

## ENHANCING EDUCATION QUALITY AT TECHNICAL UNIVERSITIES THROUGH THE WAY OF SPECIALISED LABORATORIES BUILDING

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**Abstract:** The article presents selected approaches to the modernizing of a technical higher education at the Department of Automation and Production Systems of Faculty of Mechanical Engineering of University of Žilina with the main goal to increase the both theoretical and practical knowledge levels of graduate students and to raise their competitiveness in the labour market. The article is aimed at modern means supporting higher education process in the field of automation of mechanical engineering production. The main attention is paid to new department's laboratories: the laboratory of automation of production processes by robots built as an integrating basis for learning several specialized subjects and the laboratory of CNC machines programming. Both laboratories are utilised for intensive tuition in the framework of bachelors' and masters' programmes and also for the solution of research tasks.

**Keywords:** technical university education, specialized laboratory workplaces, robots and CNC machines programming, multimedia, E-learning.

### Introduction

The problem of high unemployment of young people in Slovakia is still current. Failure of graduates to find a job is influenced by three possible reasons:

- Redundancy of our graduates (higher offer than demand),
- Lack of practical experiences of graduates,
- Regional problem.

Although the graduates of technical universities are now much more applicable to the labour market as three - four years ago, the problem of inadequacy of their practical experience still remains. Therefore our University of Žilina and of course our Faculty of Mechanical Engineering (FME) support the trend in building the excellent research centres and specialized laboratories and also interconnection

educational process with industrial practice. These activities have created better conditions for increasing of university teacher's expertness and for students a better access to new advanced technologies. This was also reflected in the evaluation of Slovak university's faculties by Academic Ranking and Rating Agency (ARRA) in November 2014 where our FME ranks second position among the 24 evaluated technical faculties [1]. On the other hand, the ability of FME's graduates to be successful on the labour market is not as good as we wished ourselves. The survey of employers' interest in university graduates done by *Profesia.sk* in June 2014 [5] and based on a criterion of number of views CVs of jobseekers by employers show the follows:

- University of Žilina is the 3rd most attractive university among 10 Slovak universities,

- Faculty of Mechanical Engineering of University of Žilina ranks the 11th position among 20 Slovak university faculties,
- The 5th most requested profession is machinery industry,
- Students who have completed higher education in the Žilina region are on the 2nd position of the employers' ranking interest.

Results of the survey showed that FME's graduates have a good chance to be successful in the labour market if they demonstrate sufficient professional knowledge, creative - thinking ability and professional skills for the required job position. Our task is to create all conditions for obtaining these abilities. Higher education in Slovakia is currently undergoing the accreditation process. The level of modernization of laboratory equipment is one of the important evaluation criteria for technical universities. Therefore the activities of the Department of Automation and Production Systems in last five years were aimed at innovation of our laboratories and creating supportive educational materials in the form of multimedia programs and E-learning's lectures too. The main goal was to enhance attractiveness of our study program for students and also interest about our graduates from employer's side too. Today employers in automotive and machinery industry need graduates which can innovate the production process and apply the newest technologies to achieve rapid, high-quality and flexible production [6]. Therefore the long-term plan for the Faculty of Mechanical Engineering's development for the period 2014–2020 [4] is based on the interest in supporting such education which can flexible adapt to not only current but also forecasted requirements of industrial practice. There the key task is to give expert knowledge and skills to students through the use of faculty resources [9] which also include building of specialized laboratories equipped with modern technologies. Such laboratories should allow:

- Supporting of research's development and transferring of obtained new knowledge into educational process.
- Creation of model scenarios for solution of chosen problems of industrial practice directly in the laboratory,
- Involving clever students into research in framework real research projects solving.

All these possibilities create better conditions for enhancing quality of graduate's theoretical knowledge and practical experiences.

### **The strategy of the Department's laboratories building**

Department of Automation and Production Systems (DAPS) is one of the ten departments at FME of University Žilina. DAPS guaranties the study programme "Automated production systems" that is aimed to: the problems of automation in machinery, automotive and other industries, the application of CA systems in pre-production, production and post-production stages of the part realisation and the creation of control systems for automated production systems. For about 10 years ago DAPS made the decision to start upgrading of theirs existing laboratories, respectively building new laboratories to reflect current and predicted demands of industrial practice. The attention was focused on creating a pleasant working environment for the department's staff and students and obtaining modern production machines and robots, including the corresponding computer equipment and software and didactic technique too. This strategy has been gradually step by step fulfilled by using the funds obtained in the framework of research projects solved at the DAPS and partially with the financial support of the FME's Dean. Currently, our students can benefit from the several laboratories of modern type.

