MODERN TECHNOLOGIES AS A DETERMINANT OF SUSTAINABLE ECONOMIC GROWTH AND DEVELOPMENT OF SMALL OPEN ECONOMIES
- Potentials, challenges and possible responses -

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ARTICLE INFO
Review Scientific Paper
Received: 28.09.2020.
Revised: 11.11.2020.
Accepted: 09.12.2020.

doi 10.7251/ACE2134085B
UDC
005.94:[005.336.4:334.71

Keywords: *ICT, industry 4.0, innovation, economic growth, productivity, business processes and models, small open economies*

JEL Classification: M2, O3, O4

ABSTRACT

The modern age is characterized by strong development and application of information and communication technologies (ICT) and Industry 4.0, which determine significant changes in the economy and society as a whole, and especially affect production and business processes, economic growth and development, productivity, business models, required qualifications and workers' skills, the education system, as well as people's daily lives. Thanks to that, developed countries are already achieving significant effects in terms of efficiency, productivity, flexibility, gross domestic product (GDP) and living standards growth, and there are opportunities for small open economies to create their own approaches to accelerate growth and convergence with developed countries. Otherwise, the negative consequences known as digital sharing are also possible.
The aim of this paper is to present, based on relevant literature and experiences of individual countries, the potentials, challenges and possible responses of economic and business policy makers aimed at the application of ICT and Industry 4.0 in small open economies, such as the Western Balkans.
The paper is structured as follows: *Introductory remarks* - elaboration of the theoretical basis, characteristics and implications of ICT and Industry 4.0 on the economy and society as a whole; *Methodology* - review of relevant current literature; *Results* - presentation of basic potentials, challenges and possible responses of small open economies in the function of accelerating economic growth; and *Discussion* - concluding remarks and recommendations for possible responses.

1. INTRODUCTION

The development and wide application of modern technologies, primarily information and communication (ICT), in all spheres of human life, from living conditions of individuals, through education, production and business processes and models, to the functioning of the state and society as a whole, essentially transform modern society economy. Therefore, in the relevant literature, modern society is increasingly referred to as information or digital, economic system and economy as a new, digital or knowledge-based economy, and the current fourth industrial revolution as Industry 4.0, or already as Industry 5.0, which begins in Japan and will be based on human-machine cooperation (Petrillo et al. 2018). At the same time, this technological, social and economic environment as a whole is a reality of developed countries and economies, but thanks to the fall in the prices of ICT products and services, they have become available throughout our planet. This provides a chance and opportunity for underdeveloped societies and economies in transition, as well as small and medium-sized businesses, to innovate their business, increase efficiency and competitiveness, and create their own business and development strategies by using the availability of technology, information, knowledge, and markets, which enables them to successfully engage in globalized economic flows.

The new economic and development paradigm of Industry 4.0 represents the integration of IT tools (such as *big data, cloud, robot, 3D printing, simulation*, etc.) by connecting to a global network by transmitting digital data. This enables creation of smart/intelligent solutions that allow to increase the efficiency of business processes and reduce costs through the value chain and maximizing results measured by creating added value. The key ideas of Industry 4.0, initially presented by Kagermann at the Hanover Fair in 2011 (Lee et al. 2014, Zhou et al. 2015), developed in 2013 in Germany and then spread relatively rapidly in Europe and around the world (Zhou et al. al. 2015).

Industry 4.0 has become a generally accepted term in scientific and professional circles, and different authors interpret it in different ways depending on which aspects of this phenomenon are in their opinion crucial. For the purposes of our research in the function of this paper, we provide the following three definitions or understandings of Industry 4.0. The Industrial Internet Consortium (2017) defines Industry 4.0 as the *integration of complex physical machines and devices, with networked sensors and software, used to predict, control, and plan for better business and social outcomes/results.* Kagermann (2014) indicates that Industry 4.0 represents *a new level of organization and management of value chains throughout the life cycle of products.* Hermann et al. (2016) state that Industry

4.0 is *a collective term for technologies and concepts of value chain organization*. Selected definitions, as well as the approaches of many other authors in the relevant literature, indicate that the prevailing understanding is that the essence of Industry 4.0 consists of new technologies, digitalization and robotization, and that key areas or aspects of Industry 4.0 are: Internet of Things (IoT), cyber physical systems (CPS), information and communication technologies (ICT), enterprise architecture (EA) and enterprise integration (EI) (Lu 2017). Accordingly, Industry 4.0 encompasses three basic aspects (Petrillo et al. 2018): (1) *Digitization and increased integration of vertical and horizontal value chains*: development of customized products, digital customer/consumer orders, automatic data transfer, and integrated customer service system; (2) *Digitized offer of products and services*: complete description of products and related services via intelligent networks; (3) *Introduction of innovative digital business models*: a high level of interaction between systems and technological capabilities that develops new and integrated digital solutions. The basis of industrial internet is real-time integration and availability and enterprise-wide control system. The effect of these changes is a radical transformation of traditional "industries", i.e. branches or activities, by changing their approach to work using new technologies, new machines and equipment, new materials and other inputs, with knowledge becoming crucial input (Petrillo et al. 2018). Therefore, strategic, operational, environmental and social opportunities are positive drivers of the implementation of the Industry 4.0 acquis, whereas challenges in terms of competitiveness, future capabilities, as well as organizational and production capabilities limit its progress. For practical application at the micro level, and as a first step in the application of Industry 4.0, it is necessary to provide an adequate understanding of the opportunities and challenges it brings, which depends on the overall characteristics of the company (Müller et al. 2018).

