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Adapting technical higher education to labor market dynamics in the context of Romania's reindustrialization

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Abstract

Our research aims to analyze the correlation between the situation of technical higher education in Romania and the labor market requirements, in the context in which reindustrialization policies are being promoted at the European and national levels. Technical universities in Romania are not keeping up with the needs of the labor market. There is a need for an educational program adjusted to the requirements of the labor market and an educational system that capitalizes on practical skills so that future engineers can innovate and provide solutions to the challenges of today's industry. The results show that, although Romania has a high share of engineering graduates, above the European average, the continuously decreasing trajectory of the working-age population in the economy and a high emigration rate affect the labor market balance. The implications of these facts for Romania's future economic growth are briefly discussed.

Keywords: *Engineering; students and graduates; reindustrialization; Romania.*

1. Introduction

The European Commission has often made clear that new skills are needed in the labor market for a sustainable and resilient economy. All measures taken to decarbonize the economy and reduce energy consumption, efficient use of natural resources through effective strategies, protect ecosystems and biodiversity, etc., require jobs that combine cross-cutting skills with specific skill sets. Most green skills and green jobs are in the fields of engineering, science, and technology, as well as management and monitoring. (European Parliament, 2020). In this respect, Europe's higher education institutions are playing an increasingly important role by accelerating the dissemination of research results and stimulating collaboration and partnerships with businesses. Universities and industry can develop symbiotic relationships (Figure 1), provided that their expectations are complementary: tertiary graduates are absorbed by industry, and research in universities is used by industry and transformed into products and services.

Numerous examples show that the industry would like graduates whose skill sets align with the requirements of today's economy. To achieve this goal, firms fund concentrated research in universities and support the establishment of new laboratories, which identify new research topics (Brito et al., 2017). In this context, Romania, like many other former communist countries, needs to adapt the structure and offer of technical university education to correspond to the new trends and ensure a qualified and competent workforce to support the many projects currently underway through European funding programs.

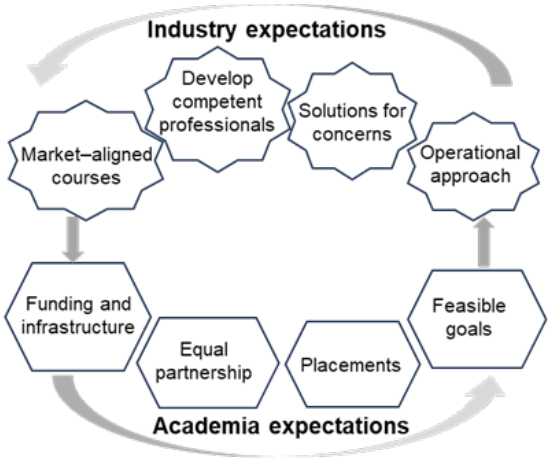

Figure 1. Relationship between industry and academia. Source: adapted from Gann et al. (2018)

The theoretical ground of this investigation intersects two research fields. The first one includes studies related to the situation of higher education, especially technical education. Romania is currently facing a decline in the number of students choosing to become engineers (Dobrescu & Radu, 2015; Curaj, Salmi and Hâj, 2022). The situation is the complete opposite of the communist period, when many young people chose to study engineering (Rădulescu, 2006). During the communist years, the massive industrialization of the country made engineering the most sought-after profession. Admission to the country's technical universities was very strict and the authorities supervised and encouraged only the best students to enter. Whether in the machine-building or petrochemical industries, the engineering profession came with social prestige and high incomes. After the 1989 Revolution, economic and social changes affected the demand for engineers in society. Most of the country's industrial platforms were closed or significantly downsized, so jobs in this field, including those for graduates of higher technical education, declined significantly (Ministry of Education, 2023). The second direction is offered by the new interest in reindustrialization and sustainable economy. The current trend of reindustrialization, manifested throughout Europe and supported by numerous investments (Borgersen & King, 2016), is reflected in a need for engineers in all fields of activity (Capello & Cerisola, 2023; Popescu et al, 2024). In Romania, there is an estimated shortage of around

500000 engineers (Panorama, 2023). To be able to develop products with high added value, there is a need for people with adequate technical qualifications in all the fields in which such products are made - electronics, electrical, telecommunications, fine mechanics, and the auto industry. Starting from these premises, the main objective of this article is to highlight, present and discuss the correlation between the development of higher technical education and the industrial development of Romania, in the current context of European policies and provisions. The analysis of indicators such as the share of students and graduates in engineering compared to other fields and the determination of deviations from the EU average, the identification of the determining factors of the reduction of young people's interest in engineering, the formulation of practical recommendations for all stakeholders completes the objectives of our study. The paper's structure is presented as follows: after section 1 (introduction and review of the literature), section 2 presents the methods and data sources used to achieve the previously mentioned objectives. Section 3 presents and synthesizes the study's results and shows to what extent the results obtained validate the working hypothesis. In the last section, we formulate the conclusions of the study and provide practical guidelines for decision-making in this sector of activity.