### **Laboratory of CNC machines programming**

The laboratory was built to allow students to obtain practical experiences and skills with NC machine tools programming. Laboratory is equipped with 10 PC stations, two CNC machine tools for turning and milling technologies performing: EMCO ConceptTurn 55 and EMCO ConceptMill 105 (Fig. 1). Control software EMCO WinNCSinumerik 840D is also available on each PC station. Laboratory equipment has been completed by 3D printer – Easy 3D Maker two years ago. The laboratory integrates teaching of subjects as follows:

- automation of technological processes,
- programming of production machines and

- automation of the product technological preparation.

For teaching of these subjects multimedia educational programmes, educational texts, didactical aids and web applications were created. All these materials are available to students, either directly in the process of teaching in the laboratory or at the Faculty website in the framework E-learning courses [2, 3]. It means that students can study the actual issue when they want individually and repeatedly and apply their knowledge to solve the projects during the whole actual term. Created educational materials represent a large amount of files that need to be completed and

updated continually. That is why the independent educational portal is now prepared at our DAPS. The goal of its creation is to create the better conditions for its further developing and expanding by the latest gained knowledge and practical experiences without a restriction for the loaded files size what is our actual problem for the files stored at the Faculty website. This educational portal will include systematically organized and professionally supervised information on programming CNC production machines and will serve better education for students of both presence and distance learning forms.



Fig. 1. Laboratory of CNC machines programming

### **Laboratory of production processes automation with robots**

Primarily the laboratory was built for the purpose to present the ways of automation of the product assembling process (see Fig. 2) with utilisation of industrial robot Fanuc LR MATE 200iC, designed single-purpose assembly unit and other simple auxiliary devices for achieving a fully automated operation of the workcell except the gravity storages fulfilling with mounted parts. But currently in the laboratory conditions for the robot Fanuc repeatability measuring are prepared. The research of the issue of the human-robot cooperation in product assembly process is preparation too. Laboratory workplace is also equipped with PC station with offline programme Fanuc Roboguide v. 8 -

HandlingPRO and its other extension option - AutoPlace v.8. This programme enables to verify the proposals of automated workplace equipped with Fanuc robots by simulation and to generate robot control program for the real automated workplace application.

The laboratory integrates teaching of several subjects which are aimed at:

- automation of a product assembly by robots and manipulators,
- control systems designing for automatized production systems,
- robot online/offline programming (see Fig. 3),
- application of safety systems for automated workplaces.

For these purposes lectures and study materials have been created. They are available for our students in the framework the educational E-learning courses at the Faculty website in

electronic form [8]. Verified methodological steps of the automated workcell designing and practical experiences with the laboratory

workcell building have already been implemented in the process of tuition.



Fig. 2. Laboratory workplace of automated assembly



Fig. 3. Fanuc robot online programming



Created laboratory workplace including newly-created study materials covers the issue of production processes of automation, especially of the assembly process automation, with focusing on [7, 10]:

- methodical steps of automation of a product assembly with robots application,
- utilisation of computer aid in an assembled parts production preparation,
- simulation of the working cycle of assembly robot in virtual environment of CAD/CAE systems or offline program and
- control systems and safety operation of automated workplace.

By this way the laboratory workplace integrates the base areas of solution of the automated assembly systems designing. The possibility of confrontation of theoretical knowledge and the real application in laboratory of automated assembly allows students to understand better the issues of the product assembly automation. Then the students can approach more creatively to the seeking better solutions of their term projects. The laboratory supports also the

department research activities and the students at all academic levels can participate in solving of the research subtasks.

## Conclusion

The paper presents two of specialised laboratories of the Department of Automation and Production Systems which were built to enhance educational process quality and to make it more attractive for students of study programme Automated Production Systems. Technical and software equipment of both laboratories allows students to use real machines, advances software and the latest information technologies for the industrial practice tasks solving. This way our graduates can have a better start position at the labour market. Moreover, the possibility to work in these laboratories is also interesting for foreign students which complete their short-term study stays at our DAPS under the Erasmus or other study students exchange programmes.

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