Engineering Education in South East Europe: University Niš As a Supraregional Academic Education Center For Product Development

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Abstract

After the war in former Yugoslavia until 1999 stability and academic education needed to be reconstructed. This topic has been focused by the DAAD program „Academic Reconstruction South East Europe". It is financed within the Stability Pact for South East Europe. A cooperation between the University Karlsruhe (TH) and eight universities in South East Europe was founded in 2005. The project focuses on a reconstruction and to improvement of the curricula at the partner universities. Therefore a joint education module on product development based on the Karlsruhe Education Model for Product Development (KaLeP) [1] was created and introduced. A supraregional center for product development was built up at University Niš named Machines Development and Construction Center (CERP). CERP is designed to fit the needs of a curriculum according KaLeP and it supports the integration of project work into academic education which leads to the development of key competencies of future development and design engineers. CERP is equipped with team workspaces for student teams to ensure a realistic working environment. Courses of the joint education module on product development based on KaLeP are hold at CERP and students and professors from the partner universities travel to Niš to attend the courses at CERP. CERP is giving students from supraregional universities in South East Europe the possibility to improve their academic education. In this paper the idea of CERP will be presented and the KaLeP-Curricula at CERP will be explained.

Introduction

Today companies all over the world demand for academic graduates with much more than only professional competence. Companies expect engineers e.g. to possess methodological skills, social competence and creativity. In the past academic education focused on teaching technical knowledge, but with changing business environments, engineers and graduates are faced with new work contents and contexts; working in multi-national teams is just one of them. The Karlsruhe Education Model for Product Development (KaLeP) focuses on more than just teaching technical knowledge. It aims on integration of project work into academic education in product development to support the development of key competencies [3]. In addition the situation in South Eastern Europe is special: It is a crisis region seeking for stability and reconstruction since the escalation of Kosovo War in 1999. The Stability Pact for South Eastern Europe was founded to rebuild stability in all areas, including the area of academic education which is a very important aspect. Following aspects have to be taken into account when rebuilding education systems: The rebuilt state of academic education needs to be higher in quality than the former state since situations and expectations of students, graduates and demands of industry are changing. Therefore the approaches of both KaLeP and Academic Reconstruction in South East Europe can be matched perfectly.

STABILITY PACT FOR SOUTH EASTERN EUROPE

The Stability Pact for South Eastern Europe was launched in 1999. As the first comprehensive conflict prevention strategy of the international community it aimed at strengthening the efforts of the countries of South Eastern Europe in fostering peace, democracy, respect for human rights and economic prosperity. The Stability Pact provided a framework to stimulate regional co-operation and expedite integration into European and Euro-Atlantic structures. It is a forum where countries of the region and international actors could sit side by side on an equal basis to identify

common problems and devise shared strategies to tackle them. The broad mandate and the strong international support for the Stability Pact allowed it to convince South Eastern European countries to engage in a wide and articulated regional cooperation program, which brought about both practical benefits and deeper political understanding. [7].

DAAD SPECIAL PROGRAM "ACADEMIC RECONSTRUCTION SOUTH EAST EUROPE "

The German Academic Exchange Service (DAAD) program „Academic Reconstruction South East Europe" has been sponsored within the Stability Pact for South Eastern Europe since 1999. The program „Academic Reconstruction South East Europe" focuses on a fast and sustainable development and enhancement of the academic education in fields which are important for reconstruction of these areas. These fields encompass engineering, mathematics, computer science, agriculture and forestry, health care and welfare, law and economy as well as Europe- and Regional-Studies. Therefore a qualification of trained scientists for universities, economy and public administration is needed. Sponsorships of regional partnerships between universities, scientists and students and of dialogs to overcome ethnic and political borders are aspired to build up a German-South East European network of university cooperations [5].

KALEP - The Karlsruhe Education Model For Product Development

A new approach in engineering design education, the Karlsruhe Education Model for Product Development (KaLeP) was introduced in 1999 [1, 2]. KaLeP combines different types of course settings in a consecutive sequence of classes on increasing levels, each level is oriented towards certain fields of product development-specific knowledge: Mechanical Design I/II/III (concerning systems), Methods of Product Development (concerning tools and methods) and Integrated Product Development (concerning processes). Both the courses Mechanical Design I/II/III and the course Methods of Product Development are mandatory for all students and are attended by several hundreds of students per year (currently 750). The structure of KaLeP is shown in figure 1 and its elements will be explained in the following [6].

