EUROINTEGRATION TENDENCIES IN IMPLEMENTATION OF 'INDUSTRY 4.0' IN EUROPEAN COMPANIES

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Received: 1. 10. 2019
Accepted: 15. 10. 2020
DOI: https://doi.org/10.30924/mjcmi.25.2.14

Review
UDC 005.591.6:331.5](4)

Abstract

The current level of technological development made it possible to predict upcoming changes, the expected commercial availability of breakthrough technologies and the impact they will have on business organization, manufacturing and labor market. The fourth industrial revolution, driven by automation, digital technology and Big Data, is expected to start in a few years. The number one external risk currently perceived by companies is digital disruption. The aim of the paper is to examine the current trends in terms of technological development and workforce transition for the preparedness of companies and labor market for the upcoming changes. The paper reviews the results of research, indicating the dominant orientation of companies, with regards to the expected digital disruption, trends shaping the fourth industrial revolution and strategies for preparation for the upcoming changes.

Keywords: *automation, labor market, digital disruption, fourth industrial revolution*

1. INTRODUCTION

The term "Industry 4.0" first appeared in 2011, in a document, prepared by the German government, concerning the strategic initiative for the industrial development "High-Tech Strategy 2020 for Germany" (Pereira, Romero, 2017). Kolberg & Zühlke (2015) specify it as a network approach that applies the principles of Cyber Physical Systems and Internet technologies. With its main driving elements - advanced digitalization, cloud technologies, and automation – it is expected to lead to significant increase in production efficiency through real time communication (Lasi, et al., 2014; Kagermann, 2015). Grbavac et al. (2003) state that the connection between science, technology and knowledge generates a creative environment that brings about rapid changes in technology and creates opportunities for innovations which result in improved products. The shifts in production and emerging markets will lead to increased

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competitiveness, which will require the companies to be more customer-oriented and to focus on customization and adoption of new business models via automation (Castelo-Branco, et al, 2019). Accoding to Pfeifer (2017, 9), "*new technologies affect production, distribution and consumer behavior, and have been perceived as both a threat and an opportunity. They open new markets, enhance the speed of communication and delivery, but they also enable non-professionals (amateurs) to produce and create almost 'professional-style' services, namely, advertising campaigns, and clutter the competitive space with unprofessional services*". As The Future of Jobs Report (Centre for the New Economy and Society, 2018, v) from The World Economic Forum states, "*The emerging contours of the new world of work in the Fourth Industrial Revolution are rapidly becoming a lived reality for millions of workers and companies around the world*." According to Buble (2015, 4), the major changes which will occur in the 21st century "*are already manifested in the emergence of new economy, new employees, new values, new businesses and new business models.*" The Future of Jobs Report (Centre for the New Economy and Society, 2018) expects technological advancement to reduce the number of workers required for certain tasks, but also to increase demand for new roles. Accordingly, the demand for the new skills necessary to perform in the new roles will increase, although they may not yet be available to the required extent. While the current labor market lacks the new skills, a European Commission study (Cedefop, 2016) also expects an increased shortage of working-age population threatening the economic growth. Implementation of new technologies is, therefore, not only preferred by companies as the major cost management tool, but also necessary, as a solution to the shortage of working-age population.

2. AIMS AND METHODOLOGY

In April 2016, the international consulting company Deloitte (Aguilar, 2016) published the results of their biennial cost survey on cost improvement practices and trends, with the participation of 210 of the so-called Fortune 1000 companies, i.e. the largest US companies in terms of revenues. A new type of company was identified, in addition to the three traditional categories of companies, i.e. (1) distressed, (2) positioned for growth and (3) growing steadily. The new category was named "thriving in uncertainty" and it included the companies that pursued two seemingly contradictory goals – aggressive growth and aggressive cost improvements. The companies were preparing for the expected recession, while simultaneously planning for business expansion. Another important finding regards the perception of digital disruption. While, in earlier research, the uncertainty related to digital disruption was grouped with other competitive risks, it gained a stronger importance in the 2016 survey and emerged as the third most frequently cited external risk, with 15% of companies perceiving it. A similar survey, conducted by Deloitte in nine EU countries (Great Britain, France, Germany, Spain, Italy, Belgium, Netherlands, Poland and Norway), in December 2016, confirmed the existence of the new category of companies, as well as the new trend related to increasing uncertainty related to digital disruption (Aguilar, 2016).

