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Improvement of Product Development Studies in Serbia and Bosnia and Herzegovina

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UNIVERSITY OF MOSTAR

FACULTY OF MECHANICAL ENGINEERING AND COMPUTING

REPORT

Education in the field of Industrial Product Development and Management of Product Development & Innovation Management

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INTRODUCTION

University of Mostar (SVEMO) is a higher education institution formally established in 1976. but it's origins reach back to 1895. (from the Franciscan School of Theology – the first school at a university level in Herzegovina founded in Mostar). It is student-oriented and research-oriented higher education institution with a fundamental responsibility for the social and cultural development of individuals in preparing their future roles in society. Through research it contributes to the expansion of knowledge to society particularly via the development and implementation of new scientific achievements and technologies. SVEMO consists of 11 Faculties, 6 Institutes, Students Hostel, University Sports Facilities and University Library. University of Mostar realizes study programs on Bachelor, Master and Doctoral level, which are harmonized with the principles of Bologna declaration, with nearly 4000 new students per year.

History of the Faculty of Mechanical Engineering and Computing in Mostar started in 1959, when it was established as a High Technical School of Mechanical Engineering. The original motive for which the school was established was a wish to enable students to be educated in technical engineering in Mostar and in Herzegovina, to create a nucleus of scientific thought and to enable new knowledge transfer to economy in this especially important geographical-economic region of Herzegovina. Led by these ideas, the school lived and passed through many transformations, and in 1976 it became an independent faculty within the University of Mostar.

Aware of the fact that the educating system is closely related to technical development as well as to social changes which are permanently happening in the world, the Faculty started a new part in its history in the academic year 2002/2003. Together with the Faculty of Mechanical Engineering a Computing study started, and the faculty was named the Faculty of Mechanical Engineering and Computing, University of Mostar. Today, when we live in a technologically dependent world, appropriate and timely made harmonization of higher education to the needs of society in general is of great importance. Respecting the principles of the Bologna declaration, we are trying to meet the challenges of the future.

The mission of Faculty of Mechanical Engineering and Computing is based on two basic features of all institutions of higher education:
– education, trough the teaching and trough the research process students, and the existing higher education personnel in all areas of teaching that exist at the Faculty, so that they can be productive in their current and future activities,
- scientific and research work – continuous monitoring and improvement of scientific and research work at the Faculty; training and inclusion of the larger number of young people in this process, linking Faculty with the environment.

Taking into account the fact that the Faculty of Mechanical Engineering and Computing operates in the wider region, its mission is also to help the economic, social and cultural development of the region, providing professional and scientific support.

STATE OF PRODUCT DEVELOPMENT AT FACULTY OF MECHANICAL ENGINEERING AND COMPUTING

Mechanical Engineering study is harmonized with provisions of Law on Higher Education, by which it is determined to be adapted to Bologna process and to value student's work in accordance to ECTS. It is organized in accordance to the principles of Bologna declaration on three levels:

- Bachelor degree studies,
- Master degree studies and
- Doctoral studies.

Bachelor degree study of Mechanical Engineering lasts for 3 years (six semesters), and there are 33 obligatory courses and 2 elective courses that all B.Sc. students have to pass. Students can achieve 180 ECTS points. The first four semesters are common for all modules of Mechanical Engineering. In the fifth semester students, according to their own interests, choose one of the following modules:

- Production Engineering
- Construction Design
- Industrial Engineering and Management
- Mechatronics
-Security and Safety.

During the VI. semester on bachelor degree level, students are required to do practice in industry for a period of one month (182 hours). The department for Constructions Design provides practical work in design departments of regional companies, as much as possible within the cooperation with regional companies.

ECTS points are assessed by methods which varying according to the nature of the courses (most courses combine continuous assessment, such as seminars, projects, lab work, orals and written examinations etc.).

Students who successfully complete the Bachelor degree can be enrolled in Master degree studies for the Master of Engineering. Master degree studies last for two years (four semesters) and there are 17 obligatory courses and 4 elective courses. Students can achieve 120 credits. Modules on Master degree are identical to modules of Bachelor degree studies. Each of the offered five modules of study has its own characteristics and role in the industry development, and thus society. During the II.semester on master degree level, students are required to do practice in industry for a period of one month (182 hours). The department for Constructions Design provides practical work in design departments of regional companies, as much as possible within the cooperation with regional companies.

Doctoral studies lasts for 3 years (six semesters), during which students can achieve 180 credits. The new doctoral study acording to Bologna declaration started in 2011. with 16 students. In 2012. there were no new students in doctoral study.

The module of Product development at the Faculty of Mechanical Engineering and Computing, University of Mostar has not been defined as an independent entity, however there are two courses directly related to product development – Methodical Design (bachelor level) and Computer aided Integrated product Design (master level), and product design is partially represented in a lot of modules of Mechanical Engineering Study, especially in those of Construction Design module.

Construction Design module deals with the design of products, machinery and equipment through several interconnected stages of task clarification, conception, embodiment to realization. Construction Design includes knowledge of creative engineering activity and represents bridge between science on the one hand and the practical realization of the other. Methodical and technological specialties, the application of modern computer techniques and particularly methods of artificial intelligence are features of the modern design process.

