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HOW THE CURRENT FOURTH INDUSTRIAL REVOLUTION EFFECTING THE LEADERSHIP?

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Abstract

Innovation leadership is critical in enhancing a firm's success in today's changing markets. This research investigates the changes in entrepreneurial leadership attributes amid the fourth industrial revolution and the fast pace of technological advancement. This study helps to understand how leadership traits may help entrepreneurs fully exploit the advantages of this revolution and gain a competitive advantage. The content analysis method used for this research utilized written data regarding 23 leaders from 20 companies from the latest 19th century during the first industrial revolution until the current fourth industrial revolution. Results reveal noticeable leadership attributes emphasized in the fourth industrial revolution, such as communication, coaching, innovation, forecasting future, team-builder, and more. Those attributes are in tight correlation with the current novel digital leadership paradigm and the known effects of the fourth industrial revolution on the firms and leaders. Results reveal that current entrepreneurs tend to be open-minded while avoiding rejecting innovation from other firms and are willing to share the experience with the adjacent technology ecosystem.

***Keywords**: Entrepreneurial leadership, Innovation, Digital leadership, Fourth Industrial Revolution*
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Introduction

When looking at the history of humankind, innovation contributes so much to the achievement of important goals in history, and is one of the essential shaping forces of history, relying on human creativity to overcome any technological restraints. One of the first innovation theorists, Austrian economist Joseph Schumpeter, stated that innovation appears to be one of the significant forces supporting economic development. Schumpeter advocated that innovation is the ultimate source of economic growth and hence is worthy of study (Fagerberg et al., 2013). Furthermore, innovation is the primary driving force for companies to prosper, grow, and sustain high profitability (Christensen, 1997).

Today, the world is at a crossroads- the fourth industrial revolution on the horizon, and the rate of technological advancement has accelerated dramatically. As stated by one of the experts in the field, "We will not experience 100 years of progress in the 21st century — it will be more like 20,000 years of progress [at today's rate]," says Kurzweil (2004, p. 1). Meanwhile, as the barrier to introducing innovative technology decreases due to the accessibility of high-power computing power and of-the-shelf complex systems, the general public's adoption rate of emerging technologies has become very quick. Moreover, the ability to learn independently has

increased, thanks to the extensive internet knowledge base. This enables the development of nonconventional innovations by individuals and groups that were not previously involved in innovation, which means they can deploy and develop new products and technologies much more efficiently than they used to years ago (ourworldindata.org, 2020).

This research examines the relationship between the current time-innovation paradigm, leadership attributes of current technology firms, and the significant changes to the technological environment due to the emergence of the fourth industrial revolution. The primary goal of this paper is to answer the question of how the entrepreneur adapts their leadership attributes to cope with today's rapidly evolving world. Consequently, this research should answer this critical question: What is the effect of the fourth industrial revolution on entrepreneur leadership attributes?

This research contributes to better understanding how the fourth industrial revolution's changes in the current technological ecosystem affect entrepreneurs and urges them to modify their leadership style to achieve their firm's goals and succeed with innovation initiatives. Those findings link the existing academic knowledge in domains like innovation, leadership, and the fourth industrial revolution, and lay a new base-ground for further research. In addition, the study establishes a preliminary foundation for upgrading the fourth industrial revolution's innovation paradigm, which can be included in the theory of the current open, interactive innovation model. Furthermore, the research creates an opportunity for further research regarding companies' management style, which altered and changed due to the fourth industrial revolution.

To establish a common baseline, it is necessary to consider the classic definition of innovation which Miriam-Webster defines as "the introduction of something new" and "a new idea, method, or device — novelty" (Miriam-Webster, 2016), even though the definition of innovation evolves year after year (Khayyat & Lee, 2015). A well-established definition of innovation was written by the Organization for Economic Cooperation and Development (OECD) in its Oslo Manual for Innovation: "An innovation is a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes, and that has been made available to potential users (product) or brought into use by the unit (process)" (OECD, 2018, p. 20).

Entrepreneurs are considered the leading force for promoting innovation. Hence, contemporary scholars are seeking to learn more about the entrepreneur leadership attributes that boost innovation. Managing innovation is a challenging and intriguing research topic, even though the causes often remain elusive and there are numerous hurdles to success in innovation. Several researchers attempted to establish a relationship between the role of entrepreneur leadership attributes in a firm's success and its innovation itself (Zuraik & Kelly, 2019). Recently, the relationship between leadership and the fourth industrial revolution and its influences has been studied.

In contrast, an updated type of digital leadership was introduced. The connection in the historical perspective, which may enrich the understanding of the role of leadership in promoting innovation in a changing environment, and how they cope with those changes, is still missing in the current knowledge. This research aims to investigate this issue, which may be beneficial to determine what modifications need to be implemented within the present-day firm's manager role.

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After analyzing 23 leaders from 20 companies across the four industrial revolutions, the results of this research affirm the initial assumption that there are a few differences in entrepreneur leadership attributes, as we can analyze nowadays, in the recent past and the distant past. The most significant distinctions are related to social behaviors and execution capabilities. Entrepreneurs nowadays are more communicative, capable of mentoring their subordinates, socially involved, and skilled at team building. They, probably due to the rapid advancement of technology, tend to be performance-oriented and with solid execution capabilities. Entrepreneurs from previous eras tend to be hard workers, ambitious and motivated, had a greater need for power, and were more tough-minded. The results are in line with the current dominant innovation paradigm of the interactive open model, whereby companies should rely on the knowledge of customers, suppliers, universities, and consulting teams rather than developing innovations themselves. Therefore, they should work alongside their open system to develop innovations (Chesbrough, 2003; Cohendet et al., 2017). According to the findings of this study, this is closely related to the attributes of the entrepreneur.

The remainder of this paper is structured as follows. First, we will discuss the literature and the relevant research background, followed by the proposed theoretical framework. Next, we will present an overview of the collected data from the selected firms, an analysis of this data, and the results of each study. The paper concludes with a discussion of the theoretical and managerial implications, limitations, and opportunities for future research.

Literature Review and Research Background

The research tries to merge three domains: the innovation phenomena, the leadership, and the changes in the technology world due to the fourth industrial revolution. There is a way to look at the strategic innovation engine through the leader's perspective or entrepreneurial leadership by the inherent connection between innovation and entrepreneurship.

To investigate the effect of the fourth industrial revolution on innovation, we can check the link between those domains. Therefore, this chapter consists of four main segments – innovation, the fourth industrial revolution, leadership and entrepreneurship, and the last, which connects all the preceding.

Innovation

Innovation is a widely spread phenomenon and not restricted only to the technology field. There is a wide range of points of view on innovation from different fields. The integration of these views should reveal the essential characteristics of innovation. Most scholars see innovation as a process that responds to a need or opportunity, depends on creative effort, introduces novelty, furthers the need for change, and overall brings an invention to use (Kooij, 2018). The innovation can also be realized by the mechanism which produced the innovation – such as the combination of old and new knowledge, the change-factor the innovation brought, or from the scholar's perspective, as it depends on the source and the outcome of the innovation (Kooij, 2013; Ballot et al., 2015; Rajapathirana & Hui, 2018).

If we follow this logic, another approach to categorize an innovation is through the four effects or outcomes of the innovation and the source of the innovation or the problem that needed to be solved. This method categorizes innovation initiatives into four categories – sustainable innovation, disruptive innovation, breakthrough innovation, and basic research (or frontier research). Sustainable innovation is when there is a fair summation and definition of the approach problem and an understanding of how to solve it. This type of innovation neither

affects nor generates a new market. Disruptive innovation, the concept of which was introduced at the end of the 20th century twenty years ago by Christensen (1997), is an idea that describes a process whereby a smaller company with fewer resources can successfully challenge established incumbent businesses. Disruptive innovations introduce a very different value proposition to the market than has been available previously. Usually, disruptive technologies underperform compared to established products in mainstream markets, as described above. Breakthrough innovation (or radical innovation) can be considered as the opposite of sustainable innovation. While the firm invests in major leaps with technology and introduces new products or services, this occurs instead of constant improvement (incremental innovation) (Byun et al., 2020). Primary research is a type of innovation that is based on pure science. As stated by Paula Stephan, in many cases, "basic research provides answers to unposed questions" (Stephan, 1996, p. 1205). This is not the case for the engineer's search for workable technology. At the same time, the results of this innovation initiative are mostly the discovery of new phenomena, and the measure of this activity is in publications. This contrasts with other types of innovation where the outcome is a product and rising sales and profits (Heraud, 2017), so they directly impact the firm's performance.

Another way of looking at innovation is to categorize it by type. The widely used categories of innovation are, as mentioned, product, process, organizational, and marketing. This research will focus on the product type of innovation. Product innovation refers to introducing a new (or significantly improved) product or service in the firm's portfolio to the market, thus influencing sales and product quality, among other business performance measures (Rajapathirana & Hui, 2018).

We should also look at innovation paradigms and how they change over hundreds of years. The expected differences between the innovation paradigm eras are the three main dominant models. The first paradigm is the close linear model, which existed until 1970-1980, and treats innovation as a linear process starting with a scientific effort that produces the invention, then the development of the product, and finally, the marketing of the product. The second paradigm is the open interactive model (or complex system of innovation), which sees innovation as a process involving the whole system and led to the development of broader innovation theories, such as national innovation systems and the Oslo Manual. This dominant model existed until the beginning of the 2000s and was founded by establishing a dedicated university institute for the academic field of innovation, such as the Science Policy Research Unit (SPRU) at the University of Sussex. The third and current leading paradigm is the open interactive model of innovation, which reflects the development of innovation theory towards a fully systemic, dynamic, nonlinear process involving a range of interacting agents. This model emphasizes that knowledge flows between actors, expectations about future technology, market and policy developments, political and regulatory risks, and the institutional structures that affect incentives and barriers (Greenacre et al., 2012).

Industrial revolution

The evolution of innovation theories and paradigms must be linked to the current state of technological advancement. Consequently, we can distinguish between the four industrial revolutions during modern history. Each of them had a significant impact on the economic and financial globe. The first revolution in the 18th century was driven mainly by the invention of the steam engine resulting in the first large-scale manufacture of textiles, steel, and other goods (Daemmrich, 2017; Mantoux, 1947). The second revolution occurred at the beginning of the 20th century, i.e., the invention of the internal combustion engine, which led to the car industry, large-scale transportation, and mass-industry facilities. During this revolution, over 70% of

American households gained access to electricity, and a wave of new consumer products entered people's lives (Nye, 1990). The third revolution was the information revolution. It took place between 1960 and 1980 and was driven by the invention of the personal computer and, with it, the ability to conduct fast and efficient data analysis. It also witnessed the establishment of the first foundation anchors of the internet infrastructure as we know it today, allowing us to store and access large amounts of data, information, and other resources (Schwab, 2017).

We are now in the emergence of the fourth industrial revolution. This technological revolution will fundamentally alter the way we live, work, and relate to one another. The transformation will be unlike anything humanity has experienced before in its scale, scope, and complexity. The current revolution, the fourth industrial revolution, started at the beginning of the 21st century and described a world where individuals move between digital domains and offline reality using connected technology that enables them to manage their lives. This revolution emphasizes machines and computers' abilities to link and control the physical world (Schwab, 2017). This revolution is still in its making and represents positive and drastic changes in how we work, live, and do business. It is global and without any physical boundaries in terms of location or geographical center. This revolution is developing at a pace much faster and higher in intensity than the previous revolutions.

This change will be historic in terms of size, speed, and scope. The drivers of this change are physical, digital, and biological. The physical change is made by autonomous vehicles, 3D printing, robots, and new materials. In contrast, digital change is carried out by the internet of things (IoT) and the internet of services (IoS). The biological change can be seen in generic sequencing, genetic engineering, synthetic biology, and biological editing. Even at present, a technological transformation has strongly influenced every aspect of economic and social life, including basic mechanisms like demand formation, capital accumulation, and employment generation (Schwab, 2017; Dosi, 2012).

Under the fourth industrial revolution, the growing digitization of production and processes in the global economy has triggered far-reaching changes in firms and societies. These changes should not be regarded only as engines of transactional efficiency, which leads to much better labor exploitation. These changes also affect the repositories of competencies, knowledge, and creativity in firms and societies and significantly affect society. Accordingly, the 'fourth industrial revolution' refers to technologies and concepts of value chain organization as the European Commission set a path to digitize European industries (Amin & Cohendet, 2012).

Digitization means automation, which in turn means that companies do not incur diminishing returns to scale, or at least less of them do. To understand what this means at the aggregate level, compare Detroit in 1990 (then a major center of traditional industries) with Silicon Valley in 2014. In 1990, the three most prominent companies in Detroit had a combined market capitalization of $36 billion, revenues of $250 billion, and 1.2 million employees. In 2014, the three most prominent companies in Silicon Valley had a considerably higher market capital ($1.09 trillion). They generated roughly the same revenues ($247 billion) but with about ten times fewer employees (137,000) (Schwab et al., 2016; Manyika & Chui, 2014).

We do not yet know just how this revolution will continue. However, one thing is clear: our response must be integrated and comprehensive, involving all stakeholders of the global polity, from public and private sectors to academia and civil society. At the same time, the central aspect of this revolution is automation, or the machine era, and the use of big data in the field of brain, mind, neurosciences research, and more. The prediction is that the fourth industrial revolution will increase global income and, thus, promote the global economy. The revolution

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will also improve the quality of life for the global population, mainly those who have access to the digital world. Technology will create new products and new markets and introduce new services that increase the efficiency and pleasure of our personal lives (Rostow, 1985; Johannessen, 2018; Maynard, 2015).

Leadership and entrepreneurial leadership

The question of managing and promoting innovation within the firms still does not have a concrete answer and is considered an interesting research topic. At the same time, the prerequisite often remains elusive (Heraud, 2017) and the barriers to achieving success in innovation (Rajapathirana & Hui, 2018). Thus, there is a need to create links between entrepreneur leadership attributes, the firm's success, and the firm's innovation. One of the best-known and well-used definitions of leadership was made by Stogdill, who in 1950 defined it as "the process (act) of influencing the activities of an organized group in its efforts toward goal setting and goal achievement." This definition regarding the influencing process and its outcome is also acceptable by present-day scholars (Antonakis et al., 2004; Fiedler, 1996).

The term entrepreneurship is generally associated in everyday use with a person creating a new organization. However, to link it to this research, the term entrepreneurship is used as the principal label to cover all research that involves "the process of uncovering and developing an opportunity to create value through innovation and seizing that opportunity without regard to either resource (human and capital) or the location of the entrepreneur – in a new or existing company" (Churchill, 1992, p. 586; MacVaugh and Schiavone, 2010). Thus, entrepreneurs are involved in innovation initiatives at any firm's scale – from small and newly established to large corporations.

To define the term of entrepreneurial leadership, there is a need to check the outer layer of the role of this type of leadership as a critical area in which entrepreneurs can maintain their competitiveness when faced with dynamic and changing environments (Fernald et al., 2005). Entrepreneurial leadership is positively related to business performance through encouraging innovation and development within customer and competitor orientation (Van Zyl & Mathur-Helm, 2007) and provides a means to explore the role and influence of leadership within entrepreneurial settings. An entrepreneurial leadership style is used "…to solve complex business, social, and environmental problems" (Greenberg et al., 2013, p. 57). Entrepreneurial leadership can be defined as a derivate of leadership as a type of leadership that creates imaginative scenarios that can be used to assemble and mobilize a "supporting cast" of participants who become committed by the vision to the discovery and exploitation of strategic value creation (Gupta et al., 2004, p. 242). The definition of entrepreneurial leadership can be summarized as the responsibility to maintain the firm's competitive advantage in changing and dynamic enrolment, the ability to promote innovation, solve complex business problems, and increase the strategic values of the firm. Entrepreneurial leadership exists in any type and scale of organizations, but on the condition that the organization is promoting innovation initiatives.

There is a long-term debate regarding the sets of attributes of leadership and entrepreneurship. This debate deals with the combination of the attributes of those two terms, whether they are overlap or separate (Antonakis and Autio, 2007). Even-thou while trying to define the attributes of entrepreneurial leadership, the common understanding is that the related attributes arise from both domains (Cogliser and Brigham, 2004; Renko et al., 2015). While trying to define what is the optimal set of leadership attributes, there is a slight disaccord. However, there is no doubt about their importance (Goffee & Jones, 2006). Entrepreneurial leadership attributes are considered critical factors in addressing challenging conditions and recognizing and exploiting

new potential opportunities for the firm (Harrison et al., 2016). Those attributes result from extensive academic investigations and research and can be linked to several essential categories such as charisma, creativity, decision-making ability, ambition, knowledge, vision, and more, and will be used in this research. When trying to link the leadership attributes of the current industrial revolution, research defines several attributes as superiors - creativity, inspiring, credibility, more comprehensive knowledge, collaborative and interactive and trustfulness of the subordinates (Sandel, 2013)

Intersection between innovation, leadership, and fourth industrial revolution

This research aims to investigate the changes in the innovation phenomena, and more preciously the leadership phenomena related to innovation, entrepreneurial leadership, due to the changes in the world as part of the fourth industrial revolution, and due to the significant changes in the world followed it. Some of those effects rose debate within the scholar communities, such as the effect of the fourth industrial revolution on the leadership.

The first inter-relation to examine is between leadership theory and the fourth industrial revolution. The updated leadership model is digital leadership or e-leadership, a term derived from the fourth industrial (or digital) revolution. The term digital leadership is relatively new and combines both leadership skill and digital capability to optimize the benefit of the current fourth industrial revolution and its technologies that boost the firm's business performance (Mihardjoa et al., 2019). Gartner (2018) has set the standard definition of this term "Digital Leadership is the preferred corporate leadership approach to lead in the digital age." Digital Leadership described by Sow & Aborbie (2018) as a demonstration of strategies adoption positively influencing digital transformation processes, or as the process of social influence mediated by technology to produce a change in attitudes, feelings, thinking, behavior, or performance with individuals, groups, and organizations (Stana et al., 2018). Digital leadership can adapt to rapid technology development. It is considered the critical factor to facing the fourth industrial revolution era, which has also been proven destructive for companies that cannot go hand in hand with the changing times (Syam and Sharma, 2018; Berman, 2012; Jovane et al., 2008).

Ideal e-leadership considers a leadership that follows the fourth industrial revolution demands. Consequently, leaders who follow technology development must have skills in influencing, encouraging, guiding, directing, and moving others in the fourth industrial revolution era (Utomo & Darma, 2020). The leadership attributes which link to the digital leadership model are the ability of innovation, digital skills, strong networks, collaboration, participatory engagement and vision, curious, risk-taking, adaptive to changing environment, teamwork efficiency (Kazim, 2019; Swift et al., 2019; Toduk, 2014). Those attributes are with connection to today's corporate leaders' duties, as described – to carefully assess how to harness emergent digital imperatives, to apply new ways of collaboratively working, to deliver new levels of personalized customer servicing, and to incorporate new digital technologies and platforms (emerging technologies) for digital transformation (Danoesastro et al. 2018).

The second inter-relation is between the innovation theories during the time and the industrial revolution. This can be summarized in the following table, which links the main innovation paradigms and theory to the relevant industrial revolution.

Table 1 Innovation Model During the Time

Era	Main Innovation Paradigm	Innovation Theories	Major Historic Events	Industrial Revolution	Noticeable Firms
1930-1970	The Linear Closed Model	Older Linear Model Linear and Closed Model Creative Destruction Technology-Push - Demand-Pull Model National Level Research	WW2	2nd - Engine and motorized	Ford Moros AT&T
1970-2010	Interactive and Closed Model	Innovation System National Innovation System Complex System Theories System Integration Networking Model	Cold War	3rd – Digital Revolution	IBM Microsoft
2010 -	Open Interactive Model	Open Innovation Open Innovation Ecosystem Interactive Model collaborative process Innovation Disruptive Innovation	Globalization	4th – Automation and Artificial Intelligence	Google Facebook AirBNB UBER

Source: Author own editing (2021)

Method

This research used the content analysis method to extract data about entrepreneur leadership attributes and find the variations between different eras of time and different industrial revolutions. The content analysis method is a qualitative research method that starts with actual observations and the collection of original documents and then proceeds to code layer after layer, employing analysis and comparisons to refine concepts and categories before constructing a systematic theory (Fendt and Sachs, 2008). Content analysis can analyze written, verbal, or visual communication messages (Krippendorff, 2019) and has a long history of use in different academic areas. As a research method, content analysis involves being systematic and using an objective method of describing and quantifying phenomena (Krippendorff, 2019; Downe-Wamboldt, 1992).

The content analysis method is more conducive to eliciting the underlying leadership attributes of the entrepreneurs from documents and other written texts. This approach allows us to make validated inferences from different kinds of sources. It enables us to condense words into fewer content-related categories. Words, sentences, and the like are believed to have the same meaning when categorized into the same categories (Cavanagh, 1997). An advantage of this method is that large volumes of textual data and different textual sources can be dealt with and used in collaboration (Elo & Kyngas, 2007).

Data Collection and Analysis

To build the sample for the content analysis, three steps were conducted. The first list of companies that participated in the NYSE (New York Stock Exchange) was taken from the early beginning of the 19th century until now. In the second step, 20 companies were chosen arbitrarily from this list (as well as 2 of the company from other sources) as a sample for the

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research, reflecting the presentation of each industrial revolution. In the third step, the notable leader was recognized for each company, and written data was gathered regarding his leadership, precisely the linked leadership attributes.

The total sample was of 23 leaders, all founders or general managers of those companies– 11 from the phase before the fourth industrial revolution and 12 after its occurrence, so this distribution is balance. This study's data was digitalized documents and texts from open databases, such as the internet, newspapers, and online digital archives. Those documents include interviews with the firms' CEOs, biographies, and historical descriptions of their leaders. Therefore, the chosen firm's leadership attributes have been extracted and analyzed due to this data's focal point. The complete dataset analysis enabled the examination of the changes in those attributes during the various industrial revolutions. For each leader, at least three different sources were used. The next step is to perform content analysis. For this stage, a list of 58 leadership attributes was used. This list was gathered from the current knowledge for leading entrepreneurship leadership attributes (Bindlish and Nandram, 2018). This list was the basis for the content analysis phase (while the majority, approx. 70%, included in the content analysis results).

Results

This chapter discloses the results and outcome of this research and the leadership attributes of the managers within the firms to recognize the effect of the fourth industrial revolution on leaders.

The content analysis results reveal salient differentiation between the leadership attributes in the fourth industrial revolution era and before. We can notice several significant differences in several attributes. First, attributes that are more common in the early industrial revolution other than in the current one include ambition, motivation, hard-working, and resource management. On the other hand, several attributes were more common after the fourth industrial revolution, such as coaching, communication, ethics, execution, forecast future, innovation, inspiring, strategic thinking, and team building. The analysis reveals that achievement and creativity, risk-taking, social influencing, and proactive attitude of the leader is quite common in both eras.

The table attached summarizes which leadership attributes were more common before the fourth industrial revolution and after. The research also revealed other leadership behaviors which cannot be assigned to one of the leadership attributes but contribute to the analysis. Before the fourth industrial revolution, we can notice aggressive behaviors through the rivals' fighting and conflict (H. Osborne Havemeyer from The American Sugar Refining Company and A. Carnegie from United States Steel Corporation). On the contrary, more collaborative attitudes were noticed after the fourth industrial revolution, such as working with the ecosystem and sharing experience, collaborating with customers and other companies (H. Vestberg from Verizon, M. Benioff from Salesforce, M. Parker from Nike, and A. Gorsky from J&J). Both eras seem to acknowledge the importance of hiring the best employees who fit the company culture.

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Table 2 Leadership Attribute Before and After the Industrial Revolution

Before fourth industrial revolution	**After Fourth industrial revolution**
Ambition	Communicate
Motivation	Coaching
Resource management	Ethics
Hard working	Execution
	Forecast future
	Innovation
	Influence
	Performance oriented
	Strategic thinker
	Team builder
Achievement	
Creativity	
Friendly	
Risk taker	
Social influencing	
Visionary	

Source: Author own editing (2021)

Conclusion and Discussion

The research's primary purpose is to answer the research problem of how the entrepreneur adjusts their leadership attributes to cope with the current fast-changing world as a preliminary or pilot test with a relatively small dataset. This research answers the question: What is the effect of the fourth industrial revolution on entrepreneur leadership attributes?

The research results affirm several insights regarding the impact of the fourth industrial revolution. First – the results indicate that this revolution altered and adjust the leadership attributes of the entrepreneur. Several attributes are more noticeable in this fourth industrial revolution era than in previous industrial revolution eras. This research suggests that those attributes can be linked to the characteristics of the revolution and disclose how the current-time leaders should cope with the significant changes related. Among those attributes, some as innovation, forecast future, execution, and performance-oriented can be linked to the speed of technology advancement and the excessive adoption rate of new products. Other attributes may link to the need to share information and work along with the technology ecosystem and must form an excellent professional group to cope with those changes; among those leadership attributes, we can specify communication, team builder, and coaching. The results emphasized few timeless attributes common throughout all generations and the previous industrial revolutions, such as risk-taking, achievement, and creativity. The results also link to the digital leadership paradigm, which describes the leadership attributes and skills needed to promote the digital transformation within companies and boost a firm's business performance, among those attributes – strategic thinking, execution, and visionary mindsets of the leaders. Even though to the limited sample (23 firm's leaders), there is a distinct relationship between the existing knowledge of the fourth industrial revolution and its effects, the leadership paradigms, epically the digital leadership theory, to the results in this research, mainly in the necessity of the leader to cope with the high pace of the technology. This unique phenomenon of the fourth industrial revolution forces the leader to adjust himself, mainly in execution, performance, and innovation, as reflected in the research results.

Theoretical Contribution

Due to the current state of the emerging fourth industrial revolution, the technological environment is undergoing enormous changes. The pace of these changes keeps growing (Schwab, 2017; Dosi, 2012). On the other hand, entrepreneurs need to align themselves towards much more complex innovative environments because the knowledge is developed by all the ecosystem members, including customers, direct and indirect competitors, universities, and consulting teams (Chesbrough, 2006). This situation forces the entrepreneur to adjust their leadership attributes to cope with situations, bring about innovation, and stimulate economic and marketing success for the firm. Also, there is a link between the research results to digital leadership characteristics, such as the tendency to coach the employees, communication channels within the organization, and the importance of speed all over the development phase (Yücebalkan, 2016).

This research aims to link all the mentioned factors and step into an interesting intersection, which has hardly been explored yet, to answer how entrepreneur leadership attributes have changed as a result of the fourth industrial revolution. In order to answer this question, an intensive literature review was conducted on those main topics and consisted of three main segments, the first dealing with the innovation phenomena and the different types of innovation and summarized the changes in the innovation paradigm over the last two centuries. Second, regarding the past industrial revolutions and the current ones, and what their implications have been. Third, about entrepreneurship and leadership, focusing on the impact of leadership on innovation and what attributes enhance the innovation factor within leadership.

This research suggests a new method to analyze innovation and adaptability to the current era, thus by checking the development and changing leadership attributes during the era of time, specifically on different periods of industrial revolutions. We would suggest a new perspective to look upon the firm's strategy, mainly the role of the leaders to adjust the firm's decision-making and aligning the selections at the innovation pathway. This research suggests that leaders choose a collaborative mindset to share ideas within their ecosystem. This mindset may enhance the ability of the firm to utilize the knowledge and the products available in the technology ecosystem and focus the firm investment in more needed projects while avoiding waste in unnecessary efforts.

The research outcomes also influence the factors by which new startups can be measured and analyzed, mainly in their first stages. As we demonstrated, the pace of technology nowadays, due to the fourth industrial revolution, is much higher than in the past, so firms should adjust themselves to the changing environment and gain competitive advantages. The research brings attractive leadership attributes that may be used to analyze the firm's leaders and predict the firm's success rate with this current changing economic and technological environment.

Different contribution perspectives may be to the field of managers education and training academic field, as the research emphasizes several leadership attributes that may benefit current managers. As most of the leadership attributes are part of life-long training and learning, the research results, as the preferred leadership attributes, may be emphasized during the current study programs of managers and business leaders.