Industry 4.0 and the knowledge-based economy, i.e. their practical application in developed countries, lead to the creation of smart products and smart factories and new business models whose key factor is consumer/customer. They can choose the properties of the products they need and want, as well as change their orders even at the final stage of the production process at no additional cost (Schechtendalh et al. 2015). Smart products contain sensors, recognition components and processors that carry information and knowledge, transmitting them to consumers/customers, as well as feedback to the production system of the smart factory (Abramovici and Stark 2013). Industry 4.0 technologies, methods and tools increase the cost and time efficiency of production processes, product quality and thus overall competitiveness, affecting the entire product life cycle and providing a new way of product production and business (Alberts et al.

2016, Pereira and Romero 2017). New business models based on the Industry 4.0 paradigm establish a complete network communication between different companies, factories, suppliers, logistics, resources, customers/consumers, with real-time business optimization possible for each participant or phase, depending on the demand and status of participants in a network structure, which generates profit maximization of all participants with limited resource sharing (Kagermann et al. 2018). The changes also include traditional business models by their transformation through: (1) additional innovations of value creation and delivery, (2) diversification through reconfiguration of networked value ecosystems, as a radical innovation, but also through creation of new smart business models based on "smartization" of products and service (Ibarra et al. 2018). In the world of Industry 4.0, based on digitalization and automation, new business systems have emerged and are functioning as sustainable, but they have not yet become mainstream (de Man and Strandhagen 2017).

In this overall context of the Industry 4.0 paradigm, the education system as a whole faces additional challenges, including dual education, professional practices, lifelong learning, as well as additional training and education of existing employees in accordance with the needs of the new work environment and new business models. This means that "knowledge workers" need to be prepared for the new business and work environment of Industry 4.0, and probably soon 5.0, which is changing dramatically and requires new, larger and more adequate knowledge and skills. New education systems should therefore, in addition to general IT knowledge and skills and interdisciplinary skills development, anticipate the future needs of a knowledge-based economy and society, as it is very likely that today's students will work in industries or services that did not exist at the time they began their schooling (Maresova et al. 2018).

The key competencies of "knowledge workers" in modern and future manufacturing and service companies in the knowledge economy and paradigm of Industry 4.0 and the upcoming 5.0, will be those based on IT, software, software applications and automated processes and systems. These will include not only basic know-how and the ability to use digital devices, applications, Web 2.0 and various electronic tools, but also the use of required user oriented skills such as: CAD /Computer Aided Design/, CRM /Customer Relationship Management/, ERP /Enterprise Resource Planning/. In addition, communication, social and organizational skills, teamwork, project team work, and intercultural awareness and knowledge of foreign languages will be increasingly important. In order to improve their skills and encourage innovation, "knowledge workers" are expected to be involved in the lifelong learning process (National Institute for Education 2018).

In addition to the above, the application of ICT, as the basis of Industry 4.0 and modern and future knowledge-based economy, in accordance with economic theory and previous empirical evidence, creates significant potential for labor productivity growth and economic growth. Although there is debate in the scientific community about the intensity and dynamics of these impacts, including the controversy of slowing economic growth and accelerating innovation (Gordon 2018), empirical research confirms that the use of ICT during the 1990s significantly contributed to accelerating GDP growth and labor productivity in developed countries, especially in the United States (USA: Jorgenson 2001; Oliner and Sichel 2002; EU15: van Ark et al. 2002; Daveri 2002). Thus, in the USA in the period 2000-02, the average labor productivity grew at a rate of 3.4%, while in the period 1995-2001, that rate was 2.5% (Economist 2003). The positive impact of the ICT and IT sectors on growth and labor productivity in the same period was achieved in Southeast Asia (IMF 2001, Lee and Khatri 2003), as well as in most European transition countries (CEE), which contributed to their convergence with EU15 economies. 2004). Therefore, one must be aware of the empirically confirmed fact that new technologies make a full contribution to labor productivity growth and economic growth with a certain time lag (for example, electricity about 40 years after discovery and application, after more than half of US companies started to use it in production processes) (Piatkowski, 2004). The intensity and dynamics of the effects of the application of ICT significantly depends on the ability of each economy and its companies to use them productively. At the macro level, the diffusion and application of ICT are encouraged by the development and strengthening of economic, institutional and regulatory infrastructure, and at the micro level, changes in the structure, organization and business models of companies.

2. METHODOLOGY - REVIEW OF RELEVANT CURRENT LITERATURE

The issue of ICT, the fourth industrial revolution or Industry 4.0 and their essence and implications for the economy and society as a whole, has attracted special attention of many researchers and institutes of various profiles, creators of economic and business policies, scientific and business conferences, international institutions. .. On the basis of these researches, a large number of papers were created and published.They observe and discuss this complex area from different angles and present the results to the interested academic and business public.

The review of relevant literature for the purposes of this paper was facilitated because we found in the literature and as a further guide selected two papers that conducted detailed research and presented a review of papers from relevant databases of peer-reviewed papers on Industry 4.0, with the initial "search engine" were key words that are also in line with the goal of our paper. These are the papers:

(1) Maresova, Petra et al. (2018): Consequences of Industry 4.0 in business and economics, *Economies, ISSN 2227-7099, MDPI, Basel, Vol.6, ISS.3, pp. 1-14*, http: //dx.doi,org/10.33907economies6030046
(2) Petrillo, Antonella et al. (2018): Fourth Industrial Revolution: Current Practices, Challenges, and Opportunities. *Digital Transformation in Smart Manufacturing.*

