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The Importance of New Technologies in The Education and Professional Development of Future Engineers in The Technical Profession

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***Abstract*:** *We live in a time characterized by rapid technological changes in almost all spheres of life. Education must therefore be much more flexible and open to all the challenges of the 21st century. Modern educational information and communication technologies introduce innovations in the way of implementing the teaching process in order to overcome many shortcomings and in the function of modernizing education. One of the goals of modern university education is to connect formal (university education) and informal through the acquisition of applicable professional knowledge and skills through the student's work on practical problems in companies. With this combination, students who choose it, get both theoretical and required practical knowledge and skills. Applying the dual principle in the modernized system of higher professional education in Serbia will be of key importance in attracting employers and companies, as well as introducing support mechanisms that would ensure the quality of the learning process in both learning environments. At the Technical Faculty "Mihajlo Pupin" Zrenjanin, University of Novi Sad, Serbia, students' professional practice after the third and fourth year of study has been conducted for many years. This paper analyzes the role of new technologies, engineering, and other communication in the work of students of our faculty and future engineers, in solving specific problems in the industry. Also, the importance of lifelong education is highlighted as one of the elements supporting the need to introduce some modern forms of learning.*

Keywords: *Education, Computer Aided Design (CAD), Internet of Things (Iot), Industry, Professional Practice*

1. Introduction

At the beginning of the 21st century, many previous understandings about the need for new knowledge and the way to acquire new knowledge are being seriously tested. At this time, knowledge is becoming the most important resource of every nation and state, and investing in knowledge is the most profitable investment. Knowledge is acquired through education, and the highest education level occurs at faculties. The entire education system, from elementary to high school, should be harmoniously connected and present individual stages adapted to each age. [1]

Mechanisms must be incorporated into the education system to permanently review, update and modernize the program contents. The determinants of the new educational system are computerization, the Internet, and distance learning. Changes in approaches traditionally used to solve engineering problems are also inevitable.

Education must follow the world's innovation trends by forming a new profile of experts who are trained to work independently, to select and find information, process it, and use it. Serbia, as part of Europe, must not remain isolated. What has been started in the world in the field of education and development and improvement

of education should not be stopped but should be accepted, and a full contribution should be made to education reform at our higher education institutions. [2]

It should be noted that in addition to the increase in the need for skills related to the application of information and communication technologies (ICT), the Internet has changed the way and dynamics of knowledge and information dissemination in all areas. It follows from this that it is necessary to integrate ICT into all aspects of the educational process, with the aim of more effective and efficient education, which achieves ICT-related skills that are decisive for the competitiveness of national economies and increasing opportunities for new jobs and employment. [3]

The quality of the education system is one of the elements for ranking the IT sector segments in Western Balkans countries. Also, among the important goals is the acquisition of practical knowledge and skills needed for inclusion in the world of work, which implies a standardization platform (activities covered by international standards, as well as in nationally standardized fields of creativity - ICS), with examples of standardized sources of knowledge. [4]

In modern production, design cannot be imagined without computer-supported technologies. Therefore, computer-supported technologies (CAD/CAM technologies) are a mandatory segment of the education of future engineers and designers. Likewise, constant improvement of already existing knowledge of designers in the field of application of new technologies is imperative for quality products and ensuring competitiveness in the market. University-educated engineers must be prepared to a large extent to work together with people from other professions and disciplines, to use the opportunities of new technologies, and to apply them to products and production processes responsibly. Innovative thinking and work are of decisive importance for the education of engineers. Engineers develop, calculate and experiment, plan, and manage economic flows.

The existing educational profiles at faculties in Serbia can prepare engineers for the challenges of the economy in transition, and labor organizations should have confidence in engineers who are educated at our universities and faculties.

Companies want personnel who can immediately join work processes without a long internship, and student internships are a sure way to secure personnel ready to engage in work. Student internships, well thought out, organizing professional visits of students to production companies and laboratories, familiarizing students with technological processes, machines, and measuring equipment, reviewing technical documentation and insight into the state of the factory, will contribute to better potential employment opportunities for graduated engineers in the economy. By adapting to the market, students are provided with practical knowledge that can be applied immediately. [5]

In the paper, the empirical research of the students of the Technical Faculty "Mihajlo Pupin" Zrenjanin, University of Novi Sad, Serbia, which were worked on concrete examples in various companies and the faculty's laboratory, will be presented. During their internships, students were given tasks that they successfully solved.