In design process it is necessary to consider all valid solutions through which optimization leads to the realization of the optimal product, machine or device. Education in this module involves the acquisition of theoretical knowledge and practical skills necessary for a detailed static and dynamic analysis of structures, stress analysis and structural design of components, methodical design, development and implementation methods of computer aided analysis and design - applying CAE / CAD / CAM technology.

Students are also introduced to methods of experimental stress analysis, testing of dynamic characteristics of structures, machines and mechanisms, as well as engine and motor vehicles. Students who successfully complete the module of Construction Design are able to connect basic knowledge and procedures and methods of product and machinery design. He or she can work as a designer in the production of machinery, constructions, cranes and elevators, engines and vehicles, transportation equipment, and also in field of the maintenance and exploitation of machinery, equipment, and technical devices.

Table 1 presents an overview of obligatory courses related to product design at the bachelor and master degree studies.

The obligatory courses in bachelor degree module Construction Design offer a solid basis for systematic approach in product development process. The elective courses depend upon personal interests of students. Through these courses students are able to gain theoretical knowledge and competences in methodology of product design and development.

***Table 1**. Selected courses related to Industrial Product Development – University of Mostar, Faculty of Mechanical Engineering and Computing*

COURSES				
BACHELOR DEGREE STUDIES				
Title of courses	Semester	Number of hours/semester		Credits
		L	W/E	
Engineering graphics and CAD	1	2	3	4
Technology and society	1	2	0	4
Basics of Management	2	2	1	4
Mechanical elements I	3	3	2	6
Strenght of Materials	3	3	2	6
Mechanical elements II	4	2	2	6
Technology II	4	3	2	6
CAD-Computer aided design	5	2	2	4
Mechanism design	5	2	2	5
Strenght of construction	5	2	2	4
Methodical design	6	2	2	5
MASTER DEGREE STUDIES				
Optimization of construction	1	2	2	5
Numerical methods of construction analysis	1	2	2	6
Computer aided integrated product design	1	2	2	5
CAD/CAM systems	2	2	2	4
Project management	3	2	2	4
Design for manufacturing	3	2	2	5
Industrial design	4	2	2	6

The course Methodical design (VI. Semester on bachelor degree study) is directly related to Product Development. The aim of this course is to introduce the basic concepts of the theory of product, theory and technology of design process to students, in order to acquire the knowledge required at all stages of product development.

Content of course *Methodical design*:
Why study the design process? Product development teams and team work. Types of constructions. Methodology of product design. Engineering specification. Concept generation. Concept evaluation. Embodiment design. Intelectual property.
The course is organized through lectures (30 hours) where students acquire theoretical knowledge in this domain, and exercises (30 hours) where students work on product development projects.

The course *Computer aided integrated product design* (I.Semester on master degree study) is directly related to Product Development. The aim of this course is to enable students to develop their skills in the application and integration of theoretical knowledge and practice acquired in related technical courses and industrial practice in order to:

- enable them to learn the strategic aspects and integration processes of product and process design of new products;
- enable them to apply appropriate methodologies and software tools that are involved in the development of products and processes.

The course is organized through lectures (30 hours) where students acquire theoretical knowledge in this domain, and exercises (30 hours) where students work on product development projects.

Content of course Computer aided integrated product design:
Introduction to simultaneous engineering, definitions, requirements for success. The modern approach to engineering, integration, globalization, rapid growth and development. Methodology of integrated product and processes development. Model of product development. Model of development of the manufacturing process. Multidisciplinary teams to develop products and processes. Development phases. Designing products, steps and tools. QFD method. Rapid prototyping. Integrating industrial ecology into integrated product development. The introduction of integrated product development to the small and medium companies.

Figure 1. Students on lecturing

Neither the bachelor degree studies or master degree studies have elective courses studies directly related to Product Development, Management of Product Development & Innovation Management.

None of the courses on doctoral level is directly related to the Industrial Product development and Management of Product Development & Innovation Management, but it is incorporated in some courses, such as:

- Theory of construction
- Product design and ergonomy
- CAD/CAM
- Computer aided design of engines and vehicles
- Design evaluation methods
- Optimization of construction
- Artifical inteligence in design

CONCLUSION

Analysis of the current state of education in the field of Product Development and Management of Product Development & Innovation Management (PDMPD&IM) at the University of Mostar, Faculty of Mechanical Engineering and Computing shows the following:

For bachelor degree students, the product development is most involved in the module Construction Design, where they have enough opportunities to learn fundamentals of product design and development through the courses presented in the Table 1. Some of the these courses could be improved by implementing new teaching methodologies, introducing new teaching materials (handbooks, power-point presentations etc.), new workshops, new lectures in relevant domains etc., and also by equipping laboratories with modern equipment in order to improve research in a field of new technologies.

There is still no clearly defined study program or even module which would be exclusively dedicated to Industrial Product Development and Management of Product Development & Innovation Management. There is a space for improvement of the current state in this field.

Beside the course Computer aided integrated product design, some master degree study modules include some courses in the field of Product design and Project Management (Table 1). Some of the current courses could be additionally improved by implementing new teaching methodologies, introducing new teaching materials (handbooks, power-point presentations etc.), new workshops, new lectures in relevant domains etc.

There are no obligatory courses on Doctoral degree studies strictly defined and named as PDMPD&IM, but it is incorporated partially through courses mentioned above.
All analyzed courses are well harmonized with the principles of Bologna declaration and promote the importance of product design for future development of mechanical engineering.