2. Data and Methodology

The statistical data used in this paper were taken from the National Institute of Statistics of Romania, as well as from Eurostat, both platforms representing a gateway for downloading data sets relevant to the topic addressed. To complete the information, reports and studies published by the Ministry of Industry, the National Bank of Romania, and the Ministry of Education, as well as articles published in the specialized economic press were consulted. As methods used, we mention: quantitative analysis of statistical data and their primary processing by using programs such as Excel to produce descriptive statistics; comparative analysis of Romania's values with the EU average or with the values recorded by other European countries; production of graphs for a better visualization of the disparities between the indicators used.

3. Results and Discussion

3.1. Evolution of the number of engineering students and graduates in Romania and the European Union.

An analysis of Eurostat (2022) shows that almost a quarter (24.7%) of graduates have turned to business, administration, or law degrees (Figure 2), followed by engineering, manufacturing and construction (14.7%) and health and well-being (14.1%). The same trend is followed by graduates from Romania: most graduates have followed business (26.8%), while engineering,

production – construction it is also highly appreciated (16.8% in Romania, 2.1% above the EU average).

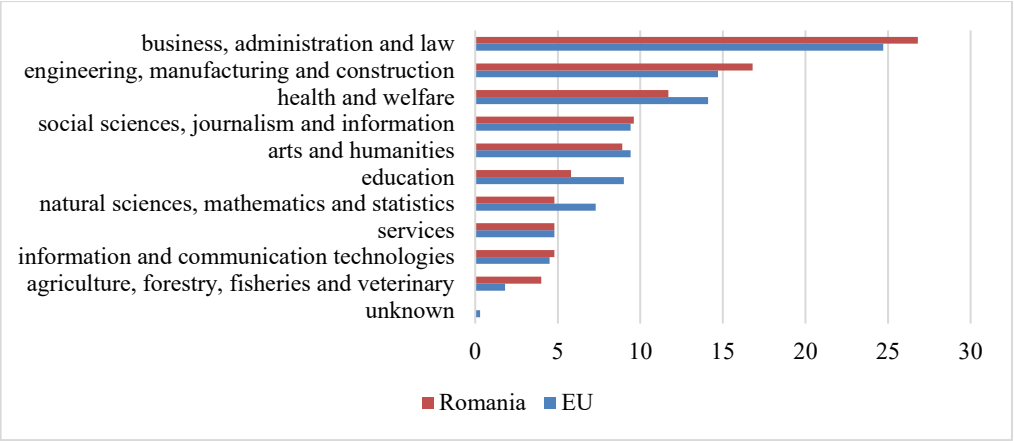

Figure 2. Distribution of tertiary education graduates by broad field of education in Romania and the European Union, 2022. Data source: Eurostat.

The engineering field has seen a decline in interest among young people as computer and communications technology has become increasingly attractive. When opting for their field of study, many technically inclined young people gave up studying civil engineering (considered more difficult). They have turned massively to IT, a sector that also benefits from many tax breaks, a situation not only in Romania but also in other European countries such as Finland, Estonia, Ireland, etc. (Figure 3).