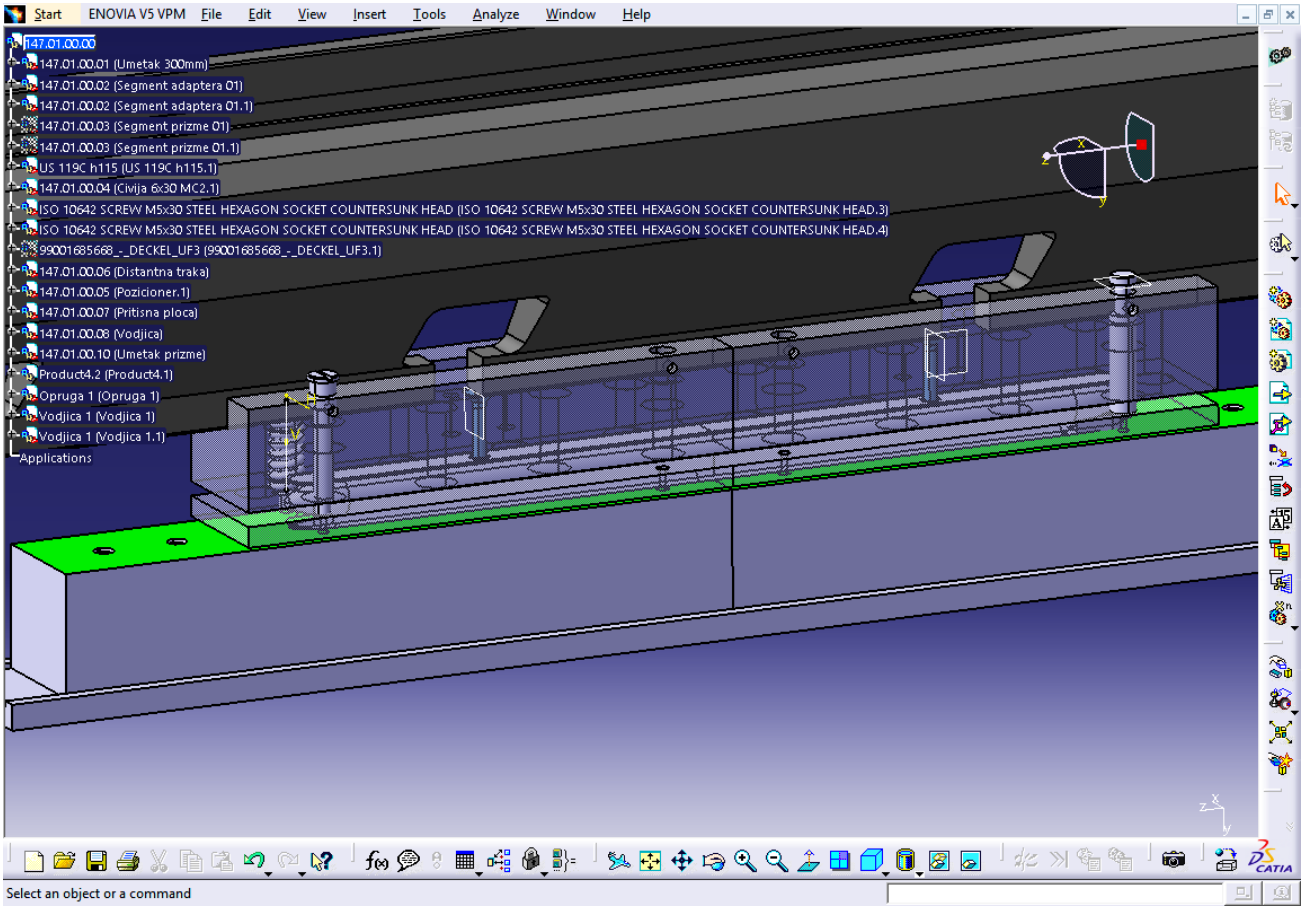
2. Empirical Research of Students

2.1. Construction of The Tools for Deep Drawing Extraction Using CAD Software CATIA V5 with The Aim of Reducing Material Deformation [6]

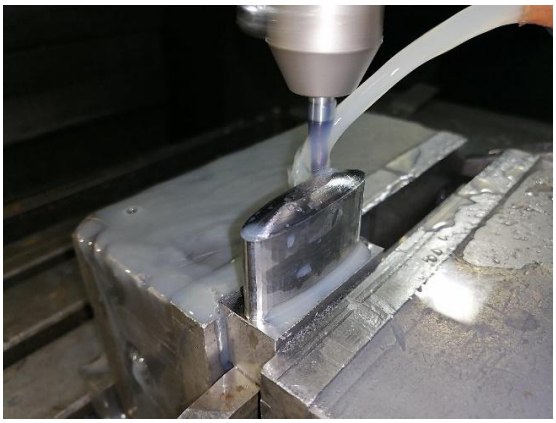
This empirical work presents research based on proving that the application of a constructed tool for a CNC punch machine in the CATIA V5 software reduces the deformation of the material during deep drawing extraction.