Managerial Implications

There are some valuable managerial takeaways in this research. The first is the need for firms to train and improve top management, which should be adapted to the fast-changing

environment of the present day. Second, academic institutions should enhance study programs, especially management ones, such as MBAs. Third, venture capital institutes and related funding firms should predict the success rate of startup companies in their earliest stages. This research may help guide them in this process.

The results affirm that the current era of the fourth industrial revolution forces the entrepreneur to adapt and improve their ability to use off-the-shelf technologies, which accelerates innovation. The current entrepreneur must work within a close technological ecosystem and share common problems and solutions to utilize the technology's capabilities, so the entrepreneur can focus only on the firm's next invention. Thus, today's entrepreneurs should be adept at on-the-shelf technology capabilities such as cloud computing, open-source codes, software module sharing with the public, complex algorithms for known problems, and more. A willingness to use them will enhance the ability of the firm to keep up with the fast pace of the current revolution.

Limitations & Future Research Directions

The limitations of this research are its very nature, as it considers somehow small-scale research consists of only 23 leaders from a considerable period. The dataset should be broader, so the statistical reliability increase; this is the plan for the following research project. Other limitations are concerning the newness of the fourth industrial revolution as it is still in progress, so some of the associated attributes may still be developing. The proposed solution for this is to assure a similar result after the situation stabilizes. Another limitation is the research method itself, as content analysis extracts the information from the written texts. Thus, this information may be biased, either from the writer's perspective, which may be the leader himself, i.e., in an autobiography, or from the writer's perception, which may differ from the actual situation. Some of the leadership attributes may be emphasized at a particular time. In contrast, others may be dimmed due to cultural effects, so that historical perspectives may be biased.

Other than analyzing a much broader sample, future research proposals try to link the leadership not only to the industrial revolution sequence but also to the industry segment and the firm's success rate. This research may reveal a deeper layer by linking a specific leadership attribute to the market segment. Combining with the firm's success rate may be valuable for future understanding of the manager's role.

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THE PROTECTION OF TRAIN CREWS DURING THEIR WORK IN THE AGGLOMERATION OF BUDAPEST

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Abstract

A peaceful, prosperous era for Hungary began with the Compromise of 1867. Especially the development of Budapest was impressive at the turn of the 19th and 20th centuries, which made the capital a real metropolis in the heart of the Carpathian-Basin. At this time, the establishment of the proper railway network and railway connections gave the basis of the economic prosperity of the country. Development of railway had not only positive, but also negative effects, such as the emergence of dangerous criminals, robbers, thieves, violent people who harmed the passengers and threatened the safety of rail transport. In the recent years, the number of violence attacks increased against the train-crew members (e. g. ticket inspectors, train drivers). Especially trains running in the agglomeration of Budapest have required police actions. The study consists of three main parts. The first part contains a brief presentation of the Hungarian railway system, the second part presents the suburban and local railways (HÉV) in the agglomeration of Budapest, and the third part presents the nature and number of crimes committed against the train crew members and the security regulations against attacks.

Keywords: *train, abuse, law, transportation, railway*
JEL classification: *R41*
LCC code: *TF 501-668*

Introduction

In the more than 150 years since the handover of the first Hungarian railway line (Pest-Vác) in 1846, the continuously expanding Hungarian railway network was able to follow the needs of industrializing economy, while being the engine of the development of modern society. Following the Compromise of 1867, the state played an increasingly important role in the development of the railway network, and for this, it sought and received authorization to take out a significant amount of state loan for the development of the railway. Hungarian State Railways (MÁV) is one of the oldest transport companies in Hungary. In 1869, the Ministry of Public Works and Transport decided to purchase the privately owned Pest-Hatvan- Lučenec (Losonc)-Banská Štiavnica (Selmecbánya) railway line from the bankrupt owner. The company operating this line and the soon-to-be-handed Zákány-Zagreb line has been named the Hungarian Royal Railways. This year is considered to be the founding year of MÁV, and the purchased line became MÁV's first railway line. The era of the Hungarian railways up to World War I coincided with the intensive integration of the country into the European economic system and the booming pace of rail transport as a developing transport sector in an international context. During this period, one of the basic conditions for the economic recovery of the country, individual regions and settlements was the construction of an adequate railway network and the establishment of a railway connection (Erdeiné Késmárki - Gally-Fenyvesi, 2012). In response to this need, one of the most dynamically developing railway networks in contemporary Europe was created in a few decades (Köller, 2003). The largest extent of the

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Hungarian railway network was reached by the beginning of World War I, when 21,200 km of normal track gauge and approx. 1,600 km narrow-gauge railway line was built (Figure 1). By then, a significant part of the Hungarian railway lines, about 19,000 km, were owned or operated by MÁV, only a fraction of them were managed by private companies (for example, the Danube-Sava-Adriatic Railway Company, whose lines were nationalized only in 1932). An important part of this railway network was the local railway network. The main aspects of the construction of local railways were savings, the involvement of local materials, assets, capital and labour, as well as the low-cost level of the operation in line with the small turnover (Tisza, 1996, Áldorfai et al. 2017). Such were, for example, the local railways from Budapest to Esztergom and from Budapest through Lajosmizse to Kecskemét, which are now part of the MÁV line network. Figure 1 shows a map of the Hungarian royal state railways and the local railways under their management from 1914. The map showed 138 local railway lines, of which 129 were normal gauge and 9 were so-called narrow-gauge. MÁV's branch network later developed from most of these lines. In 1918, 57% (approximately 13,000 km) of the 23,000-kilometer Hungarian railway network was in the hands of HÉV companies (Wettstein -Szabó, 2005).

Figure 1: Map of the Hungarian royal state railways and the local railways under their management in 1914

Source: (MMKM, 1914)

Territorial changes following World War I marked a significant transformation in the company's life, as most of the line network became the property of other countries (Péli - Neszmélyi, 2015). The Hungarian railway network was established in sync with European development and until the World War II it was able to keep pace with technical developments (network density, proportion of double-track lines, proportion of electrified lines, speed allowed on the track, proportion of seamless superstructure, proportion of bulky rails, number of stations, level crossings, structures, interlocking, etc.). Today, the MÁV Group is Hungary's largest and most important fixed-track transport service provider. The responsibilities of the 30 member companies of the company group include, among other things, the operation of the track network, passenger transport, traction, maintenance and vehicle production. On July 1, 2007, the passenger transport subsidiary, MÁV-START Zrt. was established, which serves passengers on the Hungarian 7,273 km railway network at a total of 1,344 points (railway stations, stops) every day, with thousands of trains a day. The company currently operates 1863 passenger cars, 467 motor cars and 976 (diesel / electric) locomotives (MÁV-START, 2020).

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The changes in recent decades (such as motorization, the development of transport, changes in travel habits and needs, digitalisation, environmental protection, etc.) are having an impact on the environment and challenging the railways to respond. Examining the passenger transport data (Figure 2) it can be identified that the measured data has been a steady decline the 1970s, and with the development of motorization, the railways have been gradually pushed out of the traditional transport market. With the emergence of the market economy in the 1990s, and the disappearance of the previously artificially maintained economic environment, the railways collapsed as the adverse effects on rail transport occurred simultaneously. After the low point of 2010, due to developments and railway renovations, the decline has stopped, and the number of passengers has even increased by about 10 million in the last 10 years. This promising trend was broken by the downturn caused by the Covid-19 epidemic in 2020.

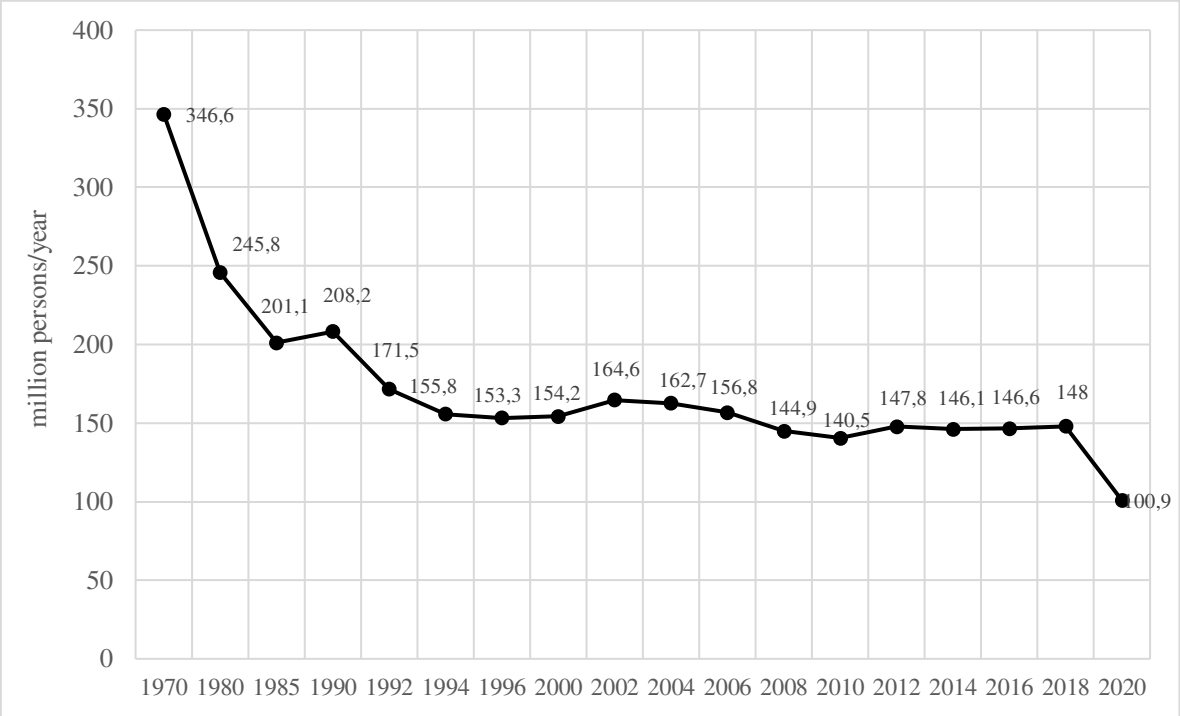

Figure 2: Statistics on rail passenger transport (1970–2020; million persons / year)
Source: (Köller, 2003, KSH, 2021.)

After the unification of the capital in 1873, the number of people, who worked in Budapest, but built houses and lived in cheaper areas of the surrounding settlements, increased rapidly. There was a growing demand from commuters to travel in increasing numbers between their place of residence and their place of work. Today, the Hungarian railway network is characterized by a central layout that follows the centrality of Budapest arising from historical and economic conditions of the country. A significant proportion of the transit and long-distance segments of rail passenger and freight transport affects the capital. The national network structure has a positive effect on the direct provision of agglomeration and long-distance connections for Budapest. The central role of the capital culminates in commuting among employees and students. More than 50% of the domestic railway passenger traffic appears on the railway network of Budapest and its surroundings. Figure 3 shows the railway network map of the Budapest area and the year of construction of the railway line.

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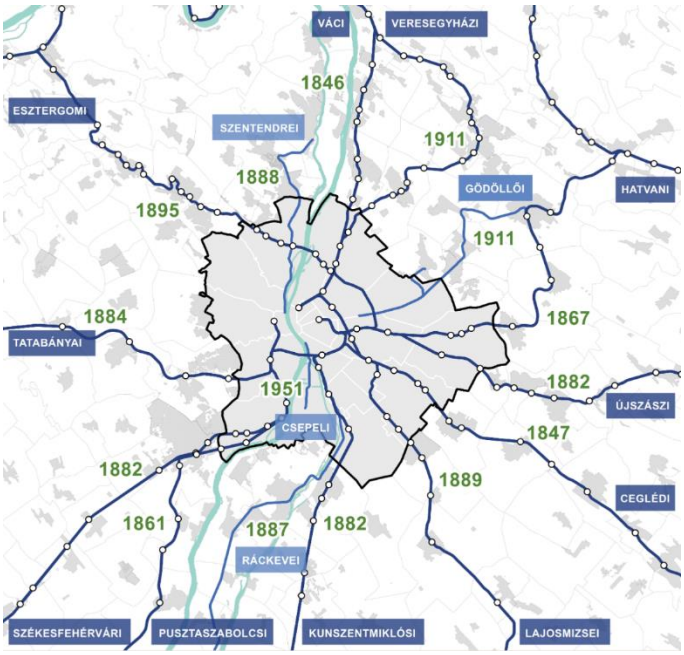

Figure 3: Budapest suburban railway network

Source: BFK (2021)

The largest railway traffic in the agglomeration of Budapest is handled by lines 100a (Budapest – Cegléd – Szolnok), 70 (Budapest – Vác – Szob) and 30a (Budapest – Székesfehérvár). Lower traffic can be measured on lines 142 (Budapest – Lajosmizse), 150 (Budapest – Kunszentmiklós – Tass) and 71 (Budapest – Veresegyház – Vác) (Table 1.). Due to the poor condition of the railway infrastructure on these lines, the lower level of service seems to be a significant influencing factor. According to surveys, the busiest railway stations in Budapest are the main railway stations (Budapest Nyugati, Budapest Keleti, and Budapest Déli railway stations), as well as Budapest-Kelenföld and Kőbánya-Kispest stations (MÁV-START, 2020).

Table 1: Daily number of passengers on suburban or local rail lines in the Budapest agglomeration

Line number (Start and end station)	Daily number of passengers (persons)	Percentage distribution (%)	Service provider
H5 (Batthyány square – Szentedre)	116 000	25%	MÁV-HÉV
H7 (Boráros square – Csepel)	59 000	13%	MÁV-HÉV
H8-H9 (Örs vezér square – Gödöllő/Csömör)	43 000	9%	MÁV-HÉV
70 (Budapest – Vác – Szob)	42 000	9%	MÁV-START
100a (Budapest – Cegléd – Szolnok)	42 000	9%	MÁV-START
30a (Budapest – Székesfehérvár)	31 000	7%	MÁV-START

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120a (Budapest – Újszász – Szolnok)	27 000	6%	MÁV-START
H6 (Közvágóhíd – Ráckeve)	27 000	6%	MÁV-HÉV
1 (Budapest – Tatabánya)	16 000	3%	MÁV-START
80a (Budapest – Hatvan)	15 000	3%	MÁV-START
2 (Budapest – Esztergom)	13 000	3%	MÁV-START
40a (Budapest – Pusztaszabolcs)	12 000	3%	MÁV-START
71 (Budapest – Veresegyház – Vác)	10 000	2%	MÁV-START
150 (Budapest – Kunszentmiklós – Tass)	6 000	1%	MÁV-START
142 (Budapest – Lajosmizse)	5 000	1%	MÁV-START
Total	464 000		

Source: Self-editing based on BFK (2021)

The lines of fixed-track transport (railway, HÉV) densely network the agglomeration of Budapest. As can be seen from Table 1, the local railways operated by the MÁV-HÉV can be considered as an important pillar in the transport of Budapest and the agglomeration. Today, 892 trains run daily on five lines of the HÉV, on a network of barely 100 kilometres, on a track length of 174 kilometres, with an outstanding schedule on school days (MÁV-HÉV, 2019). The daily number of passengers is approx. 245 thousand people (Table 1).

The construction fever of local railways did not escape Budapest in the 19th century. As the first swallow, the Budapest – Szent-Lőrinci Local Interest Railway Co. handed over the narrow-gauge tracks built between Üllői út and the Lőrinc Brick Factory in April 1887. However, the line did not become part of the later core network, its HÉV nature ceased in a short time and it became part of the tram network, so it has not be considered a real, classic HÉV line. The first ten-kilometer HÉV line between Budapest Közvágóhíd and Soroksár was handed over on August 7, 1887, and in the same year it was extended to Haraszti, and then in 1892 to Ráckeve. The first section of the Gödöllő line (from the Keleti Railway Station to Cinkota) was handed over to traffic on July 20, 1888, while the Filatorigát – Szentendre line was handed over to traffic on August 17, 1888. The first HÉV in Csepel was opened as the wing line of the Ráckeve HÉV in 1912, then the Csepel high-speed railway was built to Boráros Square in 1951. These HÉV lines still work today, albeit on some slightly changed routes. The Vác – Budapest – Gödöllő line was built as a local railway line outside of Budapest, but it is definitely worth mentioning. When the line was handed over in October 1911, it was the first electrified railway line in Hungary. It was connected to MÁV's track network at all three endpoints of the track. In Rákospalota and Vác, it had a direct connection with the MÁV main line in the direction of Szob, in Gödöllő with the Budapest – Hatvan – Miskolc MÁV main line, and with the Budapest – Gödöllő BHÉV line. The two parts of the electrified line were the 41-kilometer main line

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between Rákospalota – Veresegyház – Vác and the 11-kilometer wing line branching from Veresegyháza to Gödöllő (Lovas, 1999). The line was operated by MÁV. Following the post-World War II reconstruction, traffic began with steam traction on both the main and side lines. In 1970, MÁV closed the Veresegyház – Gödöllő line. Currently, the Vác – Veresegyház – Budapest line is MÁV's electrified line 71.

More than 80% of the passengers on the lines operated by MÁV-HÉV travel within the administrative boundaries of Budapest. The traffic of Békásmegyer, Kaszásdűlő, Csepel would be unsolvable without the HÉV lines operating here. At the same time, the biggest problem of HÉV is that the stops and tracks have remained almost unchanged since their construction, they did not follow the change of travel habits and the development of the city. In order to deal with the situation, we can consider the development of the 11 suburban MÁV and the five MÁV-HÉV lines as the Government Decision of 1563/2018., 1564/2018. and 1565/2018. (XI. 10.), which formulate the intention to create a well-thought-out, uniform fixed-track networks in order to provide a suitable alternative to private transport.

Material and method

Tens of thousands of passengers take part in rail traffic every day, unfortunately, as in other areas of life, there are passengers who do not take into account other passengers or the train staff employed by MÁV-START Zrt. Both passengers and traveling crew are regularly abused by aggressive passengers, who may be drunk or under the influence of a mind-altering substance. The railway company shall take all possible measures to guarantee the safety of on-board ticket inspectors. In recent years, MÁV has concluded a number of police and civil guard agreements, ordered security personnel, railway escorts, and implemented security investments. The railway company pays special attention to assisting in criminal proceedings for crimes against workers.

According to Act C of 2012 on the Criminal Code, ticket inspectors are persons performing public duties, therefore attacks against them are considered as criminal offenses and must be severely punished. According to Section 310 of Act C of 2012 on the Criminal Code:

„Assault on a Public Official

(1) Any person who:

a) attempts to prevent a public official or a foreign public official in his lawful proceedings by force or by threat of force;

b) takes certain action to compel a public official or a foreign public official to do, or to refrain from doing, some act;

c) assaults a public official or a foreign public official during or because of his proceedings; is guilty of a felony punishable by imprisonment between one to five years.

(2) The penalty shall be imprisonment between two to eight years if the assault against a public official is committed in a gang, by displaying a deadly weapon or by carrying a deadly weapon.

(3) The organizer or head of the gang referred to in Subsection (2) shall be punishable with imprisonment between five to ten years.

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(4) Any person who participates in a gang arranged to commit assault against a public official is guilty of a misdemeanor punishable by imprisonment not exceeding two years, while the organizer and the head of the gang shall be punishable for a felony by imprisonment not exceeding three years.

(5) The person who assaults a public official or a foreign public official because of his proceedings shall be punished according to Subsections (1)-(4), even if the assaulted person is no longer a public official or foreign public official at the time the criminal act was committed.

(6) Any person who engages in preparations to commit assault against a public official is guilty of a misdemeanor punishable by imprisonment not exceeding one year.

(7) A person participating in the above-specified gang shall not be prosecuted under Subsection (4) if he leaves the gang voluntarily or by order of an authority."

Research results

With the help of the Security Directorate of MÁV-START Zrt., I conducted a research to determine the number and typical location of such crimes (Figure 4) (MÁV-START, 2020).

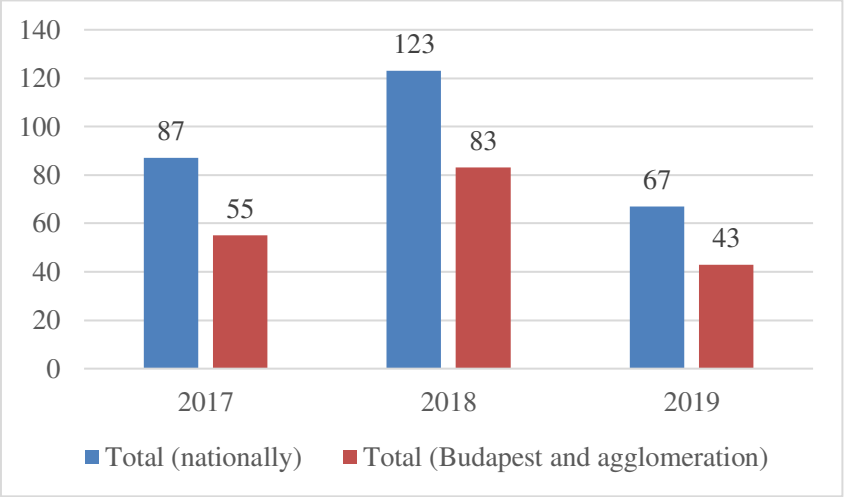

Figure 4: Number of abuses against train crew on the lines of MÁV-START Zrt. (2017–2019)

Source: Self-editing based on MÁV-START (2020) data

In 2017, there were 86 attacks on train crew. Typically, they were punched in the face, spit out, or subjected to verbal aggression. There were also cases where the perpetrators threatened them with knives, kicks, punches, obstructed their free movement. The vast majority of offenders (more than 3/4) wanted to travel without a ticket or with an invalid or transferred ticket. In 2017, 75 complaints were filed and one court judgment was rendered (other proceedings are pending). In the following year (2018), there were already 123 cases of abuse on ticket inspectors. In 2019, there were 67 attacks on ticket examiners, of which 32 degenerated into acts (punches, jolts, scratches, kicks), and in one case there was more than eight days of injury. According to the data of the railway company (MÁV-START, 2020), in the three years examined, almost 70% of the abuses took place on the busiest suburban railway lines in Budapest (Figure 4).

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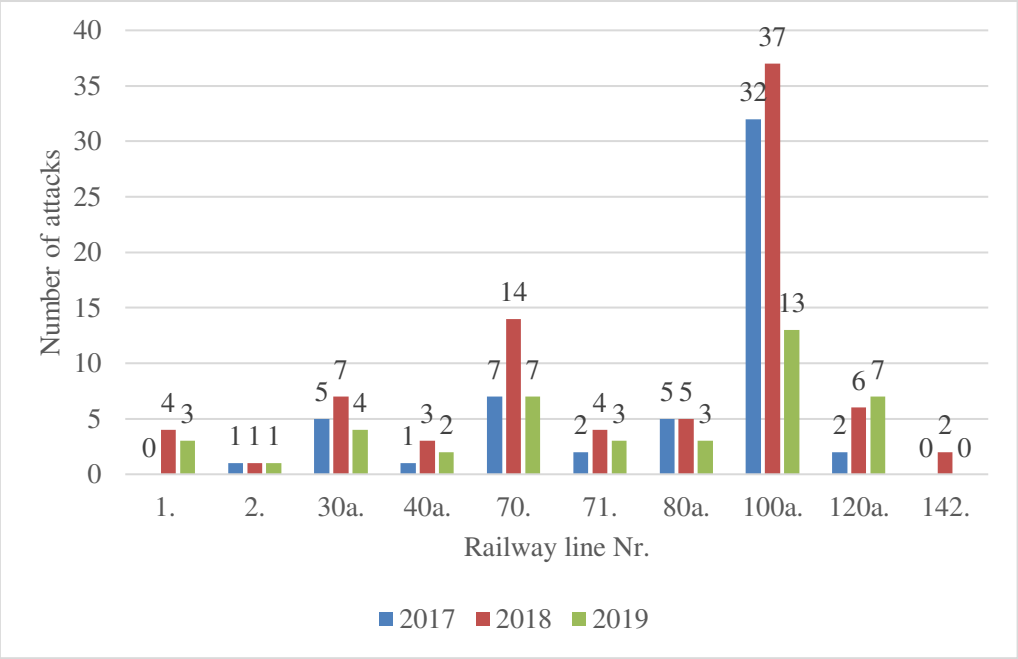

Figure 5: Number of abuses of train crew on the Budapest suburban lines of MÁV-START Zrt. (2017–2019)

Source: Self-editing based on MÁV-START (2020) data

Figure 5 shows that the most problematic line of suburban traffic in Budapest is the line 100a (Budapest – Cegléd – Szolnok) from a safety point of view, where the number of abuses against train crew members was exceptionally high in all three years compared to other suburban lines.

To address the unsustainable situation, the railway company has introduced a package of measures (MÁV-START, 2020):

- An awareness campaign was also launched as part of the package.

  - Passengers are reminded through loud passenger information devices that violence against public officials always involves police action and has criminal consequences.
  - Warning stickers were placed on the windows of the cash registers of the stations and in the interior of the vehicles.

- On some lines, at certain times, ticket inspectors check tickets in pairs and put a railway guard or standby police officer next to those who work alone between six in the evening and six in the morning.

- To prevent attacks, almost 80,000 trains a year escorted by security staff and 8,000-8,500 by police.

- From 2017, the railway company carried out practical testing of a new camera system. In 2018, the system was extended to certain parts of the Budapest agglomeration. Construction of a nationwide mobile camera recording system has begun.

- From September 2019, in addition to the previous ones, the company's ticket inspectors received an additional 103 body cameras and docking stations were installed at 12 sites.

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- As more appropriate conflict management methods can often be used to prevent a more serious stroke, the affected employees participate in special conflict management trainings in order to develop their skills.

- From August 2020, the company's ticket inspectors received an additional 66 body cameras. Experience has shown that the use of a body camera is a very effective tool in preventing the abuse of ticket inspectors. In order to avoid incidents, unlike the previous voluntary practice, from August 2020, ticket inspectors serving on designated trains will be required to use a body camera in Budapest-Esztergom, Budapest-Pusztaszabolcs, Budapest-Cegléd-Szolnok, Budapest-Újszász-Szolnok, on the Budapest-Göd-Vác-Szob, Budapest-Veresegyház-Vác and Budapest-Lajosmizse-Kecskemét railway lines.

Conclusions

In addition to the growing demand for mobility, transport safety is an increasing challenge both internationally and domestically. Rail transport and safety are inseparable concepts: without strict rules ensuring a high level of safety, rail transport would not have been able to develop, as neither passengers nor staff would have travelled by train. Railway safety can be divided into two closely related areas: to reduce operational safety or the risk of accidents, and to increase the safety of property. The MÁV Group can feel the positive effect of property protection expenses. In the field of property security, the greatest challenge for the railway company is the occurrence or prevention of damage and theft related to track, structure, telecommunications, insurance and power equipment, material theft and other acts against property. The measures introduced by the railway company showed tangible results already in 2019. The number of crimes has decreased significantly in the last year, for example, the number of abuses against ticket inspectors has almost halved compared to the previous year, in which increased control by the authorities shall felt.

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IMPROVING SUPPLY CHAIN EFFICIENCY THROUGH SIMULATIONS - LITERATURE AND METHODOLOGICAL REVIEW

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Abstract

Increased competition, efficiency and profit orientation largely determine the operation of today's companies. While the XX. In the twentieth century, the emphasis was on mass production, large batch numbers, and economies of scale, until today, consumer demand has shifted significantly toward individualized products and services. The consumer expects almost perfect quality, reasonable price and immediately available stocks. That is why it is necessary to tailor the supply chain to the needs of consumers as perfectly as possible. Every small change in the way a company operates can have different effects that managers need to respond to immediately.

In a company where there is some flow of auxiliary fuels, semi-finished or finished products, the proper design of the supply chain is a focal point that largely determines its operation and efficiency, as logistics costs significantly affect the consumer prices of products and services. The solid foundation of my topic is provided by the logistics knowledge and the supply chain management that extends it, which already examines the entire supply chain instead of one player at a time. A XXI. The development of information and IT in the 21st century makes it possible to apply new approaches in this field as well and to develop an approach in which we do not assess the effects of changes in retrospect, but prepare for them in advance.