Replication of this study (Aguilar, Girzadas, 2019) indicated a strong shift in the focus of companies from save-to-grow towards save-to-transform orientation. This significant shift is the result of the substantial increase of the fear of expected digital disruption, with 61% of companies recognizing it as the top external risk, and

of widespread implementation of digital technologies and innovations. The surveyed companies recognize and prioritize the importance of transformation of business strategies. The key role in cost saving strategies is now held by automation and digital technologies. The primary focus of companies is now on developing technology capabilities, mainly cognitive and artificial intelligence, ERP infrastructure and automation. Thus, the companies are saving to invest in digital transformation, rather than to expand their business and streamline their processes. Among the new technologies, cognitive/AI, automation and cloud technology are in the primary focus of the surveyed companies (Table 1).

Table 1. Planned implementation of digital technologies within the next 24 months

Cognitive / AI	Automation	Cloud
63%	62%	49%

Source: Aguilar, Girzadas (2019)

The top two stated reasons for implementing the mentioned digital technologies are:

- tightening data security and business control;
- reducing costs and increasing productivity.

The importance of implementing digital technologies is further emphasized by their success in meeting the expectations of companies in which they have already been implemented (Table 2).

Table 2. Success rate of digital technologies in meeting expectations

Cognitive / AI	Automation	Cloud
83%	76%	85%

Source: Aguilar, Girzadas (2019)

As the surveys conducted by Deloitte pointed out, the struggle of companies during the implementation phase of their initiatives persists. Technological improvements, enabling data availability and supporting the decision-making process with relevant information, have been recognized as a new solution to such problems. Implementation of digital technologies in companies with a designated digital leader is 140% higher than in companies who do not have one which suggests that *"digital solutions are the most advanced level of cost management"* (Aguilar, Girzadas, 2019, 7).

3. RESULTS AND DISCUSSION

3.1. Trends and technologies shaping the future business environment

The implementation of digital technologies and automation has an undeniable position in the future success of businesses. However, the preparation for their implementation requires much wider focus than on the technologies themselves. The Future of Jobs Report (Centre for the New Economy and Society, 2018) from The World Economic Forum expects significant changes in the way companies produce and distribute their products, due to breakthrough technologies by 2022. According to the report, by that time it is crucial for companies to prepare for the fourth industrial revolution and proactively equip their workforce with the needed skills to avoid the talent shortages. Figure 1 presents the expectations stated by the report, predicting the trends to impact business growth.

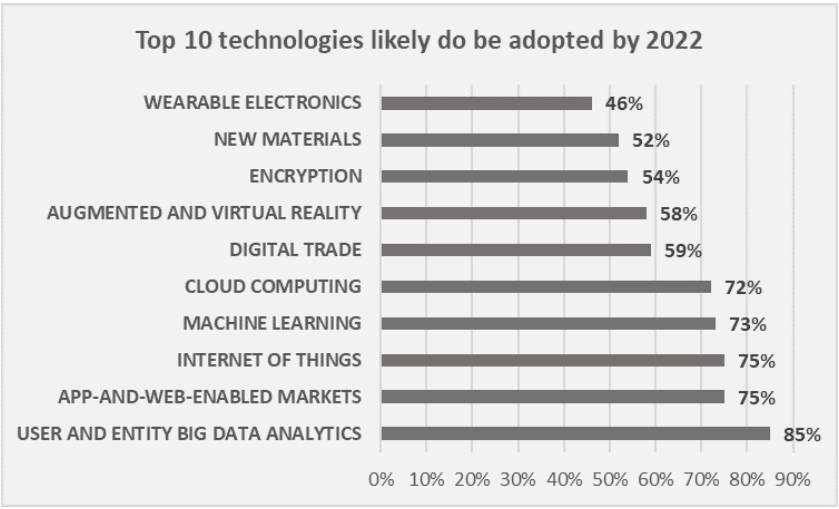
Figure 1. Top ten trends impacting business growth, up to 2022

