



University of Niš

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Improvement of Product Development Studies in Serbia And Bosnia and Herzegovina

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Faculty of Mechanical Engineering



Tempus

REPORT

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

University of Niš (UNI) was established in 1965. UNI consists of 13 faculties with 1480 teachers and 630 non-academic staff, with 28660 students. From the establishment until today, 53069 students graduated, 2462 students got their master degree and 1345 acquired PhD. As the only university in the area of southeast Serbia, UNI has become a promoter of the educational, economic, social and cultural development of the entire region, providing scientific and technical support, as well as establishing of intellectual and cultural links with the world. Alongside with the realization of these tasks on its way to the academic development, UNI has created a rich tradition within the academic milieu of Serbia and Balkan. UNI has significant experience in education in the field of Industrial Product Development. Education in field of product development is primarily provided by Faculty of Mechanical Engineering.

Industrial Product Development

Faculty of Mechanical Engineering established the new educational model in field of Industrial Product Development since 2005. The new education model is based on KaLeP (The Karlsruhe education model for industrial product development) developed at Institute for Product Development of Karlsruhe Institute of Technology, but takes into account cultural and social characteristics of Western Balkans Countries region and previous experience in product development education. Implementation of new education model was preformed through several subjects related to product development education already existing in the curriculum of Mechanical Engineering Faculty, University of Nis since year 2005.

Table 1 gives an overview of directly and indirectly related subjects to the core module "machine design and product development" at the bachelor (BA), master (MSc) and doctoral (PhD) studies in which the implementation of the new educational model was performed.

In order to prepare future engineers to their industrial positions a special focus is given to subjects that offer a broad basic understanding of development-related aspects. The basic subjects in the bachelor degree program "machine design and product development" represent an ideal base for a structured and methodical development of products. The electoral subjects depend of personal interests and

preferences of students. Theoretical education is contributed with practical experience and this knowledge is implemented during seminars and praxis with real examples from industry.

Table 1. Selected subjects related to Industrial Product Development from curriculum of University of Niš – Faculty of Mechanical Engineering

| Subject | Sem. | L/W/E/P | Credits |
|--|------|---------------|---------|
| Bachelor studies | | | |
| Strength of Materials | 2 | 2.7/0/2.7/0.6 | 6 |
| Material Science | 2 | 1.8/0/2.6/0.6 | 6 |
| CAD and Technical Drawing | 2 | 2.7/0/2.7/0.6 | 6 |
| Machine Elements 1 | 3 | 2/0/2/0 | 5 |
| Machine Elements 2 | 4 | 2/0/2/0 | 4 |
| Machine Elements 3 | 5 | 2/0/2/0 | 6 |
| Basis of Design | 4 | 2.6/0/1.8/0.6 | 6 |
| Virtual Design | 5 | 1.8/0/2.6/0.6 | 6 |
| CAD - Geometric modeling | 5 | 1.8/0/2.6/0.6 | 6 |
| Master studies | | | |
| CAPD - Computer application in product development | 1 | 2.6/0/1.8/2.4 | 6 |
| Modeling and Simulation | 2 | 2.6/0/1.8/0.6 | 6 |
| Finite Element Method | 2 | 2.8/0/1.8/0.6 | 6 |
| Tribology | 2 | 2.6/0.6/1.8/0 | 6 |
| CAD/CAM/CAE | 3 | 2.6/0/1.8/0.6 | 6 |
| Basics of Product Development | 3 | 1.3/1/0/2.7 | 6 |
| Methods of Product Development | 3 | 1.3/1/0/2.7 | 6 |
| Integrated Product Development | 3 | 1.3/1/0/2.7 | 6 |
| Doctoral studies | | | |
| Virtual Product Development | 2 | 3/0/0/3 | 10 |
| Integrated Product Development | 2 | 3/0/0/3 | 10 |
| Simulation in Product Development | 3 | 3/0/0/3 | 10 |
| Project Management | 3 | 3/0/0/3 | 10 |
| L- lectures, W – workshops, E – exercises, P- practical work | | | |

The courses integrate theoretical and methodological knowledge aimed to make a decisive contribution to the promotion of theoretical and methodological competence. Courses programmes are designed to promote the development of creativity and the potential to elaborate by combining the lecture with independent development work of the students.