Four researchers from P. Maresova's team made a selection of papers from the Web of Science, Scopus and Science Direct databases, published in the period 2014 - first quarter of 2018, using the following search keywords: Industry 4.0, economy, economic development, production economy and financial sector. In this way, 2275 papers were initially identified, with the most papers published during 2015. By applying the appropriate elimination criteria, all initially "selected" papers were analyzed, and their number was reduced to 292 for further processing, whereas 67 papers were the subject of the final review of the entire content. The paper presented the results and findings of the finally selected 30 papers, of which 20 papers were presented at scientific conferences. The focus of the analysis was to determine whether the papers, i.e. the authors, deal with the following aspects of Industry 4.0 in the context of business and economy: work environment, skills development, economic growth and macroeconomic aspects, sustainability/environment, digitization/smart factories/intelligent manufacturing, security/safety, government policies to support and implement Industry 4.0, and changes in business systems and processes. Detailed description of the topic of each paper in the field of research related to the concept of Industry 4.0 is given for 10 research papers published in academic journals, stating the purpose, basic findings and, most importantly, in the opinion of the authors of this study, the limitations of the study/paper. Key conclusions of the work of Maresova et al. (2018) are: Studies have described the impacts of Industry 4.0 on the labor market, education, changes in operational processes or economic growth. However, many studies do not have a coherent view of the topic they are dealing with. The authors usually focus on the aspect of business and economic implications and continue to examine it more deeply. The papers are usually based on the Industry 4.0 initiative, but omit related initiatives, such as the Work 4.0, Management 4.0, Marketing 4.0 and other initiatives. The connections and relationships of all relevant stakeholders, private and state-owned companies, the state, trade unions and employers' associations, are often ignored. The authors of this research believe that these interrelationships should therefore be taken into account, in order for individual countries to adequately prepare for the social and economic impacts that the current trend of digitalization and automation brings with it. In the future, one can expect an increasing connection between industry, science, research and new innovative technologies, which must be approached in a complex way to make the transition to Industry 4.0 successful.

The A. Petrillo's research team searched the Scopus database, the largest database of abstracts and peer-reviewed literature, with the term Industry 4.0 being the search engine. The subject of the search were scientific articles, papers presented at conferences and book chapters published in the period from 2012 to 2017, which contain the keywords Industry 4.0 or smart manufacturing. Initially, 886 papers were identified, and having in mind that Industry 4.0, both as a concept and as a new paradigm, originated in Germany, most of them come from Germany. The researchers then focused only on the published papers, of which there were 274 in the observed period. A review and analysis of these papers found that 73% of them relate to engineering issues and aspects, 39.4% to aspects and communication issues and 20.4% on business process management. Further analysis of selected papers was performed using the following seven keywords that characterize Industry 4.0: cyber-physical systems, big data or digitalization, the Internet of Things or wireless communication, automation or artificial intelligence or robotics, additive manufacturing or 3D printers, cloud computing and simulation/augmented/virtual reality. It was determined in what way and to what extent the mentioned keywords were elaborated, and what are the mutual relations in the analyzed papers, as well as the list of the most cited analyzed papers by other authors. The importance of a number of preconditions that need to be met in order to successfully apply the key technologies of Industry 4.0 and achieve positive implications for the economy at the macro and micro level, both in developed and developing countries, was also emphasized. The investment in Industry 4.0 in a sample of 235 European companies in the amount of EUR 140 trillion was also analyzed, which should enable the digitalization of their value chains for more than 80% of companies over the next 5 years.

Having in mind the goal of our paper, the relevant literature was also consulted, which presents the implications and experiences of transition economies, of new EU members, and Central and Southeast European countries in building a knowledge-based economy, ICT application and overall Industry 4.0 acquis, productivity and economic growth and the possibility of successful convergence or catching-up of developed countries (Piatkowski 2004, 2005, Cuaresma et al. 2012, Radosevic 2006, 2009, 2015).

3. RESULTS - PRESENTATION OF BASIC POTENTIALS, CHALLENGES AND POSSIBLE RESPONSES OF SMALL OPEN ECONOMIES IN THE FUNCTION OF ACCELERATING ECONOMIC GROWTH

In accordance with the topic and goal of this paper, our focus is on business and economic aspects, potentials, challenges and possible responses of economic and business policy makers, i.e. the search for an answer to the question: *Whether and with what approach the application of modern ICT can be a determinant of sustainable economic growth and the development of small open economies and a factor that will support their convergence with developed countries?*

Research synthesized in the paper of P. Maresova et al. (2018) point to the following key aspects of the business and economic implications of Industry 4.0:

(1) *Education and work skills* - emphasized need for "intelligent operators" in smart factories for which a new system of education and preparation for the development of adequate skills in a completely changed work environment should be created and implemented. This system implies an innovative and interdisciplinary higher education for new "knowledge workers" with new content in the field of ICT and Industry 4.0, including working methods, which combine alternating schooling and work, including learning practices. In addition, it is necessary to further educate and train "old" or existing workers to make them productive in new digitized production, service and overall business processes and models, through initial retraining and additional training, and subsequent continuing and lifelong education, together with new workers, in order to continuously maintain the necessary competencies in accordance with further innovations and the needs of the knowledge-based economy and society.

(2) *Application of smart technologies, intelligent production and digitalization of production, service and business processes* - which enables highly automated production and business processes and smart systems, especially in some sectors (automotive and electrical industry) in order to adapt faster to changing business environment. This increases cost efficiency, provides prerequisites for better and more successful planning and control systems, more efficient organizational and business models, and production flexibility, even in small batches in manufacturing of mass-produced products.