Business growth impacting trends	Business growth impacting trends
Increasing adoption of new technology	
Increasing availability of big data	
Advances in mobile internet	Advances in artificial intelligence
Advances in artificial intelligence	Increase of cyber threats
Advances in cloud technology	
Advances in new energy supplies and technologies	
	Shifts in legislation on talent migration
	Shifts in national economic growth
Shifts in national economic growth	Shifts of mindset among the new generation
Expansion of affluence in developing countries	Increasing protectionism
Expansion of education	Shifts in government policy
Expansion of the middle classes	Effect of climate change
	Shifts in global macroeconomic growth
	Increasing aging societies

Source: Authors (according to data, published by Centre for the New Economy and Society, World Economic Forum, 2018)

Figure 2 presents the top ten technologies that will be shaping the business environment, in order of proportion of companies, likely to adopt them.

Figure 2. Top ten technologies, by proportion of companies, likely to adopt them by 2022



Source: Authors (according to data published by Centre for the New Economy and Society, World Economic Forum, 2018)

This outline of technologies likely to be adopted presents not only the technologies companies need to consider, but at the same time the areas of skills that need to be adopted in order to be prepared for their implementation. Santos et al. (2017) outlines the drivers of Industry 4.0, its design principles and expected accomplishments (Figure 3).

Figure 3. Drivers, principles and expected accomplishments of Industry 4.0

Source: Authors (according to Santos et al., 2017)

The stated drivers, governed by the Industry 4.0 principles, are expected to lead to potential scenarios described in expected accomplishments. The significance of these accomplishments is confirmed by the European Cluster and Industrial Transformation Trends Report (Sirtori et al., 2019, 2), published by the European Commission in December 2019, which identifies ten global megatrends that will be shaping future development of emerging industries. The report specifies megatrends as "*sustained forces on a global and macroeconomic level that influence the development of business, environment, economy, society, cultures and citizens' lives on a local and global scale* ". These megatrends include:

1. Automation – increase in the use of robotics, AI and control systems to minimize human intervention in operation leads to expected change in human-machine working hours' ratio.

2. Mass customization and servitization – growing demand for customized products and services, together with advancements in technology that add value, through delivering affordable goods and services customized for individuals. Innovations supporting this trend are 3D printing, social media and e-commerce.

3. Integration of subjects and objects – includes new technologies, such as the Internet of Things, which interconnects unique devices within an existing Internet structure, virtual reality (VR) and augmented reality (AR). Using VR in the stage of product development and design speeds up product development and enables developers to make quick modifications. Using AR devices, such as electronic goggles with computer-generated graphics, has high value in manufacturing, e.g. assisting the workers with their job tasks in real time. Gathering and analyzing information in real time helps avoiding errors, thus making training and production faster and more efficient.

4. Data-driven world - digital transformation is critical. This includes transformation of manufacturing equipment to enable the utilization of big data, in

combination with cloud computing and provide better understanding of operations, processes and future needs. According to Pereira and Romero (2017), innovation in the field of big data will enable easier analysis of databases and obtaining of reliable information that facilitate risk assessment and planning. According to the consulting company McKinsey & Company (McKinsey Global Institute, 2015), the utilization of big data for the purpose of predictive maintenance will enable companies to reduce their maintenance costs by 20%, reduce unplanned outages by 50% and extend machinery life by years. The ability to predict when maintenance should take place saves time, money and resources. The use of data analytics techniques to understand customer preferences and future development will be critical in all industries.

5. Cybersecurity & block chain – cybersecurity has been gaining increasing importance in the recent years. The need to protect information systems and data within the network is perceived as a top priority by companies. Block chain represents a possible solution through utilizing cryptography and timestamps, thus keeping a permanent record of interactions.