The main lectures related to education in field of Industrial Product Development according to KaLeP are located in the third semester of Master studies. Those courses are organised as one large integral divided into three different components:

- Lectures,
- Workshops, and
- Student work on development project.

These components cover different educational goals. The lecture, always the major component of the education concept, provides the theoretical fundamentals for both the other educational components. Purpose of other components is to enable students to in practice implement their knowledge because in that way best education results are achieved.

Lectures

In Lectures students are introduced to product development of industrial enterprises with particular reference to the requirements of small and medium sized companies. Based on practical experiences and examples from industry, the theory of planning, design, cost control and management of the development and innovation process knowledge is introduced and discussed. Problem solving processes, system analysis, team leading, product lifecycle and development strategies are presented and discussed, as well. Students are taught how to define profile of the product and product concept from ideas and how to efficiently evaluate different concepts and variant solutions.

During lectures teacher actively communicate with the students by discussing of all the topics presented during lectures. The lecture is designed for a limited number of students (maximally 30) to ensure interactive contact of professor and students.

This offers the possibility of teaching in discursive form with the use of multimedia tools to aid better presentation of the subject. If necessary the official time allotted to lecture is relaxed to enable open-end discussions.

Teaching process must be in accordance with development project and effectively accompanies phases of the student's development project.

Workshops

In the workshops knowledge is actively built up and developed with the first real application experiences. This is achieved through:

- A direct and practical translation of the learnt methods directed to the industrial product development process.
- Simulation of team work during solving of practical problems on the workshop.

A total of 13 Workshops cover and expand knowledge in the following topics:

- Team processes,
- Product lifecycle,
- Project management,
- Definition of product profile, check list, design process,
- Presentation technique,
- Evaluation of concepts and variant problem solution,
- CAD,
- Simulation,
- Organisation processes in enterprises, procurement process
- Validation of mechanical systems.

Certain workshops are led by guest professors and industrial engineers, depended by topic covered by a workshop. Guest professors are often presenting via audio-video link which enable engagement of international leading experts which significantly improve quality of the course.

These workshops are set up to deepen and extend knowledge and are not used for the direct concurrent support of the student project work.

Student development project

The aim of student project is the development of realistic industrial product from product profile up to the virtual prototype (3D-CADModel) or from the idea up to the validation of manufactured prototype (Fig. 1) by independent student team.

Provider of the development task is always an industrial company which defines either the development area (if projects start from product profile) or an idea (if project starts from the idea). The number of participants in the project work, and by that in the course, is limited to 30.

The project work is so extensive, that it can only be solved by division of labour within the team.

On project start, based on set of predefined tests, course professor and his assistants select candidates for the course. Teams are formed by course professor based on the results which determine personal profile of the students from the aspect of team work.

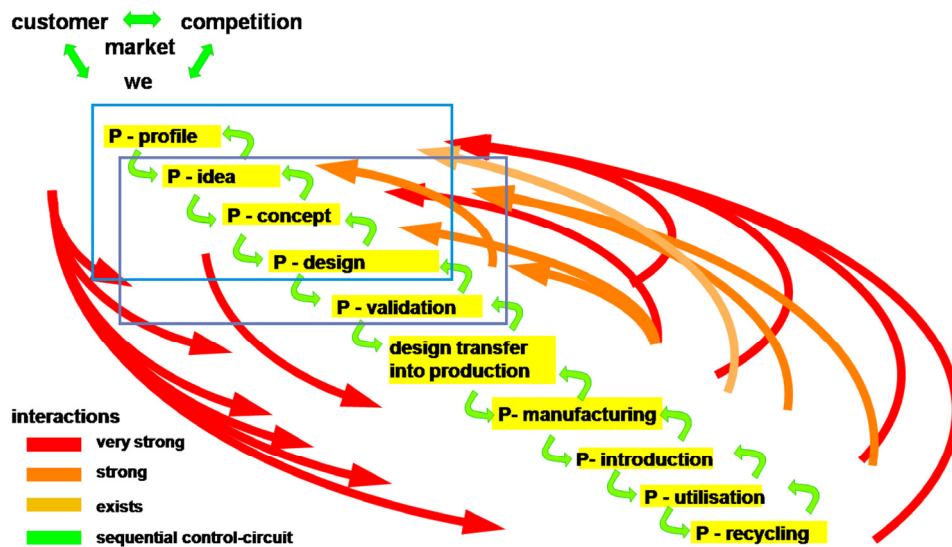


Fig. 1. Two variants of the development project: from product profile to virtual prototype and from idea to validation of actually manufactured prototype