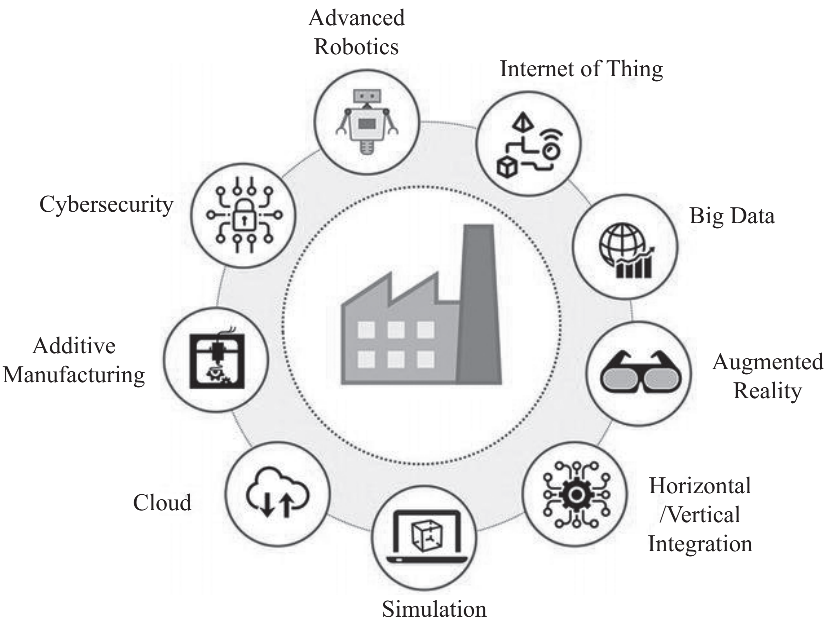
(3) *Government policies as elements of support or the necessary framework* - which enable, improve and promote the process of application of Industry 4.0 in various ways at the national and regional level (education, investment, social policy).

(4) *Changes in the domain of economy or production* - which also determine changes in the structure of industrial indicators that no longer correspond to the structure of GDP. Industry 4.0 is becoming a growth factor, either by applying ICT technologies in existing companies/sectors, or by forming new companies in the IT sector.

(5) *Social transformation, as a result of the digital transformation of the production, service, as well as the public sector* - leading to significant changes in the labor market, which drives changes in the education system. These are changes that will lead to the disappearance of some existing and the emergence of new jobs, which are announced quite dramatically, both in terms of intensity and dynamics. Some research (Osborne and Strokosch 2013) indicates that about 47% of all employees in the USA will be at risk of losing existing jobs, while the ratio of the number of "vulnerable" or threatened with disappearance and the number of new jobs in Germany is 7: 6 (Arntz et al . 2016). An adequate response and social approach to current and expected further changes in the labor market is the concept of "digital" education for Industry 4.0 and the knowledge-based economy and society that should combine mechanical and electronic engineering and information technology to develop digital skills in the whole society. In connection with the digitalization of government administration and services for employees, the unemployed and those at risk of unemployment (Kuhnova 2017).

Research synthesized in the work of A. Petrillo et al. (2018) were focused on current practices, challenges and opportunities for the application of the Industry 4.0 acquis, whose main goal is to accelerate and make production more efficient. The key technology of Industry 4.0 is cyber physical systems (CPS), which is a set of several different technologies that create an independent, interconnected and intelligent system of integrated different and physically distant objects/elements. Such cyber physical systems enable the generation and collection of data, their processing and aggregation, and use as support for decision making. Cyber physical systems function at the following 5 levels: (1) *smart connectivity* - obtaining real-time data via intelligent sensors and transmitting them via specific communication protocols; (2) *conversion of data into information* - the possibility of collecting data and their conversion into information that has added value; (3) *digital twins* - the ability to represent real time in digital reality; (4) *cognition* - the ability to identify different scenarios and support the appropriate decision-making process; (5) *configuration* - providing feedback on physical reality from virtual reality and applying corrective actions at the previous level.

Key Technologies of Industry 4.0 are synthesized by the following graphical presentation:



Graph 1. Key Tehnologies of Industry 4.0. Source: Petrillo et al. 2018. p. 9

In order to successfully apply the technologies and achievements of Industry 4.0 and achieve the expected effects, it is necessary to provide appropriate prerequisites, in particular: (1) creating awareness of the importance of innovation, (2) education and innovation management, (3) identifying potential improvements, and (4) creating an appropriate education system that will continuously provide the necessary qualifications and skills for "knowledge workers", both new and retraining and training of existing workers/employees in accordance with the new needs of the labor market in the Industry 4.0 system. It is very important to keep in mind the overall changes determined by the application of system 4.0 (technologies, smart factories, business models, qualifications and skills, market, ...), and the need to adapt appropriate approaches to each individual country, company, research organization.

In line with the above, *the main challenges for developing countries and countries in transition*, which are the focus of our paper, are: (1) training of "intelligent factory operators" as "knowledge workers", in order to acquire specific digital business management skills, (2) flexibility, as there are relatively few companies that have so far implemented the leading 4.0 systems, and (3) the need to provide adequate funding to begin the process of planning the introduction of the Industry 4.0 system at the national or regional level.

Industry 4.0 has a significant impact, not only on the IT sector, but also on traditional industries, such as oil and gas production, electricity generation and distribution, rail transport and mining. The economic opportunities and implications of Industry 4.0 are very broad and affect the entire economy and all countries. The greatest expected economic effects will be in the most developed countries that invest the most in Industry 4.0 technologies, which contributes to strengthening their national economies, but through outsorcing undisputedly motivated by economic reasons, these effects will be transferred to countries with low costs and incomes.

