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TECHNOLOGY TRANSFER AS AN ACCELERATOR FOR POST-PANDEMIC INDUSTRY RECOVERY

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***Abstract:** The present paper evaluates the role of technology transfer (TT) in the post-pandemic recovery of the Romanian industry. It illustrates the current state of the industry in Romania, highlighting the effects of the COVID-19 pandemic in the context of demand shifts, production and operational challenges, supply chain disruptions, labor shortages and financial constraints. It identifies TT as a viable solution and as an accelerator for post-pandemic recovery, considering the need for research, development, and innovation to restart the industry. The paper examines the case of a Romanian production plant and describes various applicability scenarios for TT in a country which has been impacted by the pandemic and is also lagging in industrial performance compared to other European states.*

***Key words:** technology transfer, production, innovation, industry, pandemic*

1. INTRODUCTION

1.1 Post-Pandemic Context

The outbreak of the COVID-19 pandemic, in 2020, coupled with the rapid spread of the infections in the subsequent period, led to global widespread disruptions. The pandemic impacted not only the health and social systems, which were in a constant state of emergency, but had a strong negative ripple effect on world economies. Countries were thrown into a state of shock, while their economies were forced into stagnation and even regression. The effects of the pandemic were extensive, involving trade and export, commerce, the service industry, and production. [1,2]

As an aftermath of the COVID pandemic, the trajectory of industrial production in Romania has shown a consistent shrinkage. Latest available data, according to Eurostat has shown that, the start of the pandemic brought a significant plunge in industrial output, April 2020 showing a drop of 27.9% in production compared to the previous period (year-to-year). Industrial production then made a steady recovery, peaking in April 2021, but has consistently been on a descending slope

starting with January 2022. Another important indicator for the current state of the Romanian industry is the Net Trade in Goods and Services (NTG), which has been constantly declining within the past few years but has decreased at an accelerated rate since the pandemic, going from -10.87 Billion USD in 2020, to -16.18 Billion USD in 2021. Regarding the Global GNI, representing the total value contributed by all resident producers, including product taxes, it has remained constant in 2019 and 2020, but has seen an increase of 12.9% from 2020 to 2021. However, looking at the GNI from a per capita perspective, it has abruptly dropped by 8.2% from 2019 to 2020, but has made a recovery by 2021. [3,4]

Regarding the Romanian workforce, the COVID pandemic has significantly affected the availability of human resources, with an emphasis on tourism, as well as the production industry. The measures imposed by the government, including limiting or completely suspending the activity of certain economic entities led to a destabilization of the workforce. In the industrial sector, where most of the activity occurs in a factory setting and workers operate within close

proximity of each other, COVID outbreaks were frequently recorded. Unlike other sectors, where telework greatly helped to maintain the work activity, for the industrial sector, this was not an option. Workers had to be present in the factories, thus they were always at a higher risk of contamination. Workers were thus either sent on medical leave in the case of an outbreak or contamination or were temporarily laid off if the factory could not function under the pandemic restrictions. A part of the workforce became ill, developed complications and were no longer able to work. According to the Romanian National Institute of Statistics, the unemployment rate registered at the national level was 3.38% at the end of December 2020. This was an increase of 0.41 % compared to December of 2019. [5,6]

Another human resource-related aspect worth mentioning is the accelerated digitalization of work during the COVID pandemic. However, the shift to digital and remote work was only applicable in certain office-based occupations. Over half of the Romanian economy consists of local enterprises which operate in the fields of hospitality, commerce, industry, and construction. These fields are characterized by manual labor and activities which cannot be performed through telework. Thus, a part of the human resources engaged in manual, production labor, were drawn to other work and career opportunities which offer the possibility of working remotely. [7]

Supply-chain disruptions generated by the pandemic context have played a major role in the destabilization of the Romanian industry. Since many of the Romanian industries rely on the import of raw materials and parts from Western Europe, supply-chain problems have had a negative ripple effect of the manufacturing and production processes. The most challenging supply-chain-related issues have been the shortage of raw materials and key components, production and workforce scaling to meet reduced demands, delayed shipments, production line reconfigurations, and controlling costs. [8]