6. Globalization and geopolitics – collaboration across borders and accumulation of knowledge, increasing cooperation of cluster organizations, changes in labour and idea flows.

7. Demographic shifts – expected aging of society, lack of available people in working age, international migration will contribute to radical transformations, such as urbanization and change in demand for products and services.

8. Green & circular economy – a new economy concept, resulting from social concerns, climate changes and limited availability of resources. It is a competitive economy achieving high social and environmental standards through utilization of sustainable production, new technologies and advanced materials.

9. Urbanization & smart city – population growth and migration, supporting transition towards smart houses, smart materials, sustainable hotels, intelligent systems for control of building operations, etc.

10. Smart mobility – technological development leading to utilization of alternative fuels and creation of new modes of transportation, such as autonomous vehicles, smart boats, shared transportation.

Sirtori et al. (2019) claim that the most impacted by these megatrends will be digital industries, mobility technologies and logistical services. The megatrends that are expected to impact the emerging industries to the largest extent are mass customization, smart mobility and green and circular economy. Expected industrial transformation trends indicated by Sirtori et al.'s (2019) research are in line with the expectations specified in The Future of Jobs Report (Centre for the New Economy and Society, 2018), related to the impact of technological innovation on the ratio of work performed by humans and that performed by machines or algorithms.

The highest increase in machine working hours between 2018 and 2022 is expected in the job tasks, related to identifying and evaluating job-relevant information, while the highest proportion of machine working hours compared to human working hours in 2022 is projected for the tasks related to information

and data processing and to seeking and receiving job-related information. Prevalence of human working hours is expected mainly for tasks, related to communicating and interacting. In general, the ratio of machine working hours will be increasing, especially in repetitive, monotonous tasks, enabling human workers to focus on tasks requiring human skills, such as critical thinking, persuasion, negotiation, leadership and management.

3.2. Managing the integration of new technologies and workforce transition

Knowledge plays an important role in the innovation process and "*the ability to use knowledge is crucial in achieving high innovation performance and the strategic competitive advantage*" (Prokop et al., 2019, 130). According to Scremin et al. (2018), new infrastructure and smart technologies deliver the expected results only, if the company is able to use them effectively. In preparation for the upcoming change related to commercial use of new technologies and the resulting need of new skills, companies are evaluating their strategies. Table 3 presents strategies for addressing shifting skills needs and percentage of companies likely to adopt them, as projected for 2022.

Table 3. Percentage of companies, likely to adopt strategies for shifting skills needs

TYPE OF STRATEGY	STRATEGIES	% of companies
EXTERNAL	Strategic redundancies of staff who lack the skills to use new technology	46%
	Expect existing employees to pick up skills on the job	65%
	Retrain existing employees	72%
	Look to automate the work	81%
INTERNAL	Hire freelancers with skills relevant to new technology	54%
	Hire new temporary staff with skills relevant to new technology	61%
	Outsource some business functions to external contractors	64%
	Hire new permanent staff with skills relevant to new technology	84%

Source: Authors (according to data published by Centre for the New Economy and Society, World Economic Forum, 2018)

As shown by Table 3, the majority of companies are planning to hire new staff with requested skills. Based on this, it is possible to expect the shortage of skilled professionals in the labor market. Apart from this strategy, the second most likely measure to adopt is to automate the work, using the new technology. Five out of eight planned strategies require the job candidates, employees or external providers to be skilled in new technologies, which means that the upcoming period will require a great focus on training and acquiring relevant skills. The surveyed employers expect that 54% of their employees will require significant reskilling or upskilling, their primary focus will be on the employees performing key roles (Centre for the New Economy and Society, 2018). Such substantial changes, related to integrating new

technologies and workforce transition, will require cooperation with external partners. Table 4 presents an overview of preferred partners for this cooperation.