Industry 4.0 has the potential to significantly improve business processes in manufacturing companies through greater: (1) *efficiency* - savings of raw materials, materials and energy; (2) *productivity* - through the application of intelligent technologies; (3) *flexibility* - using cyber-physical systems; (4) *individualization of demand* - by integration of customers/consumers into networks/cyber physical systems/ and (5) *decentralization* - faster decision-making based on available data. In order for this potential to become a reality and for the stated effects to be realized, the companies that claim them must first invest significant funds in Industry 4.0 technologies. Only large and financially strong companies can afford that "satisfaction", and an additional problem is that it is difficult to objectively assess the return on such an investment. Therefore, countries that have the ambition to use the potential of Industry 4.0 for further economic growth should, through appropriate economic policy measures, create and implement national and regional investment plans in this area, as well as incentives for companies to invest in Industry 4.0. Companies that for any reason stay out of the changes brought about by Industry 4.0, risk business failure and disappearance from the business scene as a result of technological lagging behind competitors. Therefore, facing the current and especially future challenges of strengthening the competitive position imposes as a strategic goal the digitalization of production processes based on Industry 4.0 technologies, the creation of new business models in the real, financial and public sectors. This strategic goal results in obligations for companies, governments, universities and the education system as a whole, science, researchers and research centers, financial and other institutions, to develop the national research and innovation systems, in order to create their own technological and innovative potentials, including also transfer and successful application of current and new technologies, which can be a factor of convergence of developing countries and small open economies, i.e. reaching the level of development and income in developed economies and societies.

The set of changes brought about by Industry 4.0 significantly modifies the work environment and work patterns, which determines the need to adapt the education system as a whole, including higher education, alternating education and jobs for new "knowledge workers", and lifelong learning and continuing education of all employees through investment of employers in maintaining and acquiring their new knowledge and skills. New skills should, among other things, enable more efficient bridging of the gap between engineering and information sciences, automatic learning and artificial intelligence, which have become a reality of modern times, and create a precondition for efficient and integrated application of all acquired knowledge. In order to adequately respond to these challenges, university study programs should be designed to prepare future "workers" for the needs of the factories of the future. Acquiring computer knowledge and skills and learning foreign languages should be a mandatory, not an optional part of modern university studies. The study should be more student-friendly, with the easing of bureaucratic procedures, additionally supported by summer schools focused on raising awareness of computer science, and mandatory visits to smart factories. Through these visits and student internships, it is possible for students to get acquainted with their functioning as a company, but also for these companies to acquaint students with the technologies they apply (Petrillo et al. 2018). In order to provide appropriate skills for "knowledge workers", in addition to university education as the first stage, further professional development (school/work transition/) is very important, as a phase that provides the first technical qualification to future workers. This is realized through various workshops, which include technical issues as well as the acquisition of "soft skills", and work in university companies that allow students to adapt their profiles to the requirements of companies in which they will develop their business careers and contacts with these companies. Student internships also enable the acquisition of technical experiences, as well as the development of personal skills and inclinations for teamwork. Finally, the third and final stage of professional development, the phase of continuous education and training of the "intelligent factory operator", as a key worker of smart factories, is the inevitability for every smart factory to continuously invest in additional education of its employees in order to maintain and improve their knowledge and skills in modern conditions.. This is confirmed by the data that more than 80% of the total of over 300 American manufacturing companies during 2013 and 2014 invested about $ 1,000 per year in continuous training of each employee (Acenture, Manufacturing Institute 2014).

Previously elaborated potentials, challenges, as well as approaches of economic and business policy makers are significantly and successfully applied in a number of developed world economies. In the context of the aim of this paper, the question arises: *What are the opportunities and chances for small open economies in such a modern economic environment that have an urgent need to accelerate their economic growth and reduce the income and living gap in relation to developed countries?*

The results of relevant research have confirmed that the potential for accelerating economic growth exists in underdeveloped and transition countries, small and open economies, by investing in the transfer and application of technologies and knowledge from developed countries, which base their growth on their own innovations and technological progress, which is a slower process. It is about the so-called iron law of convergence or the catching-up effect that allows countries that create and implement an appropriate approach to technology transfer and application from more developed countries a convergence rate of about 2% per year (see more in: Barro and Sala-i-Martin 1992, Rodrik 2013, Barro 2015, Petrović et al. 2019). Transfer and application of knowledge and technologies from developed countries is also possible through foreign direct investment (FDI), as one of the modalities of inclusion in global value chains. At the same time, countries that strive for faster growth and successful convergence should create and implement their own approach, which will provide appropriate positioning at the beginning or end of global value chains, in order to maximize added value, based on its creation and retention. This means it should be borne in mind that the legality and the fact that research and development and design are initial activities in the value chain, represented by a smiling curve, and marketing and services are the final ones that provide the highest added value (OECD 2013). Therefore, it is necessary to develop one's own capacities in these areas in order for companies, regions and countries to be competitive and a partner to "key players" in global value chains at these stages, and not only in production activities characterized by the lowest added value. The overall effect of upgrading own economic performance of all participants will depend on the successful or desirable positioning in global value chains. This assessment is confirmed by the experiences and results achieved in this area by the countries of the Visegrad Group (V4). The results of empirical research (Vlčkova 2015) indicate that these countries, measured by the participation index, are among the most integrated into global value chains. However, this share is based on a high share of foreign value added, a low share of services in their exports and a dominant share of production activities, due to the size of these economies (with the exception of Poland), production orientation, and the fact that these countries have served as a platform. for outsourcing manufacturing activities, mainly to German companies. In order to improve their position and achieve greater economic benefits from participation in the global value chains the V4 countries, as well as other small open economies, need to improve the level of education and skills and flexibility of the workforce, to improve and develop their own research and development potential. environment, strengthen and stabilize institutions, critically assess the role of FDI, strengthen domestic ownership in companies to prevent the repatriation of profits. The goal of these activities is to provide control over what, how and for whom to produce (Vlčkova 2015) in order to make the most of share in global value chains. In addition to the above, research on the external dimensions of smart specialization provided through participation in global value chains in the countries of the European Union admitted to membership after 2004 (EU13) (Radosevic and Stancova 2015), indicate that the effects of technology transfer and improvement largely depend on whether countries and regions use through mutual cooperation the global value chains and international research and development networks as levers, connections and learning mechanisms in the process of smart specialization. Global value chains and the multinational companies that establish them can be drivers of productivity growth and economic growth, if used as mechanisms of learning and innovation in “domestic” companies. This requires an appropriate approach/policies that: (1) stimulate demand (not supply), drive FDI in research, development and innovation, (2) focus on the quality of FDI and global value chains, (3) integrate FDI and innovation policy, (4) develop a strategic approach to the internationalization of research and development, and (5) strengthen and upgrade horizontal links in the innovation system.