1.2 Solutions for the post-pandemic recovery

The economic rebound of Romania is forecasted to be primarily based on the increase in household consumption, which currently

corresponds to 63% of the country's GDP. Recognizing this situation, the Romanian government has initiated several measures to maintain and boost consumption. In this context, the recommended solution for exiting the post-pandemic economic lag would be increasing the added value generated by the economy. Thus, one of the most promising approaches to achieving this goal would be by encouraging innovation by utilizing new technologies and innovative scientific discoveries. [9]

Many West-European enterprises currently operate in Central and Eastern Europe (CEE), having implemented their production and manufacturing facilities in this area due to reduced labor costs. However, the research development, and innovation (RDI) activity that is being performed by the parent companies in West-European countries far surpasses the RDI activity taking place within the branches and subsidiaries operating within the CEE space. The branches and subsidiaries can either be the recipients of the RDI results obtained by the parent company, or they can continue to function with outdated technology. [10]

The technology strategy is a key predictor for the long-term success, competitive advantage, and sustainability of an organization. In this context, there are two options for obtaining new and relevant technology: internal research and development (R&D) within the company and technology transfer (TT). [11]

2. TECHNOLOGY TRANSFER

2.1 What is technology transfer?

The European Commission defines Technology Transfer (TT) as the process of transmitting end research results from science and technology, together with the applicable know-how to the socio-economic environment and to the socio-economic sector, in order to benefit the business sector, as well as society. [12]

TT is an extensive process, which includes the management of all stages connecting research to the final implementation within economic activity and society. The process commences with the scientific and technological discoveries that are made by academic institutions and research centers. The research results then undergo different stages of processing, including

research disclosure, assessment, and intellectual property protection, followed by research marketing, licensing, and finally, the implementation of research within product and process innovation with the end-goal of financial return. [13]

TT is a catalyst for innovation, which, as mentioned above, is the key to innovation, and subsequently, to economic competitiveness. To implement innovation, an organization has a variety of possibilities to alter and improve its operational approach, its utilization of factors of production and the types of output it generates in order to enhance its performance or productivity. According to The Oslo Manual, there are four types of innovations: product innovation, process innovation, marketing innovation, and organizational innovation. [14]

The success of companies which operate in a supply-and-demand-driven economy is dependent on securing a competitive advantage. And the historical evolution of companies has demonstrated that there is a clear link between innovation and TT. To facilitate innovation, organizations must secure several elements, including material resources, information resources and technical knowledge, human resources, capital, as well as infrastructure. Thus, the innovation factor and the competitive advantage of businesses are conditioned by the transfer and acquisition of best practices, skills, know-how, information and ideas, intellectual property, and operational models. [15]

2.2 Applicability and benefits

A country's access to novel technologies that can be applied with business and industry processes, is a key factor, which determines the country's competitiveness and long-term sustainability. TT is a generator of innovation, as well as financial return for both the initiator, as well as the recipient of TT. In the context of economic expansion, TT is a clear accelerator of growth, specifically within industry. [16]

Studies have shown that companies from recently industrialized countries, which engage in manufacturing and production, typically depend on the transfer of innovation and know-how from their partners in more developed economies. Due to the fact that local companies have limited R&D

resources and lack the capacity to engage in internal research, transferring technology from more developed countries would allow them to obtain a competitive advantage. Thus, international technology transfer (ITT) can provide Romanian businesses with the solution to successfully exiting the post-pandemic slowdown of industry and production. [17]