The aim of the research was an overview of stress-strain relationships, deformations during extraction, extraction voltage, and factors that influence the improvement of the process because deep extraction is performed under the conditions of a complex stress state of the element being extracted. Then determining whether both constructed versions of the tools in the CATIA V5 software, for the hydraulic CNC apcant press

and the CNC puncher, can reach the given product quality criteria. As a result, a reduction in material deformation was obtained, which minimizes the total production costs (Figures 1a and 1b).



a)



b)

Fig. 1. a) Tool construction for a CNC apcant press in CATIA V5 software; b) Making a puller on a CNC milling machine

2.2. Application of Finite Element Method in The Design of Compressed Air Tank with Analysis of Results [7]

This student's empirical work presents the importance of FEA technology as an important aspect of production preparation in industry. The calculation of the pressure vessel is presented analytically, and after that, the model of the vessel is built in SolidWorks. A simulation of stress in the case of working pressure and vessel dimensions was also performed, as well as an analysis of the results (Figures 2a and 2b).

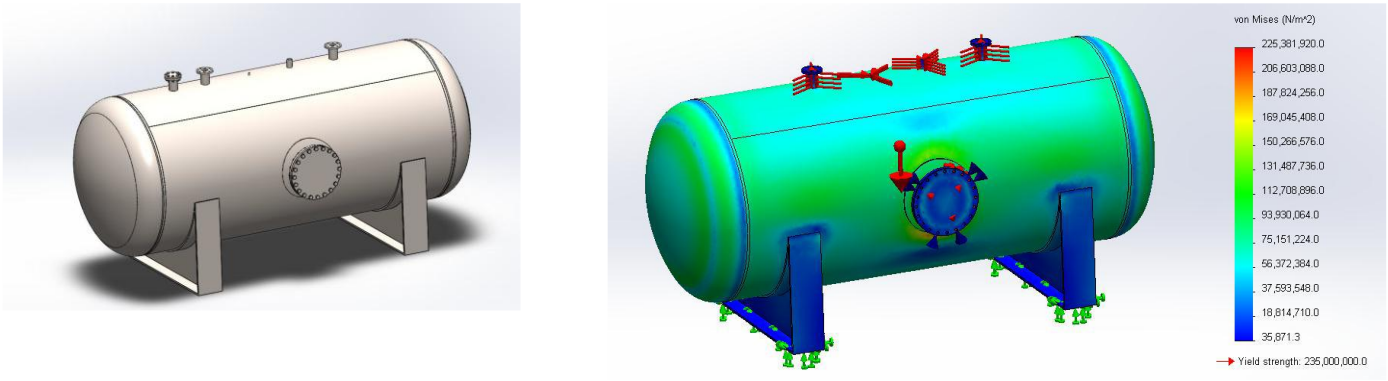


Fig. 2. a) The final appearance of the tank model; b) Simulation result

In this research, a 3D model of the compressed air tank was first formed according to the calculated thickness of the cylinder walls with all connections. After that, the material Č 0361 (S235JRG2) was added to the components, with all its technical characteristics in the SolidWorks program database. The force of gravity is assigned, as well as the pressure of compressed air acting on all components of this assembly. Finally, a network was formed, and the load calculation of the entire assembly was performed, and after analyzing the results, it could be concluded that the compressed air tank assembly meets the conditions of exploitation. This was also confirmed by the calculation of the safety factor of the assembly, where all components are marked in blue, which means that they meet the given criteria (Figure 3).

