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THE NEED FOR AN INTERUNIVERSITY MASTER'S PROGRAM IN INDUSTRY 4.0 IN THE REPUBLIC OF MOLDOVA

This article discusses the imperative for the creation of a new collaborative interuniversity master's program in Industry 4.0 across three Moldovan higher education institutions. Development of such a new master's program is the main goal of the ERASMUS+ project titled "Enhancing MEchanical Engineering EDUcation in Moldova for Industry 4.0/ NeedEDU4.0". The proposed master's program will be created and executed through partnerships between technical educational institutions and the industrial sector. Its primary focus is to equip future engineers in automotive construction with current knowledge and skills by integrating best practices from European Union university partners. The introduction of this modern joint interuniversity master's program in mechanical engineering is anticipated to facilitate collaboration between universities and enterprises, to enhance the employability of graduates from mechanical engineering programs, thus enhancing regional development, cultivating lifelong learning skills, encouraging social innovations, and promoting inclusivity.

Keywords: higher education, Industry 4.0, NeedEDU4.0 project, automotive industry, master's program

INTRODUCTION

Industry 4.0 (I4.0) represents one of the most challenging themes for engineering design and for engineering education. Driven by I4.0, jobs are becoming more flexible and complex. Today's students will work and will deal with an increasingly globalized, automatized, virtualized and flexible world. They will compete for employment on a global market. As such, new competences and skills will become more important. In fact, the adoption of Industry 4.0 technologies will allow manufacturers to create new jobs, to meet the needs introduced by the growth of existing markets, and to introduce new products and services.

Therefore, students will increasingly have to master a combination of classic mechanical engineering and information technologies (IT). At present, there is an obvious gap between employers' expectations and the abilities that students tend to acquire during higher education, so matching education supply and occupation demand is a key issue of a high unemployment rate.

Currently, the employment situation in Moldova is very challenging. In particular, with the economic downturn following the outbreak of COVID-19, the employment rate of university graduates has dropped significantly. Thus, according to official information presented by the National Bureau of Statistics, the unemployment rate climbed from 11.9% in 2019 to 15.5% in March 2024 among young people with higher education (bachelor's and master's). This is a serious issue as the unemployment rate amongst such individuals is four times higher than the country-wide unemployment rate (3.1%) [1].

The increase in the share of emigrants with higher education from 10.9% in 2013 to 17.5% in 2021 is another worrying factor. Only 26.5% of the national labour force is employed in knowledge-intensive activities, which remains at a modest level below the sub-regional average. This issue can be attributed to the significant mismatch between labour-market requirements and the skill level of labour market entrants. This can be seen in the most recent edition of the Global Competitiveness Report (2018) which assesses 140 economies. In 2018, the World Economic Forum introduced a new methodology emphasizing the role of human capital, innovation, resilience and agility, as not only drivers, but also defining features of economic success in the 4th Industrial Revolution. This has led to Moldova being ranked 3/140 on skills and 71/140 on labour market, with low ranks on the indicators concerning the hiring and firing practices (94) and cooperation in labour-employee relations (70) of talent [2].

Indisputably, to make optimal use of its human resources, counteract emigration trends and ensure the efficient use of public resources, the economy needs to attract and retain the young workforce, which represents an indispensable need, a source of new ideas and talents, in fact a strategic resource in achieving the 2030 Agenda on Sustainable development in Republic of Moldova.

Improving Moldova's Education System is central to the country's efforts to boost its economic growth and development. A better-educated workforce will help overcome one of the biggest constraints faced by businesses in Moldova – skilled labour – and will help foster a thriving business environment, attracting investments which, in turn, will raise people's standard of living and reduce labour migration.

Investing in people is key to preparing for the future and fostering societal and economic resilience.

Being part of Eastern Partnership (EaP), Moldova's committees have to fulfil the following (EaP policy beyond 2020 Reinforcing Resilience - an EaP that delivers for all) [3]:

- (i) To reduce the gap between the labour market and the education sector;**
- (ii) To increase the support for the employability of youth and for youth entrepreneurship;**
- (iii) To get going labour market measures, such as the Youth Guarantee, to be adapted to the partner countries' labour markets.**

Another historical commitment in the perspective to become a member of the European Union (EU) requires the implementation of the EU *acquis*. The subsequent Association Agendas agreed between the EU and Moldova establish clear priorities in order to implement the Association Agreement and its Deep and Comprehensive Free Trade Areas (DCFTA). Adoption of the Association Agenda (2021-27) is imminent [4].