In my research work, the optimization of logistics activities through simulation is the focus. The simulation has been an integral part of technical sports and engineering work for many years, this methodology is not yet used in the field of supply chain management, which would provide an opportunity to analyze the effects of changes without risk and would be a tool for companies to model and measure their activities. And measurability would provide an opportunity for correction and improvement, which plays an essential role in increasing efficiency and effectiveness. Based on this line of reasoning, I believe that the combination of supply chain management and simulation holds untapped potentials.

In my article, I will review the currently known and useful simulation methodologies, which shows the processing of the issue and the prevalence of the methodologies.

Keywords: *Supply chain, logistics, simulation, process development, efficiency improvement*
JEL besorolás: *C63*
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Preamble

Globalization and, as a result, there are no or very few products or services that are not available anywhere and from anywhere in the world. This ongoing compliance burden places a huge burden on companies. The rapidly evolving logistics and supply chain / network material flow and information flow processes are no longer just about the so-called basic processes (RST -

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warehousing, transportation, storage), but the classic cost and time reduction goals seem to be constantly transforming along the supply chain. (Gyenge 2019)

Nowadays, logistics is no longer just a sales promotion activity, but in many cases it also determines the shopping experience. Just think about it, if we choose the ever-expanding way of consuming and shopping online, we want to take possession and use the product right away. The shopping experience is largely determined by the time the product is received. Companies are constantly trying to respond to needs, which can reduce lead times; they bring inventories closer to users, use fewer chain members in the supply chain, and so on.

In addition, in many cases we have the ability to follow the path of our shipment from the seller to the consumer, which is extra information and added value that was not important in the past and is essential today to maximize the customer experience.That is why it can be stated that nowadays it is no longer products and services that compete with each other, but entire supply chains, which can now be interpreted as a criterion for gaining competitive advantage, with the main goal of the supply chain maximizing value and meeting customer needs. (Kozma - Pónusz, 2016)

Logistics / supply chain management is an ever-changing, evolving field of science that has no choice but to take advantage of competitive advantages and meet the ever-increasing expectations of consumers by incorporating technical and technological innovations into its own operations and processes. In addition to more efficient operations, changes can have other effects throughout the supply chain that are unpredictable and can generate losses throughout the process. With the development of technology, we now have the opportunity to observe and study changes and developments with the help of simulation modeling. As Grygoryev says: Modeling is one way to solve real-world problems. In some cases, we can't afford to experiment with real objects and look for solutions like this: build, destroy, or if changes are too expensive, dangerous, or impossible. In these cases, we can build models, we can use modeling languages to represent reality. (Grygoryev, 2018)

Formation and development of simulations

The indisputable advantage of simulations is that we can observe processes after making changes without construction, destruction, and costly changes. Just as evolution is part of continuous adaptation and development to environmental change, economic actors face similar challenges due to changes in the economic environment. With the help of simulations, companies can prepare, what's more, benefit from change, avoid dangers, and take advantage of opportunities.

The development of simulations can be examined from several aspects:

• How to use

• Programming language and environment

• By areas of use,

however, David Goldsman Richard E. Nance James R. Wilson reviewed the development of the topic from an interesting approach. They took a series of events and discoveries that influenced the development of the simulations. (David Goldsman Richard E. Nance James R. Wilson, 2009)

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The development of the simulation was divided into different stages:

As a first step, the pre-computer period was defined as:

Precomputer era: From Buffon to World War II. (1777-1945)

The Monte-Carlo method is usually derived from Buffon's needle experiment. The famous "needle-throwing" experiment, first proposed by Buffon in 1777, provides a good example of probabilistic modeling from a geometric perspective (Buffon, 1777). Suppose we have a large flat surface separated by a series of equidistant parallel lines. with distance d. (For example, we might think this is an alternating red and white striped field of the American flag.) An experimental ldd-length needle is thrown to the surface "randomly" and we want to calculate the probability that the needle intersects one of the parallel lines (e.g., the flag lies on both the red and white stripes). It is assumed that the surface is large enough for the needle to always touch it and that the boundary effects are negligible. Since Buffon's published solution contained an error which Laplace corrected in 1812, the Buffon-Laplace terminology is also used for the needle problem. (Laplace, P. S., 1812)

A century later, the simulations took on a surprising role in one of the most important applied statistical developments. William Sealy Gosset became a brewer at Arthur Guinness, Son & Co. Ltd. in 1899 at the age of 23. Guinness allowed Gosset to publish certain key statistical results, provided it used a pseudonym and no proprietary data was used. These results were published under the pseudonym "Student" beginning in 1908 with an article formulating the material now called Student Distribution (Student, 1908). Because Gosset's analysis results were incomplete, he used the crude form of the manual simulation to test his conjectures on the probability density function for the Student's t-distribution. This is the first application of the simulation in the industrial field active area.

The main problems in using the simulation include the strategic problem of designing a simulation experiment and the following tactical problems to run the simulations defined in the experimental design:

The start problem, i.e., determining when the simulation is in equilibrium (steady state), that any transients have died due to the initial state of the simulation;

• Estimation of the accuracy (variance) of steady state estimates based on simulation; and

• Perform accurate comparisons of alternative system simulations. In other words, what is the best set of alternative systems or system configurations in a competition?

For the boot problem, Conway (1963) proposed the first widely used rule for truncation (deletion) for observations contaminated with initialization bias generated by simulation.

Conway provided remarkable insight into the problems and solution strategies that would define the simulation for the next fifty years.

Second phase: The formative period (1945-1970)

Goldsman and colleagues believed that the rapid development of simulations in this era was due to two determinants:

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• Construction of the first general purpose electronic computers such as ENIAC (Burks and Burks 1981);

• The work of Stanislaw Ulam, John von Neumann, and others using the Monte Carlo method on electronic computers in order to solve certain problems in neutron diffusion during the formation of the hydrogen bomb that were analytically unsolvable. (Cooper 1988)

In the 1950s, the proliferation and availability of electronic computers helped spread simulation techniques in various disciplines.

In 1960, Keith Douglas Tocher, a professor of operational research at the University of Southampton, developed the General Simulation Program (GSP), the first general-purpose simulator as a tool to simulate an industrial plant containing machines. (Tocher and Owen, 1960) Tocher's role in the '60s was outstanding and decisive, as he created the first textbook of simulations in 1963, The Art of Simulation (1963) and in 64, the activity-cycle diagram (ACD). ACD became the cornerstone of simulation education in the UK and the focus of research on program generators in the 1970s.

Long before his appearance in the American simulation language, Tocher devised and implemented an approach to combined simulation (discrete events and continuous model running) (Tocher and Splaine 1966). In 1960-61, Geoffrey Gordon introduced the General Purpose Simulation System (GPSS) as the Director of IBM Advanced Systems Development. GPSS is designed to facilitate rapid simulation modeling of complex remote processing systems, including, for example, urban traffic control, receiving and switching telephone calls. IBM's ease of use at the time and its software marketing policy made GPSS the most popular educational simulation language in the United States. A detailed description of the history of GPSS is summarized by Gordon. (Gordon, 1981, Káposzta, Nagy 2015)

In the 60s, the Simscript simulation program appeared. Based on FORTRAN, a common programming language (Backus, 1978), the initial 1963 version of the SIMSCRIPT simulation program was intended for users who were not computer experts and used a formula to define the model, initialize the model, and generate reports. The second generation, SIMSCRIPT 1.5, removed the limitations of FORTRAN, and SIMSCRIPT II served as a concept and idea generator, at the time it was considered the most ambitious programming language development. The published SIMSCRIPT II was a "layered" language with five defined levels. A comprehensive description of SIMSCRIPT is contained in the works of Markowitz (1979) and Nance. (1996).

Philip Kiviat, of Cornell University in the United States, has been instrumental in the development and implementation of SIMSCRIPT II. To Steel in 1961, where he developed the GASP (General Activity Simulation Program). Kiviat joined RAND Corporation in 1963 and became the main driving force behind SIMSCRIPT II. A successful version of GASP was developed with Alan Pritsker. RAND, IBM, Cornell, and U.S. Pat. Along with Steel, the Royal Norwegian Center for Computer Science was a hotbed for the development of the simulation language.

Kristen Nygaard and Ole-Johan Dahl started working with SIMULA in 1961. (Nygaard, 1961) With the strong support of Univac and a significant programming staff in addition to the two, SIMULA I was created as an extension of ALGOL 60, producing arguably the most influential programming language in computing. The history of the development of the simula is summarized by Nygaard and Dahl in 1981. (Nygaard and Dahl 1981)

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The forerunner of the Winter Simulation Conference (WSC) in 1967 was the Conference on Simulation Applications Using the General Purpose Simulation System, which is now the most important international forum for disseminating the latest developments in system simulation. R. W. Conway, B. M. Johnson, and W. L. Maxwell of Cornell University laid down the central problems of digital simulation. Simulation problems were divided into two broad categories (Conway 1959):

• simulation structure and

• use of simulation

The problems in building a simulation model are as follows (Conway 1963):

• Modular design of simulation programs for easy reworking;

• Computer memory management;

• Checking for errors resulting from discretizing all continuous quantities inherent in digital simulation;

• Design and implement an efficient time management mechanism; and

• Manage files containing simulation entities.

Although many of the above problems have been resolved, the design and implementation of an effective time-saving procedure for dealing with certain types of events - even to this day - involves research and development.

The expansion period (1971-1980):

During this period, the specialists working in the field of simulation underwent continuous development of analytical tools in parallel with the evolving computing tools. With respect to discrete event computer simulation modeling languages, we immediately think of, for example, Pritkser and Hurst GASP IV; Kiviat, Villanueva and Markowitz SIMSCRIPT II.5; Pritsker and Pegden SLAM; Pegden SIMAN; Nance's conical methodology for object-oriented model development.

Historical overview of simulation approaches

After a historical review of the simulations - from which we learned what discoveries and mathematical methods led to the modeling of our present age - I would now like to bring together a variety of modeling forms and methods based on the work of Roberts and Pegden 2017.

Over the past 50 years, simulation has increasingly become a tool for analyzing operational processes. With the development of technology, simulations also developed in different ways, according to principles, and became tools for research and development and application. According to Roberts, simulation modeling is the part of simulation problem solving that serves to develop the model. This means the interpretation of a real problem in terms of a simulation language in which we are able to map, observe and solve reality.

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However, the use of simulations requires some expertise, which I have formulated as follows (Kiviat, 1967):

• Correct problem definition and setting of objects.

• Use modeling concepts to abstract essential features of the system as a model.

• Collect and compile data and inputs for the model.

• Convert the model to computer-readable code capable of simulating the system.

• Instruct the computer to perform the simulation correctly and efficiently for different scenarios.

• Summary and analysis of simulation output in power meters.

Simulation languages have changed over the years, however, simulation approaches are similar. The simulation language executes a system model to dynamically influence the behavior of the system over time while changing the value of state variables over the simulated time.

Simulation languages can generally be divided into two parts:

1. Discreet

Where the state of the system changes in discrete units during specific events

2. Continuous

Where the state of the system changes continuously over a specified period of time. Today, most simulations are multimodal and support a modeling paradigm where discrete and continuous capabilities are mixed.

Modeling World views

During the 60-year history of the simulation, four different worldviews became used and dominated:

• Event

It provides the most flexibility, but is harder to use.

• Activity

Gives more context to events with some limitations.

• Process

Easier to use, but reduces modeling flexibility.

• Object

It is the simplest and most natural, but it limits the complexity of the model.

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These views were developed by pioneers in the 1960s, (Gordon 1961; Markowitz et al. 1962; Tocher 1963; Dahl and Nygaard 1966) they have changed significantly today, not the basic ideas. They focused on achieving a balance between ease of use and flexibility when developing modeling tools. The development of simulation languages can be traced back to making process and object views more flexible while maintaining ease of use. However, modern simulation languages combine different methods and operate as a multimodal system.

Event-driven modeling

Events are consecutive points in time at which the system makes changes. It is the responsibility of the modeler to ensure that events are recognized and state changes occur. If the event occurs, the transition from the present to the offspring should be mapped. The data obtained should be collected and displayed.

Event-driven modeling focuses on a calendar of future events that shapes all future events. The operation of the discrete event simulation language can be described as follows:

1. Removes the next event from the calendar and updates the simulation time to that time

2. Performs the status update procedures for that event

This logic can be implemented in any widely used programming language, such as Fortran, C ++, C #, and so on. The functions of the programming language greatly facilitate the development of the simulation program. SIMSCRIPT II.5 added the basic options for defining entities, assigning attributes to entities, and collecting entities into sets. In the first 20 years of the simulations, the event-driven worldview was very common due to its flexibility and usability, however, the models were difficult to understand and required a high degree of proficiency from the user. A common method for visual modeling of discrete events is the event graph introduced by Schruben (Schruben 1983), which is a very useful and valuable tool, but its general use is severely limited.

Modeling with activities

Pidd (Pidd 2004) describes a model related to the three-phase approach called activity acquisition.

The essence of the approach is that activities form the basis of state changes when events occur. The three-phase method has evolved, but the activity scan consists of the following steps:

1. Advances the time to the next event

2. Processes one or more subsequent connected events and

3. It processes all other operations that depend on the occurrence of bound events.

While there is a need for a calendar of future events, there is also a need for a list of both tied and conditional events. These subsequent state-dependent (state-dependent) event lists are rescanned until no activity is started. Central to the three-phase approach is the use of a conceptual modeling tool that is now used as an “Activity Cycle Diagram” (originally referred to as a “wheel diagram”). Useful for identifying the activities of any system.

Process modeling

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Process modeling appeared mostly in the form of GPSS (Gordon, 1961). Both a GPSS modeling tool and a simulation language developed at IBM. He saw the world as entities (transactions) that moved special purpose blocks in a complex model. Each block had a certain function. There is almost one-to-one correspondence between the block diagram and the simulation code. So the simulation model has a visual and written equivalent. This correspondence is important because the GPSS modeler can essentially translate the visual model almost directly into instructions, and instead of linguistic syntax, visual semantics has become the primary tool for modeling. This approach meant that the simulation modeler did not have to be a programmer, and so GPSS introduced a large number of people into the world of simulation who would not otherwise have participated in it.

It worked as follows:

In GPSS, the simulation performed two lists: a future event calendar and a current event calendar. When entities are created, they move through the block diagram as much as they can. If they encounter a block that may schedule their departure a little later, the entity is added to the future event calendar. However, if the entity cannot continue (resources may not be available), the entity is added to the current event calendar. The current event calendar is conserved and retrieved until no further action is taken (similar to scanning an activity), then the next event is removed from the event calendar and the time progresses.

An improved version was released in 1983 and several new process languages were developed. Further developments in the 1980s included better random number and random variant generation, variance reduction, efficient calendar management, and more efficient collection of statistics.

Object-oriented modeling

Another view of process modeling is that the model is a set of interacting processes or more generally objects. Developed in the 1960s, Simula (Dahl and Nygaard 1966) provided an early implementation of the idea of objects as elements of simulation, and that these objects could contain logical operations that control this object and that could interact with other objects in a synchronous or asynchronous manner. objects. Object-oriented simulation modeling usually falls into two camps. The first, exemplified by Simula, is that the simulation language should contain object-oriented concepts that allow the modeler to develop advanced simulation programs. Concepts relevant to this approach, such as abstract data types, inheritance, polymorphism, composition, parameterized types, etc., allow for a wide variety of objects and behaviors. The models are compact, efficient and expandable. In other words, they provide a better environment for simulation programming. Today, models are usually built in C ++ or Java in the context of simulation packages. The ideas introduced by Simula provide the basis for some recent developments in simulation for language designers to use an object-oriented approach to modeling simply easily and flexibly.

The ideas introduced by SIMULA are the most significant advancement in computing in the last 50 years, according to Roberts. The other object-oriented simulation modeling camp sees it as consisting of a wide range of predefined objects, each with a set of behaviors that are thought to be relevant to the control and use of the objects. This modeling orientation simplifies the model building process by offering a more natural and in many cases easier to use modeling paradigm. In the object-based approach to modeling, we create our model by placing software objects in our model that represent the physical components of the system.

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In object orientation, the modeler simply describes the physical components of the system and the behavior and actions already built into the objects for those objects. Therefore, a working object has a predefined behavior that allows it to interact with the machines in the model and other workers. It's hard to imagine a more natural way to build a model than using a collection of pre-built modeling components that mimic the components of a real system. The challenge with this approach is that if we want to model anything in the real world, we need an extensive library of objects to be able to capture the vast variety of real objects you may encounter.

Due to its flexibility, process modeling has remained widespread, however, there has been an increasing emphasis on object-oriented simulation over the past 20 years. Newer object-oriented tools have rich object libraries that focus on specialized application areas such as manufacturing, supply chain, and healthcare. Simula also introduced the concepts of behavioral classes and subclass objects as part of an explicit modeling paradigm. The innovative work of simulation language design is realized through object-oriented simulation tools. Its advantage over process and event-oriented simulation is that we can assemble the logic of our model and the associated animations in one step.

System dynamics model

Systems Dynamics is a modelling approach developed at MIT in the late 1950s by Jay Forrester (Forrester 1961). It is a continuous form of simulation where variables vary continuously over time. System dynamics is sometimes used to approximate large-scale discrete systems (e.g., population modelling). In its general form, system dynamics has state variables that are dynamically related to a set of differential equations. However, for most applications, models consist of 'levels' and 'ratios', where levels are simply state variables and ratios are first-order differences (Sterman 2000).

System dynamics models are commonly used to represent stock and material flow diagrams. Causal loop diagrams are visual representations of the structure and behaviour of a system. The main simulation language for system dynamics was Dynamo, nowadays the common languages are Stella and Vensim. PowerSim and AnyLogic include system dynamics components, but also include event and process model features. We think of system dynamics models as continuous models, but the majority of applications involve modelling large discrete systems with many entities.

Agent based modelling

Agent-based modeling extends the concept of objects to agents whose properties are related to human behavior. In this way, the agents have intelligent independent properties and are able to make decisions. Although agents are independent, they are surrounded by other agents, so there are rules that govern individual decision-making and interactions between agents.

The functional structure of agent-based modeling is as follows (North and Macal 2007):

Agents are placed in the system and then allowed to evolve from the interaction of the agents. Each agent is a separate entity that interacts with other entities in the system. The focus is on modeling the behavior of the agent as opposed to the behavior of the system. In traditional process orientation, entities follow a series of process steps that are defined from top to bottom by the system. In contrast, agent-based modeling determines the local rules of behavior for each entity from the bottom up. Agent-based modeling is often implemented using an object-oriented

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modeling toolbar, so we do not view agent-based modeling as a new worldview, but rather an application that is implemented based on an object-oriented worldview.

A state diagram can be used to determine the framework of agent-based modeling and the behavior of agent classes (Shannon 1949). The state diagram can be used to determine the states that can be taken up by the agents, as well as the transient states that, when met, cause a transition between state pairs. Each diagram typically determines the behavior of an object in a particular class and the state transitions for object instances in that class. Although there are several versions of state diagrams, each defines states as nodes and defines arcs for the transition between states. The spread of agent-based modeling has become increasingly prominent since the 1990s, as with the development of computers, it is possible to manage the number of agents within a model, giving the user a high degree of flexibility (Káposzta et al. 2017).

The most common agent-based tools are Swarm, NetLogo, and AnyLogic.

Branch of simulation modeling

After an overview of history and approach, I created a branch diagram of simulation modeling, with which I would like to mold worldviews and orientations into a more transparent form.

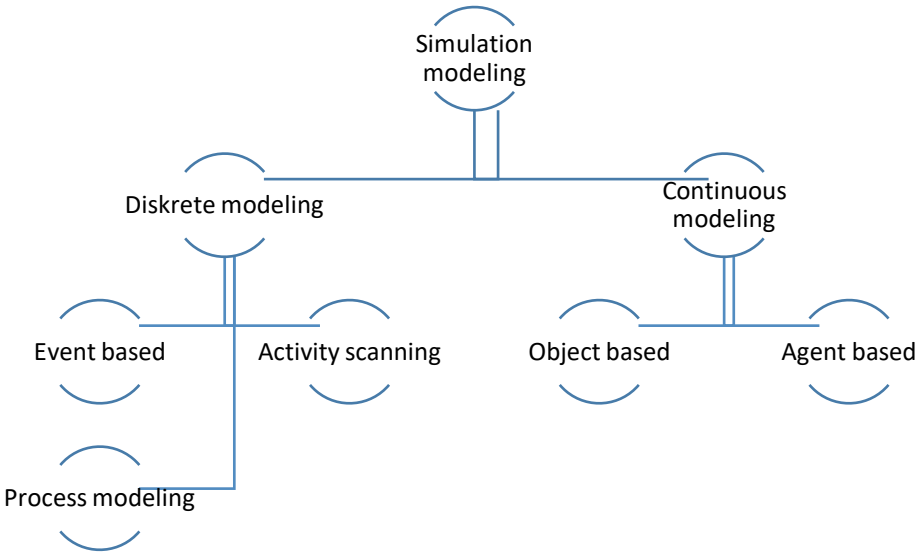

Figure 1: modeling branch diagram

Source: Own editing (2021)

Simulation as a decision support tool

The development, unbroken development, and brief history of the simulations testify to the immense need on the part of economic professionals to understand reality as accurately and accurately as possible. With the acceleration of technological development and the advent of industry 4.0, the importance of information as one of the most important raw materials becomes even stronger. Various methods are known for processing information, but simulations are extremely suitable for observing real-world problems. In a business environment, we may be able to make costly, dangerous, or impossible changes using simulations, the effects of which can be observed in cyberspace. Companies that choose to incorporate the use of simulations

into their operations and thus be able to prepare for changes in the business environment can gain a competitive advantage over other market players.

Many companies have already begun to use simulation in operational processes as a decision support system, as Rozinat et al. (Rozinat et al., 2008) There is also a concrete example in the literature of how simulation can help increase efficiency. Salam and Khan (Salam and Khan, 2016) investigated a more efficient way of using the space of containers in maritime transport using simulation. Goldratt research labs (Goldratt research labs., 2018) conducted a study in which a steel plant was examined using simulation. Thanks to the comprehensive investigation and the improvements developed with the simulation, the processing capacity of the plant increased by 15%, which resulted in an increase in sales. The examples also show that the use of simulation can lead to efficiency gains and thus to building a competitive advantage, which is key for companies in today's globalized world.

Model building practice

Professionals have recognized the value of being able to observe and experiment with how their environment works by modifying different variables. In the historical overview section, I listed the events that led to the development of the simulations. It can be said that it took several pre-age thinkers to build on each other in order for the simulations to develop. With the development of computers, various simulation modeling tools have also evolved. Their goal is to model reality in virtual space, which reflects as much as possible the processes you want to observe. In the theoretical overview, I reviewed the different principles, variants and their development of modeling tools. In this part of my research, I will present the steps required for model building through a practical example. Currently, we can talk about several widespread and used simulation tools that meet the expectations of korun. In my research, I also chose one of these tools, which is AnyLogic. In the AnyLogic simulation tool, we can create models according to different approaches, which can be:

• Agent based
• System dynamics and
• Discrete event-driven model

Thus, we may be able to examine the same problem from several aspects.

I will present the steps of model building according to the agent-based modeling principle. Agent-based modeling is a form of modeling that has been used for about 15 years, with the advantage of showing the area / process to be studied from a completely new perspective. Agent-based modeling does not have a general programming language, but rather the structure of the model consists of a graphical editing interface or scripts.

In practice, agents can take many forms:

- Person
- Company
- Vehicle
- Project
- Product
- Idea

Agents can communicate, influence each other's behavior, or, conversely, be isolated.

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1. As a first step, we create a new model.

Then let's review the structure of the tree diagram as our model. By default, an agent class has a simulation experiment and a built-in database for reading the input data and writing the simulation outputs. In addition, we can use the runtime environment to upload the results to the cloud. Here we specify how customers get to the purchase.

2. Once we have reviewed the structure of our future model, the creation of agents can follow. Since we would like to create several similar objects, we select the agent population when creating the agents. We name the agents as buyers and then assign an appearance to them.

The parameters of the agents are then set. In our case, we focus on consuming an ad-sensitive product. We set the ad effectiveness parameter, which shows how many percent of consumers will be ready to make a purchase in a simulated day, to 0.1.We set the population size, which was determined at the beginning of the example to 5000 people. We then set the environment. In the Set New Environment menu, we create a default environment that scatter our agents based on an even distribution. After that, the model can be run, but until we set up the behavior of the agents, apparently nothing happens.

3. Defining consumer behavior.

The best way to determine the behavior of agents is with a state diagram.

Here you can define states and transitions. First, we specify the entry point of the state diagram, which is associated with the state of the user. We assign hearts to different states so that we can distinguish the potential consumer from the consumer. While running the model, it can be assumed that the agents become discolored during the simulation.

4. Visualize results using graphs.

The results can be viewed by including graphs. You can do this by specifying different functions, depending on what you want to show. We can fine-tune their results by also determining the following:

- Word of mouth effect
- Product life cycle
- Consumer impatience

Through this example, you can see what an agent-based model is suitable for in practice.

Figure 2: Defining a model

Source: Own editing (2021)

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Conclusions

In the present research, I have tried to summarize the historical events and research leading to the development of simulations, without which there would be no simulation tool today. After sequencing these, along with the development of simulation tools, I also reviewed different approaches. Finally, I presented the basic steps of model building through a market simulation example. From all this, it can be seen that simulation, as a decision support tool, can be very useful for a company to observe different situations in cyberspace.

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THE IMPACT OF SINO-US TRADE IMBALANCE ON THE US ECONOMY AND THE TREND PREDICTION OF SINO–US TRADE IMBALANCE

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Abstract

The trade friction between China and the United States is a trade problem arising from the difference between China and the United States with regard to the balance of trade and values. As Sino–US trade develops; the trade imbalance is becoming increasingly prominent, which directly leads to the Sino–US trade war. This paper attempts to explore whether the expansion of the US–China trade deficit will result in the slowdown of the US economy and to study the development trend of Sino–US trade imbalance, emphatically discusses the impact of Sino–US trade on US GDP and establishes a model to conduct the trend prediction of Sino–US trade imbalance in the near future. The study proves that there is a two-way and long-term relationship of influence between the trend in the US–China trade deficit and in the US GDP, during which the Sino–US trade contributes to the economic growth in the United States. Meantime, the scale of Sino–US trade imbalance will still increase in the short run.

Keywords: *Sino–US, trade imbalance, US economy, Cointegration analysis, Trend Prediction.*
JEL classification: *B23, F10, F14, F17,*
LCC code: *HB135*

Introduction

Over the past 40 years since the establishment of diplomatic relations, China and the United States have seized the historic opportunity of economic globalization, seized each other's economic complementarities, and promoted the advancement of bilateral economic and trade cooperation from scratch, from small to large, from single to multiple. Trade volume of commodities between China and the United States rose from 2.5 billion US dollars in 1979 to 633.5 billion US dollars in 2018, resulting in a 252-fold increase. Trade volume of services exceeded 125 billion US dollars, and two-way direct investment aggregated nearly 160 billion US dollars. Sino–US economic and trade cooperation has reached an unprecedented depth and breadth, bringing tangible benefits to both countries and the people and contributing to the prosperity and stability of the world economy. (Ministry of Commerce, PRC, 2019) As of 2018, the total value of China–US bilateral trade in imports and exports was 633.52 billion US dollars, and China's trade surplus with the US was US$323.32 billion. (Phoenix Finance, 2019) Trade imbalance is dynamic and frequent, while trade balance is a short-term phenomenon and relative. The trade between various countries in the world has always been incompletely balanced. Even if economic globalization exerts some balanced effect on the distribution of trade flow between countries, it is impossible to form a completely balanced trade pattern. (Chen, 2007)

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Zheng, Shi and Wang (2006) believed that in the long run, as long as a country's foreign trade imbalance can be made up by other items in the international payments account, and it did not lead to the deterioration of the international payments, or bring the potential risk of deterioration or hidden danger to the country's economic development and financial security, the imbalance is acceptable, or say, a country's ability to cope with external negative impacts can sufficiently maintain the surplus or deficit of trade balance in a relatively long period of time. In other words, the key to judging whether trade imbalance is dangerous is not the scale of imbalance, nor the length of the imbalance time, but the concrete analysis of a country's national conditions. Some countries can maintain the status of foreign trade imbalance for a long time and on a large scale, without affecting national economic development and financial security, but for some other countries, short-term and slight trade imbalance are likely to cause financial and economic crisis.