Figure 1: Elements of the Karlsruhe Education Model for Product Development

Karlsruhe Education Model for Product Development
KaLeP Elements

	Systems	Methods	Processes
Degree program	Bachelor of Science	Master of Science	Master of Science
Course title	Mechanical Design I/II/III	Methods of Product Development - Design Process	Integrated Product Development
Setting	• lecture • tutorials • project work	• lecture • tutorials	• lecture • tutorials • project work
Key competencies: Level of acquisition	high	medium	very high
Course contents	• design engineering • team work • self organization • communication • idea transfer	• methodological skills • creativity techniques • processes in product development • problem solving methods	• team leading • team development • project management • presentation • moderation
Number of students per year	~750	~400	~40

hanical Design I/II/III:

In the Mechanical Design course team oriented project work was introduced and proved to be a successful means to enable students not only to develop competence regarding machine elements but also to learn how to work and cooperate in a design team. The course Mechanical Design I/II/III is part of the first two years of study for the duration of three semesters. It contains the elements lecture, tutorials and project work. The lecture focuses on theoretical contents of design engineering which will be implemented in the tutorials in example cases. In the project work design teams consisting of five students are set up and all design teams need to fulfill a complex design task with project. Previous tasks have included a ball bearing assembling machine, legs for a humanoid robot and a carousel placed on a car trailer. During the project work in all courses of Mechanical Design I/II/III the teams are coached continuously by faculty staff and experienced and trained student tutors. During these team meetings all students receive individual feedback regarding the individual performance and the team performance. The performance is assessed according to five fields of competence: professional, methodological and social competencies as well as potential of creativity and the ability of transferring ideas. These five fields of competence are shown in figure 2. Recent integral educational approaches [7] emphasize similar skills and competencies required by successfully working development and design engineers [6].

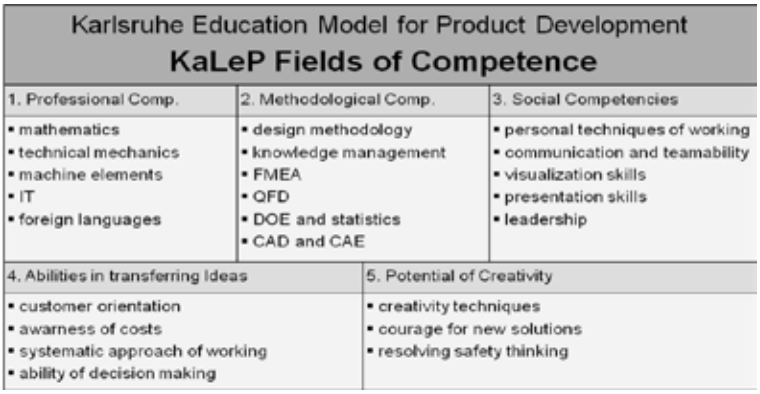
Methods of Product Development – Design Process:

The course Methods of Product Development – Design Process focuses on the methods and processes in Product Development and design processes. Contents are different essential phases within the design process, like clarification of the task, conceptual design and embodiment design. The main components of these phases and appropriate methods to handle the phases are discussed. Strategies for finding optimal designs are given and creativity techniques for the early conceptual design phase are presented. Then design rules for embodiment design and suitable quality assurance techniques for the early Product Development phases are discussed. Also different methods for problem solving are described in detail in the lecture. Thus the students gain an expanded knowledge about design processes.

Integrated Product Development:

The course Integrated Product Development is offered only to a small number of selected students due to the intense coaching in workshops and project work. Product development processes as well as tools and methods to manage these complex processes are discussed in this class. Similar to the course Mechanical Design, the course Integrated Product Development consists of the three elements lecture, workshops and project work. In the project work design teams consisting of six students are set up and all design teams need to fulfill very complex development- and design-task for the duration of one semester. The task in the project work is an assignment of an industrial partner. This ensures realistic development problems and realistic decision scenarios. The project starts in early stages of Product Development, i.e. the identification of market trends and needs and the student teams need to define the market relevant development objectives in the beginning of the project. The development objectives need to be kept updated all the time. The project work is supported by coaching through skilled faculty staff and the team behavior is supervised and observed by psychologists.

Figure 2: Fields of Competence in the Karlsruhe Education Model for Product Development



University Niš As A Supraregional Academic Education Center For Product Development

To reconstruct academic engineering education in South East Europe a cooperation project between the Institute of Product Development at University Karlsruhe (TH) and eight universities in South East Europe was founded in 2005. It is sponsored by the DAAD within the program „Academic Reconstruction South East Europe". Eight universities in South East Europe join the project as university partners with the Institute of Product Development at University Karlsruhe (TH):