Achieving a competitive advantage implies either creating new products or sourcing novel technologies for production and market insertion. For this purpose, access to affordable and abundant labor has become less relevant, in comparison to technology and associated skills and knowledge. In the context of national productivity, the economic growth of developed countries cannot be justified simply through the presence of natural resources, accessible and affordable labor, appropriate production equipment, reduced interest rates and minimal budget deficits. As an example, developed and prosperous countries such as Germany and Sweden have reached their current status in spite of appreciating currencies, expensive labor or a shortage of workers. Economies which encourage and support technological development and innovation have the highest chance of succeeding both internally, as well as globally. Obtaining a high technological capacity is the key determinant of the technological convergence of less developed economies. Thus, in order to thrive, less developed countries, such as Romania, should focus on obtaining access to sources of new technologies. ITT offers a variety of pathways, including product trade, know-how trade, human resource movement, and foreign direct investment (FDI). FDI is seen as one of the most important TT generators, as it frequently implies technology spillovers from foreign to domestic companies, as well as attracting financial capital. Another pathway for ITT is international cooperation. Local enterprises can thus expand their RDI expenditure and obtain an enhanced technological intensity, as well as technical innovation for their production process and output. [18,19,20,21].

Besides international TT, Romanian companies with limited R&D capacity also have the possibility to collaborate with locally based academic institutions and research organizations.

University technology transfer (UTT) implies marketing and capitalizing on academic research by with the purpose of obtaining economic impact and financial benefits. Thus, research breakthroughs and innovative discoveries are capitalized upon by “entrepreneurial” academic institutions, which license their research output as intellectual property and subsequently trade it to the business sector. Thus, economic enterprises reach out outside of their own existing resources for innovation. By transferring the research results of academic institutions, instead of engaging in costly R&D, businesses have the advantage of eliminating the risk and minimizing the costs associated with engaging in research and innovation. [22]

3. CASE STUDY

To best illustrate the effects of technology transfer, we will present the case of a Romanian production plant, referred to as PP throughout this case study, to comply with management’s anonymity request and GDPR regulations. The PP, which is located in the North-West region of the Romania, currently operates across four different sectors: the automotive industry, the electronic industry, matrix production and maintenance, and winter sports equipment production.

For the purpose of this case study, we will be referring to the activity of winter sports equipment production. In this context, the PP has completed a project for increasing efficiency by changing the injection channel from direct injection to curved channel/tunnel injection. Much like the entire Romanian industrial sector, the PP was also strongly impacted by the effects of the pandemic and the economic crisis that followed. The PP was faced with cost increases for raw materials of up to 30-80%, delivery delays for raw materials, supply chain blockages, order fluctuations, and human resource scarcity due to staff migration to more flexible work fields. The PP had been searching for solutions to increase efficiency, cut costs and reduce the need for human resource. Thus, the PP resorted to transferring a new technology and adapting it to its production processes. This is a process innovation, which, according to Eurostat, is

defined as the implementation of a breakthrough or significantly enhanced production or delivery method, which can refer to major changes in work and production techniques, equipment, or technology. [23]

Towards the end of 2020, the PP decided to implement a technology which had been utilized by Italian manufacturers of sports shoe soles. The PP intended to change the method of injecting plastic into the mold of the ski boots which it produces. Thus, instead of direct injection, it would use a curved channel for optimal injection of the plastic material, adapted to the texture, density, consistency, and purpose of the plastic material used for the component of the ski boot. The new injection matrix and adapted manufacturing process would allow for the simultaneous injection of plastic material into the matrix containing both the right, as well as the left ski boot. With the old technology, the injection points were previously prominently sticking out of the product and had to be manually cut off by an operator. The new technology would allow for the production machine to be adapted to automatically cut the plastic injection point, leaving a smooth finish, which did not require additional manual labor. (Figure 1)

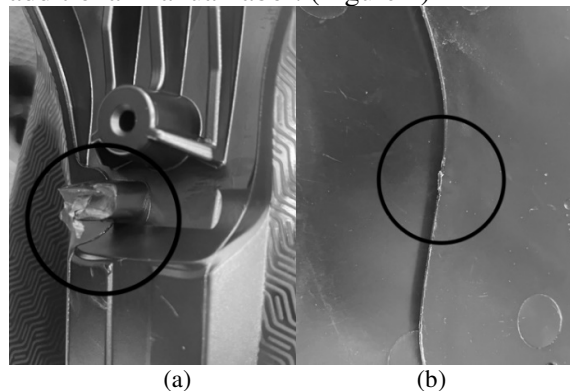
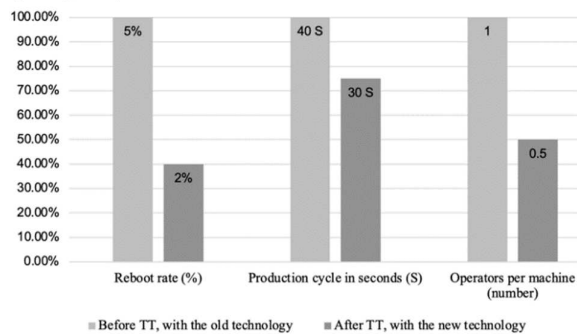


Figure 1. Injection point of products, with the old technology (a) and with the new technology (b).