Table 4. Preferred external and internal partners for new technologies and workforce transition

Preferred partners	% OF COMPANIES
Labour unions	23%
Government programs	47%
Local educational institutions	50%
International educational institutions	52%
Academic experts	63%
Industry associations	66%
Professional services firm	75%
Specialized department in my firm	85%

Source: Authors (according to data published by Centre for the New Economy and Society, World Economic Forum, 2018)

As Table 4 shows, the majority of companies would prefer a specialized department in the company to manage the integration of new technologies. This is supported by the results of a survey conducted by Ostojić Mihić et al. (2015) on 36 major companies in Bosnia & Herzegovina on the topic of innovation and business excellence. As the study states (Ostojić Mihić et al., 2015, 87), "*one of the key factors for the development of an innovative enterprise is a clearly organized system with an appointed officer in charge, i.e. a Chief Innovation Officer*."

The overview in Table 4 also shows that a successful solution to the upcoming changes related to the fourth industrial revolution requires cooperation of private and public sectors, involving governments, educational institutions, as well as associations and labor unions.

Prokop et al. (2019) conducted a research in Central and Eastern Europe countries, with the focus on implementation of innovations, showing that the resources from public funding in fact often lead to the weakening of innovation activities. This is generally associated with extensive administrative burden and not receiving sufficient amount of funds to generate innovation. Therefore, companies in the small CEE countries prefer to use their internal resources or they stop innovation activities. Thus, the process of involving institutions and governments also needs to be reviewed and innovated, offering reduced administrative burden and increased flexibility.

4. CONCLUSIONS

The aim of the paper was to consider the future strategy of employment. In the current time of global COVID-19 epidemic that significantly influences the global trend of employment and production, it is essential to search for new opportunities for effective combination of human/machine workforce. The need of flexibility in terms of management and working time was reflected by employers in the form of "*home office*". This, however, does not satisfy social needs of employees, such as social interaction, mentoring, team work and personal contact. The year 2030 will bring

several changes resulting from changing needs in the labor market. As the demand for manual and basic cognitive skills declines, the market will focus on higher cognitive abilities, soft and technological skills. Thanks to the technology, we can reduce common tasks to a minimum, which will allow us to take on more roles. The Fourth Industrial Revolution, thus, brings a shift from one-way specialization to multidirectional specialization. New technologies can help develop businesses, eliminate problems with a lack of suitable candidates, create new jobs, but also completely eliminate some job roles by automating work tasks. Breakthrough technologies push the boundaries between the job tasks performed by human workers and those performed by robots or algorithms. This transforms not only the way products are manufactured and distributed, but also the global labor market.

New technologies go hand in hand with new required skills and create an urgent need for transformation in the field of training and skills development. As the presented research shows, companies widely recognize the importance of implementation of new technologies in order to retain competitiveness and majority of them plan to address the lacking skills by hiring new professionals with the required skills or using external providers. It becomes obvious that, although the commercial use of breakthrough technologies is expected to start the new industrial revolution as soon as 2022, the labor market is not yet prepared for the new demands. The period from 2019 to 2022 is described as a period for formulating strategies and preparing for the expected significant change. As Šimurina and Tica (2006, 12) state, some countries "*have lost entire industries due to inflexibility*" in regards to implementation of new technologies. In order not to miss the window of opportunity to gain competitive advantage, or, in some cases, to remain on the market, companies need to review available technology, assess their possible implementation and elaborate strategies to address the necessary changes in the area of business transformation, manufacturing, as well as workforce and talent availability.

References

1. Aguilar, O. (2016). *Thriving in uncertainty.* USA: Deloitte Touche Tohmasu.
2. Aguilar, O. (2016). *Thriving in uncertainty: Cost improvement practices and trends in Europe.* London: Deloitte Development LLC.
3. Aguilar, O., Girzadas, J. (2019). *Save-to-transform as a catalyst for embracing digital disruption*. USA: Deloitte Development LLC.
4. Buble, M. (2015). Tendencies in evolution of 21st century management. *Management: Journal of Contemporary Management Issues,* Vol. 20, No. Special issue, 1-17.
5. Castelo-Branco, I. (2019). Assessing Industry 4.0 readiness in manufacturing: Evidence for the European Union. *Computers in Industry,* Vol. 107, 22-32.
6. Cedefop. (2016). Future skill needs in Europe: critical labour force trends. *Cedefop research paper*, No.59. Luxembourg: Publications Office.
7. Centre for the New Economy and Society. (2018). The Future of Jobs Report 2018.
8. Grbavac, V., et al. (2003). The Information Technological Revolution at the Beginning of the 21st Century. *Društvena Istraživanja: časopis za opca društvena pitanja,* 12, 5(67), 847-870.
9. Kagermann, H. (2015). Change through digitization – Value creation in the age of Industry 4.0., *Management*