Table 1: The partner universities of the South East Europe network

Country	University	Department	Contact
Bulgaria	TU Sofia - Technical University Sofia	FDIBA – Department for German Engineering- and Business Studies	Prof. Dr.-Ing. Ilia Iloyadjiev
Serbia	University Niš	Department for Mechanical Engineering, Chair for Machine Elements	Prof. Dr.-Ing. Vojislav Miltenovic
Serbia	University Belgrade	Department for Machine Elements and Design	Prof. Dr.-Ing. Miodrag Jankovic
Serbia	University Novi Sad	Faculty of Engineering	Prof. Dr.-Ing. Milosav Georgijevic
Republic of Macedonia	University "Sv. Kiril i Metodij" Skopje	Faculty of Mechanical Engineering	Prof. Dr. Tomislav Zlatanovski
Albania	Polytechnic University of Tirana	Faculty of Mechanical Engineering	Prof. as. Dr.-Ing. Andonaq Londo Lamaqi
Bosnia and Herzegovina	University Sarajevo	Faculty of Mechanical Engineering	Prof. Dr. Momir Sarenac
Montenegro	University Podgorica	Faculty of Mechanical Engineering	Prof. Dr.-Ing. Rados Bulatovic

Approach: Joint education module based on Product Development KaLeP

A joint education module on product development in the network of partner universities in South Eastern Europe based on KaLeP was developed and introduced. The modules are set up bilingually in German and English to enable the partner universities to translate the modules into their national language. So the KaLeP idea can be spread out widely in South East Europe and it can be implemented in national degree programs. The South Eastern European universities in Belgrade, Niš, Skopje und Sarajevo took part and successfully implemented the education modules into the curriculum.

Main Result: CERP – Machines development and construction center

The joint education module resulted in the development of a supraregional center for product development to be based at the University in Niš in Serbia to be called CERP. At CERP courses from the joint education module on product development based on KaLeP are offered at one specific location in South East Europe. Students, staff, faculty and professors from the other partner universities of the network in South East Europe can take part in these classes held at CERP. Block courses are scheduled at CERP in Niš to fit the partner universities schedule and curricula, then both teachers and students from the partner universities travel to Niš for the courses. For conducting the project work within the courses of the joint education module on product development based KaLeP CERP was equipped with team workspaces for the student teams. The team workspaces provide full equipment of IT-infrastructure and relevant software for the student's projects. Impressions of the team workspaces are captured in following figure.

Figure 3: Impressions of the newly equipped team workspaces at CERP

Introduction of KaLeP: Integrated Product Development at CERP

CERP was founded at the Department for Mechanical Engineering at University Niš under the direction of Prof. Dr.-Ing. Vojislav Miltenovic in 2006. First the KaLeP course Integrated Product Development was offered in a cooperation project with University Karlsruhe (TH) where first success of CERP could soon be achieved and monitored. Contact and communication possibilities were established between CERP and University Karlsruhe (TH) to enable exchange of information between the Serbian and German students and the faculty staff. There were regularly monthly telephone and video conferences to control and supervise the progress of the project. For the start and the end of the project joint meetings and presentations were arranged. Students, faculty staff and industrial partners from Germany and South East Europe came together at CERP and University Karlsruhe (TH). The project work was completed successfully by all participating student teams. They fulfilled the educational and the technical objectives pointed out in the beginning. CERP gained publicity and the general public in Serbia showed great interest in the Integrated Product Development project: The state-run television as well as several regional television stations and the print media reported on CERP, the project and the results in detail.

KaLeP-Curriculum at CERP

An overall curriculum for a Master of Science degree due to the Bologna process was set up to meet the joint education module on product development based on KaLeP and to fit the South East Europe network partner universities requirements and possibilities. Five master modules have to be fulfilled by the participating students. One of the Master of Science degree modules is named “Mechanical constructions, development and engineering” and it focuses clearly on the education of product development. A maximum of 25 students from all over the university network will be admitted to participate in this module. In total the module stretches over a period of time of two years to cover four semesters of study. The module curriculum consists of five obligatory subjects, nine elective subjects, a company internship and a final master thesis. The courses are: Computer Aided Product Development, Systems Modelling and Simulation, Structural analysis of Mechanical Systems, Systems Quality, Basics of Product Development, Methods of Product Development, Integrated Product Development and Industrial Design.

Summary

The work within the network between the Institute of Product Development at University Karlsruhe (TH) and its eight partner universities in South East Europe sponsored by the DAAD within the program „Academic Reconstruction South East Europe” was successfully completed: The idea of KaLeP was successfully implemented into the idea of academic reconstruction. Based on a joint education module on product development based on KaLeP the Machines Development and Construction Center (CERP) was founded at the University Niš in Serbia. CERP offers courses from the joint education module on product development based on the Karlsruhe Education Model for Product Development (KaLeP) at one specific location in South East Europe. Students, staff, faculty and professors from the other partner universities of the network in South East Europe get the opportunity to implement the KaLeP courses in their curriculum. By combining the idea of KaLeP and the idea of academic reconstruction in South East Europe great opportunities are established for engineering education in product development.

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