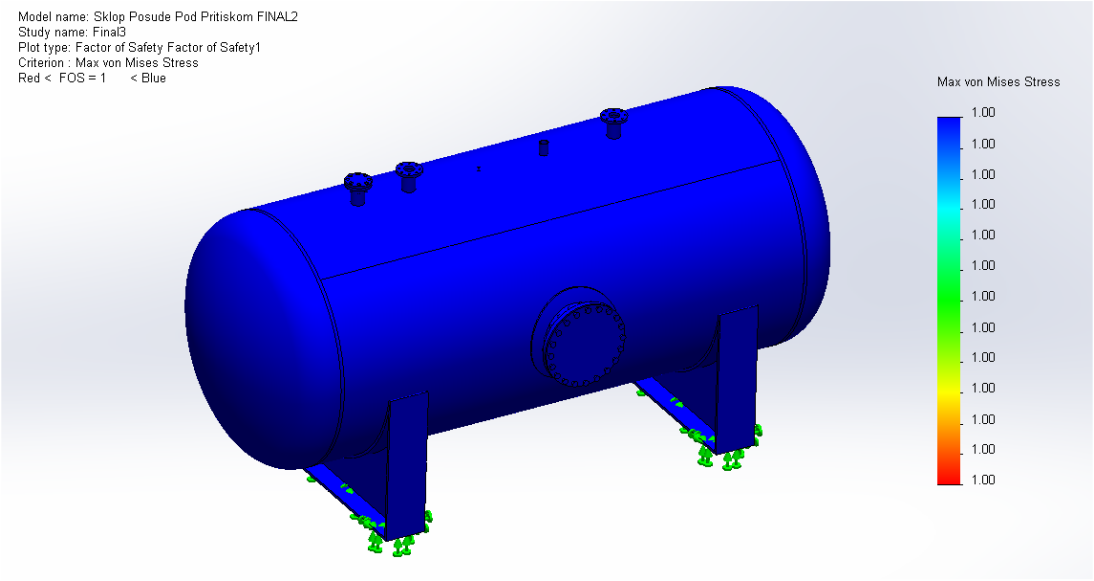


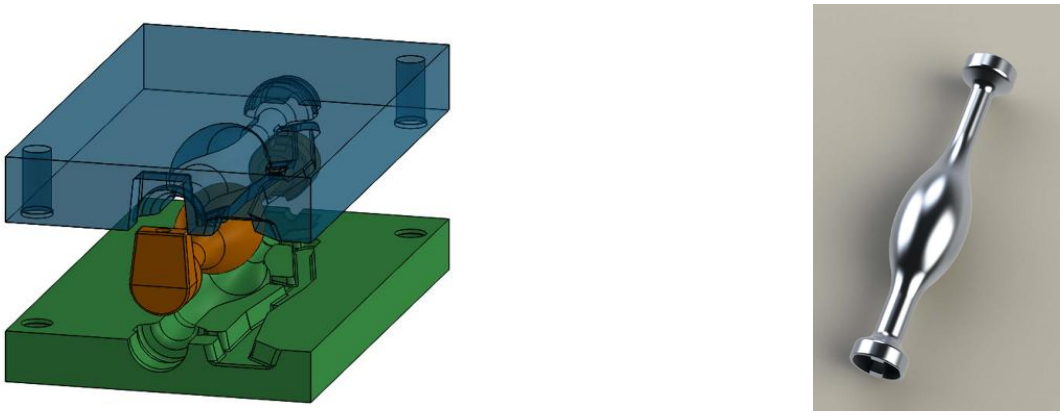
Fig. 3. The result of the safety factor calculation

2.3. Application of The CAD System in The Process of Automating Procedure of Constructing Castings for Casting in Molds with Material Consumption Analysis [8]

In this empirical work the importance of the CAD system in the process of automating the design and construction of castings is shown. The conditions that the constructor should fulfil when constructing casting tools are given. A description of the casting technology is also given - a special procedure (mold casting) of the barricade post.

The subject of this research, the technological development of the casting tool, can be considered the first and most important stage in the production cycle of the barricade post. If the construction of the finished barricade post is not adapted to the requirements of the casting technology, this must be done by the designer of

the casting tools in such a way that, based on the drawing of the finished part (barricade post), he will draw a drawing of the casting, and according to the drawing of the casting of the barricade post, he will construct a casting tool intended for casting (Figures 4a and 4b).



a) b)

Fig. 4. a) Casting tool intended for casting a barricade post; b) Photorealistic image of a barricade post

2.4. The Usage of Solar-Powered Sensor Stations in The Iot Environment

Nowadays, the mass use of sensor stations is understood in environments such as the Internet of Things (IoT) and smart technology environments. All of these systems involve the use of many sensors, and the location of these sensors is often in an open space without access to the electrical network. The use of batteries solves the problem of electricity supply. But the use of the batteries themselves imposes the need for their frequent replacement and charging. One of the solutions is the usage of solar energy sources to supply power to the sensor stations and recharge the batteries they use. [9]