In addition, countries striving for faster and sustainable growth, such as all Central and Eastern European (CEE) countries, should, as part of their overall development and convergence strategy and policy, accept, promote and implement structural changes in the function of building society and knowledge-based economies, including the technologies and changes that Industry 4.0 brings with it (Piech and Radosevic 2006). Unlike the period at the end of the 20th and the beginning of the 21st century, when the growth of these countries was achieved due to redistribution and efficiency increase based on FDI production capacity (static modernization effect), future growth will depend on technology accumulation and FDI spillover effect (dynamic effect of modernization) (Szalavetz 2000). Thus, the path and transition to a knowledge-based society and economy does not only mean focusing on the knowledge-based manufacturing sector and branches or activities based on high technologies, but also the diffusion and application of new technologies throughout the economy by stimulating innovation systems in order to make the economic growth based on the “new” economy long-term. Therefore, it is necessary to encourage the development of the knowledge intensive services sector (KIS - knowledge intensive services), as well as all sectors to use ICT technologies, not just the IT sector. Given that CEE countries with small open economies are highly dependent on access to foreign markets and FDI, it is very important that they link their national innovation policies and systems appropriately to FDI and the global value chains in which they are involved (Piech and Radosevic 2006). Research also indicates that the competitiveness of Southeast European countries in the context of integration and convergence with developed European countries largely depends on their individual research and development potentials (primary infrastructure, human resources, institutions), as well as joint research and their funding, where through mutual cooperation they present themselves as partners who can be partners to the economies of the European Union (Radosevic 2009). This cooperation has the potential to help overcome obstacles and bottlenecks, and also to strengthen national and joint innovation systems, which will be able to base convergence or catch-up strategies, not only on imitation of available technologies and knowledge, but also on their adaptation. and innovation, so that the ability to innovate and the importance of science for convergence remain crucial (Fagerberg and Srholec 2005). One of the important messages is that the traditional definition and treatment of science and technology policy as a sectoral policy should be expanded so that its focus is on connecting public research and development institutions with domestic industry, agriculture and the medical sector, and use of international assistance to integrate research and technological development in the countries of Southeast Europe into European programs and better interconnection of local innovation systems (Radosevic 2009).

The research team of Cuaresma C, and others (2012) sought to answer the question of who are the drivers of growth, convergence and prosperity of 11 countries of the European Union (EU11) (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and Slovakia). This group of developing countries initially achieved impressive results in the development of the market economy and its positioning in the institutions of the European Union. The per capita income convergence process with developed Western European countries (EU15) is expected to continue, but at a slower pace. At the same time, the greatest contribution to further convergence is expected from the reduction of the gap in investment in human capital in relation to the EU15. In the area of trade and finance, integration between the EU11 and this group of EU15 countries is expected to continue, and the focus will be on strengthening stability in cross-border banking. In the field of enterprise and innovation the good results have been achieved in job creation, productivity growth and competitiveness in the international market, but innovation indicators indicate that the group of EU11 countries is lagging behind other EU member states. Demographic trends in Europe raise questions about the sustainability of the European growth model, pension policies as well as policies to close the education gap, incentives for labor market participation and the return of skilled workers will be increasingly important for the economies of EU11 countries. Although the integration of EU11 countries has helped to improve the quality of government work by strengthening the rule of law, economic openness, and promoting the right to vote and accountability accompanied by high costs for social benefits, public administration and governments in the EU11 are less efficient than in the EU15 and in developing countries with a similar level of income, which is negatively reflected on growth. In addition, in line with the further expected deterioration of the demographic situation, pressures for higher social spending are expected.

A significant contribution to the study and consideration of the impact of ICT, Industry 4.0 on growth in transition economies, as well as the potential for economic development in the new EU countries and candidate countries, is provided by empirical research presented in M. Piatkowski in 2004 and 2005.

The paper "The Impact of ICT on Growth in Transition Economies" (Piatkowski 2004) analyzes the multi-channel contribution of ICT to growth in labor production and productivity in eight CEE transition economies (Bulgaria, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia and Slovenia). in the 1995-2001 period.