The Commission Opinion on the Republic of Moldova's application for membership of the European Union clearly states that significant efforts are needed in order to tackle the employability of youth "The labour market features significant structural weaknesses, as reflected by the very low employment rate of around 49% in 2020. There is a mismatch between skills and job requirements ... some graduates continue to struggle with finding jobs matching their qualifications. Employment services and labour market programmes are hampered by limited funding, while the creation of good quality jobs is held back by insufficient private and foreign investment in higher value-added sectors" [5].

Thus, national priorities stipulated in EU strategies (Moldova: SD "Education 2030"; National Development Strategy "European Moldova 2030"; Moldova's **Digital Transformation Strategy 2023-2030; Employment Programme of Moldova for the period 2022-2026**) demonstrates awareness of the need for a drastic conceptual change in all areas, with a **focus on a sustainable development**.

Targets 4.4 and 4.7, which are part of SDGs 4: „Quality Education” ,aim to substantially increase the number of young people and adults with relevant skills for the labour market and to ensure that all students acquire the knowledge and skills needed to promote sustainable development and lifestyles. Target 4.4 aims to, by 2030, substantially increases the number of youth and adults, who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship. Target 4.7 aims to, by 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development.

All these strategic documents highlight the emerging need to involve all key actors, i.e. higher education institutions, students, industry and government in order to increase employability through actions that would harmonize the content of study programs with the real needs of the labour market.

Thus, this article discusses the need for development of a new joint interuniversity master's program in Industry 4.0 within three Moldovan higher educational institutions, in order to increase the employment in automotive companies of the university graduates of mechanical engineering programs.

AUTOMOTIVE INDUSTRY IN REPUBLIC OF MOLDOVA

Although the Republic of Moldova is not yet a car manufacturing country, but it **plays an important role in the world automotive industry**. The industry is well integrated within global supply chains, as **the main investors** are well known international companies: Lear Corporation, Dräxлмаier Moldova, Gebauer & Griller, Sammy Cablaggi / Kablem, Elektromanufacturing / SUMIDA, Confezioni Andrea Carcover, SEBN Sumitomo Electric Bordnetze, Fujikura Automotive, Coroplast Fritz Mueller, APM Automotive, Blacksea EMS, Arobs Software, Whetec / MG2C, Hub Multico / Quality and Equip-Test, that deliver various components, including hi-tech for the latest types of cars, including hybrid cars, hybrid plug-ins and even electric cars to the largest manufacturers of cars and trucks including the giants Ford, Renault, BMW, Mercedes, Volvo etc.

Despite facing a series of socio-economic challenges over the past two decades, the Republic of Moldova has made significant progress towards improving its business environment, integrating into the international community and attracting foreign investment.

Until now, large direct investors prefer to locate themselves in Moldova's Free Economic Zones (FEZ), which represents an excellent location for industrial development and production relocation oriented for exports. It is a key growing sector for the Moldovan economy. This is due to an increased focus on the unused industrial potential of Moldova and the maintained industrial orientation in the education system (Technical University, technical colleges and vocational schools). The higher education system in Moldova plays a crucial role to train qualified students. The country has strong technical faculties and specific colleges, which trains students in sector-specific areas.

In recent years, the automotive industry in the Republic of Moldova has one of the highest growth rates. According to the National Statistics Office of Moldova from 2015 to 2020, the export from this sector increased 1.75 times. Moreover, **as of 2022, the automotive industry** of Moldova has more than 300 million

euros in investments and more than 20 thousand people with an average monthly salary of 10 thousand lei. It **provides 33% of export of industrial goods from Moldova and 15% of total export of the country.**

According to the Chief Administrator of the Balti FEZ, one of **the major problems, which only intensified during the military crisis** in the region, is **the availability of qualified Moldovan workers for this sector.** In view of these changes, mechanical engineers need to be well trained and highly skilled. Innovation is an extremely important issue for success in mechanical engineering. It often supports clear market position and differentiation among competitors.

The adoption of Industry 4.0 technologies allows automotive companies to create new jobs, to meet the needs introduced by the growth of the existing markets, and to introduce new products and services [6].

It is evident the interest of the industrial sector is to find professionals who are trained for the new challenges that arise. Hence, the university is working towards this. After all, university is one of the main environments in which future professionals of the sector are formed. The key lies in the close relationship that must exist between the competences that the students acquire at university and the professional profile necessary to exercise the different professions.