In this paper, the author holds that the impact of Sino-US trade imbalance on the US economy is the core content of the research on the impact of Sino-US trade imbalance. The direct cause of the trade war between China and the United States is that the United States believes that the Sino–US trade imbalance has a negative impact on the U.S. economy. To further illustrate the relationship between the Sino–US trade deficit and the US economy, in this paper, whether there is a long-term equilibrium relationship between the expansion of the US–China trade deficit and US economic growth is discussed from this perspective. Trade balance is a dynamic and relative concept, which changes with time and domestic economic conditions. In the short term, there are big differences between China and the United States in terms of industrial structure, technological development level, economic level, resource endowment, and consumption tendency. This also makes China and the United States highly complementary in the field of economic and trade cooperation. Therefore, it is difficult to change the Sino–US trade imbalance in the short term. In this paper, an empirical model is established from this perspective to analyze and predict the trend of Sino–US trade imbalance in the short term, thus expecting the Sino-US trade relations.

In this paper, a combination of empirical analysis and normative analysis is used to discuss the impact of Sino–US trade imbalance on the US economy, and through normative econometric and mathematical model analysis, such as cointegration analysis, unit root test, and time-series regression analysis, etc., the Eviews8 software is used to establish the econometric model to analyze the impact of Sino–US trade imbalance on the US economy. In addition, China's exports to the United States, China's imports from the United States, and Sino–US trade balance are fitted and predicted.

This paper focuses on two issues. 1) Is there a two-way long-term relationship between the trend of the Sino-US trade imbalance and the GDP of the United States? Is this relationship beneficial to the growth of the GDP of the United States? 2) Will the Sino-US trade imbalance continue to expand? What is the trend in the short term?

Sino–US Trade Imbalance, Mercantilism and Trade Protectionism

The school of mercantilism was the first to set about an in-depth exploration in the relationship between the balance of trade and economic growth, in which what they strongly advocated were that a country should "pay reward for export and impose restrictions on import" and encourage trade surplus.

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Mercantilism is a national economic policy aiming to maximize a country's exports while minimize its imports. Mercantilism was dominant in modernized parts of Europe from the 16th to the 18th centuries, a period of proto-industrialization, (Laura, 2008) before falling into decline, although some commentators argue that it is still practiced in the economies of industrializing countries, (Samuelson, 2007) in the form of economic interventionism. (Kanopiadmin, 2017) It promotes government regulation of a nation's economy for the purpose of augmenting state power at the expense of rival national powers. High tariffs, especially on manufactured goods, were an almost universal feature of mercantilist policy. (John, 2001) Mercantilism can be divided into early mercantilism and late mercantilism. The early mercantilism proposed by W. Stafford, John Hales, etc. centers on money balance theory, it equates wealth with precious metals such as gold and silver, and stresses that the national interests lie in the increase of currency. It strictly prohibits the exports of gold and silver, and pursues the absolute principle of buying less and selling more in foreign trade, namely, to reduce imports and increase exports to reserve gold and silver currency. The late mercantilism was mainly proposed by (Thomas Mun, 1628), who argued that the economic activities between countries dominated by the static view of world resources can be regarded as a kind of "zero-sum game", that is, one country's economic income is at the cost of another country's economic loss. Precisely supported by this view, late mercantilism explicitly advocates to taking "trade balance theory" as the core. In terms of policy suggestions, they proposed that countries should protect and reward exports and production, and take protectionist measures to restrict domestic imports, especially for those industries of strategic significance. Thomas Mun held that currency produces trade and trade increases currency. In his classic work of mercantilism, England's Treasure by Foreign Trade, he wrote that the means to increase England's treasure is to develop foreign trade, but a principle must be observed, that is, the total value of commodities sold to foreigners should be greater than that of commodities purchased from them; he stressed that a country should maintain its trade surplus, in order to achieve this purpose, a country should never hesitate to implement trade protectionism policies, such as giving subsidies to exports, implementing quotas and high tariffs on imports of consumer goods, etc. These policies can encourage exports of domestic commodities and restrict imports of foreign commodities. There into, he advocated increasing the exports of agricultural products and industrial manufactured goods, reduce the imports of foreign manufactured goods, and oppose British residents to consume imported products that can be produced in Britain. The late mercantilism theory shows that, as early as the 14th to15th Century, the theoretical research on the balance of trade attracted the attention of economists, but the theories in this period mainly focused on the importance and influence of the balance of trade.

Lin (2006) believed that China's foreign trade policy has a mercantilist tendency, which has led to the low efficiency of foreign trade and the "immiserizing growth" of the macro economy. Zhai (2007), Hu (2009), Huang (2009), Xiao (2009) and Cheng (2009) agreed that since the reform and opening up in the 1970s, the "import substitution" and "export-oriented" implemented by China at the very start is one of the significant causes for the huge trade surplus in distinct "export-oriented" economic development strategy after the reform in 1994. But E.g. Li (2006) analyzed China's import and export data from 1980 to 2004, and concluded that if China did implemented mercantilism, it should have large-scale trade surplus against every trading partner country, but the surplus only came from a few big European and American countries. China’s trade deficit against South Korea and Japan has been continuously expanding respectively since 1991 and 2002, which can hardly support the mercantilism of China's trade policy and system.

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In December 1791, Alexander Hamilton, the first American finance minister, a representative of the requirement of independent development of the American economy, proposed the tariff thought of protectionism for the first time in the Report on Manufacturing Industry submitted to the United States Congress. He believed that the infant industries in the United States should be protected in order to make the American economy independent. Later, Friedrich List, a scholar of German historical school, elaborated the famous trade theory of protecting infant industries in the book The National System of Political Economics, which was published in 1841, and stressed that "some industrial products can be prohibited from being imported, or the stipulated tax rate is actually equal to all or at least part of the banned imports". Since then, the protectionist trade theory has been developing rapidly.

Since then, the theories of contemporary trade protectionism represented by the "Neo-Mercantilism School" and "New Trade Protectionism School" of Keynesianism demonstrate the facilitation of trade surplus to the growth of a country's national income from the perspective of national income. Later, an increasing number of western economists begin to pay close attention to the relationship between the balance of trade and economic growth. In terms of the current research situation, it seems that most governments and scholars, particularly these American protectionists, have a profound tendency to "surplus", which argues that countries should focus on the regulation of trade deficit, as well as the pursuit of trade surplus in international balance of payments.

Under the guidance of free trade theory, the primary objective of foreign trade is to replace trade surplus with comparative advantage obtained from international trade. In order to meet the needs of constantly expanding foreign trade, the gold standard system emerged. For the trade balance and adjustment of international payments under the gold standard system, David Hume introduced the "price-coin flow mechanism". It refers to that under the gold standard system; a country's deficit in the international payments means the net output of the domestic gold. Due to gold outflow, the domestic gold stock decreases, and the money supply would decrease, thereby causing a fall in the domestic price level. After the price level falls, the competitive capacity of domestic commodities in the foreign market would be enhanced, and the competitive capacity of foreign competitive capacity in domestic market would decline, then exports would increase and imports decrease, and the deficit in the international payments would be reduced or eliminated. Similarly, the external surplus cannot be sustained, because the internal flow of gold would increase the domestic money supply, thereby resulting in the rise of price level, which is not conducive to exports but beneficial to imports, thus the surplus would tend to disappear. According to this mechanism, the price change caused by gold would exert a regulating effect, so as to automatically improve trade balance. (International goldstandard system, 2009)

In the 1930s, J.M. Keynes pointed out in his representative work The General Theory of Employment, Interest and Currency (1936) that, although the classical free trade theory has demonstrated that a country's foreign trade surplus and deficit tend to be balanced through automatic adjustment with the theory of automatic adjustment of international payments, these theories ignored that the adjustment of trade balance would affect a country's national income and employment. Therefore, Keynes held that the impact of trade balance on national income and employment should be carefully analyzed. Through research, he found that trade surplus can increase national income and expand employment, while trade deficit can reduce national income and aggravate unemployment. Therefore, he highly praised the mercantilist idea of state intervention, advocated to strengthen the state's intervention effect in foreign trade, favoured

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trade surplus and opposed trade deficit. In the book, Keynes also proposed the famous multiplier theory, and thereafter he constantly improved it into a new set of trade protection theory. The theory holds that, under the role of trade multiplier, national income can increase exponentially at a certain rate with the progressive increase of exports. That is to say, the more a country expands its exports and reduces its imports, the greater the trade surplus, and the greater the role on the domestic economic development. Therefore, the countermeasure for a country to increase effective domestic demand is to restrict imports and reward exports, that is, create full employment and increase effective demand. The optimal policy for a country is to implement trade protectionism, maximize exports and reduce imports as far as possible.

Later, the followers of Keynesianism continued to improve the Keynesian trade protectionism theory. The scholars represented by Wynne Godley put forward the new protectionism trade theory. Through the analysis and expansion of the protectionist trade theoretical model, the theory verified the important role of the international payments on a country's national income, and proposed that maintaining foreign trade surplus has the direct bearing on the improvement of a country's national income and the realization of full employment. Hence, it is necessary for a country to restrict imports and reward exports to speed up the growth of its national income. A series of Keynesian trade protection theories have provided sufficient theoretical basis for western developed capitalist countries to implement super-protection trade policy and pursue surplus income of foreign trade after World War II. Then various countries in succession implemented the trade theories to pursue trade surplus and expand their trade surplus. Meanwhile, Keynes and his followers further demonstrated the importance of trade surplus to a country's economic development. From this point of view, the Keynesian trade protection theory is of great practical significance for the economic development of capitalist countries. However, the theory did not investigate the possible impacts of trade surplus on the world economy, and especially lack an overall analysis of the positive and negative impacts of trade surplus on a country's economy.

However, with the continuous deepening of research in academic circle on the relationship between the balance of trade and economic growth, many scholars have put forward that in some specific bilateral trade, such as Sino–US bilateral trade, the economic growth of a country does not occur simultaneously along with the country's favourable balance of payments, and more often the trade deficit coexists with economic growth. John Muller, a British economist, conducted a more detailed study on the relationship between trade development and economic growth, whose theory had a profound influence on the subsequent research from economists. He considered that international trade offers two types of benefits obtained by a country, and they are trade benefits and development benefits, and he made a specific explanation for both. (Xu, 1989) First, due to trade exchange, each country engages in productive activities in which they are better specialized, thus making the factors of production flow to sectors with high productivity. And higher productivity leads to higher output, thus income is improved. Then, based on international trade, a country can import the raw materials, machinery equipment and other products that the original country lacks, which also augments the investment factors. Consequently, the development benefits lie in the fact that trade can facilitate a country's development and innovation. Countries can obtain more cheap products than when they are in the state of seclusion via international division of labour and free trade, and also promote better allocation of production factors. (Ma, Zhang, 1998) Zhu (2006) deemed that despite there is a huge economic and financial imbalance, the United States still enables to keep economic and financial growth while maintaining the imbalance (deficit), and thus maintaining the pattern in which world economy is imbalance and growing. The US President's Council of Economic Advisers also concluded that the expansion of trade deficit has been a "Safety Valve" for the US economy, import of cheap products keeps the low inflation rate in America, and capital

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inflow maintains the low interest rate, contributing to keeping the growth of the US economy and the decline of unemployment rate. Hence, currently in the academic circle, two completely different views on the relationship between the balance of trade and economic growth have formed. On the whole, there is insufficient empirical research on the relationship between the US-China trade deficit and US economic growth. Thereby, from this perspective, this paper intends to explore whether the expansion of the US-China trade deficit will lead to the slowdown of the US economy and the Trend Prediction of Sino-US Trade Imbalance.

Material and method

Model Construction

To conduct a quantitative study on the impact of Sino-US trade imbalance on the US economy, this paper adopts the variables of US GDP and US import volume from China, and establish the model as follows:

$$LnGDP=a+b*LnIMP+e$$

In which, LnGDP is the natural logarithm of US GDP, LnIMP is the natural logarithm of US import volume from China, a is a constant term, B is the influence coefficient to be estimated, and e is the residual.

Data and variable selection

Data source and description

This paper selects the annual data, as well as the data of US GDP and US imports from China of 37 years from 1983 to 2019.

Table 1: US GDP data（trillion US dollars）

Year	US GDP
1983	3.63
1984	4.04
1985	4.34
1986	4.58
1987	4.86
1988	5.24
1989	5.64
1990	5.96
1991	6.61

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1992	6.52
1993	6.86
1994	7.29
1995	7.64
1996	8.07
1997	8.58
1998	9.06
1999	9.63
2000	10.25
2001	10.58
2002	10.94
2003	11.46
2004	12.21
2005	13.04
2006	13.81
2007	14.45
2008	14.71
2009	14.45
2010	14.99
2011	15.54
2012	16.2
2013	16.78
2014	17.52
2015	18.22
2016	18.71
2017	19.49

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2018	20.53
2019	21.37

Source: Wind- Economic Database, 2020

Table 2: Data of Sino-US import and export trade（US $10000）

Year	China exports to the United States	China imports from the United States
1983	171,000	232,000
1984	230,000	366,000
1985	265,000	437,000
1986	247,000	353,000
1987	296,000	381,000
1988	338,000	663,000
1989	439,000	786,000
1990	519,000	658,000
1991	619,000	801,000
1992	850,400	890,100
1993	169,640,0	106,880,0
1994	214,6100	138,940,0
1995	2,472,874.30	1,612,296.60
1996	2,670,808.60	1,617,865.10
1997	3,271,837.90	1,628,958.90
1998	3,796,497.30	1,699,694.50
1999	4,201,807.70	1,948,631.70
2000	5,214,200.20	2,236,460.60
2001	5,431,891.20	2,620,359.20
2002	6,995,940.20	2,722,790.00
2003	9,251,014.70	3,388,296.30

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2004	12,497,345.10	4,465,266.00
2005	16,293,872.20	4,873,497.70
2006	20,351,628.70	5,922,285.60
2007	23,276,133.10	6,986,058.10
2008	25,232,726.60	8,149,672.50
2009	22,090,481.00	7,746,032.50
2010	28,337,485.60	10,206,045.30
2011	32,456,473.50	12,214,439.00
2012	35,199,988.30	13,287,829.70
2013	36,848,066.30	15,255,224.60
2014	39,614,740.47	15,918,730.80
2015	41,014,516.94	14,978,093.13
2016	38,911,253.57	13,512,428.36
2017	43,314,647.73	15,517,727.48
2018	47,981,164.16	15,536,585.43
2019	41,793,571.80	12,233,890.90

Source: Wind- Economic Database and Website of China Statistics Bureau, 2020

Data adjustment

Since the data of US GDP and US imports from China are both current prices, the price indices need to be adjusted in order to make the annual data comparable. The base period of the adjustment is 1983 and set to be 100. Then, to avoid large difference between the values of the variables, the natural logarithms of all the adjusted data are obtained.

Empirical test and results

The annual data of China's imports and US economic growth from 1983 to 2019 are tested, the two variables are treated equally as endogenous variables, the CE model with intercept under Johansen co-integration test is selected, and EVIEWS8.0 is used to obtain the following test results:

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Table 3: Johansen Co-integration Test between US GDP and U.S.-China Trade

	Eigenvalue	Trace statistic	5% critical value	Assumed CE number
Trace test	0.575894	33.20364	20.26184	None *
	0.086895	3.181651	9.164546	At most 1
	Eigenvalue	Max-eigen statistic	5% critical value	Assumed CE number
Maximized eigenvalue test	0.575894	30.02199	15.89210	None *
	0.086895	3.181651	9.164546	At most 1

*Note: The lag interval is 1-1, * denotes that the null hypothesis is rejected at 5% significance level. Conclusion: Trace test and maximum eigenvalue test indicate that there is a co-integration equation at the 5% level.*

According to the test results in Table 3, the two variables are treated equally as endogenous variables. The trace test and maximum eigenvalue test show that there is a co-integration equation at the 5% level. The standardized co-integration relational expression is as follows:

$$LnGDP=0.462082\times LnIMP+7.252718$$

$$(8.773154) \quad (15.45038)$$

The T statistic is in the bracket under the coefficient of the co-integration variable. Since the T statistic is large, the variable is significant in the cointegration relational expression. As the estimated coefficient of LnIMP is 0.462082, which indicates that the US import volume from China has a significant positive impact on the US GDP. If the US import volume from China accelerates by **1%**, the US GDP gains a synchronous growth of **0.462082%**.Unit root test is conducted on the EC sequence:

Table 4: Unit Root Test of EC Sequence

Variable definition	AADF statistic	10% critical value	Test form (C,T,P)
LnGDP and LnIMP EC sequence	-1.930898	-1.611059	(0, 0, 1)

Source:own editing (2021)

It can be seen from the above table that the EC sequence is stationary at 10% level and fluctuates around 0. The following conclusion can be drawn: there is a bidirectional long-term relationship

between the changing trend of the U.S. –China trade deficit and US GDP. Meanwhile, the coefficient of LnIMP in the cointegration relational expression is positive, so the Sino–US trade contributes to the American economic growth in the current period.

Prediction of Development Trend of Sino-US Trade Imbalance

Based on the data of Sino–US import and export trade from 1983 to 2019, this paper uses time series regression analysis method and Eviews8 to build the econometric model, that is, China's export to the US, China's import from the US and the Sino–US trade balance are fitted and predicted.

The theoretical equations of trend prediction are as follows:

$$Y1 = \alpha + \beta X \quad (1)$$

$$Y2 = \alpha + \beta X \quad (2)$$

Where Y1 represents China's exports to the US; X represents the time series in unit of year; Y2 represents China's imports from the US; α is the intercept; β is the coefficient of the time series and represents the direction and quantity of changes. Y1 and Y2 are respectively fitted by linear regression, and the results are as below:

Empirical test and results

Table 5: Regression Estimation Results of Y1 and X

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	140.4126	9.096843	15.43531	0.0000
C	-279462.0	18203.04	-15.35249	0.0000
R-squared	0.871912	Mean dependent var		1503.616
Adjusted R-squared	0.868252	S.D. dependent var		1627.691
S.E. of regression	590.8048	Akaike info criterion		15.65339
Sum squared resid	12216760	Schwarz criterion		15.74046
Log likelihood	-287.5877	Hannan-Quinn criter.		15.68409
F-statistic	238.2488	Durbin-Watson stat		0.153923
Prob (F-statistic)	0.000000			

Source: own editing (2021)

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Table 6: Regression Estimation Results of Y2 and X

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	47.53396	3.488098	13.62747	0.0000
C	-94563.29	6979.784	-13.54817	0.0000
R-squared	0.841419	Mean dependent var		552.1742
Adjusted R-squared	0.836889	S.D. dependent var		560.9185
S.E. of regression	226.5385	Akaike info criterion		13.73625
Sum squared resid	1796189.	Schwarz criterion		13.82332
Log likelihood	-252.1205	Hannan-Quinn criter.		13.76694
F-statistic	185.7080	Durbin-Watson stat		0.202736
Prob (F-statistic)	0.000000			

Source: own editing (2021)

The analysis of the above regression results shows that the determination coefficient R-square of Y1 and X, Y2 and X are **0.871912 and 0.841419**, respectively, and the goodness of fit is relatively high; the F statistics is 238.2488, and the corresponding P values are 0 and less than 0.05, indicating that the linear relationship among Y1, Y2 and X is significant. Further analysis of the estimation coefficient of X in the two models shows that in the regression of Y1 to X, the estimation coefficient is 140.4126, the P value of significance test is 0 and less than 0.05, suggesting that X exerts a significantly positive impact on Y1; in the regression of Y2 to X, the estimation coefficient is 47.53396, and the P value of significance test is 0 and less than 0.05, indicating that X exerts a significantly positive impact on Y2. Because the values of the two regression models are positive, Sino-US trade will continue to develop in the future, and the estimation equations of the model are as below：

$$Y1 = -279462 + 140.4126 \times X \quad (3)$$

$$Y2 = -94563.29 + 47.53396 \times X \quad (4)$$

According to the above two regression models, this paper predicts the trend of Sino-US trade, and on this basis, the variation trend of Sino-US trade balance is calculated (see Table 5). From 2020 to 2026, Sino-US trade will continue to grow, and China's trade surplus with the US will continue to exist and expand, and the volume will increase from 271.62 billion dollars in 2020 to 327.34 billion dollars in 2026.

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Table 7: Prediction of 2020-2026 Sino-US Trade Balance（US $100 million）

Year	Amount of exports	Amount of imports	China's trade surplus
2020	4171.5	1455.3	2716.2
2021	4311.9	1502.9	2809.0
2022	4452.3	1550.4	2901.9
2023	4592.7	1597.9	2994.8
2024	4733.1	1645.5	3087.6
2025	4873.5	1693.0	3180.5
2026	5013.9	1740.5	3273.4

Note: Calculated according to Equation 3 and 4.

In conclusion, the Sino-US bilateral trade volume will continue to increase for some time to come and benign interaction is still the mainstream of bilateral economic and trade relations between the two countries. China needs to strive for long-term interests in the adjustment of internal and external balance. Of course, such adjustment is a dynamic equilibrium and a gradual process guided by policies and based on market mechanism, rather than arbitrarily taking radical measures to restrict normal trade contacts.

Conclusions and Suggestions

There is a two-way and long-term relationship of influence between the changing trend of the US-China trade deficit and US GDP, during which the Sino-US trade is conducive to the US economic growth. The economic complementarily of China and the United States is the driving force for bilateral trade growth. The two countries are both rivals and partners; they complement each other's strengths and achieve mutual benefit and win-win results. Pursuing broader markets and greater interests in competition and cooperation is inevitably the most prominent feature of the subsequent development in bilateral trade between China and the United States. Under the circumstances of economic globalization, the US investment in China is accelerating and the intra-company trade is continuously developing, and China's foreign trade surplus based on processing trade make it difficult to solve the trade imbalance between China and the United States within a short time. In the short run, the scale of Sino-US trade imbalance is still enlarging, but in the long term, Sino-US trade should move towards balance. China necessarily continues to expand domestic demand and lower its trade surplus with the United States. Foreign trade dependence is a double-edged sword that the rapid progress of foreign trade can stimulate effective demand in the case of insufficient domestic demand, thus playing a positive role in accelerating the stable growth of GDP. However, a heavy price can be paid on account of excessive dependence on foreign trade and its trading partners if political or economic turbulence occurs. For a long time, China's consumption level is still relatively low, and the improvement of consumption level cannot keep pace with the improvement of domestic productivity, so that the augmented consumption needs can only be met by part of the domestic production supply, but have little effect on the increase of import demand. Meanwhile, the long-term sufficiency of effective domestic demand also makes domestic manufacturers which are

represented by foreign direct investment enterprises sell more products to foreign markets. As one of China's principal export markets, the US trade deficit inevitably keeps expanding. Thus, China should continue to unswervingly carry out the policy of expanding domestic effective demand and accelerating the shrinkage of China's trade surplus with the United States.

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HUMAN RESOURCES REQUIREMENTS FOR REINDUSTRIALISATION IN BORSOD-ABAÚJ-ZEMPLÉN COUNTY

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Abstract

After World War II, Borsod-Abaúj-Zemplén county evolved into a major industrial centre due to coal mining, which was given priority in order to meet the industry's growing demand for energy. Following the change of regime, the processes of deindustrialisation, which affected the various parts of the country very differently due to their diverse characteristics, had serious consequences in this county. Decline in mining had a major role in this. The county's economic and social indicators still reflect this shock. The 2008 financial crisis shed doubts on the process of deindustrialisation. In its Communication for a European Industrial Renaissance (2014), the European Commission expressed its commitment to industrialisation, the modernisation of Europe's industrial base and the promotion of a competitive framework for EU industry. The success of reindustrialisation depends on a number of closely related factors. This article focuses on a single branch of the national economy: mining, and seeks to find the answer to whether a quality workforce and the necessary know-how are available in the region. We have prepared a SWOT analysis for the revitalisation of deep mines in Borsod-Abaúj-Zemplén county and we collected the most important statistical data about the deep mining. The history of mining is reviewed and the training needs are presented to assess the viability of revitalizing mining, with a focus on the specific features of human capital. Restarting mining in Borsod-Abaúj-Zemplén county is ideal because there are many unskilled or low-skilled unemployed people for whom traditional manual work is the only realistic alternative and the county still has the professional background in the science of mining.

Key words: *Deindustrialization, Mining, Human Resource*
JEL codes: *J2, L7*
LCC: *HD28-9999*

Introduction

The current mining situation in Borsod-Abaúj-Zemplén county was basically caused by two processes. The change of regime following the collapse of socialism induced qualitative and quantitative changes in the political, economic and social system, a unique process in history, which the different regions of the country experienced in different ways due to their different circumstances. In the county, the mining company's mines closed one after the other. The process of deindustrialisation is linked to structural change. In the same period in Hungary, the transformation of the economic structure as a result of the transformation recession, the decline of industry, including mining, was of particular importance, especially in areas such as B-A-Z county, where concentrated and large-scale industrial structures were established and operated. In these areas, serious scars were inflicted on the labour market and, through it, on society.

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The global economic crisis that has unfolded since the end of 2008 has fundamentally challenged the process of deindustrialisation. De-industrialisation is a process that is not in a state of equilibrium and can be prolonged, causing severe damage to a given unit of territory. In the view of many, the European economy, including the Hungarian economy, has become unbalanced, with a bottlenecked economic structure that relies too heavily on the creative industries. In order to boost economic growth, there is a renewed need to revitalise the industrial sector, including the mining sector. In other words, a kind of re-industrialisation must take place in Hungary. This will depend to a large extent on the ability of a region to preserve and, if necessary, partly redefine its mining traditions. It is essential to strengthen the local links between the existing industry and the mining sector and thus reduce the risk of delocalisation in the future. This industrial development is a long-term process, which depends on a number of inherited factors. The diversity of factors (in particular the labour force), the institutional background and the adaptability of the regions are the key to success or failure. The revitalisation of the mining segment requires well thought-out and innovative strategies. But these must in no way reflect pre-1980s thinking.

Following the financial crisis of 2008, the European Union saw the strengthening of the industry as an opportunity for recovery (EC 2010, 2014). In the post-crisis decade, the Hungarian industry's geographical transformation was marked primarily by the continuity and intensification of industrialisation processes (Lux, 2020). Although research focuses mainly on the manufacturing industry, a similar potential may exist in mining. In Borsod-Abaúj-Zemplén county, there is a high number of unemployed unskilled or low-skilled workers, and traditional manual labour is perhaps the only realistic alternative for them (Hajdú, 2021). The required educational background is still in place and perhaps, the mining traditions have not completely become vanished either.

Literature review

By the end of the 20th century, the services sector had gained increasing significance in developed countries at the expense of the industry. This process is called deindustrialisation, which, with the decline in industrial activity, has also led to a decline in the number of industrial employees and in the ratio of industry in GDP. In OECD countries, the process has also been strengthened by the outsourcing of industrial activities and by the North-South trade (Alderson, 1999). A study by IMF considers deindustrialisation as a feature of successful economic development, primarily resulting from higher productivity in manufacturing (Rowthorn and Ramaswamy, 1997). While in the USA and in the countries of Western Europe deindustrialisation took place even after the 2000's, reindustrialisation was more characteristic in the countries of Central and Eastern Europe (Nagy et al. 2019 Although traditional industries were in decline, the industry continued to drive economic development, in other words, structural change was also observed. Foreign direct investment and the relocation of international activity also had a key impact on the relevant processes (Barta et al. 2008). Following the financial crisis, the European Union announced the Europe 2020 strategy (EC 2010), which aims to achieve smart, sustainable and inclusive economic growth. The European Commission's relevant communication (EC 2014), published two years later, proposed a reform in Europe's industrial policy and aimed to increase the share of industry in GDP and its the role in employment.