This paper, i.e. research in the function of its development, is a significant contribution to understanding the potential and impact of ICT in developing countries and transition economies, given that most of the available literature mainly contains research results of ICT contribution to accelerating GDP growth and labor productivity in developed countries. especially in the United States. This contribution was especially emphasized during the 90s of the last century. Despite the collapse of the "internet bubble" and the unfulfilled expected stronger effect of the "new economy", it seems that technological advances brought by ICT have not stopped, as evidenced by the continuously high growth rates of labor productivity in the US which during 2000-02 were on average 3.4% versus "only" 2.5% in the period 1995-2001. (Economist 2003). Similar trends have been observed in other developed countries, including Ireland, the Netherlands, Australia, Denmark and the United Kingdom (OECD 2004, 2003, van Ark and Piatkowski 2004). In contrast, there has been little research and evidence in published papers on the impact of ICT on the economies of developing countries and transition economies. Exceptions are several IMF publications (IMF 2001) which indicate that there is a positive impact of ICT on output growth in the late

1990s in selected Southeast Asian countries, and the paper of Lee and Khatri (2003) proving the impact of capital investment in ICT on economic growth in the countries of Southeast Asia. The first assessments of the impact of ICT investment in ICT and the contribution to economic growth and productivity growth in the 4 new EU member states, members of Group V4 (Czech Republic, Hungary, Poland and Slovakia), based on growth accounting methodology, are presented in M. Piatkowski (2003). This methodology was also used in the paper of the same author who investigates the impact of ICT on growth in eight transition economies (Piatkowski 2004). Starting from the fact that ICT products and services are the results of "production" of ICT industry or sector and at the same time input for branches/activities that use ICT products and services, the overall impact of ICT on economic growth is realized through the following 4 channels: (1) production of goods and services, which directly contribute to the growth of aggregate value added created in a given economy; (2) increase in total factor productivity (TFP) of production in the ICT sector, which contributes to the growth of total factor productivity in a given economy; (3) the use of ICT capital as an input in the production of other products and services; and (4) contribution to total factor productivity in the economy as a whole based on productivity gains in non-ICT products and services sectors, determined by the production and use of ICT (spillover effect).

This research found that during the observed period, ICT provided a significant contribution to GDP growth and labor productivity in the eight transition countries covered by the research, with significant differences between the analyzed countries. The contribution of ICT through the increase in the value of capital/investment in ICT and the growth of total factor productivity in the ICT manufacturing sector brought an average of 0.87 percentage points to production growth in four CEE countries (Czech Republic, Hungary, Poland and Slovakia), for which only there were enough data. The stated aggregate contribution of ICT in these countries was higher than in the developed 15 EU countries (EU15), which in the same period was 0.73 percentage points. Based on these indicators, it can be concluded that ICTs have contributed to convergence, i.e. catching up with the EU15 by these four CEE countries (V4). The survey also found that the contribution of ICT capital alone to output growth in the five leading CEE countries (previous four countries plus Slovenia) averaged 0.61 percentage points, and was significantly higher than in the EU15 countries (0.46 percentage points on average). However, in the remaining three analyzed countries (Bulgaria, Romania and Russia), the contribution of ICT capital to the growth of production was much lower than in the previously mentioned five leading CEE countries, but also lower than in the EU15 countries. A similar "pattern" was confirmed by comparing the contribution of ICT capital to labor productivity growth. Therefore, this research found that in the three mentioned "lagging" transition economies, ICT did not enable convergence, i.e. catching up with the EU15 countries, but on the contrary, the gap in the level of development and income was deepened.

The research was also focused on the future perspectives of economic growth of the analyzed countries. Given the fact that post-transition growth reserves in the observed countries are largely depleted, it was assumed that the future growth of these economies will largely depend on the ability and capacity to use ICT productively. The Polish economy was taken as a projection of future impact, and it was estimated that ICT capital is likely to contribute 0.6 percentage points to the average GDP growth of 4% in the period until 2025, without taking into account the possibility of finding new, more productive ICT applications, which could further increase the contribution of ICT to economic growth and productivity growth. In addition, the mentioned spillover effect should be borne in mind, as there is a realistic expectation that the increasing use of ICT will accelerate the pace of innovation and knowledge diffusion, and that firms/companies, industries/branches and the economy as a whole will have a chance to accelerate productivity growth through imitation, acceptance and application of concepts, models and ideas developed by other more developed countries. However, it is very wrong and dangerous to expect that ICT will be able to be used productively in any country, branch or activity, or company, without providing appropriate assumptions. These assumptions necessarily include changes, i.e. reviewing and adjusting economic policies at the macro level, changes in the structure, organization and business models at the micro level, improving the level of knowledge and ICT skills of the workforce. The experience of countries that have been successful in this field so far, indicates that the continuous and consistent improvement of economic, institutional and regulatory infrastructure must be ensured at the macro level, in order to accelerate economic growth and productivity growth, based on technological progress and its application, in modern conditions embodied in ICT and their diffusion and application. In this context, economic policies, which seek to maximize the benefits of ICT and Industry 4.0 as a modern scientific and business paradigm, must focus on creating a favorable business environment, open borders for trade, increasing foreign capital inflows and spending on human capital, improving law enforcement efficiency, strengthening macroeconomic stability, and above all, promoting competition in the labor market.

The paper "The Potential of ICT for Development and Economic Restructuring of the New Member States and Candidate Countries" (Piatkowski 2005) presents some of the key research results of one of the studies within the project “Foresight on Information Society Technologies in an Enlagred Europe” (FISTE), realized by the Institute for Prospective Technological Studies, one of the seven research institutes within the DG Joint Research Center (JRC) of the European Commission. The survey covered new EU member states at the time: the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia, including also candidate countries: Bulgaria, Romania and Turkey, and Croatia, which has not yet had candidate status. Within this project, monographs were created for all the mentioned countries, based on the conducted research. They present analyses of the development of the information society in each of the countries, positive and negative impacts, strengths and weaknesses of each country, and give a look at the possible outcomes, based on quantitative data. The synthesized report and accompanying reports presented at the expert workshops identified three main challenges that will affect the development of the information society in Europe in the next decade: (1) Changing competitive pressures: the potential of ICT for economic growth; (2) Growing social divisions: the role of ICT in social or digital disparities; and (3) Growing demographic pressure: the tertiary transition in education. The key findings of the conducted research related to the first mentioned challenge can be synthesized as follows:

