university libraries working together and cooperating in order to make information more accessible to their users and the communities they serve.

Among the most important projects in Macedonia is the Joint European Project TEMPUS titled Development of Environmental and Resources Engineering Curriculum (DEREC). The two main objectives of this project are to develop a new up-to-date three years undergraduate curriculum in Environmental and Resources Engineering at the Ss. Cyril and Methodius University in Skopje, on the base of the European Credit Transfer System and in accordance with the Bologna System, and to fulfill the conditions necessary for offering a Joint Degree Program in Environmental and Resources Engineering, which is to be implemented jointly on the basis of an agreement between the University Ss. Cyril and Methodius University in Skopje and the University of Florence [4]. The DEREC consortium is consisted of ten faculties from

six universities. Two of the universities are Macedonian – the Ss. Cyril and Methodius University in Skopje and the South East European University in Tetovo, and the other four universities are from Italy – the University of Florence, Greece – Aristotle University of Thessaloniki, Austria – the Technical University of Vienna and Germany – the Ruhr University in Bochum.

This project instigated and supported cooperation among the libraries of the institutions included in the project. It primarily strengthened the already existing cooperation among the libraries of all the institutions from Macedonia which participated in the project – mainly libraries of engineering faculties. Without signing some formal agreements or memoranda, the heads of all these libraries agreed to work together towards achieving of the goals of the project and to share resources, documents and staff, if necessary. Through the Macedonian National and University Library *St. Klement of Ohrid,* all of the faculty libraries cooperate with a lot of other libraries form all over the world, which means that the net of collaboration is even wider.

Regarding the interlibrary loan, a very important moment for our library was the signing of the free document delivery and interlibrary loan agreement between the Library of the Faculty of Mechanical Engineering and the Faculty of Electrical Engineering and Information Technologies on one side and the Library of the University of Florence as a Grantholder Institution, on the other. As one of the outcomes of the DEREC project, the basic goal of signing this agreement for cooperation was to support the environment related study course and to provide the students with information and resources connected to environmental and resources engineering curriculum, but also to provide materials that would support the research in this field. The libraries will cooperate through interlibrary loan, providing bibliographic databases, document delivery service and delivery of electronic copies of books and articles. The collaboration between these two libraries is not an ordinary cooperation – it is a strong partnership with a great motivation for support, mainly because both the libraries would have to serve the same users – the students of the new environmental and resources engineering curriculum.

Right after the signing of the agreement, the librarians of the two institutions started their cooperation and exchanged ideas, visions of further cooperation and data about the collections. The library of the Faculties of Mechanical and Electrical Engineering and IT at the moment is passing through a transitional phase of an automation of all its processes and it recently entered in a regional library system named COBISS (Co-operative Online Bibliographic System & Services) [5] and all the collection is in a process of being inserted in the new data base. Soon, all our stocks will be searchable through the new web-PAC. In the mean time,

lists of the overall collection of periodicals were sent to the colleagues of the University Library in Florence and through their web-PAC we can browse their collections.

4. Conclusion

Besides the problems that can interfere on the way of the cooperation among the academic libraries and which are mainly of technical or financial matter, with the development of the library and information science in our country and the better understanding of the importance of the libraries and its services, more projects of this type – projects that support the cooperation among the libraries, appear. The cooperation between the libraries of different countries is the way to bridge the gap among libraries and to facilitate the information flow.

Even though the DEREC project is time-limited, the cooperation on the library level will continue to exist and to contribute to better education, because the libraries are keepers of knowledge and information and basic promoters of permanent education and information literacy.

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