Students work in the simulated environment of the mid-sized enterprise in which the virtual management is composed of course professor, his assistants, project sponsor representatives and guest professors. Management role is to ensure all resources needed for successful project work as students are actually employed in mid-sized enterprise. Student teams are located into separated virtual offices in which they dispose with all hardware and software tools necessary for project work. Students have to think about the whole project when they generate a solution for a small part, they have to think about system correlations and interfaces and the problems that they have to solve are mostly evolved from the project itself and not given in the task itself. So they get a very high self-reliance of their learning process and the motivation for understanding and learning is quite high. This requires a bigger autonomy of the students than a “classical” way of education as it is practiced in most fields of academic studies, but it gives the students the best chance to understand the things they are learning. The basic task of management is to control and evaluate student’s project work. The project is divided into four phases. At the end of each phase a milestone is predicted in which students present their project work to virtual management which decides on future course of the project based on these presentations. On the project end student teams present the whole development project to virtual management and representatives of regional industrial companies. In certain cases the management awards prizes for the best solutions. Each team makes an evaluation of their group performance and their individual team members in a feedback briefing. The results are handed to the management for an assessment.



Fig. 2. Final project presentation

Based on assessment of virtual management and student's engagement on lectures and workshops, the work, knowledge and degree of understanding of course problematic of individual students is evaluated. In that way, students are evaluated not only by course professor and in that way additional objectivity is added to evaluation process.

Management of Product Development & Innovation management

Currently, University of Niš does not offer the curriculum in field of Management of Product Development & Innovation management. Although Faculty of Economics provides a broad education in Management fields since the beginning of university education in Niš, it was not directed towards education in management as an engineering discipline.

Since 2012, Faculty of Mechanical Engineering provides education in Engineering Management at Bachelor and Master level. Again, the of Management of Product Development & Innovation management are not in focus of engineering education. There are some subjects in curriculums (Table 2) essential to education in field of Management of Product Development & Innovation management but the key subjects/topics are missing. Another problem is that the subjects are distributed over several modules so the students can not pursue education in above mentioned field.

Table 2. Selected subjects related to Management of Product Development & Innovation management from curriculum of University of Niš – Faculty of Mechanical Engineering

| Subject | Sem. | L/W/E/P | Credits |
|--|------|---------|---------|
| Bachelor studies | | | |
| Management basics | 2 | 3/0/2/0 | 7 |
| Economics of enterprises | 3 | 2/0/2/0 | 6 |
| Marketing | 3 | 3/0/2/0 | 7 |
| Management of human resources | 4 | 3/0/2/0 | 6 |
| Basics of finance | 4 | 2/0/2/0 | 6 |
| Strategic management | 6 | 3/0/3/0 | 8 |
| Business law | 6 | 3/0/2/0 | 4 |
| Industrial management | 7 | 3/0/2/0 | 7 |
| Management of investments | 7 | 2/0/2/0 | 6 |
| Project management | 7 | 3/0/2/0 | 7 |
| Basis of design | 6 | 3/0/2/0 | 7 |
| Master studies | | | |
| Product management | 1 | 3/0/2/0 | 7 |
| Methods and techniques of project management | 1 | 2/0/2/0 | 6 |
| Management of projects and investments | 2 | 3/0/2/0 | 6 |
| Knowledge management | 2 | 3/0/2/0 | 6 |
| Process management | 2 | 3/0/2/0 | 6 |
| Methods and techniques of human resources management | 2 | 3/0/3/0 | 6 |
| L- lectures, W – workshops, E – exercises, P- practical work | | | |