Analyses by Nagy et al. show that, despite the set economic policy objectives, manufacturing employment in the EU-15 has stagnated since 2013 (the gross value added has risen slightly), while in post-socialist countries the contribution of manufacturing to employment had increased

up to 2008, and then, after a significant decline, it has demonstrated an upward trend since 2013. The ratio of gross value added also has an increasing trend. The authors note that in Western Europe deindustrialisation is still taking place, while in some Central and Eastern European countries the experience is lopsided, with reindustrialisation observed in addition to declining employment (Nagy et al. 2019).

As regards the preconditions for reindustrialisation, in addition to the previously predominant quantitative criteria (taxation level, wage level and road access), various quality factors (quality of the local government, qualifications and skills of the workforce, available supplier networks, clusters and business services) are gaining significance in Central European economies (Lux 2013a). Lux (2013a) also emphasises that these parameters are localised and must characterise a region simultaneously, i.e. their concurrent, favourable appearance is required. Another key feature includes path dependence (Lux, 2013b, and Molnár and Lengyel, 2015), i.e. the effect of past events and traditions can also be detected. According to a study of the period between 2009 and 2014 in Hungary (Lengyel, 2017), reindustrialisation was barely perceptible at the level of the national economy between 2009 and 2014. While the manufacturing industry's share in gross value added has increased in some counties, including Borsod-Abaúj-Zemplén county, deindustrialisation took place in the capital city and its agglomeration. The analyses by Nagy et al. (2019) also confirm that the transformation of Hungary's manufacturing industry is more similar to the one seen in the EU15 than to other post-socialist countries.

Based on its geographical and natural features, Borsod-Abaúj-Zemplén county is one of the most diverse regions in Hungary, as it is the place where the Northern Massif meets the Great Plains. Consequently, the economic and geographical position of the county is favourable. In addition to lignite and ore deposits, it abounds in mixed minerals (e.g. bentonite, limestone, andesite and tuff), in forests covering most of the mountains and in mineral springs, hot spas and healing waters. The county is also rich in tourist attractions: two of Hungary's 10 national parks, the Aggtelek National Park and the Bükk National Park, are located in this region, along with caves, medieval castles serving as theatres of history, romantic country houses, mansions, listed buildings and ethnographic traditions that have been added to the list of mankind's "intangible cultural heritage" (Siskáné et al. 2013).

The county has areas of different economic development. The north-eastern border with Slovakia is an agriculturally underdeveloped land, while the north-western region is industrialised. The economic significance of heavy industry, which used to underpin the previous development of the county, has significantly decreased in recent decades, as numerous coal mines and metallurgical plants have been closed. As a result, Ózd and the Sajó River Valley mining region were hit by economic crises. At the same time, in the region around Bükkábrány, significant lignite assets are still produced by opencast mining, and these serves as a raw material for the nationally significant electrical power plant installed on the foothills of the Mátra Mountains. South Borsod, the Tokaj Foothills and Zemplén have a diverse economic structure. In addition to the presence of industry in these areas, the wine regions of long traditions in the Bükk Foothills and the Tokaj Foothills are also of great significance.

Gross domestic product was HUF 2,073,434 million in 2018 in Borsod-Abaúj-Zemplén county, accounting for 4.86 per cent of the country's economic performance. Despite the nearly unbroken rise in per capita GDP in recent years, the figure characterising the county only amounts to 60 to 70 percent of the national average. However, the data shows significant fluctuations. After a period of growth up to 2005, performance declined as a result of the 2008 crisis, and this decline was well above the national average. After the low point seen in 2010

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(when the per capita output barely exceeded 60% of the national average), the county started to catch up, and in 2018, it performed 73.6 per cent (KSH).

In late June 2020 85,112 business organisations were registered in Borsod-Abaúj-Zemplén county, representing an increase of 0.2 per cent on a year earlier. Businesses amounted to 90 per cent of all organizations, 23 per cent were partnerships and 76 per cent were sole traders. The number of not-for-profit organisations was 6851. The number of *businesses operating with foreign direct investment* has been steadily declining since 2012 (there were 395 such businesses in the county in 2010; 335 in 2015, and 302 in 2018 in the county), but their foreign capital has increased significantly, reaching HUF 1122.2 billion in 2018, and thus their share in the country's total foreign capital has also increased (to 14.17% by 2018). According to the number of *registered businesses per 1000 inhabitants*, at the end of June 2020, Borsod-Abaúj-Zemplén county had the lowest value of all the counties. At that time, no more than 121 businesses were registered per 1000 inhabitants. In 2014 and 2015, there were 111 businesses, and in 2017, 114 businesses per 1000 inhabitants, representing a very modest increase (in the same period, the national average also increased slightly) (CSO, 2020).

In a *sectoral approach*, nearly 30 per cent of all organisations operate in agriculture; however, as sole traders predominate this sector (96.4%), in terms of employment it is much less important (merely 2.41% of the employees work in agriculture). Second to agriculture, most organizations are engaged in real estate transactions (9660), next comes trade and automotive repair (7407), followed by professional scientific and technical activities (7139). A total of 3754 organisations are active in industry (mining, quarrying, manufacturing, electricity, gas and steam supply, air conditioning, water supply, sewerage, waste management and remediation activities), representing 4.4 per cent of all organisations (with 29.3% of all the people employed in this sector). A significant part of the *value of investments* is realised in industry (72.7% in H1 2020). In terms of investments, the manufacturing industry is worth mentioning within industry, as a higher ratio of the development resources are used in this sector. In 2019, the value of investments amounted to HUF 669,747 million. In a national comparison, per capita figures may be used. This is HUF 1042,000 in Borsod-Abaúj-Zemplén county, against the national average, being HUF 875,000.

Industrial production (excluding water and waste management) amounted to HUF 2,824,486 million in the county in 2019. This translates to HUF 4,396,000 per capita (in 2019), higher than the national average (being HUF 3,538,000). Within industry, manufacturing accounts for 97.93 per cent of production (CSO, 2020). More specifically, the manufacture of chemicals, products, vehicles, computers, electronic apparatuses and optical products are the most significant, and these sectors also exhibit the highest productivity (production per employee).

Material and methods

We collected and analysed the statistical data about the mining in Borsod-Abaúj-Zemplén county. The time horizon of the data presented varies, as the collection of historical mining data at county level is often difficult because some of the data is difficult to obtain.

The qualification requirements and standards for mining jobs have been reviewed on the basis of Section 50/A (2) of Act XLVIII of 1993 on Mining and on the basis of Decree 60/2009 (XI. 3.) of the Ministry of Labour and Social Affairs (which provides for the professional qualifications and experience required for the occupation of jobs of technical safety significance in mining). We have prepared a SWOT analysis for the revitalisation of deep mines in B-A-Z

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county. Our analysis is valid within the currently known legal, economic, technical and social framework.

Results – The history of mining in Borsod-Abaúj-Zemplén county

Since the late 1700's, *coal mining and ore mining* have played a key role in employment in Borsod-Abaúj-Zemplén county. Mine closures began as early as the 1960's as a result of economic restructuring (previous mine closures were due to mine depletion). Closures continued and the last step in Borsod-Abaúj-Zemplén county was taken in 2004, when an era ended on conclusion of the Borsod Coal Mines liquidation process and the termination of the company.

Table 1: Former mining centres

Locality	The beginning of mining	Mine closure	Locality	The beginning of mining	Mine closure
Abod	1921	1927	Ormosbánya	1870	1988
Alacska	1897	1973	Ózd	1840	1985
Alberttelep	1917	1989	Parasznya	1767	1939
Arló	1852	1947	Pereces	1830	1973
Bánfalva	1920	1965	Putnok	1923	2001
Bánhorvát	1890	1945	Radostyán	1858	1987
Bánszállás	1841	1957	Rudabánya	1892	2004
Barcika	1881	1946	Sajóbábony	1929	1946
Bekölce	1997	2003	Sajógalgóc	1822	1990
Berente	1919	1984	Sajóivánka	1880	1946
Borsodnádasd	1940	2002	Sajókaza	1769	2003
Diósgyőr	1850	1967	Sajókazinc	1820	1948
Izsófalva	1868	1977	Sajókápolna	1822	1934
Edelény	1850	1995	Sajólászlófalva	1864	1959
Farkaslyuk	1840	1990	Sajószentpéter	1888	1973
Felsőnyárád	1880	1978	Sajóvárkony	1834	1947
Hódoscsépány	1850	1923	Sajóvelezd	1867	1930
Járdánháza	1845	1957	Sáta	1890	1960
Kazincbarcika	1947	1993	Somsály	1854	1972
Királd	1822	1984	Szendrő	1893	1944
Kondó	1890	1962	Szuhakálló	1869	1996
Kurityán	1873	1985	Szuhogy	1910	1945
Lyukóbánya	1859	2004	Tardona	1769	1924
Mónosbél	1868	1926	Vadna	1921	1994
Múcsony	1890	1945	Varbó	1810	1936
Nagybarca	1920	1966			

Source: The authors' own elaboration based on a publication by Rónaföldi, Zoltán (2012), entitled "A borsodi és Ózd vidéki szénbányászat fontosabb évszámai, eseményei" (Important dates and events in coal mining in Borsod and in the neighbourhood of Ózd)

An analysis of the coal mining data (Figure 1) reveals that the extracted amount rapidly increased between 1950 and 1969, reaching its highest level at 6,029,000 tons in 1969. Production decreased slightly up to the early 1980's, and then dropped drastically in the period following the change of regime (3,826,000 tons of coal was mined in the county in 1989 and

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then only 2,908,000 tons a year later). Between 1993 and 2011, the extracted amount fluctuated between 1,700,000 and 1,100,000 tons per year, and after the mine closures, barely 600,000 tons of coal were mined per year.

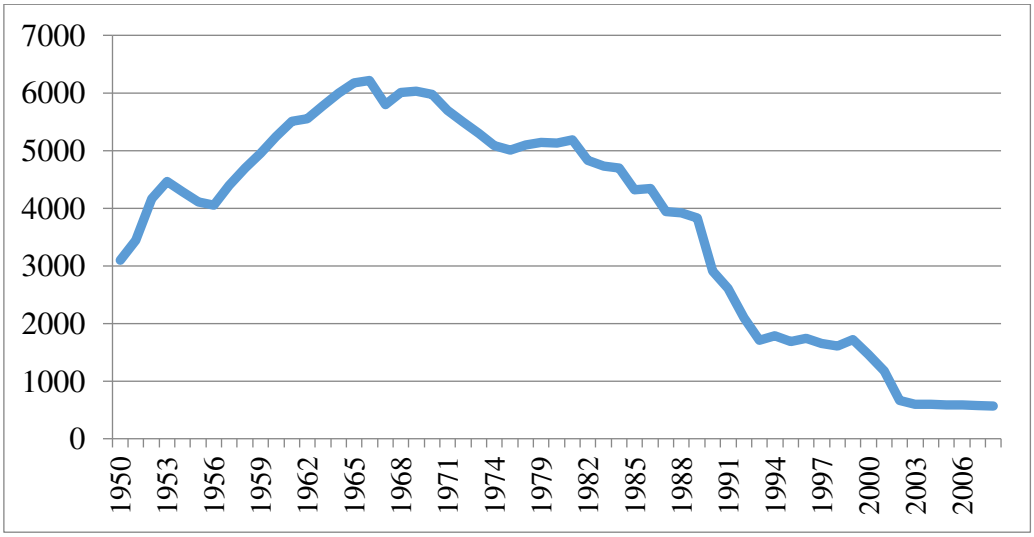

Figure 1: Coal mining in BAZ county between 1950-2008 (tousand tons)
Source: CSO, B-A-Z megyei statisztikai évkönyvek (Annals of statistics for BAZ county)

The county's employment data shows that the number of people working in industry (Figure 2) increased steadily between 1950 and 1975, peaking at 150,910 industrial employees. Between 1975 and the change of regime (1989), a slight decrease was observed, which was then followed by a drastic decrease.

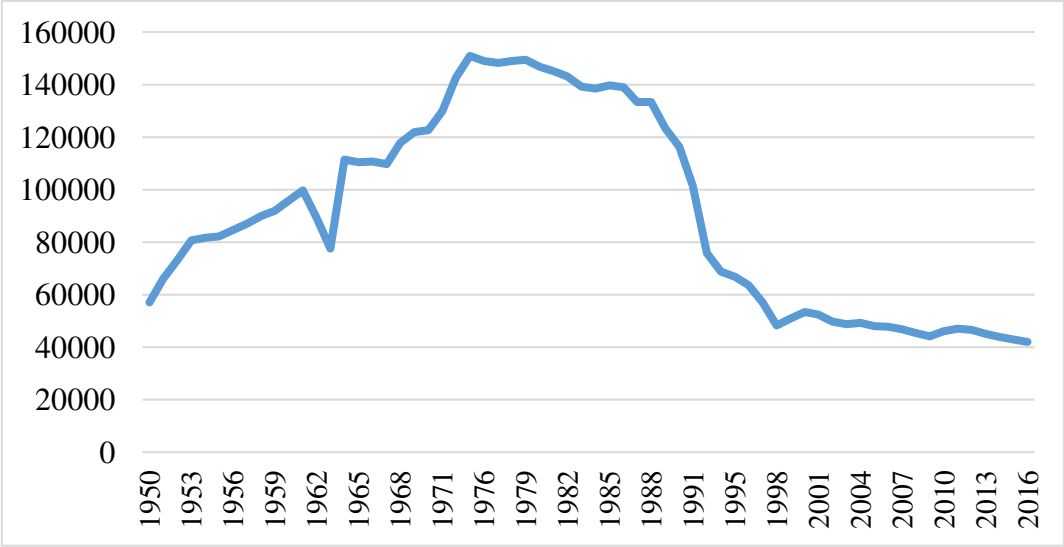

Figure 2: People employed in industry, 1950-2016, BAZ county
Source: CSO, B-A-Z megyei statisztikai évkönyvek (Annals of statistics for BAZ county)

Developments in the number of people working in coal mining in the county were also surveyed (Figure 3). Due to the absence of earlier data, the trend is only depicted from 1978, but based on existing data, the highest number of people worked in coal mining in 1961 (28,712 people), and the headcount was 19,609 in 1978. After the change of regime, the number of people employed in coal mining drastically decreased (to 7266 people), which has further dropped to this day, as in 2011 only 378 people worked in mines in the county.

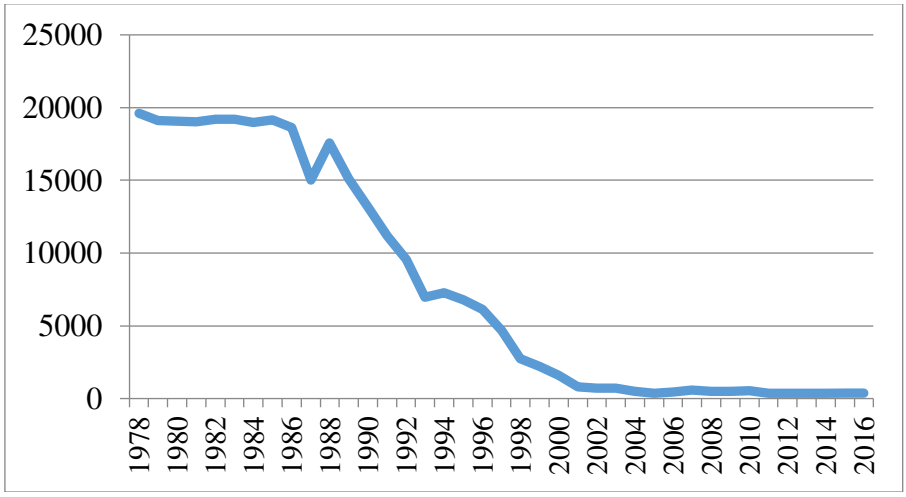

Figure 3: Coal mining employees in BAZ county, 1978-2016

Source: CSO, B-A-Z megyei statisztikai évkönyvek (Annals of statistics for BAZ county)

Based on the data of the last three censuses, the ratio of employed men to the population aged 15-59 was examined at the level of communities (Figure 4).

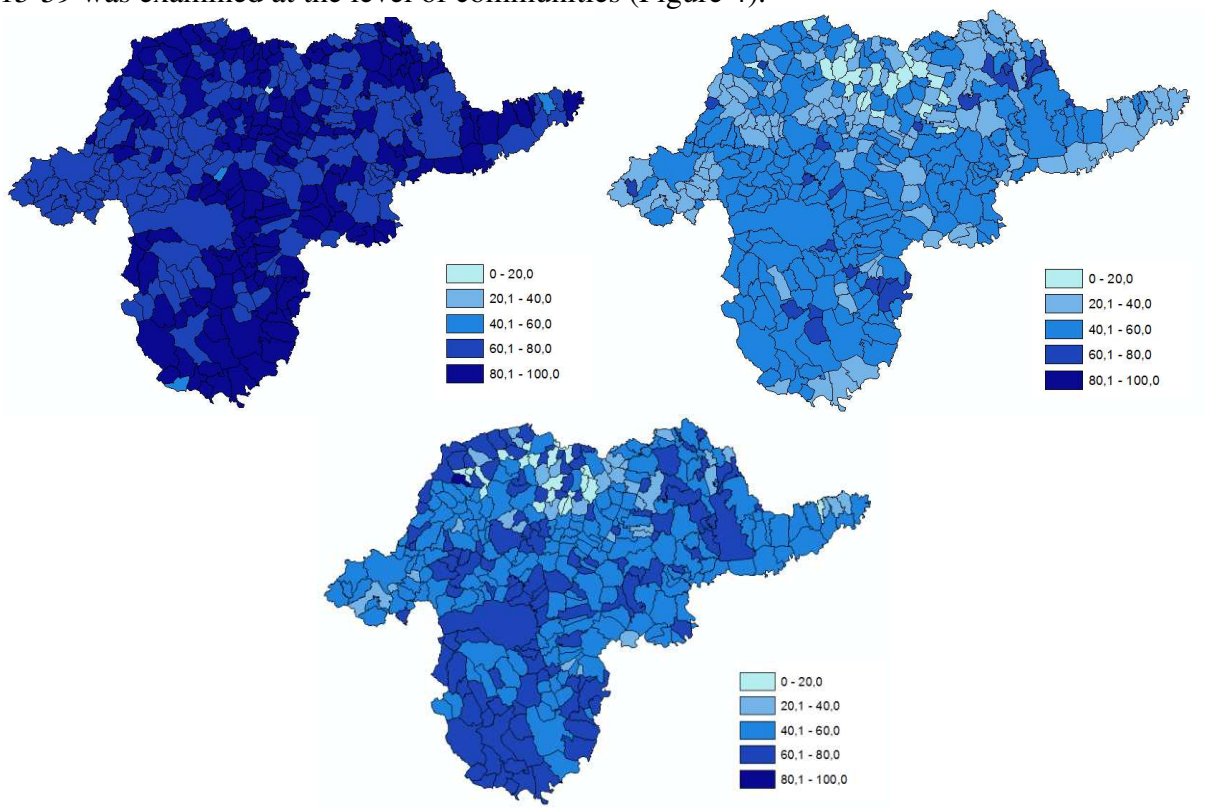

Figure 4: Employment rate among men aged 15-59 (1990, 2001 and 2011)

Source: The authors' own elaboration based on census data

In 1991, the impact of full employment, which had prevailed before the change of regime, was still felt among men. In more than half of the localities of Borsod-Abaúj-Zemplén county, employment was between 80-100 per cent, and the county average was 80.1 per cent. By 2011, it had fallen by nearly half, to a county average of 42.2 per cent. As a result of recovery from the economic crisis, in 2011 the employment pattern became considerably more stable, with the county average being 53.1 per cent. Among the economically active male population, in 2011,

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the highest employment rate was recorded at Égerszög (90.9%), Sima (80%) and Keresztéte (75%), where there are no registered Roma residents. At the other extreme is the group of localities where the ratio of employed men in the active age group is zero per cent: at Tornakápolna, Gagyapáti, Teresztenye, Tornabarakony, Pamlény, Varbóc and Nyésta (these localities already have higher ratios of Roma inhabitants).

The most common vocational qualifications required by the primary labour market in Borsod-Abaúj-Zemplén county in November 2020 included those of shop assistants, locksmiths and electricians (representing a total demand for 2657 people). According to the employer's core business activity, the number of vacancies registered in Borsod-Abaúj-Zemplén county for November 2020 was as follows: 41 persons were sought in agriculture, 371 in industry, 458 in market services and a total of 1787 in public and other services.

The idea of reopening mines emerged in 2010 as one way to restore a society based on work. For those who want to work, the most suitable job opportunities must be offered for the natural and geographical conditions of the given region. In this country, one of the breakthrough points could be the extraction and processing of the available mineral resources. As a first sign, the Borsod-Abaúj-Zemplén county Coal Mining Cluster was established on 4 December, 2013. Its members include: Ministry of National Development, Borsod-Abaúj-Zemplén county Local Government, Hungarian National Asset Management Ltd., Hungarian Mining and Geological Office, Hungarian Institute of Geology and Geophysics, University of Miskolc, National Association of Hungarian Mining Communities, National Hungarian Mining and Metallurgical Association (Törő, 2015). As no information was found about the cluster in 2020, if it was created, it is unable to fulfil its original function.

Results – Social and demographic background in Borsod-Abaúj-Zemplén county

On 1 January 2021, the population of Hungary was 9,730 thousand, of which 635 thousand lived in Borsod-Abaúj-Zemplén county. The resident population of Borsod-Abaúj-Zemplén county was 635 thousand on 1 January 2021, 0.8 per cent less than a year earlier. Accordingly, Borsod-Abaúj-Zemplén is the second most populous county in Hungary. As much as 6.5 per cent of Hungary’s population lives here. In Borsod-Abaúj-Zemplén county, population decline has been faster than the national level for a long time. The population of the county was characterised by rapid growth up to the early 1980’s. In the 1980’s, the number of births still exceeded the number of deaths, but already at that time natural reproduction was insufficient to offset the negative migration difference. Natural population decline has only characterised Borsod-Abaúj-Zemplén county since 1992. In the 21st century, the population is reduced by low birth rates, high mortality and migration losses.

Among the 16 districts of Borsod-Abaúj-Zemplén county, Miskolc is the most populous: at the beginning of 2020, 36.4 per cent of the county's population lived in the city, followed by the Kazincbarcika and Ózd districts. Over the past 4 years, the number of residents has decreased in all districts. The fastest decline was registered in Sárospatak (5%), followed by Sátoraljaújhely (4.7%), while the slowest decline was recorded in the Szikszó (0.5%) and the Tiszaújváros (1.4%) districts. At the time of the 2016 micro-census, 24 per cent of the county's population lived in Miskolc, 35 per cent in other cities and 41 per cent in villages. In 4 years the resident population has decreased by 4.2 per cent in the county seat, by a total of 4.8 per cent in the other cities and towns of the county, and by 3.5 per cent in its villages. Among the towns of Borsod-Abaúj-Zemplén, the population has increased in Szendrő, and decreased in the rest.

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Table 2: Population in Borsod-Abaúj-Zemplén county

Year	Resident population (persons)	Population density, (persons per square km)	Population as a percentage of the previous census (%)	Period (year)	Actual reproduction rate or decline (persons)	Average annual reproduction rate or decline (%)
1980	809,468	112	104.2	1970–1979	32,718	0.4
1990	761,963	105	94.1	1980–1989	-47,505	-0.6
2001	744,404	103	97.7	1990–2001	-17,559	-0.2
2011	686,266	95	92.2	2001–2011	-58,138	-0.8
2020	637,064	88	93.0	2011-2020	-47,729	-0.9

Source: Data source: CSO website, Fókuszban a megyék (Counties in focus) and https://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_wdsd003c.html
The table is the authors' own elaboration.

Similarly to national trends, but at a slower pace, the change seen for a long time in the age composition of the population has continued. For years, both the average age and the median age have been steadily increasing in Hungary. The average age of men was 40.6 years, while the average age of women was 44.8 years at the beginning of 2020. Half of the population is younger than 42 years and the other half is older than 42. At a national level, the ratio of people over the age of 65 is close to 20 per cent, while the ratio of those under the age of 14 was 14.5 per cent on 1 January 2020. In Borsod-Abaúj-Zemplén county, the average age is lower for both sexes than nationally. On 1 January, 2019, the average age of men was 39.3 years and that of women was 44.1 years in the county (CSO, 2019).

Based on the data of the 2016 micro-census, Borsod-Abaúj-Zemplén county does not have much to boast in terms of educational attainment, as it ranks second after Szabolcs-Szatmár-Bereg county (13.8%) in the ratio of people without primary qualifications. In terms of the highest level of education, Borsod-Abaúj-Zemplén county has a slightly better result, as it is in the second quartile in the ranking of counties according to the ratio of people with a tertiary degree. The county is also characterised by a high degree of heterogeneity in terms of education. The education of people living in the Miskolc District exceeds the national average, as the ratio of people with higher education in Hungary is 18.7 per cent, while in the Miskolc District it is close to 20 per cent. Among the districts of the county, the least educated are those living in the Edelény, Cigánd, Encs, Szikszó and Gönc districts.

In Hungary, including Borsod-Abaúj-Zemplén county, labour supply has been influenced by new factors in recent years in addition to the traditional ones. Below the focus is placed on the factors that encourage men's willingness to work, given that the stronger sex is over-represented among those employed in mining operations. The first important factor is demographic, as the number of people aged 15-64, who represent a potential labour supply, has been steadily declining in recent years. However, this effect is mitigated by the fact that the final exit of large numbers of people born in the first half of the 1950's from the labour market has been slowed down by raising the retirement age. Labour supply has also been boosted by the *elimination of the possibility of leaving before the statutory retirement age*, and the criteria for access to health benefits have not only been tightened recently, but previous benefits have also been reviewed and some of them withdrawn. Thus, even those who have not worked for many years are compelled to work to make up for their lost income.

The compulsory school-leaving age has been lowered from 18 to 16 years. However, those leaving education without qualifications and with a lack of general knowledge are expected to continue to find it difficult to enter the labour market.

The term of the job-seeking allowance, which is more or less linked to some previous income, has been reduced to three months, shortening the time available between losing a job and re-employment, which could in principle speed up job search. Low educational attainment, lack of skills, Roma ethnicity and residence in a disadvantaged region increase the likelihood of a more difficult than average integration into the labour market for an individual. The composition of the Roma by educational attainment and by residence also differs from those of the non-Roma population. The ratio of young people is higher among those who identify themselves as Roma, and the ratio of the elderly is significantly lower than among the non-Roma. Nearly 16 per cent of the Roma aged 15-64 has not even completed primary school, according to 2015 data, and a further 63 per cent only has primary qualifications. For the non-Roma population, these ratios were 1.0 and 19 per cent, respectively. The lowest difference between the Roma (15%) and the non-Roma (25%) was recorded in the ratio of trade and vocational school graduates to the total population (CSO, 2016). Among the total number of jobseekers in the county, in H1 2020, the highest ratio (46%) included people with qualification of 8 completed primary school grades, 26 per cent of them had vocational or trade school certificates, 24 per cent had completed secondary school, and 3.6 per cent graduated from university (CSO, 2020).

Results – Training needs in mining

When planning mine reopening, the organisation of training should simultaneously be reconsidered. Since 2013, the former collier training can no longer be launched in Hungary. In 2020, three training courses for registered trades (mining technician, mineworker and opencast miner) were available for those wishing to work in mining. Due to the low number of employees in coal mining and the low demand for training, Perfekt Zrt. only launches such vocational training courses at the Centre for Industrial Training in Pécs and at the Eurokt-Academy in Esztergom (in the latter vocational training is only available for opencast miners).