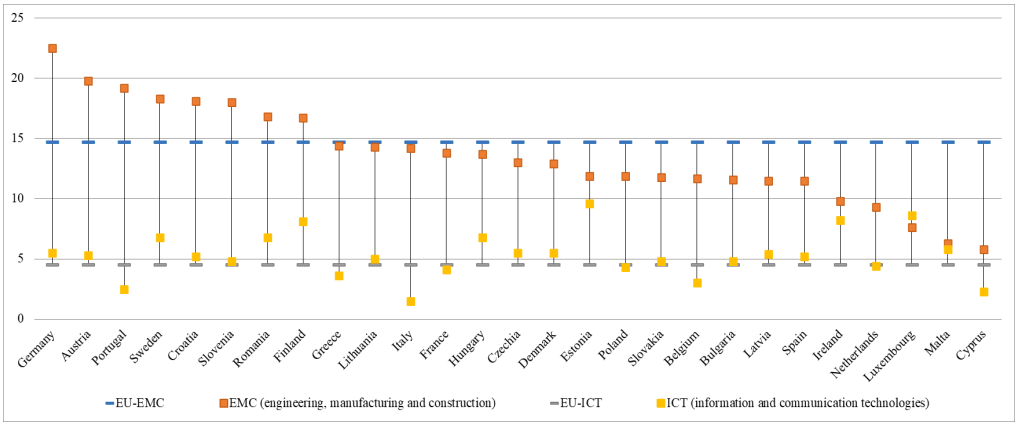

Figure 3. Distribution of tertiary education graduates in engineering/manufacturing/construction and information/communication technologies, 2022 (%). Data source: Eurostat.

After a maximum of almost 22% in 2015, the share of engineering students has continued to decline in recent years in Romania, with values below 20% (National Institute of Statistics). Among the causes that have led to the reduction in the number of engineering students, we mention the migration of young people to universities outside Romania (especially to Western Europe), the decrease in the school population, and the increase in the dropout rate during university studies. For example, in 2024, at the Polytechnic University of Bucharest, the largest technical university in the country, 9,000 students were admitted in their first year. Between 30 and 35% of them don't finish college, according to estimates (cronicile.cursdeguvernare.ro, 2024). So that leaves 6,000 students who complete their studies. Of these, around 15% go abroad and work there, leaving less than 5,000 graduates in the country, far less than the demand in the labor market.

An estimate by the rectors of Romania's technical universities (confirmed by the analysis of recruitment firms) (cronicile.cursdeguvernare.ro, 2024, p.68) shows that in the next decade, Romania will need about. 500,000 engineers. This would mean more than a doubling of the number of places in technical universities, taking into account that school drop-outs reduce the annual number of graduates to less than 20,000. The need for engineers became visible with the establishment of research centers for foreign companies. The problem of a highly qualified labor force has become visible in recent years after many of the companies that used to do only production in Romania have set up research departments. As long as multinational companies in the industry focused strictly on production in Romania, the shortage of engineers was not very visible. In recent years, many companies have partially moved their research divisions from other countries or have opened research centers in Romania, so there is still a need for specialists. Basically, since then, the problem of highly skilled labor has become very visible.

3.2. Advantages of the engineering profession in Romania today.

Engineering is one of the most promising fields of employment. From civil engineering to mechanical and electrical engineering, the demand for specialists has grown considerably. Romanian engineers have access to opportunities in both the local and international markets. Technical specializations not only provide secure jobs but also support the economy through complex infrastructure initiatives, technological innovations and green solutions. The engineering sector continues to be one of the most promising and stable sectors in the Romanian labor market, with an average of 10% of all jobs available every month and an annual expansion in the number of vacancies in this sector. This stability makes it tempting for candidates looking for a clearly defined career with varied opportunities and competitive salaries. According to data provided by the National Institute of Statistics, net salaries in this sector can exceed €2000/month, depending on specialization and experience. Flexible and responsive engineering programs are needed to cope with rapid technological progress. Their modernization is urgent in Romania due to innovation lags and skills shortages. Involving industry professionals in co-

designing and delivering relevant programs requires higher education institutions to form long-term links to facilitate the inclusion of students in companies and issue constant feedback to academia to increase the quality of programs. A study on the employability of higher education graduates in Romania conducted in 2021 (Deaconu et al., 2022) shows that the highest employment rate during their studies is recorded among those who majored in the fields of Engineering Sciences (63.9%), Social Sciences (63.7%) or Mathematics and Natural Sciences (61.2%). If we compare the generation of graduates in 2016 with the generation of graduates in 2020, we observe that in the field of engineering, the employment rate during their studies increased from 61.5% (2016) to 64.8% (2020). According to the same study, graduates with higher earnings are also those with higher job security. The most job-secure graduates are those in Information and Communication Technology (ICT) (94.6%) and Engineering, Manufacturing and Construction (77.5%).