of permanent change. Wiesbaden: Springer Gabler. 23-45.

10. Kolberg, D., Zuhlke, D. (2015). Lean automation enabled by industry 4.0 technologies. *IFAC-PapersOnLine*, Vol. 48, (3), 1870-1875.
11. Lasi, H., et al. (2014). Industry 4.0. *Business & information systems engineering*, Vol. 6 (4), 239-242.
12. McKinsey Global Institute. (2015). *The Internet of Things: Mapping the Value Beyond the Hype*. San Francisco: McKinsey & Company.
13. Ostojić Mihić, A. et al. (2015). The Role of Organizational Innovation in Achieving and Maintaining Company's Business Excellence. *Management: Journal of Contemporary Management Issues*, Vol. 20 (1), 79-100.
14. Pereira, A.C., Romero, F. (2017). A review of the meanings and the implications of the Industry 4.0 concept, *Procedia Manufacturing,* Vol. 13, 1206-1214.
15. Prokop, V. et al. (2019). Collaboration for Innovation in Small CEE Countries. *Business Administration and Management.* XXII Vol.1., 130-144.
16. Pfeifer, S. (2017). Business models of micro businesses: Empirical evidence from creative industries. *Management: Journal of Contemporary Management Issues*, Vol. 22, No. Special issue, 1-19.
17. Santos, C. et al. (2017). Towards Industry 4.0: An overview of European strategic roadmaps, *Procedia Manufacturing*, Vol. 13, 972-979.
18. Scremin, L. et al. (2018). Towards a framework for assessing the maturity of manufacturing companies in Industry 4.0 adoption. *Analyzing the impacts of Industry 4.0 in modern business environments,* Vol.12, 224-254.
19. Sirtori, E. (2019). *European Cluster and Industrial Transformation Trends Report.* Luxembourg: Publications Office of the European Union.
20. Slovak Statistical Office. (2019). Labour Force Survey Results in The Slovak Republic for the 1st quarter 2019. https://slovak.statistics.sk.
21. Šimurina, J., Tica, J. (2006). Historical Perspective of the Role of Technology in Economic Development. *EFZG Working Paper Series,* No. 10, 1-13.

EUROINTEGRACIJSKE TENDENCIJE U IMPLEMENTACIJI "INDUSTRIJE 4.0" U EUROPSKIM PODUZEĆIMA

Sažetak

Trenutna razina tehnološkog razvoja omogućuje predviđanje budućih promjena, očekivanu komercijalnu raspoloživost revolucionarnih tehnologija i utjecaj koje će imati na poslovne organizacije, proizvodnju i tržište rada. Četvrta industrijska revolucija, koju pokreću automatizacija, digitalne tehnologije i „veliki podaci", očekuje se za nekoliko godina. Pritom je najveći vanjski rizik, kojeg trenutno poduzeća percipiraju, digitalna disrupcija. Cilj je ovog rada istražiti trenutne trendove u području tehnološkog razvoja i tranzicije radne snage, u smislu spremnosti oba čimbenika za predstojeće promjene. U radu se daje pregled rezultata istraživanja, koji ukazuju na dominantnu orijentaciju poduzeća, s obzirom na očekivanu digitalnu disrupciju, trendove koji će oblikovati četvrtu industrijsku revoluciju i strategije pripreme za predstojeće promjene.

Ključne riječi: *automatizacija, tržište rada, digitalna disrupcija, četvrta industrijska revolucija*