Consequently, Industry 4.0 should be implemented in an interdisciplinary manner and in close cooperation with the other key areas and using different technological drivers. These are formerly known as the nine pillars of technological advancement, and they comprise the following technologies: Big Data; Autonomous Robots; Simulation; Universal System Integration; Industrial IoT; Cybersecurity; Cloud Computing; Additive Manufacturing and Augmented Reality [7, 8].

The biggest constraint in the development of Industry 4.0 is the lack of skilled labour, familiar with new developments in AI and IoT technologies [9]. The existing workforce needs to be trained to manage the latest equipment and software systems equipped with IoT and AI-related technologies. Although industries are dynamic in adopting new technologies, they are facing an **acute shortage of highly skilled engineers** and a workforce familiar with new technologies. **The same needs and constraints are signalled by the labour market in the Republic of Moldova.**

In this regard, Industry 4.0 obliges the establishment of lasting partnerships between technical educational institutions and the industrial sector. Both parties have come to realize the importance of dialogue and mutual support for the preparation of future engineers in the field of machine building.

ERASMUS+ NEEDEDU4.0 PROJECT

The development, accreditation and implementation of a new joint interuniversity master program (NIMP) in the field of mechanical engineering within three Moldovan higher educational institutions is the major objective of the ERASMUS+ project “EnhaNcing MEchanical Engineering EDUcation in Moldova for Industry 4.0/ NeededU4.0”.

The project objectives and activities overlap with CBHE specific conditions/objectives set out in the Programme Guide, and will:

- Improve the quality of higher education of Higher Education in Moldova by enhancing its relevance for the labour market and society and enhance its relevance for the labour market and society;
- Improve the level of competences, skills and employability of students in Moldova by new joint interuniversity master’s program in accordance with the needs of business sector;
- Enhance the teaching, assessment mechanisms for HEI staff and students, quality assurance, management, governance, inclusion, innovation, knowledge base, digital and entrepreneurial capacities.

This interuniversity master's program in Industry 4.0 will develop practical skills for designing and constructive and technological optimization of products based on CAD / CAM / CAE integration using three Virtual Learning Labs, one in each university, thus ensuring an authentic training environment with that of the design offices within the engineering companies.

It will be jointly organized by Technical University of Moldova, “Alec Russo” State University of Balti and “Bogdan Petriceicu Hasdeu” State University of Cahul through intensive collaborations with two EU universities (RWTH Aachen University and Transilvania University of Brasov) and one of the most important companies in the targeted field (Drăxlmaier).

The associated partners in this project are Ministry of Education and Research of R. Moldova (MER), National Agency for Quality Assurance in Education and Research (ANACEC) and Chamber of Commerce and Industry of the Republic of Moldova (CCI of the RM). This level of cooperation aims to support the development, accreditation and implementation of the new joint interuniversity master's program, adjusted to the national quality management system.

JOINT INTERUNIVERSITY MASTER’S PROGRAM

Indisputably, this joint interuniversity master program will contribute to strengthening the capacities of higher education institutions in the Republic of Moldova in order to increase the employment of graduates, to enhance their relevance for the labour market and overall society.

The implementation of the project NEDEDU4.0 can make a meaningful contribution by stimulating innovation and bridging Moldavia's knowledge, skills and competences gap.

It will also create economic and social value in the EU area, whereas the students who will graduate this master's program in mechanical engineering will obtain skills compatible with the requirements of the European labour market, and thus shall become valuable human resources in the European space. Erasmus+ programme is essential to reach these desired outcomes in the Republic of Moldova.

NEDEDU4.0 will address the aim of capacity building in the field of higher education through designing and implementing of a new national master's programme within three Moldovan universities, in order to support the modernisation of HE system in Republic of Moldova with the best practices applied in the EU universities partners.

The implementation will include modernization of educational programmes in accordance with contemporary training and learning approaches, the introduction of learning outcomes as well as elements of student-centred teaching and learning, and the creation of up-to-date internal and external quality assurance mechanisms.