A *mining technician* may be employed as an open-pit mining technician, a deep mining technician (miner), a blaster, a mining machine maintenance manager, a geologists, or a geophysicist. Vocational qualifications only require the completion of primary education and adequate physical fitness and health for the prospective job. A technician with general professional know-how, familiarity with tasks of an opencast and a deep miner and those related to the operation and maintenance of the machines and equipment used there. He has satisfactory knowledge as required for jobs in coal, ore, mineral, bauxite, stone, sand, etc. mining and quarrying, and is familiar, at an intermediate level, with the managerial duties. He is engaged in the extraction of solid minerals, directly at the site or at the approach point on the surface, underwater or under the ground. In the course of performing the job, he carries out excavation, cleaning, narrow work, production or abandonment, including the partial tasks of ground-breaking, lining, loading and transportation, according to the instructions and regulations received from his supervisors and to specific work orders. In the course of these workflows, he acts according to and adheres to the above-listed, reasonably expected professional knowledge also specified in the official instructions, and to any additional information learned at basic and additional training courses. He is familiar with the expected requirements for the use of tools and machines. He follows the instructions and requirements of handling, operating, starting,

and maintaining machines. He is aware of the risks inherent at his workplace, and makes decisions, gives and executes instructions accordingly in the course of his activities.

With the professional qualification of a *mineworker*, the following positions can be filled: collier (assistant collier), mineral narrow worker, deep mining classifier, operator, winning machine operator, power loader operator, machine operator, belt operator, tractor operator, pump operator, filler. His tasks include the cultivation of deep mining coal, ore and mineral mines, mining or quarrying extraction, the operation of winning, transporting, loading and servicing machines, machine inspection, manning and maintenance, and the performance of technological and unexpected work organisation tasks in relation to operation. A worker with a degree in *opencast mining* may hold the positions of an open-pit miner, a quarry miner, a mineral narrow worker, an ore narrower, an ore concentrator, a sizer operator, a winning machine operator, a machine operator, a belt operator, a master dredger, a master loader or a heap keeper. His principal duties include the operation of the winning, transport, loading and servicing machines of opencast coal, ore, mineral, stone, gravel, sand and clay mines and quarries, and the inspection, machine management, maintenance, technological and work organisation tasks related to the operation. Pursuant to Article 50/A (2) of Act XLVIII of 1993 on Mining, Decree no. 60/2009. (XI. 3.) KHEM provides for the professional qualifications and experience required to fill technically significant jobs in mining, and the jobs specified in its annex may only be filled by persons with the professional qualifications and experience specified therein.

Results – Chances of reindustrialisation in Borsod-Abaúj-Zemplén county (SWOT analysis)

Following the logical structure of the SWOT analysis, below is a summary of the most important factors of chances for mining in the county.

Strengths

In the 1800's, coal had already been mined in Borsod county. In addition to open-pit mining, miners also extracted fossil coal from under the ground through adits (Lehoczky, 1975). After World War II, the amount of coal extraction in Hungary rose to over 12 million tons due to forced military production, and a significant part was provided by the Borsod areas. This suggests a deep-rooted mining culture in the county. Between 1949 and 1959 university departments teaching mining and metallurgy were gradually relocated to Miskolc, thus giving the city's technical university the image of three technical faculties, namely mining, metallurgy and mechanical engineering. The legal successor of the institution is the University of Miskolc, currently having approximately 10,000 students in its campus. In addition to education, numerous professors at the university, which has a strong research base, are members of the Hungarian Academy of Sciences.

The county is characterised by a developed and competitive chemical industry. In a national comparison, industrial production is outstanding in the county; in 2019 it was HUF 4,396,000 per capita as against the national average HUF 3,538,000. Manufacturing has a share of nearly 98 per cent in industry, with chemical industry having a pivotal role in terms of both production value and labour productivity. Chemical technology in Borsod (No. 1 nitric acid plant and Nitrogénművek Zrt.) represents a high standard, the workforce is skilled, and market demand for these products is constantly growing (they are also suitable for sale in export markets). In terms of human resources, the number of economically active people in the county has increased (in 2006, 2016 and 2019 this cohort comprised 269,400; 284,600 and 280,800 people,

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respectively); the number and ratio of the unemployed as well as the number of inactive people has decreased in this group, which is even more pronounced in light of the change caused by decrease in the resident population. In Q2 2020, this region had an employment rate (55.3%), or the quotient of the number of employed and of the working age population, which is below the national level (59.5%) but has improved by 8.5 percentage points on 2006. Low wage level in the county: Local salaries are 42 per cent lower than the wages paid in Budapest, and the difference is between 15-20 per cent nationally. Approximately 30-40 per cent of the blue-collar workers receive a minimum wage for their work, in many cases their earnings are only a few thousand forints higher than the benefit they could receive for raising children, for joblessness or for their social condition. For this reason, a considerable percentage chooses to stay at home rather than work.

Weaknesses

The closure of underground mines caused social, physical and moral erosion. In former mining areas, the population that used to have a secure livelihood, high wages and social esteem, could no longer find any suitable alternative livelihood after the disruption of production. The population engaged in mining-related professions is aging, and the former miners with specialised experience and knowledge are already retired or about to retire. For this reason, the replacement of professionals (filling jobs that require experience) is a major challenge. Another problem is that the qualifications required for this activity (locksmith, electrician, machine operator, etc.) are in short supply in the county.

The propensity to work is low among the people who live in the region. The individual's employment decision is made by comparing the expected wage (and any non-monetary benefits earned on work) to the expenses and inconveniences associated with the job. If an individual receives income without work, he can “buy” more products and more free time from such extra income, and so his job supply will be lower than without a separate income (Killingsworth, 1983). The high inactivity rate is considered as the most important factor limiting competitiveness. Low-skilled people are overrepresented in the region: Low-skilled workers are over-represented in the region: Borsod-Abaúj-Zemplén county ranks second among counties in terms of the ratio of people without completed primary school education (13.8%). Among the districts of the county, the least educated are those living in the Edelény, Cigánd, Encs, Szikszó and Gönc districts. In Edelény, 25 per cent of the population over the age of 7 have not completed primary school education. There is no potential investor in the area; the county currently has no investor capacity.

Opportunities

The technology required for the creation of an innovative product structure in relation to mining is available, and the chemical companies located in the county and the university have the latest technological conditions. Wage opportunities in mining may be attractive, and high bonuses and shift breaks due to hazardous operations may increase the ratio of people wishing to work in the sector. Reindustrialisation is given government and EU support. As in accordance with the EU2020 strategy, the priority areas of the EIDHR include the development of the productive sector and the promotion of reindustrialisation (Varga, 2016); reindustrialisation is expected to receive significant external resources. As the continuation of mining activities requires special expertise, for which training is currently only available in Pécs and Esztergom, EU funding is warranted for the organisation of training.

The regulatory framework for supporting hazardous occupations is strengthening; further tightening of the existing legislation is expected to make benefits for mining employees more

transparent. Instead of early retirement pensions, which were abolished in 2015, in the case of work with an increased risk of health damage, the employee is compensated by reduced working hours, more leave, additional benefits or recreational measures (Világgazdaság, 2017, November 8). Government Decree no. 23/1991 (II. 9) on the Social Security Benefits Due to Certain Mineworkers was in force before 1 January 2012, and granted a significant early retirement benefit to miners if all the other conditions were met. The restoration of this early retirement benefit might perhaps be considered in order to increase the attraction of the profession, as miners are exposed to increased danger and adverse health effects during their work underground, which should be compensated. If the existing mines were reopened, a significant number of new jobs would be created, and thus the county's population, currently afflicted by high unemployment, would have a good opportunity, which could also be the key to the region's population retention.

Threats

Mining affects the local and regional environment in numerous ways. These include changes in the natural environment, an impact on water quality, and the generation of hazardous substances, which are the causes of the population's resistance to mine opening. In addition to environmental concerns, there has also been an increase in aversion to plants where accidents are waiting to happen and that are unhealthy. Deep mines have, on the one hand, an increased impact on health and a high risk of accidents, and, on the other hand, a considerably higher requirement for workers to be physically fit and healthy. Mineworkers should certainly be provided benefits to take up work despite the dangers.

This activity should only be carried out under strict regulatory conditions. Decree no. 60/2009. (XI. 3.) KHEM on the Professional Qualifications and Experience Required to Fill Technical Safety-Relevant Jobs in Mining specifies rules on the length of experience in the number of years required of a worker engaged in mining activities. The generosity of the welfare system is tantamount to competition, and for those living in the area, public service and high social benefits offer a "comfortable" position, which may have a disincentive to work. Economic recovery and emerging labour shortages are depriving the region of labour capacity. In the case of certain professions, there is a significant outflow of labour from the county, only people with a very low level of education stay here, and moreover, they do not necessarily have the appropriate state of health.

Conclusions

Following the 2008 financial crisis, the European Union saw reindustrialisation as an opportunity to recover from the crisis (EC 2010, 2014). These processes are characterised by path dependence (Lux, 2013b and Molnár and Lengyel, 2015). Due to the industrial traditions of Borsod-Abaúj-Zemplén county and the still significant industrial production, mainly of the chemical industry, which exceeds the national average, the quantitative and qualitative conditions necessary for reindustrialisation are largely in place. The aim of this article was to examine the current state of human resources in the county, as one of the qualitative factors playing a significant role in the success of these processes, and then to draw conclusions about the potential for reindustrialisation in mining.

The revival of mining in Borsod-Abaúj-Zemplén county is ideal because there are many unskilled or low-skilled unemployed people for whom traditional manual work is the only realistic alternative. In other words, tens of thousands of jobs could be created as industry expands. However, the new mining industry is sensitive to the quality of the education system,

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the level of material and intellectual infrastructure, and the quality of life in a given locality. The foundations for all this are in place in the county, with both higher education and vocational schools. The new mining technology has a low environmental impact and improves our country's energy dependence.

It was found that the county has a high number of low-skilled workers available and wages are also below the national average. The knowledge base is partly available thanks to the University of Miskolc. At the same time, the population engaged in mining professions is aging, and replacing professionals is a major challenge, especially for jobs requiring experience and the necessary qualifications (locksmith, electrician, machine operator, etc.) are also in short supply in the county. The low willingness to work on behalf of the currently available workforce is also a cause for concern. Our findings suggest that without a well-considered strategy that also takes into account education, training and labour market integration, human resources will be a critical bottleneck in the reindustrialisation of mining.

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Appendix: Minimum professional qualifications and experience required to fill technical safety-relevant jobs in mining

Job	***Education, vocational qualifications, other qualifications***	***Required specialised experience***
Specialist supervising blast and explosion-proof equipment	specialised tertiary or	1 year
	secondary or	3 years
	basic vocational qualification	5 years
Operator of mining electrical installation	At least a basic electrical qualification and completed course in mine power plant management	2 years in mining*
Operation of a machine powered by an engine of a capacity less than 50 kW unit power	Completed primary school education and the mining machine operator course 1	3 months in mining
Operation of a machine powered by an engine of 50 kW or higher unit power	completed primary school education and the mining machine operator course 2	6 months in mining
In deep mining		
Mine rescue team commander and deputy	tertiary qualifications in mining and rescue	3 years
	secondary qualifications in mining and rescue	6 years

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Head of mine rescue centre and deputy	tertiary qualifications in mining and rescue	3 years
	secondary qualifications in mining and rescue	6 years
Engine supervision	specialised tertiary qualifications	1 year
	specialised secondary qualifications	2 years
	tertiary or secondary electrical qualification	2 years
Electrical supervision	tertiary electrical qualification	1 year
	secondary electrical qualification	2 years
	tertiary qualification in engineering	2 years
Special technical supervision (ventilation, coal-dust explosion, fire prevention, water protection commissioner)	tertiary qualification in mining	1 year
	secondary qualification in mining	2 years
Mining supervision	secondary qualification in mining	1 year
Dispatch centre operator	Secondary qualification in mining, mechanical engineering or electrical equipment, and a completed course in mining dispatch centre management	2 years in mining
Mine hoist operator	completed primary school education and the mining machine operator course 2 and training course in mine hoist operation	1 year in mining
Mine rescuer	Specialised qualification in mining, or mechanical, or electrical, or construction engineering, and a completed mining rescue course	2 years in underground mining
Independent electrician in an underground mine	At least a basic electrical qualification and a completed course in independent mining electrical installation	2 years in underground mining
Firedamp- and explosion-proof electrical equipment installer, operator, inspector, maintainer and repairer	At least basic electrical qualification, and a competed course in firedamp- and explosion-proof electrical equipment handling and installation	2 years in underground mining
In opencast mining		
Mining supervision	tertiary or secondary qualification in mining	1 year
	secondary qualification in mechanical, electrical, road-, traffic and transport engineering, road construction, or civil engineering	3 years
Engine supervision	at least a secondary degree in mechanical engineering	1 year
Electrical supervision	tertiary or secondary electrical qualification	1 year

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In mineral oil and natural gas mining and in underground gas storage		
Direct manager of white- and blue-collar workers performing significant technical and safety activities	specialised tertiary or	3 years
	specialised secondary vocational qualification	5 years
Direct manager of blue-collar workers performing significant technical and safety activities	specialised secondary or	3 years
	specialised basic vocational qualification	5 years
Unaided management of a mining facility (equipment)	specialised basic vocational qualification	6 months
Blow-Prevention Team Commander (BPC)	specialised tertiary qualification	5 years
Blow-Prevention Team Deputy Commander (BPDC)	specialised tertiary qualification	5 years
	specialised basic vocational qualification	10 years

Source: Decree no. 60/2009. (XI. 3.) KHEM on the Professional Qualifications and Experience Required to Fill Technical Safety-Relevant Jobs in Mining

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A KORONAVÍRUS VÁLSÁG HATÁSA A KIS- ÉS KÖZÉPVÁLLALKOZÁSOK MŰKÖDÉSÉRE

THE IMPACT OF THE CORONA VIRUS CRISIS ON THE OPERATION OF SMALL AND MEDIUM-SIZED ENTERPRISES

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Összefoglalás

A 2019 év végén megjelenő, majd 2020-ban pandémiává vált koronavírus jelentős hatást gyakorolt nemcsak az egészségügyre, hanem a világgazdaságra is. A koronavírus-járvány okozta válság kihívás elé állította a gazdaság szereplőit. A kereslet drasztikus visszaesése és a kényszerű karantén intézkedések hatására a válság a munka világában is egyből jelentkezett, ez pedig emberek millióinak életére és megélhetésére volt azonnali következményekkel. A járvány által legsúlyosabban érintett iparágak (pl. turizmus, vendéglátás) területén tömeges elbocsátásokkal, kényszerű fizetetlen szabadságolással kellett szembenézniük a munkavállalóknak. Mint általában minden válságnak, így a koronavírus okozta válságnak is a leginkább érintett szegmensei a kis- és középvállalkozások. Jelen tanulmány a koronavírusnak a magyar kis- és középvállalkozások működésére gyakorolt hatásait mutatja be. A kutatási kérdőívet 174 válaszadó töltötte ki. Az eredmények kiértékelése során megállapítható volt, hogy a koronavírus jelentős hatással volt a hazai kis- és középvállalkozások napi működésére, valamint azok foglalkoztatottsági jellemzőinek alakulására. A koronavírus következtében pénzügyi nehézségekkel, és a szolgáltatások/termékek iránti kereslet csökkenésével küzdenek leginkább a hazai kis- és középvállalkozások, így a kormányzati támogatások és intézkedések létfontosságúak számukra. E tanulmány segít megérteni az elmúlt időszak eseményeit, áttekintést ad a magyar kis- és középvállalkozások koronavírussal kapcsolatos attitűdjeiről és válságkezelési lépéseikről.

Abstract

The coronavirus, which appeared at the end of 2019 and became a pandemic in 2020, had a significant impact not only on health but also on the global economy. The crisis caused by the coronavirus epidemic has challenged economic actors. As a result of the drastic decline in demand and the forced quarantine measures, the crisis in the world of work was immediate, with immediate consequences for the lives and livelihoods of millions of people. In the sectors most affected by the epidemic (eg tourism, hospitality), workers have had to face mass redundancies and forced unpaid leave. As with any crisis, small and medium-sized enterprises are the most affected segments of the crisis caused by the coronavirus. The study presents the effects of the coronavirus on the operation of Hungarian small and medium-sized enterprises. The research questionnaire was completed by 174 respondents. During the evaluation of the results, it could be stated that the coronavirus had a significant effect on the daily operation of Hungarian small and medium-sized enterprises and on the development of their employment characteristics. As a result of the coronavirus, domestic small and medium-sized enterprises are facing the most financial difficulties and declining demand for services/products, so government subsidies and measures are vital for them. This study helps to understand the events

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of the recent period and provides an overview of the attitudes of Hungarian small and medium-sized enterprises towards the coronavirus and their crisis management steps.

Kulcsszavak: *koronavírus, Covid 19, Magyarország, kis- és középvállalkozások, kormányzati intézkedések*
JEL besorolás: *H12, L53, M21*
LCC: *HD49-49.5*

Bevezetés

A koronavírus az Orthocoronavirinae alcsaládba tartozó faj a Coronaviridae családból (Ahmad és Hui, 2020). A koronavírus széles körben elterjedt emberek, emlősök és madarak körében, légúti, máj- és neurológiai betegségeket okozva. Napjaink koronavírus-járványát a SARS-CoV-2 vírus, röviden Covid 19 nevű betegség okozza. Az első eseteket 2019 decemberében fedezték fel a kínai Wuhan tartományban (Shang et al., 2020, Horowitz, 2020). A betegségeket elsődleges forrását a „Huan Seafood Wholesale Market" piacon azonosították, ahol élő állatokat is értékesítenek, így valószínűsíthető, hogy állatról terjedt emberre a fertőzés (Geller et al., 2012). A 2002/2003-as SARS-járványhoz hasonlóan a gazdasági hatások röviddel az első azonosított esetek közzététele után már jelentkeztek. A vírus felfedezés után napokon belül a kínai részvényindexek 3,5 százalékot estek (Duan et al., 2020). A járványt az Egészségügyi Világszervezet (WHO) 2020. március 11-én nyilvánította világjárvánnyá. Magyarország Kormánya a 1012/2020 (1.31) Korm. határozatával, 2020. január 31-én hozta létre az operatív törzset a Covid 19 pandémia elleni felkészülés és védekezés érdekében. Magyarországot a járvány 2020. március 4-én érte el (Koós et al., 2020).

Az elmúlt évtizedekben a globális üzleti környezetet kiszámíthatatlanság és bizonytalanság jellemzi. Eddig az elmúlt évtizedek legjelentősebb eseménye, amely befolyásolta és drámai módon megváltoztatta a globális üzleti környezetet, a 2007/2008-as globális válság volt. Az Amerikai Egyesült Államokból kiindult és tovagyűrűzött 2008-as globális pénzügyi válság idején több nagy cég csődbe ment, vagy kényszerült arra, hogy egyesüljön versenytársaival. A nyugat-európai bankokat is súlyosan sújtotta a válság, annak hatása az egész világgazdaságban érezhető volt az amerikai gazdaság visszaesése révén (Allen és Carletti, 2010). A koronavírus-válság újszerű a modern történelemben, ehhez hasonló, a gazdaságot is ilyen mértékben érintő egészségügyi válsággal még ez idáig nem találkoztunk. Minden globális gazdasági válság súlyos a kis- és középvállalkozások számára (Syed Zwick és Syed, 2016; Vajda és Magda, 2020), amelyek a nemzetgazdaság fontos elemei szerte a világban. A Gazdasági Együttműködési és Fejlesztési Szervezet (OECD, Organisation for Economic Co-operation and Development) előrejelzése szerint a 2008-ban kezdődött gazdasági válság óta a jelenlegi koronavírus-járvány jelenti a legnagyobb kockázatot a világgazdaságra.

Kristalina Georgieva, a Nemzetközi Valutaalap (IMF, International Monetary Fund) igazgatója szerint a koronavírus válság a 2008-as pénzügyi válsághoz képest sokkal rosszabb gazdasági válságot okoz az egész világon. A Nemzetközi Munkaügyi Szervezet (ILO, International Labour Organization) szerint a Covid 19 válságnak messzemenő hatása lesz a munkaerő-piaci tendenciákra. A vírus és az azt követő gazdasági sokkok három fő módon befolyásolják általában a munka világát:

1) a munkahelyek száma jelentős mértékben csökken (növekvő munkanélküliséget és alacsony foglalkoztatottságot eredményezve);

2) a munka minősége romlik, és

3) a munkaerő-piacokon a kiszolgáltatottabb csoportokra (pl. nők, fiatalkorúak, fogyatékkal élő személyek) negatívabban hat.

Válság idején a szervezetek első lépésként hatékony válságkezelési eszközként csökkentik költségeiket (ILO, 2011). A világ fejlett részein a legdrágább termelési költség maga a munkaerő. Ezért a válság kezelésének első lépése az alkalmazottak számának felülvizsgálata, a munkaidő csökkentése és az új alkalmazottak felvételének átmenti felfüggesztése (Lindley, 2020). A koronavírus-járvány sok szempontból kihat a gazdaságra, különösen a kis- és középvállalkozásokra, ugyanis csökken a vállalatok számára rendelkezésére álló a munkaerő, mert a munkavállalók betegek, vagy a hozzátartozóikról (gyermekeikről, idősebb rokonokról) kell gondoskodniuk, és így inkább otthon maradnak a válság idején (Tengilimoglu et al., 2022). Továbbá a kis- és középvállalkozások bevételeinek drámai és hirtelen csökkenése súlyosan befolyásolja működőképességüket és/vagy súlyos likviditási problémákat okoz (Sokil et al., 2018). Ezen kívül a fogyasztók jövedelemhelyzete is romlik, amely a fertőzéstől való félelemmel és a fokozott bizonytalansággal csökkenti azok napi fogyasztását (ECB, 2020). Ami ugyancsak a kis- és középvállalkozások fő fogyasztói rétegeinek a visszaesését okozhatja, amely aztán később pénzügyi gondokban csúcsosodhat ki. A fenti gondolatok értelmében a kis- és középvállalkozások valószínűleg kiszolgáltatottabbak a „társadalmi távolságtartásnak", mint a multinacionális vállalatok.

További probléma, hogy a kis- és középvállalkozások pénzügyi helyzete szűkös, kevés pénzügyi tartalékuk van, ráadásul ezek a vállalatok nagyon korlátozottan férnek csak hozzá a külső pénzügyi (pl. banki hitelek) forrásokhoz is (Lentner et al., 2019). Válságok idején a bankok még kevésbé hajlandók hitelezni a kis- és középvállalkozásoknak, tovább fokozva e vállalatokra nehezedő nyomást (Belás et al., 2014).

Noha a jelen világ elsődleges problémája a közegészségügy, ezen felül mégis, az egyes országok számos intézkedést vezetnek be a koronavírus-járvány vállalkozásokra gyakorolt gazdasági hatásainak enyhítésére. Az ilyen politikák különböző formákat ölthetnek, például sok országban a központi bankok lépéseket tettek a hitelezés támogatása érdekében, megkönnyítve a monetáris feltételeket és lehetővé téve a kereskedelmi bankok számára, hogy könnyebben nyújtsanak hitelt a kis- és középvállalkozásoknak (KPMG, 2020). A hazai vállalkozásokat érintő legfontosabb első gazdaságvédelmi intézkedéseket Orbán Viktor, Magyarország miniszterelnöke 2020. március 18-án jelentette be (koronavirus.gov.hu). Ezen intézkedések közül a legfontosabb volt, hogy az egyének és a vállalkozások által felvett kölcsönök tőke és kamatfizetési kötelezettsége szünetel, továbbá munkahely megőrzési támogatásokra lehet pályázni (Túróczi et al., 2020). 2020. szeptember 11-én Orbán Viktor, Magyarország miniszterelnöke újra megerősítette a gazdaságvédelmi intézkedések fenntartását, amelynek értelmében 2021. január 1-jétől további hat hónapra terjedő időszakra vonatkoznak a korábban meghozott intézkedések. A gazdaságvédelmi intézkedések elsődleges célja ugyanis a munkahelyek megőrzése, a kormányfő többször kijelentette a hazai és nemzetközi sajtóban, hogy a munkahelyeket és a családok életszínvonalát a járvány ideje alatt is meg kell védeni.

Az eddigi tapasztalatok alapján elmondható, hogy a koronavírus a legérzékenyebb gazdasági hatását a munkahelyekre fejtette ki (Huszka et al, 2020), már az első hullám idején jelentősen nőtt a foglalkoztatottak közül munkanélkülivé és inaktívvá válók aránya (Köllő és Reizer, 2021). A fenti tények után kijelenthetjük, hogy a koronavírus hosszútávon is hatással lesz Magyarország gazdaságára és társadalmára. A kis- és középvállalkozások jelentős szerepet játszanak a magyar gazdaságban, mivel a teljes alkalmazotti létszám több mint kétharmadát a foglalkoztatják, termelékenységük pedig a nemzetgazdaság több mint felét adja. Rugalmasságuk és reagáló képességük miatt a kis- és középvállalkozások fontos potenciállal

bírnak a gazdasági növekedésben. A Magyar Központi Statisztikai Hivatal adatai szerint a koronavírus-válság előtt több mint 700 ezer kis- és középvállalkozás működött Magyarországon, amelyek közel 2 millió embert foglalkoztattak és 53%-kal járultak hozzá az ország GDP-jéhez. A kis- és középvállalkozások többsége (csaknem 80%) a szolgáltatási szférában tevékenykedett, amelyek főként kereskedelmet, turizmust, vendéglátást, járműjavítást, valamint tudományos és műszaki tevékenységet végeznek.

A tanulmány célja megvizsgálni a koronavírus hatását a magyar kis- és középvállalkozásokra, valamint bemutatni a vizsgált vállalkozások által a válság leküzdése érdekében tett intézkedéseket.

Anyag és Módszertan

A kutatás célja a Covid 19 válság gazdaságra gyakorolt hatásának felmérése volt a magyarországi kis- és középvállalkozások példáján keresztül. Jelen kutatás módszere strukturált kérdőíves felmérés. A vállalkozások besorolása a 2004. évi XXXIV. törvény alapján történt, vagyis az aktuális létszám és az éves nettó árbevétel szerint kerültek kiválasztásra. Ezenfelül egy kitétel volt a felmérésben való részvételhez, hogy az adott vállalkozásnak legalább 5 éve folyamatosan működnie kell. A válaszadók kiválasztása kényelmi mintavétellel történt a korábbi kutatások adatbázisainak felhasználásával. A kényelmi mintavétel választásának indoka, hogy e technika **-** összehasonlítva más mintavételi technikákkal **-** gyorsabban és könnyebben kivitelezhető. A kérdőívet 523 magyar kis- és középvállalkozás kapta meg online kitölthető formában 2021 áprilisa és júniusa közötti időszakban. A kérdőívben az adatok a 2020. március 4. utáni időszakra kérdeznek rá, ugyanis ekkor lett Magyarországon először hivatalosan deklarálva a válsághelyzet. 174 hazai kis- és középvállalkozástól érkezett vissza értékelhető válasz, így a kérdőív visszaküldési aránya 33,2 százalékos volt. A kérdőív felépítését tekintve, nyitott, zárt és Likert-skálás kérdéseket tartalmazott a következő témákban: a vállalkozás általános jellemzői, a foglalkoztatási jellemzők, a válság vállalkozásra gyakorolt hatása, a válság leküzdésére hozott intézkedések, a kormányzati intézkedések szerepe stb.

A szakirodalomban leírtak szerint bármely válság a kis- és középvállalkozások esetében hatványozott negatív hatással jelentkezik (Golovanov és Kulikova, 2014). A kutatás hipotézise a következő:

H_1: A koronavírus hatása és a szervezet napi működési rendjének változása között szignifikáns kapcsolat mutatható ki.

Eredmények

Az 1. ábra, a felmérésben részt vevő vállalkozások kategóriájának megoszlását mutatja be. Az ábra adatai szerint a felmérésben nagyrészt kisvállalkozás (112) vett részt. Kisvállalkozásnak számít egyébként, az a vállalkozás, amelynek az összes foglalkoztatotti létszáma 50 főnél kevesebb, és az éves nettó árbevétele vagy mérlegfőösszege legfeljebb 10 millió eurónak megfelelő forintösszeg.