3.3. Reindustrializing Romania

Romania's economy has grown steadily since 2007 (the year of joining the European Union), mainly based on the positive contribution of consumption, closely followed by investment. Romania's economic structure has changed substantially over the last 20 years, with agriculture now accounting for less than 5% of GDP, while the share of industry has remained high at over 20%. The services sector is the most strongly converging with the European economy, contributing about 60% of the national GDP. In terms of the employed population, Romania's industrial sector has a similar share to the Central and Eastern European countries, but is substantially higher compared to the EU average. However, one in five employed persons still works in the agricultural sector (Figure 4). This human capital, which is still an undeniable asset to the Romanian economy, is confronted with a lack of qualified employees, especially in the industrial sector.

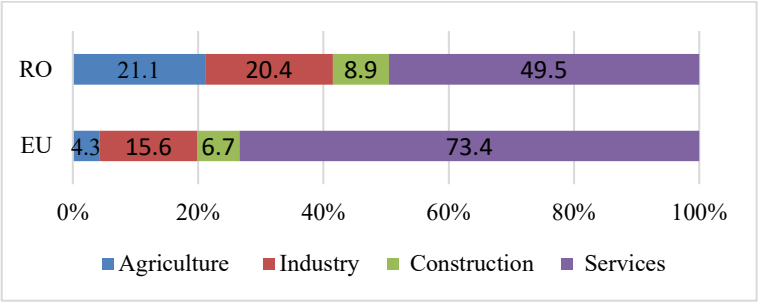

Figure 4. Share of persons employed by economic sectors (% of total), 2022. Data source: Eurostat.

Despite its macroeconomic performance, the labor market suffers from several structural shortcomings, with skills mismatches being among the most important. Romania needs to align labor force skills and labor market demand, especially in science, engineering, and technology.

This leads to underemployment, over-skilling, and skills shortages in sectors characterized by medium and high technology. Romania's manufacturing sector totaled 79,152 active enterprises in 2022 (Eurostat), up 1.5% from 2021, of which almost 78,000 were in manufacturing. In total, 1,100,669 people were employed in industry, down 3.5% from the previous year, accounting for 23.5% of those employed in the whole economy. The number of enterprises has steadily increased in recent years in most sectors, but the low- and medium-technology industrial sectors (food, textiles, clothing and footwear, wood products and furniture) account for more than 60% of the total number of enterprises and about 44% of the total number of employees (Romania's Industrial Strategy 2025 - 2030). European and national industrial development strategies cite research and development as one of the key factors for boosting economic competitiveness, alongside innovation and technological development. Ambitious targets for a green and digital industrial transition will put unprecedented pressure on all industrial sectors, not just those that have been substantially affected in the last three years, such as energy-intensive industries or industries dependent on electrical, electronic, automation, or strategic raw materials. The European Union has already devised plans to reduce these strategic dependencies, coupled with substantial resources directed toward research, innovation and technological development. In this context, the Ministry of Finance has developed the National Program for the Support of Large Industries, a program that will provide €1 billion in funding between 2025 and 2030 to support strategic investments to promote innovation in automation and the use of green technologies. This is one of the most important initiatives in the last 35 years for the revitalization and modernization of the Romanian manufacturing industry. In addition, to become competitive, the Romanian industry needs to develop the country's raw material processing branches, which requires a partnership between economic actors and authorities in the fields of economy, finance, energy, and agriculture. As the EU has readjusted its entire strategy and is trying to re-profile itself, Romania also needs to pay special attention to re-industrialization. Thanks to the European and international context, Romania has great potential at the moment, especially in the energy, aeronautics, and steel industries.

4. Conclusions

On the whole, Romania has a good situation in terms of the number of graduates in technical studies to the number of inhabitants, but not enough to meet the demands of an industry in search of highly skilled labor. This position could be improved in the future by the increase in the number of places in engineering faculties, but also by the change in the mentality towards engineering, an increasingly sought-after and better-paid occupation right from the start of a career. The current context is very favorable to these measures because, for the first time in the last 35 years, a major plan for reindustrialization has been announced in Romania, aimed at supporting industrial production activities with components that address both large industries, for technological renewal, but also components that are related to small industry or

manufacturing. At the same time, the extent to which human resources are qualified for the projected industrial development must be established. Some of the measures that need to be taken are: expansion of dual vocational and technical education, development of skills in science, technology, engineering and mathematics, teacher training, access to educational resources, laboratories and equipment, partnerships between technology companies and universities, creation of well-paid jobs and encouragement of work by prolonging working life.

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