Currently, at the Technical Faculty "Mihajlo Pupin" Zrenjanin, the new teaching platform is implementing the courses. The platform is designed to give students experience and knowledge on the development of energy-optimized sensor stations whose composition and mode of operation are adapted to power from solar sources (Figure 5). Within the Laboratory, 5 workplaces were created, which, in addition to computers, also have a microcontroller board, a set of batteries and battery chargers, a set of solar panels, a set of sensors and accompanying electronic tools and materials, as well as a set of artificial light sources that are used as a substitute for solar radiation. This is important because laboratory equipment is used indoors in the process of creating student projects and teaching.

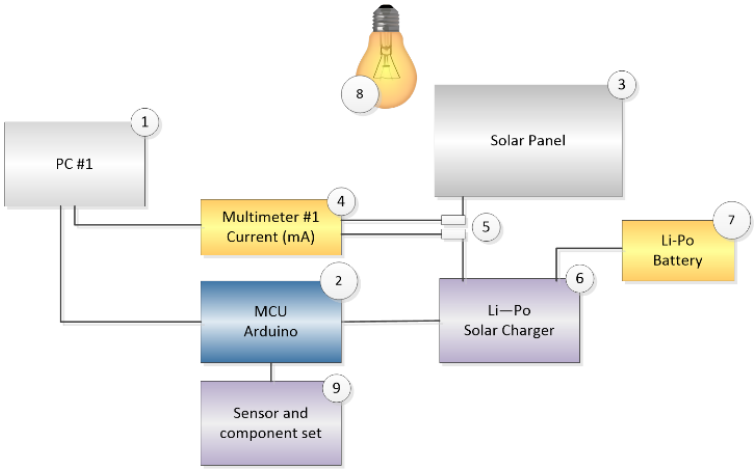


Fig. 5. An individual set of laboratory equipment for education of students (model) [9]
1 - computer for logging and display of measured values and programming of microcontroller units, 2 - microcontroller unit, 3 - solar panel, 4 - digital multimeter logger, 5 – reconfigurable contacts, 6 - solar battery charger, 7 - battery, 8 - the source of artificial light for indoor work and in laboratory conditions, 9 - set of common sensors and components of sensor nodes

This equipment is the basis for continued research and education of students in the field of solar energy applications for powering sensor stations and ensuring their independent and efficient operation, which will also increase their application in various sectors. The laboratory was formed within project no. 142-451-3118/2022-01.

3. Using New Technologies Through Life-Long Learning

The information society requires lifelong learning, where work and learning will alternate throughout life. In almost all countries of the world, the reforms of the school systems include major changes in all components of the education and teaching process. The rapid development of science, technique, and technology, as well as progressive social movements, caused significant changes in the educational process. [2]

The education system of our country is in a phase of significant changes. An important determinant of the success of higher education institutions will be how capable they are of meeting the needs and possibilities of students, and future engineers, with their curriculum, the quality of their teachers, and the way they teach.

Education is a matter of great importance, both for universities and for the industry. Many companies are interested in educating or retraining their employees through e-learning through courses organized by faculties. The accepted concept of adult education and lifelong learning is another element supporting the need to introduce some modern forms of distance learning. [5]

Experts from educational institutions and/or educational teams in the industry should monitor the state of development and trends and enable their timely and rational application through expert analyses and continuing education courses. Looking at the overall state of the industry in our country, this task is not being accomplished satisfactorily today. Reasons, among others, should be found in the lower level of cooperation between universities and industry, the low mobility of professional staff, but also the poor financial situation.

4. Conclusion

Technical-technological changes at technical faculties are very intense and comprehensive, and the curricula should enable the acquisition of sufficient knowledge so that the future expert in this field can respond to current requirements with the knowledge acquired at the faculty but also quickly get involved in solving problems related to the application of new technology.

The search for quality staff is extremely intense today. Engineers perform significant and responsible work in raising and recovering the economy and reviving the domestic industry. The task and goal of the faculty are to train high-quality engineers who, after graduating from the faculty, will be able to work in the economy immediately.

Changes in economic, social, and political areas, as well as the availability of information, determine educational needs and offers changes. The development of modern technologies means that it is a process that is constantly developing in order to modernize and prepare the educational process for the future. It is necessary to prepare the current and future generations for information technologies, which have already marked the current period, and it is quite certain that they will make an even more significant contribution in the coming period.

5. Acknowledgements

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