The improved capacity building of staff from Moldovan HEIs will make the HE system in Republic of Moldova a solid force to fight youth unemployment and social inequality and to provide the young graduates with opportunities for lifelong learning and active involvement as responsible citizens. By focusing on the objective of the Erasmus+ programme K2 action on improvement of competences and skills level in HEIs through development of new and innovative programs and teaching / learning methods, the NeedEDU4.0 project aims to develop a Train-the-Trainer Program for academic staff adapted to the new teaching-learning requirements, which will expand their competences to perform and deliver high quality and job-relevant skill set to students. In addition, by implementing a new modern joint interuniversity master's program (NIMP) in mechanical engineering, the cooperation between universities enterprises will be strengthened by enhancing regional development, lifelong learning skills, encouraging social innovations and promoting inclusivity.

Furthermore, the cooperation between Moldovan universities and EU partners will contribute to boost the quality of higher education by the exchange of experiences and good practices.

As an example of interuniversity master's programme in Industry 4.0 in European Union is the Italian master's programme "*Advanced Automotive Engineering*" jointly offered by the University of Modena and Reggio Emilia, University of Bologna, University of Ferrara, and University of Parma in Emilia-Romagna Region and supported by automotive companies known at international level: Maserati, Ferrari, Automobili Lamborghini, Ducati, Marelli, Dallara, Pagani, HPE GROUP, Haas F1 Team, and Visa Cash App RB Formula One Team. These companies together put their innovative and know-how technologies at the service of students to prepare them in design and development of high performance road and racing vehicles at the level of Industry 4.0 [10, 11].

Another interuniversity master's program in I4.0 is the Belgian master's programme "*Smart Operations and Maintenance in Industry*" jointly organised by Katholieke Universiteit Leuven (KU Leuven) and Ghent University. This program provides specialists in smart operations and maintenance, capable to implement and to deploy innovative technologies in industry. Herein, students obtain knowledge and skills in optimization of both operational and maintenance processes by using Industry 4.0 technologies [12].

The Spanish interuniversity master's program "*Industrial Mathematics*" is developed and implemented by the University of Santiago de Compostela, University of A Coruña, University of Vigo, Charles III University of Madrid and Polytechnic University of Madrid by fusion of their master's programs in *Mathematical Engineering* and *Industrial Mathematics*. The courses are performed simultaneously face-to-face in the classrooms of these five universities using a specific videoconferencing system. The main objective of this program is to provide knowledge and skills in Modelling and Numerical Simulation and devising solutions to specific industrial problems [13].

The University of Vigo together with the University of León jointly offer another Spanish interuniversity master's degree in *Industry 4.0*, main subject being *Engineering Management*. The aim of this master's degree is provide specialists interested to work in companies that are in the process of transformation or adaptation to Industry 4.0. The students obtain knowledge and skills in development of new business models and innovation processes in enterprises, implementation of Industry 4.0 technologies as Additive Manufacturing, Big Data, Artificial Intelligence, IoT, Robotics, etc. and how to face digital

transformation. Herein, they participate in activities that combine Information and Communication Technology (ICT) with mechatronic system automation, programming, design, manufacturing etc. [14].

Thus, the aforementioned Moldovan universities, having two EU universities with recognition in engineering training as partners in NeedEDU4.0 project, will contribute to the professional development of academic and technical staff in order to design a modern master's program that will ultimately equip students with the qualifications and skills needed for their meaningful participation in democratic society, intercultural understanding and successful transition in the labour market. High-quality education for all will help Europe to achieve its economic and social objectives and fuel Member States' competitiveness and innovation.

CONCLUSION

The new joint interuniversity master program (NIMP) in the field of mechanical engineering within three Moldovan higher education institutions represents a good opportunity to enhance employment in the labour field of the Republic of Moldova of engineers within the automotive industry. This program will offer interdisciplinary courses and research opportunities in three different universities that will help graduates to form a complete set of skills necessary for employment and career advancement in this industry. Also, the company Draxlmaier, being as partner in NeedEDU4.0 project, ensures that the master's program is aligned with the current needs and trends of the automotive industry. This partnership will allow students to apply their theoretical knowledges in practical works in the real industrial environment. The collaboration of the Moldovan universities with European Union partners (RWTH University of Aachen and Transilvania University of Brasov) will contribute to improve the quality of higher education by the exchange of experiences and good practices.

ACKNOWLEDGEMENT

This work has been funded by project -"EnhaNcing MEchanical Engineering EDUcation in Moldova for Industry 4.0 (NEEDEDU4.0)", - ERASMUS-EDU-2023-CBHE-STRAND-2, within the European program ERASMUS+ co-financed by the European Commission, Grant Agreement no. 101128623.

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DOI 10.36910/automash.v1i22.1339