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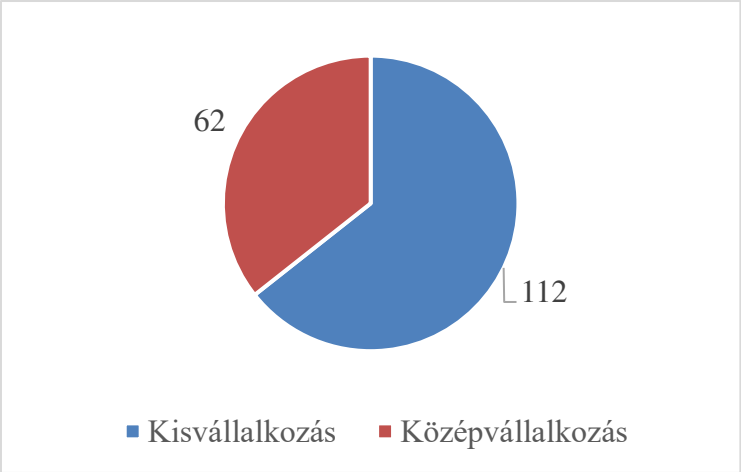
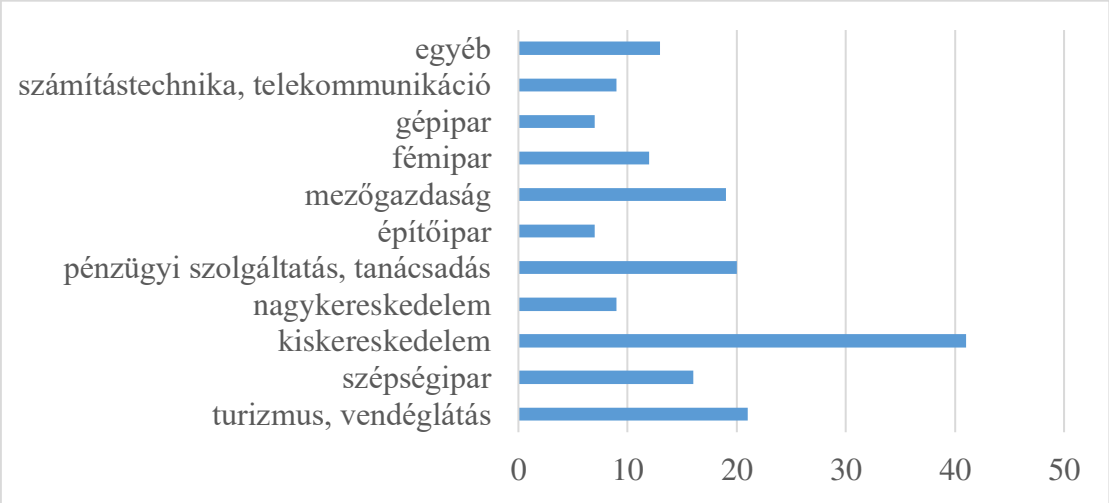


1. ábra: A felmérésben résztvevő vállalkozások kategóriája (db)
Forrás: Saját szerkesztés (2021)

A következő 2. ábrán a vizsgált vállalkozások tevékenységi köre látható.



2. ábra: A felmérésben résztvevő vállalkozások tevékenységi köre (db)
Forrás: Saját szerkesztés (2021)

A válaszadók többsége (41) a kiskereskedelemi tevékenységet végzett a felmérés idején, ezt követte a turizmus, vendéglátás (21), majd a pénzügyi szolgáltatás, tanácsadás (20). A mezőgazdaságnak (19) és a szépségiparnak (16) is viszonylag magas volt a részaránya a válaszadók között, míg a legkisebb arányban a válaszadók között az építőipar (7) és a gépipar (7) szerepeltek.

Arra az általános kérdésre, hogy a koronavírus válság milyen hatással volt a vállalkozásra nézve, a válaszadók nagyrészt (79,3%) a negatív hatást választották, ezt követte a semmi sem változott (2,4%) válasz, míg pozitív hatásról a válaszadók mindösszesen 1,8% -a számolt be. A válaszadók 16,5% -a a felmérés idején még nem tudott érdemben válaszolni a feltett kérdésre (3. ábra).

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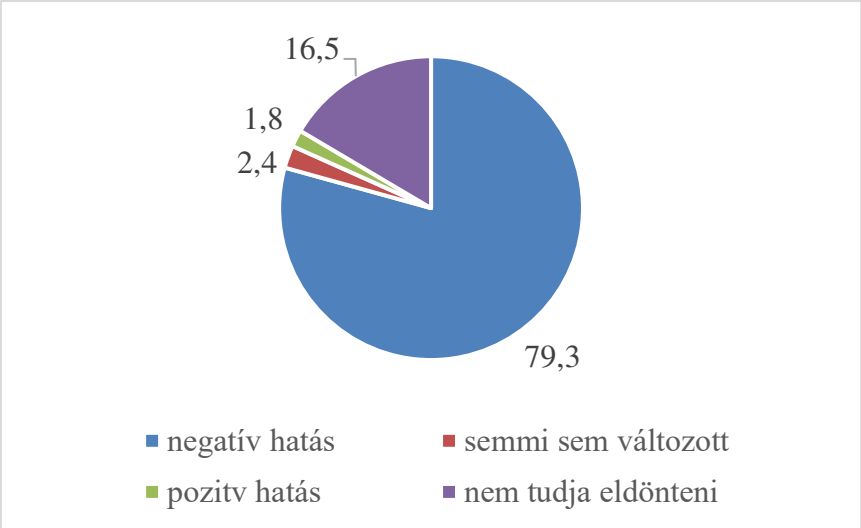

3. ábra: Milyen hatással volt a koronavírus válság az Ön vállalkozására nézve? (százalék)

Forrás: Saját szerkesztés (2021)

A fenti válaszok alapján is megállapítható, hogy a koronavírus leginkább negatív hatással volt a magyar kis- és középvállalkozásokra, megváltoztatta azok mindennapjait, és hatással volt azok gazdasági helyzetére és napi működésére, mint az, amely a következő eredményekből is jól látszik majd.

A nemzetközi szakirodalomban leírtak szerint a koronavírus válság azon kívül, hogy kihatott a vállalkozások pénzügyi helyzetére és piaci viszonyaira, a napi működésre is jelentős hatással volt (Arshed et al., 2021, Shinozaki és Rao, 2021). A napi működési rend változása elsősorban a szervezetek foglalkoztatási jellemzőit érintette (Raimo et al., 2021). Reagálva a koronavírus okozta helyzetre sok kis- és középvállalkozás esetében megváltoztak munkamódszerek, álltalánossá és elterjedtté vált a távmunka (Pulido-Martos et al., 2021).

Az 1. táblázat a koronavírus hatása és a magyar kis- és középvállalkozások napi működési rendjének változása tényezők közötti kapcsolat kereszttábla-elemzését mutatja be. A korrelációs együttható a két tényező között 0,496 (p = 0,000).

1. táblázat: Kereszttábla-elemzés eredményei

	Pearson-féle khi-négyzet (χ^2) értéke	Szignifikancia	Cramer V	Megjegyzés
A koronavírus hatása és a kis- és középvállalkozások napi működési rendjének változása	165,901	0.000	0.399	Szignifikáns közepes kapcsolat

A koronavírus hatása és a kis- és középvállalkozások napi működési rendjének változása között szignifikánsan pozitív, közepes erősségű kapcsolat mutatható ki. A kapott eredmények alapján

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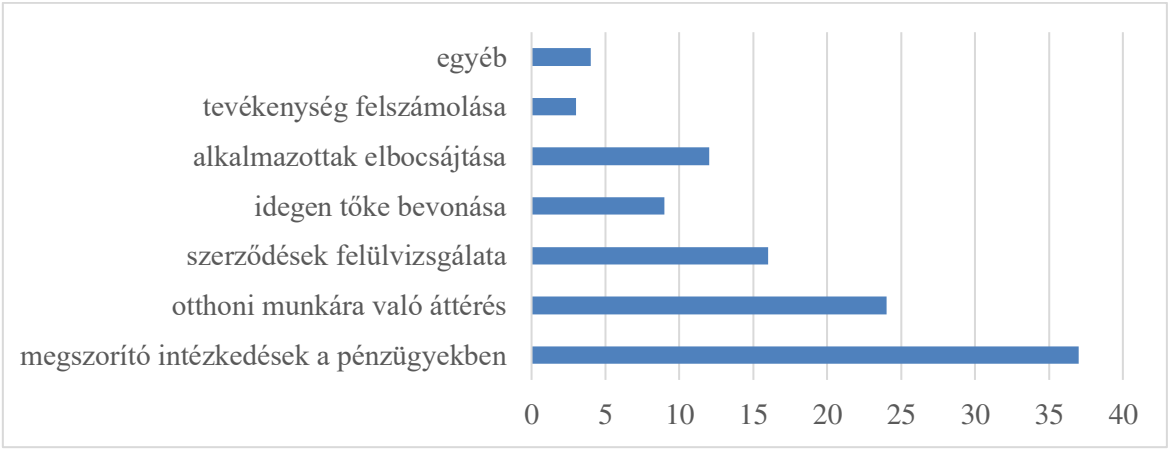
minél erősebb volt a koronavírus hatása az adott szervezetre annál jobban megváltoztatta az adott szervezet napi működési rendjét. A fent leírtak alapján H_1 hipotézist elfogadjuk.

A 4. ábra adatai szerint a koronavírus okozta negatív hatások közül első helyen szerepelt a termék/szolgáltatás iránti keresletnek a visszaesése (37%), ezt követte a pénzügyi problémáknak a megjelenése (27%), a foglalkoztatottak számának változása (12%), problémák az ellátási láncokban (12%), a nyújtott szolgáltatás/termék árának a csökkenése (8).

4. ábra: Milyen negatív hatásokat érzékelt a vállalkozása a koronavírus megjelenése után? (százalék)

Forrás: Saját szerkesztés (2021)

A következő, 5. ábra mutatja be, hogy melyek voltak a legfontosabb válságkezelési intézkedések, amelyeket a megkérdezett kis- és középvállalatoknak meg kellett tenniük, annak érdekében, hogy enyhítsék a válság okozta negatív hatásokat. Az ábra adatai szerint a megkérdezett vállalkozások mintegy 37%-a kénytelen volt pénzügyileg megszorító intézkedéseket hozni, ezt követte az otthoni munkára való átérésnek a bevezetése (24%), a partnerekkel kötött szerződéseknek a felülvizsgálata (16%), alkalmazottak elbocsájtása (12%), idegen tőke bevonása (9%). A válaszadók 3 százaléka volt kénytelen megszüntetni a tevékenységét és felszámolni a vállalkozását.



5. ábra: Milyen válságkezelési megoldásokat alkalmazott a koronavírus hatásainak enyhítésére? (százalék)

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Forrás: Saját szerkesztés (2021)

A Magyarország Kormánya által indított gazdaságvédelmi akcióterveket, - a visszaérkezett válaszok alapján - a megkérdezett vállalkozások összességében pozitívan ítélték meg. A gazdaságvédelmi akcióterv egyes pontjait 1-5-ös skálán lehetett értékelni, a kapott válaszokat a következő 2. táblázat mutatja be.

2. táblázat: Magyarország Kormányának gazdaságvédelmi akciótervének megítélése (db)
(Liker skála, ahol 1-legkevésbé hatásos akcióterv, 5-leginkább hatásos akcióterv)

	1	2	3	4	5
Foglalkoztatás költségeinek egy részének átvállalása	12	13	22	56	71
Adóterhekben könnyítés (hitelmoratórium)	9	11	16	47	91
Kötelező adminisztrációkban enyhítés	14	11	81	19	49
Képzési támogatások	11	21	27	76	39
Egyes ágazatok megsegítése	10	13	21	72	58
Hitelezési programok	19	15	34	54	52
Munkahelyvédelmi akciók	16	25	31	46	56

Forrás: Saját kutatás alapján saját szerkesztés (2021)

A táblázat adatai szerint a megkérdezett vállalkozások az adóterhek könnyítését (91), valamint a foglalkoztatás költségeinek egy részének átvállalását (71) jelölték meg, mint leginkább hatásos akcióterv. A válaszadók legnagyobb százaléka azt szeretné, ha Magyarország Kormánya az adók csökkentésével vagy az adók átmeneti felfüggesztésével segítené a kis- és középvállalkozásokat. Továbbá a foglalkoztatási jellegű támogatások is fontosak azoknak a kis- és középvállalkozásoknak, amelyek nem bocsátották el munkavállalókat. Ez egyébként összhangban áll a világ nagy szervezeteinek (OECD, ILO) azon nyilatkozatával, miszerint a kormányoknak átmenetileg át kellene vállalniuk a bérköltségek egy részét, így munkahelyeket menthetnének meg. A kormányzati akciótervek közül a legkevesebb jelölést hatásosság tekintetében a kötelező adminisztrációs terhek csökkentése (49) és a képzési támogatások (39) kapta, valószínűleg azért, mert ezek kevésbé segítenek a vizsgált kis- és középvállalkozásoknak a koronavírus válság elleni küzdelemben a többi akciótervhez képest.

A vállalkozás helyreállításának várható idejére adott válaszok alapján a megkérdezett magyar kis- és középvállalkozások a 6 hónap és 1 év közötti időszakot tartják a legvalószínűbbnek (72%), ezt követi a 3–6 hónap (21%), míg a legpozitívabb változatot (3 hónapon belül) csak a válaszadók 7 százaléka választotta. Ezek alapján arra lehet következtetni, hogy a válság utáni helyreállítást közép- és hosszú távon tervezik a válaszadók, amely nagyrészt összhangban áll azon szakértők véleményével (Dolbneva, 2020), akik 2021-et jelölték meg az üzleti élet helyreállításának lehetséges dátumaként.

Következtetések

Az elmúlt évben rengeteg hír érkezett a világ vezetőitől a koronavírus gazdaságára gyakorolt hatásairól, Kínától Amerikáig, Európától Ausztráliáig. Minden hírben a megbetegedett és elhunyt állampolgárok száma mellett ott volt az is, hogy a koronavírus jelentős csapást mért az adott nemzet gazdaságára. A jövő kulcskérdése, hogy a kormányok, hogyan tudják majd segíteni a vállalkozásokat abban, hogy ez a negatív gazdasági hatás minimális szinten maradjon.

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Jelen kutatás során is bebizonyosodott, hogy a gazdaság erősítésénél elengedhetetlen a kis- és középvállalkozásoknak a megerősítése, mivel ezek a helyi gazdaság motorjai, valamint a nemzetek legnagyobb munkaadói egyben. A saját vizsgálatok eredményei is alátámasztották azokat a híreket, amely szerint a magyar kis- és középvállalkozások jelentős része szembesült a koronavírus gazdaságra gyakorolt negatív hatásaival. A kutatás rámutatott arra, hogy összefüggés van a koronavírus és a magyar kis- és középvállalkozások napi működési rendje között. A koronavírus miatt általánosan elterjedtté vált hazánkban is az otthoni munkavégzés, ugyanis ahol lehetséges volt, ott a vizsgált vállalkozások áttértek a hagyományos munkarendről a rugalmas foglalkoztatási formákra. A távmunka hosszútávon előnyös lehet a kis- és középvállalkozásoknak, azon felül, hogy segíthet a koronavírus elleni küzdelemben az alkalmazottak motivációjához is hozzájárulhat.

A megkérdezett vállalatok szerint a kormányzati intézkedések fontosak, ezek nélkül hosszú távon nem lennének képesek fennmaradni. Így kijelenthető, hogy a kis- és középvállalkozások támogatása válsághelyzetekben különösen fontos kérdés.

A tanulmány korlátai közül kiemelendő, hogy a kutatás a magyarországi kis- és középvállalkozások szegmensére korlátozódott, valamint az idő rövidsége miatt a felmérésben résztvevők számának alacsony aránya, ezért további kutatás javasolt a témában, amelyhez jó kiindulási alapot szolgálhat jelen tanulmány.

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A COVID-19 JÁRVÁNY HATÁSAI KOMÁROM-ESZTERGOM MEGYE GAZDASÁGÁRA NÉHÁNY AUTÓIPARI VÁLLALAT 2020. ÉVI ESETTANULMÁNYOS VIZSGÁLATÁN KERESZTÜL

IMPACTS OF COVID-19 PANDEMIC ON KOMÁROM-ESZTERGOM COUNTY'S ECONOMY VIA CASE STUDY OF SEVERAL AUTOMOTIVE COMPANIES in 2020

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Összefoglalás

Komárom-Esztergom megye (KEM) egyik húzóágazata az autóipar, amely szerkezeti átalakulás előtt áll. Ennek hátterében az alternatív elektromos hajtások előtérbe kerülése, a demográfiai folyamatok miatti munkaerőhiány, valamint a „COVID-19" okozta válsághelyzet termelésre, keresletre, beruházásokra gyakorolt kedvezőtlen gazdasági hatások miatt az Ipar 4.0. folyamathoz köthető automatizációs, robotizációs, digitalizációs, mesterséges intelligencia alkalmazásával kapcsolatos globális trendek állnak.

A koronavírustól függetlenül elindult egy alkalmazkodási folyamat megyei cégek körében, újra pozícionálva termelésüket, újra gondolva a munkaerő-kapacitást, a termelési láncstruktúrát, a készletezési politikát. Ez hozzájárult ahhoz, hogy nagyobb megrázkódtatások nélkül tudták megoldani a COVID-19 járvány negatív hatásait jelentő kihívásokat. Jelen esettanulmány áttekinti néhány kiválasztott autóipari vállalat (a végtermék gyártó cég - OEM, az első körös beszállító cégek -TIER1, valamint helyi, magyar tulajdonú kis-és középvállalat) példáján keresztül, hogy milyen megoldásokkal sikerült a cégeknek úrrá lenni a járvány okozta nehézségeken. A koronavírus által előidézett gazdasági recesszió miatt (reálgazdasági és pénzpiaci bizonytalanságok) „visszalassultak a dolgok", de a rugalmasság, kreativitás – segített a cégeknek a talpon maradásban.

A kreativitást rendszerszinten azonban nem lehet az összeszerelő, bérmunka tevékenységet végző, a gyártási folyamatokat részelemeire bontó és nemzetközileg egységesített, szigorú protokollok szerint működtető multiszegmensbe bevinni. Érdemes lenne az OEM vagy a TIER1 helyett inkább a TIER2 – a kisebb méretű, második körös beszállító cégeket bevonzani a megyébe (ezekről egy részletes listát kellene készíteni). Az innováció az autóiparban nem az OEM vagy a TIER1 itteni egységeinél, hanem ezek második vagy harmadik körös beszállítóinál vannak. Ide lehetne eladni a magyar ötleteket is.

Abstract

One of the strategic economic sector in Komárom-Esztergom county (KEM) is the automotive industry, which currently faces structural transformation. The possible reasons beyond this one can be the rise of different electric drive systems, emerging labor shortages due to negative demographic trends, and the unfavourable economic impacts caused by "COVID-19" pandemic on production, investments, and supply chain. Due to these difficulties, those processes started to speed up which closely linked to Industry 4.0. global trends including application of process-related automation, robotics, digitization, artificial intelligence.

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Independently from the coronavirus, an adjustment process has begun among county firms, repositioning their production, rethinking workforce capacity, production chain structure, and inventory policy. Presumably, these contributed to address the challenges as consequences of the negative effects of the COVID-19 epidemic without major shocks. This case study provides an overview on the implemented solutions used by some selected automotive companies (original equipment manufacturer -OEM, first level supplier TIER1 and local, Hungarian-owned small and medium-sized enterprises) to overcome the difficulties caused by the epidemic. The economic recession caused by the coronavirus (due to real economic and money market uncertainties) resulted a minor "slow-down" in the county's economy but flexibility, creativity helped companies to survival.

However, creativity can not be integrated on system level into multisegment that decompose the production processes into operations, operational elements, steps and running them according to strict, internationally standardized protocols. Instead of OEM or TIER1, it would be worthwhile to attract into the county smaller, second level suppliers - the TIER2 - (a detailed list should be made about them). The innovation processes take place in the automotive industry neither at the OEM nor TIER1 units here, but in their second or third round suppliers. Hungarian original ideas can be commercialised in this corporate segment.

Kulcsszavak: *COVID-19**,** autóipar, beszállítói láncok, újrapozicionálás, rugalmasság, kreativitás*
JEL besorolás: *O14; O39*
LCC: *TS155-194; HD41; HD9720-9975*

Bevezetés

Az EU autóipari ágazata meghatározó az EU gazdaságában, a GDP-jének több mint 7%-át állítja elő. A 2020. évi 936 milliárd euró termelési érték az EU kereskedelmi mérlegében 74 milliárd eurós többletet eredményezett. Az európai feldolgozóipar 8,5%-t kitevő autóipar a végtermékgyártókkal (OEM), valamint a modularizáció és outsourcing miatt (a végtermékgyártók költséghatékonysági és lean termelésszervezési és kockázatmegosztási okokból csak a modellek tervezését és a fő modulokból történő végösszeszerelést tartják a cégen belül, a többi átadják a beszállító cégeknek) többkörös beszállítói lánccal (TIER1-TIER3) együtt 2020-ban 14,6 millió főt foglalkoztatott a kontinens 226 gyárában. Ez EU szinten a teljes foglalkoztatotti létszám 6,7 %-t jelenti. 2019-ben a kibocsátási volumen 18,5 millió autó volt, a globális termelés 20%-a (ebből 5,6 millió darabot Európán kívülre exportáltak. A COVID-19 járvány hatására a 2020 márciusa és májusa közötti időszakban a belsőégésű motoros gépkocsik előállítása 2,4 millió darabbal csökkent, ami a 2019. évi kibocsátási volumen 13%-t jelentette, közel 1,1 millió munkahelyet sodorva veszélybe. (ACEA 2020-2021); (Tury G. 2017, Tóth, Káposzta 2021).

Másfelől a különböző típusú elektromos járművek (EV) gyártásának volumene minimális mértékben változott, piaci részarányuk pedig az előrejelzések szerint növekedni fog a globális járműpiacon belül a közeljövőben. Ennek hátterében az egyre szigorodó klíma- és környezetvédelmi előírások, a gazdaság zöldítésére vonatkozó kezdeményezések, valamint az EV elterjedését ösztönző, felülről vezérelt állami támogatások állnak. (Európai Bizottság COM /2019/ 640 final); (IEA 2020; Hausler S. et al. 2020). A magyar gazdaság egyik húzóágazata az autóipar, hazánkban végtermék gyártást folytató 5 OEM működik (Audi, BMW, Mercedes, Opel, Suzuki), további három OEM (Ford, Nissan, JLR) pedig mérnöki és szervízszolgáltatásokat hozott hazánkba és 700 beszállító cégnél 2018-ban 172 500 fő dolgozott (a teljes foglalkoztatotti létszám 3,9 %-a, a teljes feldolgozóipari alkalmazotti létszám 12,9 %-a). Kibocsátási volumenét tekintve a teljes magyar feldolgozóipari export 34,8-t, a teljes

hozzáadott érték (GVA) 4,9 %-t biztosította, az előállított félmillió gépkocsi 91%-t exportálva. (HIPA 2019); (ACEA 2020).

A hazai járműgyártás a 2008–2009-es recessziót megelőző és azt követő években a gazdasági növekedés alapja volt, 2016–2018 között azonban számottevően veszített korábbi lendületéből, és ebben az időszakban már lassította, visszafogta az ipar bővülését. 2019-ben viszont az iparág kibocsátása 9,8%-kal már meghaladta az egy évvel korábbit. A növekedés sajátossága, hogy eközben az EU-ban csökkent (4,3%-kal) a járműgyártás volumene. (KSH 2020; 90). A koronavírus járvány a közép-kelet-európai régió országait sem kímélte. 2017-ben az autóipar ezen országokban átlagosan a GDP 4 %-át, az export 18%-át, vállalati szféra kutatás-fejlesztéseinek a 14%-át adta, ebben a régióban a szektor által alkalmazott 1 millió fő a térség teljes foglalkoztatotti létszámának 2,4 %-át jelentette. A térség járműgyártó cégei átlagosan 28 napra leálltak a termeléssel, a kibocsátási volumen 17-25 %-kal esett vissza a 2019. évi szinthez képest. (Klein C. et al. 2021)

Komárom-Esztergom megye (KEM) a 2264 km2-es területével az ország legkisebb területű megyéje, 133 fő/km2 (2020) népsűrűségével Pest megye után a legsűrűbben lakott térség. A megyében az egy főre jutó bruttó hazai termék (forint) tekintetében a negyedik Magyarországon. A 2018. évi sorrend: 1.) Budapest (8.070 ezer Ft/fő), 2.) Győr-Moson-Sopron 5.044 ezer Ft/fő), 3.) Fejér (4.019 ezer Ft/fő) és 4.) Komárom-Esztergom (3.880 ezer Ft/fő). KEM eredménye megközelíti az országos átlagot (3.919 ezer Ft/fő), annak 99,0%-a. 2010 és 2018 között csökkent ugyan a külföldi közvetlen tőkebefektetéssel működő vállalkozások száma országosan és a megyében is, de ennek ellenére a külföldi tőke mennyisége kétszeresére nőtt ez idő alatt a megyében (2010-ben 595 md. Ft; 2018-ban 1209 md. Ft.). (KEM TF 2030).

A KEM gazdasági versenyképességének alapját kedvező ipartelepítési tényezői következményeként a külföldi működőtőke által 1990-2020 között sikeresen megvalósított iparosítás jelenti (külső, exogén tényezők), hozzájárulva az országos átlagnál kedvezőbb foglalkoztatottsági mutatókhoz, megteremtve a belső, endogénfejlődésen alapuló továbblépés lehetőségét, annak ellenére, hogy a nemzetközi nagyvállalatok gyártó és logisztikai egységeinek a helyi gazdaságba való integrálódása a mai napig nem történt meg maradéktalanul. A jövőre nézve mindenképpen biztató viszont, hogy munkahelyeket teremtettek, korszerű technológiákat és munkakultúrát hoztak magukkal, elindítva egyfajta társadalmi szemléletformálást. A fenntartható endogénfejlődési pályára lépéshez azonban szükséges lesz a megye gazdasági szereplői közötti alulról szerveződő, tudásintenzív hálózatos együttműködések kialakulása, a klaszteresedés és a vállalkozói szemlélet erősítése (Lux G. 2017); (Fekete D. 2017; Káposzta, Nagy 2015).

KEM egyik húzóágazata az autóipar. A 2014-2020 időszakban a megye egyetlen, államilag elismert magán felsőoktatási intézményének, az innovatív vállalkozói és tudásközpontként működő Edutus Egyetemnek a jogelődje az Edutus Főiskola Tatabánya Megye Jogú Várossal (MJV), Esztergom városával, valamint a Suzuki Zrt.-vel közös pályázata alapján az 1206/2014 (IV.1) Korm. határozat Tatabánya és Esztergom térségét kiemelt járműipari központtá nyilvánította. Ez hozzájárulhat KEM hazai és nemzetközi versenyképességének erősítéséhez, összhangban az európai járműipari központok gazdasági kormányzási modelljeivel (Fekete D. 2017; 130 oldal. A megye autóipari globális szerkezeti átalakulás előtt áll. Ennek okai: az elektromos hajtások előtérbe kerülése, valamint a demográfiai trendek miatti munkaerőhiány, valamint a „COVID-19" okozta válsághelyzet termelésre, keresletre, beruházásokra gyakorolt kedvezőtlen gazdasági hatásai miatt felerősödnek az elmúlt években elindult globális trendek, amelyek az Ipar 4.0. folyamathoz köthetők, mint az automatizáció, robotizáció, digitalizáció, mesterséges intelligencia. (Molnár E. et al. 2020); (KPMG 2020); (Losonczi et. al. 2019)

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Ezen tényezők együttesen rákényszerítik a gazdasági szereplőket, hogy újragondolják az üzleti tevékenységeiket és modelljüket, a munkaerő szükségletüket, a termelési láncstruktúrát és a készletezési politikát. Még nem lehet pontosan felmérni, hogy a beszállítókat és a saját termékekkel saját piacokra lépő cégeket mennyire érintik az átállással járó változások. Másfelől a megváltozott munkaerőpiaci igények új típusú képességeket, készségeket igényelnek a munkavállalóktól, illetve a cégek munkaerő állományának oktatása, fejlesztése és produktívabbá tétele elengedhetetlen. (ACEA 2020); (Klein C. et al. 2021l); (Roland B. 2020); (Pató, B. Sz.G. és Herczeg, M. 2020)

Anyag és Módszertan

A nemzetközi, valamint az országos és a megyei szintű áttekintés szekunder kutatási módszerekkel történt (meglévő releváns dokumentumok: szakpolitikai stratégiák, publikációk, statisztikai adatbázisok, online weboldalak átnézése, majd az így összegyűjtött adatok rendszerezése, szelektálása, elemzése).