The PP thus adapted and transferred the technology for use in the manufacturing of ski boots. With the old technology, the reboot rate was at 5%, however, with the new technology, only 2% of the manufactured boots are considered reboots. This has also led to a reduction in material and product waste. Additionally, the production cycle for one pair of boots has decreased from 40 seconds to 30 seconds. Due to the automation of the injection

point cutting process, one machine now only needs 0.5 operators to function. Prior to the new technology implementation, one machine required 1 full-time operator. These key performance indicators (KPIs) are cost generating. A higher numerical value of these KPIs corresponds to higher expenses incurred by the PP. After the TT and the implementation of the new technology, these KPIs have shown a substantial decrease, with the reboot rate being reduced by 60%, the production cycle being shortened by 25%, and the requirement of operators per machine being lowered by 50%. (Graph 1)



Graph 1. Percentage decrease in cost generating KPIs after TT

The PP obtained significant benefits regarding process efficiency, human resource use, and raw material waste reduction. This was a major help during the pandemic, since the areas where the PP saw benefits were in fact the exact same areas which were severely impacted by the restrictions and economic crisis: costs, raw material, and human resource availability.

The TT has come with major financial costs, as engineers were tasked with adapting the technology to the specific production activity of the PP. However, if the PP had engaged in creating the technology from scratch and performing R&D in order to create a completely new technology and process, the associated risks and costs would have been significantly increased. Most importantly, due to the above-mentioned benefits of the implemented innovation, management is confident that it will fully recover its financial investment.

4. CONCLUSIONS

The case study above described the transfer of a new technology, which resulted in a process innovation, affecting both the production equipment, as well as the production technique. The PP in the case study is representative for the Romanian industrial sector. In the case of Romanian privately owned PPs, R&D efforts to develop a new technology from scratch would imply extremely high costs and the risk of failure when implementing the new technology. The PP from the case study however, found a way to improve its production process, lower costs, engage in sustainable development, as well as cut down on the necessary labor force by transferring a technology already in use by foreign companies operating in a similar field. This approach has helped the PP to innovate and to obtain a competitive advantage during a time when the negative effects of the COVID pandemic were still strongly impacting production. Technology transfer can be accessed by companies operating in different areas of industry, to enhance processes and final products, and thus help the companies recover from the impact of the pandemic. Thus, it can be concluded that TT is indeed an accelerator for post-pandemic industry recovery, even more so in the context of less developed countries, such as Romania, where companies are trying to gain a competitive advantage through innovation, but lack the resources for extensive R&D.

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Transferul Tehnologic ca Accelerator pentru Redresarea Industriei în Contextul Post-Pandemic

Abstract: Prezenta lucrare analizează rolul transferului tehnologic (TT) în contextul redresării post-pandemice a industriei românești. Aceasta evaluează starea actuală a industriei din România, evidențiind efectele pandemiei COVID-19 din punct de vedere al fluctuării cererii pe piață, al provocărilor apărute în producție, al întreruperilor lanțului de aprovizionare, al deficitului forței de muncă și al constrângerilor financiare. Lucrarea identifică TT ca fiind o soluție viabilă și un accelerator pentru redresarea post-pandemică a industriei, având în vedere nevoia de cercetare, dezvoltare și inovare pentru a reporni industria. Lucrarea examinează cazul unei fabrici din România și descrie diverse scenarii de aplicabilitate pentru TT în România, o țară afectată de pandemie și cu o performanță industrială vizibil diminuată în comparație cu alte state europene.

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