A primer adatgyűjtés Komárom-Esztergom megyébe betelepült, néhány kiválasztott, járműipari nemzetközi nagyvállalat (OEM és TIER1) helyi gyáregysége, valamint magyar tulajdonú kis-és középvállalat egyéni mélyinterjús és fókuszcsoportos interjús esettanulmányokon alapult. Az esettanulmány, mint kutatási módszer alkalmas arra, hogy a több szempont szerint összegyűjtött adatokat feldolgozva elemezzük a felvetett problémák szemszögéből a múlt és jelen eseményeit, folyamatait, feltárva ezek dinamikáját és összefüggéseit, amelyek alapján következtetéseket fogalmazhatunk meg a jövőre nézve, illetve különböző elméleteket tesztelhetünk a segítségével. (Eisenhardt, K.M. 1989).

Mivel az esettanulmány során az aktuális problémafelvetéshez, előzetes releváns felvetések megfogalmazásához, a megfelelő következtetések levonásához fontosak a minta kiválasztásának szempontjai, ezért a kutatómunka során törekedni kellett arra, hogy a mintában szereplő járműiparhoz köthető cégek teljes keretmetszete legyen reprezentálva, azaz legyen köztük nemzetközi nagyvállalat végtermék gyártó egysége (OEM), első körös beszállítók (TIER1), valamint helyi kis-és középvállalat is.

Jelen esettanulmány részét képezi a „Kis-és középvállalati versenyképesség vizsgálata a regionális adottságok kiaknázása szemszögéből. Komárom-Esztergom megyei esettanulmány" című PhD kutatási témának, amelynek célja, hogy feltárja a KEM ipari parkjaiba betelepült cégeknek a régióra gyakorolt gazdaságfejlesztési, társadalmi hatásait az 1990-2020 közötti időszakban. Emellett elemezi a helyi, hazai tulajdonú kis-és középvállalatok kihívásait, kitörési és tovább lépési lehetőségeit, valamint hogyan tudná minél hatékonyabban betölteni a KEM egyetlen felsőoktatási intézménye az innovatív, vállalkozói és tudásközpontként működő Edutus Egyetem a térségi szerepét, elősegítve a helyi gazdaság szereplői közötti hálózatos együttműködéseket.

Az elemzésekből levont főbb következtetések a szerzők saját szakmai véleményét tükrözik.

Eredmények

Komárom-Esztergom megyében 127 ezerről 141 ezerre nőtt a foglalkoztatottak száma 2010 és 2019 második negyedéve között. A növekedés szinte teljes egészében a versenyszektor munkahelyteremtésének tudható be, miközben a közfoglalkoztatásban dolgozók száma csökkent. A munkanélküliek száma 2010 és 2019 második negyedéve között 11 ezerről 2,6 ezerre csökkent. A munkanélküliségi ráta 8,6 százalékról 1,6 százalékra mérséklődött. A megye munkaerő-tartaléka a közfoglalkoztatottakkal együtt mintegy hatezerre volt tehető.

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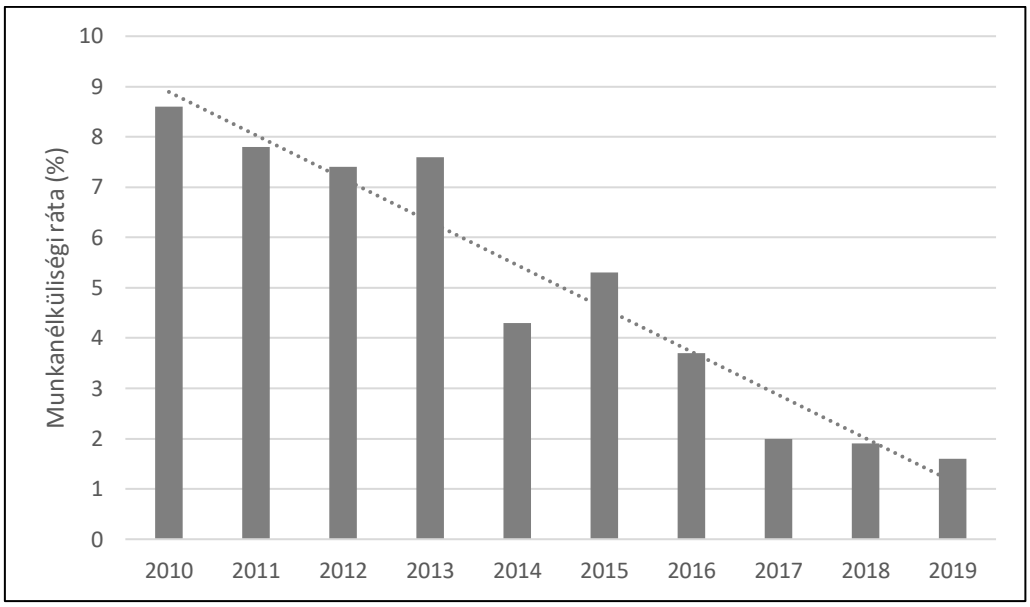
A KSH munkaerő-felmérése alapján 2019 IV. negyedévében a foglalkoztatottak és a munkanélküliek száma egyaránt csökkent az előző év azonos időszakához viszonyítva. (Országosan bővült a foglalkoztatás.) A foglalkoztatási arány kissé elmaradt az országos átlagtól, a munkanélküliségi ráta viszont itt volt a legalacsonyabb a megyék közül (2019. IV. negyedévben 1,1 %, 2019. évi szinten pedig 1,6 %), ahogyan ez az 1. ábrán látható. Komárom városában a megyei helyzethez hasonlóan alakultak a települési foglalkoztatottsági adatok.



1. ábra: Munkanélküliségi adatok az aktív népesség körében Komárom-Esztergom megyében (2010-2019)

Forrás: KSH STADAT 6.2.1.11. Munkanélküliségi ráta megyénként alapján saját szerkesztés (2020)

Ezt a kedvező folyamatot megakasztotta a járvány, a helyi gazdasági recesszió miatt megugrott átmenetileg a munkanélküliségi ráta, különösen a helyi szolgáltató szektorban. (A munkanélküliség a 2019.évi 2600 főről 2020-ban 5934 főre, azaz a korábbinak valamivel több, mint kétszeresére növekedett, de 2021-ben megindult a korábbi állapotnak megfelelő visszarendeződés. A 2. ábra a KEM regisztrált álláskeresők arányát mutatja földrajzi bontásban:

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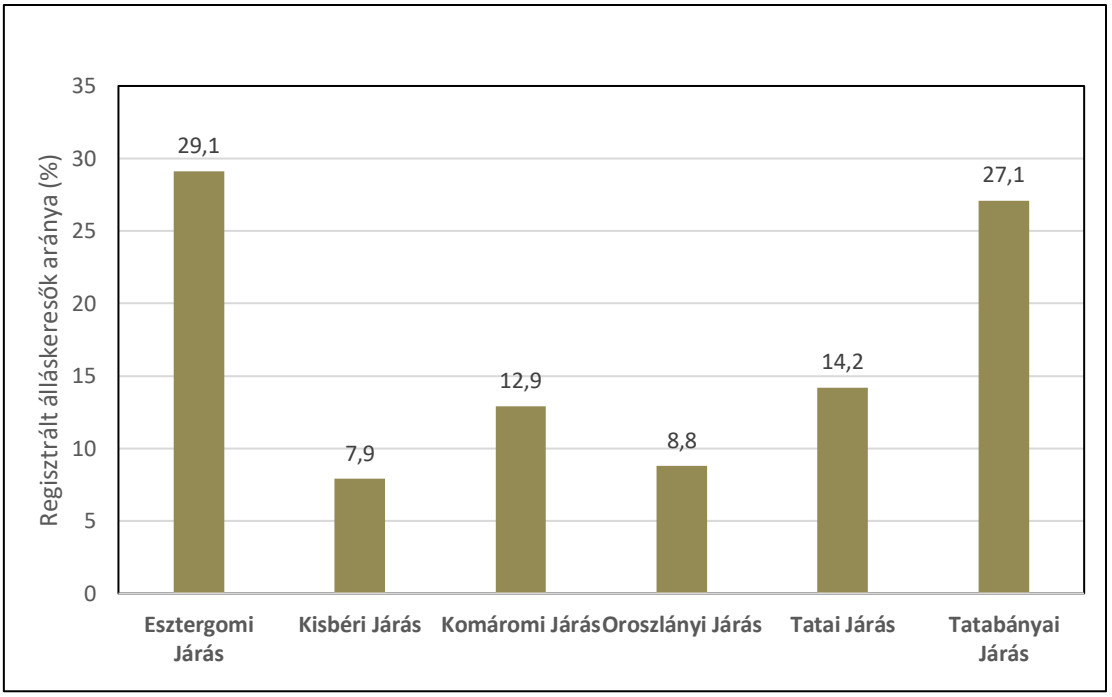

2. ábra: KEM regisztrált álláskeresők aránya földrajzi bontásban (2021. január)

Forrás: KEM Kormányhivatal adatbázis (2021) alapján saját szerkesztés (5934 fő=100 %)

KEM autóipari céges esettanulmányok

1) A Magyar Suzuki Zrt. (Esztergom) - OEM

A cég beszállítóinak 99 %-a jól vészelte át a járványt. A járvány miatti leállás idején a Magyar Suzuki Zrt-nek 600-700 fő kölcsönzött munkaerőtől kellett megválnia. A járvány idején a cég 2020. március 16-tól leállt másfél hónapra, majd 2020. április végétől egy műszakban, majd 2020. július 13-tól ismét két műszakban termelt. A termelés egy műszakkal így kölcsönzött munkaerő (akiknek csaknem 100%-a fizikai dolgozó) nélkül 2300 fővel indult újra, míg a második műszak újraindításához 400 fő új dolgozót vettek fel (előnyt jelentett a korábbi Suzuki munkaerőkölcsönzéses tapasztalat).

A nyári karbantartási leállás nem maradt el, de a COVID-19 járvány miatti beutazási korlátozások nehezítették a helyzetet: mind a be-, mind a kiutazáskor 2-2 hét karantén szükségessége is felmerülhet, ha a beutazást megelőző 5 napban 2 negatív koronavírus teszt eredményt nem tudnak bemutatni a karbantartás miatt Magyarországra utazni készülő japán mérnökök. Az éves tervezett karbantartást nem tudták előbbre hozni a COVID-19 miatti tavaszi leállás idejére, mivel a gyártósorok nagy gépeinek megvan a szigorú karbantartási ütemezésük, így 2020. augusztus 6-a és augusztus 24-e között került sor a szokásos karbantartási szünetre.

A Magyar Suzuki mérnökcsapata a 6 hetes állásidőt kihasználva végignézte a teljes gyártósort és olyan fejlesztésekre tett javaslatot, amely kevesebb élőmunkaigényt jelent a jövőben, elsősorban az összeszerelő üzemben. Ennek eredményeként a Magyar Suzuki Zrt. a sikeres, a közép- és nagyvállalatok számára meghirdetett Versenyképesség-növelő támogatási program (azonosító: VNT-2020-1) pályázata alapján 800 ezer euró állami támogatást kapott. Emellett a cég igénybe vette a rövidített munkaidős és kutatás-fejlesztési (KFI)-bértámogatást is, ugyanakkor az új munkahely-teremtő támogatás igénybevételére nem került sor.

2) Bridgestone Tatabánya Termelő Kft. – TIER1

2.1. Beszerzési terület:

A terület feladata kettős: Késztermékek értékesítése mellett a gumiabroncsgyártáshoz szükséges nyersanyagok és pótalkatrészek beszerzése. A Bridgestone Tatabánya Kft. késztermékeit több csatornán keresztül értékesíti (az autóipari „brand"-eknek való közvetlen beszállítás mellett a gumiabroncs nagykereskedőknek is értékesít (kereskedelmi szegmens), valamint az autóipari OEM beszállítói arány egyelőre 15-20 % (az autógyárak leállása kevésbe érintette őket), így az értékesítésben csupán kisebb mértékű visszaesés történt a járvány előtti időszak adataihoz képest. Az áprilisi-májusi részleges gyárleállások időbeli elcsúszásokkal ugyan, de mindhárom technológiát (12K hagyományos, 8K BIRD és EXAMATION) egyaránt érintették. 2020 júniusa óta a termelés teljes gyártókapacitással folytatódott. Tekintettel a rugalmas munkaidőkeretre, saját munkavállalókat nem kellett elküldeni.

A gyártáshoz szükséges alapanyagok beszerzése kisebb zökkenőkkel ugyan, de fennakadás nélkül folyamatosan tudott megvalósulni. A gumiabroncs keverékekhez szükséges alap, adalék és segédanyagokból készleteket halmoztak fel, mivel a cég nagy készletekkel, valamint nem just in time (JIT) rendszerben működik. (Késztermék beépülési darabjegyzék nem túl sok, inkább volumenben nagy). A nyersanyag beszállító cégek – bár a COVID-19 járvány szempontjából magas kitettségű területeken működött (Nyugat-Európa, Észak-Olaszország), de ezek folyamatosan tudtak gyártani. A szállítás vízi, illetve közúton történt Európán belül, határidő csúszások csak a határok lezárása miatt keletkeztek.

A pótalkatrészek esetében viszont voltak ellátási zavarok, fennakadások. Sok Délkelet-Ázsiai beszállítójuk van ezen a területen és a pótalkatrészek szállítása alapvetően légi úton történik, amit a repülőjáratok törlése „ellehetetlenített". Az alábbi 1. táblázat összegezi a jelentősebb pótalkatrész beszállítókat (zömmel japán tulajdonú cégek).

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1. táblázat: A Bridgestone Tatabánya Termelő Kft. pótalkatrész beszállítói

Cégnév	Rövid leírás	Üzleti profil
SMC Corporation (1959-ben alapítva, Japán, Tokió)	Kezdetben szinterezett fém szűrőket gyártott. Az SMC globális piaci részesedése 35%, Japánban 65%. Pneumatikában globális piacvezető (a 36 termelési és 5 műszaki központtal rendelkező cég 83 országban értékesít).	12000 termékcsoport: szűréstechnika, szeleptechnika, végrehajtó elemek, vákuumtechnika, szenzortechnika, az elektromos vezérlés- és hajtástechnika területén.
Schneider Electric (3 globális központtal: Franciaország, USA, Hongkong rendelkezik)	Profilja energetikai és valós idejű automatizálási digitális megoldások, amelyek a folyamatokat és az energiát biztonságossá, hatékonnyá, fenntarthatóvá teszik.	A Bridgestone számára a folyamatirányítás, PLC, szervohajtás és robotika, tápegységek, transzformátorok, tápegységek, energiamenedzsment/felügyelet, ipari automatizálási szoftverek területén felkínált termékek és megoldások relevánsak
Omron Group 1933-ban Kiotóban, Japánban alapítva	A cég, a világ egyik piacvezető cégcsoportja, 120 országban van jelen.	Ipari automatizáció, és elektronika
Keyence Corporation A japán cég a Forbes 2018.évi listáján a világ 100 legjobb vállalat egyike.	Az Osakai székhelyű KEYENCE 1974 óta stabil növekedést tanúsít, világelső az ipari automatizálási, ellenőrzési eszközök fejlesztése, gyártása terén.	Termékeik: kódolvasók, lézeres jelölők, gépi kamerarendszerek, mérőrendszerek, mikroszkópok, szenzorok és antisztatikus eszközök.
Mitsubishi Electric Corporation (1921-ben alakult, tokiói székhelyű japán cég)	Több mint 120 országban vannak gyárai, kutatási és fejlesztési központjai és kereskedelmi egységei.	Programozható logikai vezérlők, CNC vezérlők, vezérlési megoldások, ipari robotok és szikraforgácsoló rendszerek

Forrás: Saját kutatás alapján saját szerkesztés (2020)

2.2. Műszaki mérnökség (beruházási terület)

A járvány következtében több beruházási projektet 2021. évre kellett átütemezni. A karbantartási terület előtérbe került, a „kényszerű állásidőket" kihasználva preventív céllal elvégzésre kerültek a normál működési körülmények között nehezen beütemezhető karbantartások – ezek egyrészt plusz költségekkel jártak, másfelől viszont a gépek,

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berendezések üzembiztonsága megnövekedett. Az előrehozott munkák miatt a nyári leállások is zökkenőmentesebbek voltak. A járvány időszakában a munkavállalók fegyelmezettsége (maszkviselés, hőkamerás mérések, többirányú kommunikáció) segítettek a nehézségek leküzdésében. A rendszeres fertőtlenítések elvégzésére külön csapat állt fel.

2.3. Fejlesztések

A COVID-19 újabb hullámainak való kitettség megszüntetése érdekében elindult egy, több meglévő beszállító más beszállítókkal történő kiváltására irányuló hosszú távú folyamat. Ebben a megmunkálás, összeszerelés, pótalkatrészek gyártása területén lehetőségük lenne a helyi KKV-k számára is. (Szolgáltatások (fejlesztések, CE minősítésű új gépek vásárlásánál a helyi beépítési követelményeinek megfeleltetés, illetve a Bridgestone Tatabánya Kft. „házon belül" határoz meg feladatokat, amire várják a helyi cégek pályázatait, ajánlatait: adott alkatrészek kiváltására (3D modellezés, tesztelés, gyártás).

3. Borg Warner Oroszlány Kft. (Oroszlány) – TIER 1.

Alapvetően három tényező határozza meg, hogy egy autóipari beszállító meddig tud folyamatosan termelni. Az első a megrendelések mennyisége, a másik az alapanyag, a harmadik pedig, hogy el tudják-e szállítani a megfelelő időben a partnereiknek a terméket. A COVID-19 járványnak az autóiparra gyakorolt hatásai a BorgWarner Oroszlány Kft-t sem kerülték el, amely 2020. április 6-ától, két hétre szabadságra küldte a teljes állományt.

A mérnöki állomány „home office"-ban dolgozott 2020. március közepe és 2020. június eleje közötti időszakban. Emellett a gyártásközeli mérnökök egy hónapig 4 napos munkarendben dolgoztak, sor került a kölcsönzött munkaerő ideiglenes elküldése (TRIGO cég kölcsönözte az elsősorban selejtválogatásra használt munkaerőt), a fizetéseket ideiglenesen 10 %-kal csökkentették és munkahelyvédelmi támogatást is igénybe vett a cég pályázat révén.

A gyártósoroknál teljes leállás nem volt, de a termelés mindenhol csökkentett kapacitásokkal ment. Előrehozott gyártás miatt feltöltötték a raktári készleteket. A karbantartás előbbre hozására nem került sor, erre nyáron egy hetet biztosítottak. Beszállítói láncokban voltak kisebb-nagyobb fennakadások.

A 2. táblázat ismerteti a továbblépés érdekében szükséges vállalati célokat.

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2. táblázat: A BorgWarner Oroszlány Kft. céljai

Cél megnevezése	Rövid leírás
Delphi Technologies és a BorgWarner egybeolvadása (2020-ban megvalósult)	a turbó feltöltő elérte az S-görbe felső szakaszát, a jövő – (Combustion-Hybrid and Electric Propulsion) C-H-E hajtásláncok terén megőrizni a versenyképességet – elektromos egységek gyártása
eTurbó gyártás (turbófeltöltő és generátor kombinálása)	ez egyelőre kérdéses, mivel az elektromos járművek elterjedését a különböző országok állami támogatásai is segítik.
Campus Network elnevezésű megoldás bevezetése	A gyártóegységeknek Magyarországon szigetszerűen elérhető 5G-s hálózatok előszobájának tekinthető, 4G (azaz LTE) alapú ipari hálózatot épített ki a régióban elsőként a Magyar Telekom a BorgWarner Oroszlány Kft. telephelyén 2019-ben. A cég a hagyományos telekommunikáción túl elsősorban a gyártásvezérlés (PLC adatkapcsolat), telephelyen belüli logisztikát segítő szenzorok, eszközök hálózatba kapcsolásához használja a hálózatot (automatizált anyagmozgatás, Barcode olvasás). A nyilvános mobilhálózat és a kialakítás alatt lévő, 4G/LTE alapú helyi hálózat kombinációja lehetőséget nyújt a két cégnek az IoT megoldások ipari környezetben való tesztelésére, ami fontos az 5G bevezetését követő igényeknek való megfelelésben.
Hibamentes gyártás megvalósítása	0 ppm
Környezetvédelmi, egészségügyi és biztonsági (EHS) szempontok előtérbe helyezése	Az EHS mutatók (munkaidő kieséssel járó balesetek aránya, kieső munkaórák száma, hatósági bírságok stb.) jelentősen befolyásolják egy vállalat megítélését, hozzájárulnak az ügyfél elégedettséghez. Az EHS összetett minden szakterület különböző gondolkodást, tudás igényel.

Forrás: Saját kutatás alapján saját szerkesztés (2020)

4. SK Battery Hungary Kft. (Komárom) – Elektromos járműgyártó (EV) TIER1

A cég működésére, üzleti folyamataira nem gyakorolt jelentős hatást a járvány első hulláma 2020-ban. Ennek valószínűsíthető oka, hogy a komáromi gyár 2020 januárjában indította el a sorozatgyártást, egy előre meghatározott gyártási ütemterv és megrendelés állomány alapján. Az éppen felfutóban lévő gyártókapacitás még nem érte el a maximumát 2020. március 11-ig, amikor Magyarországon kihirdetésre került a járványügyi vészhelyzet. A járvány ellenére a termelés bővülése és az új munkatársak felvétele változatlan ütemben folyt. (Egy már teljes kapacitáson működő üzemnél már más volt a COVID-19 hatása, a járvány második hullámában a többi céghez hasonlóan sor került a csökkentett kapacitásokkal való termelésre és a

kölcsönzött munkaerőállomány ideiglenes elküldésére). A cég 2020 végén átesett a járműipari beszállítók számára kötelező IATF 16949 auditon.

Az SK Innovation TIER1 és TIER 2. szinten dél-koreai beszállítókkal működik együtt, azaz törekszik a külföldi beszállítóktól való függőséget és a globalizált, sokszereplős, hosszú és sérülékeny beszállítói láncok hatásait kiküszöbölni. Ezt elsőrendű stratégiai célnak tekinti. Az SK Innovation 100 % tulajdonában lévő SK Battery Hungary (BH) Lítium-ion akkumulátor (LIB) gyártósorainak ellátására az LIB négy fő komponensét biztosító cégek zöme azonos kultúra és értékrend mentén működő dél-koreai csebol (globális méretű, több üzletágban érdekelt családi vállalkozás). Ezek szintén KEM telephelyet választottak maguknak, követve Magyarországra az SK Innovation-t: Doosan (Környe), LotteAluminium (Tatabánya), Soulbrain (Tatabánya) lerövidítve a globális beszállítói láncokat.

5. B&O Engineering Kft. Komárom – nem beszállító (fejlesztő, gyártó és disztributor) helyi középvállalat

A járvány mellett még az is nehezíti a helyzetet, hogy a járműipar radikális szerkezeti átalakulás előtt áll az elektromos hajtás előtérbe kerülésének köszönhetően. Egyelőre nem tudni pontosan, hogy a beszállítókat mennyire érinti majd az átállással járó változás, de célgépgyártóként, a Rinco ultrahang technológiai termékek, az Universal Robots magyarországi forgalmazójaként, illetve a Fanuc Hungary Kft kiemelt robotikai rendszerintegrátoraként profitálni fognak a folyamatból hosszabb távon. Tapasztalataik szerint a vevőik visszamondtak különböző korábbi megbízásokat, projekteket, de az ipari automatizációra a jövőben is lesz igény – nemcsak egy lábon állnak (azaz nem kizárólag járműiparhoz köthetők az üzleti kapcsolataik). Emellett a vasúti szektorba is megpróbálnak belépni új üzletágként, valamint a kollaboratív robotok, autonóm robotok, ipari robotok jelentette növekedési lehetőségek megmaradnak a jövőben is.

Következtetések

A fenntartható növekedés, fejlődés érdekében minden térségnek – ez alól Komárom-Esztergomm megye sem kivétel – törekednie kell gazdaságának fejlesztésére. Ez magában foglalja a több lábon állás érdekében több szektor húzóágazattá tételét, a diverzifikálást, másfelől a nemzetközi nagyvállalatok térségbe történő bevonzása mellett, a helyi kis-és középvállalatok tudatos fejlesztését, minél magasabb hozzáadott értéktartalommal bíró tevékenységek megvalósítását, az értéklánc meghosszabbítását, azaz a gyártás mellett a fejlesztések, marketing, disztribúció és testre szabott vevői szolgáltatások is legyenek jelen a térségben. Egyre több nagyvállalatnál döntenek úgy, hogy visszahozzák Európába a termelést (csökkentve például a kínai beszállítók szerepét), és ez nem a járvánnyal kezdődött. A koronavírus megjelenése csupán felerősítette ezt a folyamatot, ami kihasználható lehetőséget jelenthet a KEM gazdasága számára is. A járvány szembetűnővé tette a kontinenseken átnyúló, koncentrált termelési láncok problémáit. A hatékony költséggazdálkodásra, méretgazdaságosságra való törekvés mellett számos terméknek van kevés számú, vagy egyetlen termelője, sokszor egy távoli országban. A just-in-time rendszerek egyre szélesebb körben való bevezetése, a szigorú készletgazdálkodás pedig még növelte is globális beszállítói hálózatoknak való kitettséget. A kialakuló hiány pedig hirtelen kezelendő kihívássá vált. A jövőben nem akar majd egyetlen ország sem arra kényszerülni, hogy másoktól kérjen segítséget a kialakuló hiányok kezelésének érdekében, illetve vállalati szinten is fontos lesz ezen kockázatok kezelése.

A méretgazdaságosság kérdése nem lesz megkerülhető, nem gyárthat minden ország mindent. Valószínűsíthető, hogy a nagy gazdasági régiók - az USA, Európa és Kína a hozzájuk kapcsolódó "szatellit" területekkel a mostaninál sokkal önállóbb termelési centrumokká

alakulnak majd bizonyos termékek esetében, a nagy régiók közötti kereskedelem pedig a korábbinál kisebb mértékű lesz. Ezt a folyamatot a különböző állami támogatások is ösztönözni fogják. A koronavírustól függetlenül elindult egy alkalmazkodási folyamat megyei cégek körében, újra pozícionálva termelésüket, újra gondolva a munkaerő-kapacitást, a termelési láncstruktúrát, a készletezési politikát. Ez hozzájárult ahhoz, hogy nagyobb megrázkódtatások nélkül tudták megoldani a COVID-19 járvány negatív hatásait jelentő kihívásokat.

A koronavírus által előidézett gazdasági recesszió miatt (reálgazdasági és pénzpiaci bizonytalanságok) „visszalassultak a dolgok", de a rugalmasság, kreativitás – segített a cégeknek a talpon maradásban. A kreativitást rendszerszinten azonban nem lehet az összeszerelő, bérmunka tevékenységet végző, a gyártási folyamatokat részelemeire bontó és egységesített protokollok szerint működtető multiszegmensbe bevinni. Érdemes lenne az OEM vagy a TIER1 helyett inkább a TIER2 – a kisebb méretű, második körös beszállító cégeket bevonzani a megyébe (ezekről egy részletes listát kellene készíteni). Az innováció az autóiparban nem az OEM vagy a TIER1 itteni egységeinél, hanem ezek második vagy harmadik körös beszállítóinál vannak. Ide lehetne eladni a magyar ötleteket is.

Köszönetnyilvánítás

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