1) ICT can help annaylzed countries (new EU members) in the process of economic convergence or catching up with developed European countries (EU15)
   The application of ICT provides faster productivity growth in CEE countries at the macro level, as well as at the level of branches/activities in relation to the EU15 and the USA. The research found that ICTs during the period 1995-2001 contributed to reducing the income disparities of the five leading CEE countries compared to the EU15. However, the gap between Bulgaria and Romania has widened, as the application of ICT has not encouraged convergence with the EU15 due to the weakness of their economic and institutional environment during the survey period.
2) There is potential for productivity growth in ICT-based sectors using ICT
   The research showed that there is a significant potential for productivity growth, based on the application of ICT, not only in the IT sector, but also in other sectors that do not produce products and provide services in the field of ICT, if they successfully apply ICT in their activities. Therefore, these sectors (branches or activities) will benefit more or less based on the application of ICT, depending on how successfully they can apply ICT in their activities. To the extent that this potential of ICT is realized,

individual countries and branches or activities can accelerate economic growth and increase the degree of convergence or catching up of developed EU15 countries.

The key conclusion of these studies is that the analyzed countries, which aspire to faster economic growth in modern information or society and knowledge-based economies and paradigms of Industry 4.0, should create and implement policies that encourage greater use of ICT in all sectors, activities, including the public sector, and create an economic and institutional environment in which the business sector will invest more in ICT. This is a precondition for contributing to a significant acceleration of economic growth through the development of the information society in these countries in line with the Lisbon Strategy.

4. DISCUSSION - CONCLUDING REMARKS AND RECOMMENDATIONS FOR POSSIBLE RESPONSES

In the relevant literature, strategic acts, including also everyday business communication, modern society is increasingly referred to as information or digital, economic system and economy as a new, digital or knowledge-based economy, and the current fourth industrial revolution as Industry 4.0. This technological, social and economic environment as a whole is a reality of developed countries and economies, but its achievements have become available throughout our planet. This provides an opportunity for underdeveloped societies and economies in transition, as well as small and medium-sized businesses, to use the availability of technology, information, knowledge, and markets to innovate their businesses, increase efficiency and competitiveness, and create their own business and development strategies that enable them to successfully engage in globalized economic flows.

The new economic and development paradigm of Industry 4.0 represents the integration of IT tools (such as big data, cloud, robot, 3D printing, simulation, etc.) by connecting to a global network by transmitting digital data. On this basis, smart/intelligent solutions can be created to allow to increase the efficiency of business processes and reduce costs through the value chain and maximize results measured by creating added value. The application of this modern paradigm implies: (1) *Digitization and increased integration of vertical and horizontal value chains*; (2) *Digitized offer of products and services and* (3) *Creation and application of innovative digital business models.* The effect of these changes is not only the strong development of the IT sector, but also the radical transformation of traditional "industries", i.e. branches or activities, by changing their approach to work by using new technologies, new machines and equipment, new materials and other inputs, whereby knowledge becomes the crucial input.

The set of changes brought about by Industry 4.0 significantly changes the work environment and work patterns, which determines the need to adapt the education system as a whole, including higher education, alternating education and jobs for new "knowledge workers", and lifelong learning and continuing education of all employees through employers' investing in maintaining and acquiring their new knowledge and skills. New skills should, among other things, enable more efficient bridging of the gap between engineering and information sciences, automatic learning and artificial intelligence.

In order to successfully apply the technologies and achievements of Industry 4.0 and achieve the expected effects, it is necessary to provide appropriate prerequisites, such as: (1) creating awareness of the importance of innovation, (2) education and innovative management, (3) identifying potential improvements, and (4) creating an appropriate education system that will provide the necessary qualifications and skills for "knowledge workers" on a continuous basis, both for new workers, and retraining and additional training of existing workers or employees, in accordance with the new needs of the labor market.

The application of ICT, as the basis of Industry 4.0 and modern and future knowledge-based economics, in accordance with economic theory and previous empirical evidence, creates significant potential for labor productivity growth and economic growth. Although there is debate in the scientific community about the intensity and dynamics of these impacts, empirical research confirms that the use of ICT during the 1990s significantly contributed to accelerating GDP growth rates and labor productivity in developed countries, especially in the United States. Thus, in the USA in the period 2000-02, the average labor productivity grew at the rate of 3.4%, while in the period 1995-2001 that rate was 2.5%. The positive impact of the ICT and IT sectors on growth and labor productivity in the same period was achieved in Southeast Asia, as well as in most transition European countries (CEE), which contributed to their convergence with the economies of EU15 countries. Yet, one should keep in mind the empirically confirmed fact that new technologies make a full contribution to the growth of labor productivity and economic growth with a certain time lag. The intensity and dynamics of the effects of the application of ICT significantly depends on the ability of each economy and its companies to use them productively. At the macro level, the diffusion and application of ICT encourages the development and strengthening of economic, institutional and regulatory infrastructure, and at the micro level, changes in the structure, organization and business models of companies.

Industry 4.0 has the potential to significantly improve business processes in manufacturing companies through greater: (1) *efficiency* (2) *productivity* (3) *flexibility* (4) *individualization of demand* and (5) *decentralization*. In order for this potential to become a reality and for the stated effects to be realized, the companies that claim them must first invest significant funds in Industry 4.0 technologies. Companies that for any reason stay out of the changes brought by Industry 4.0, risk business failure and disappearance from the business scene as a result of technological lag behind competitors.

The following question logically arises in the context of the aim of this paper: *What are the opportunities and chances in such a modern economic environment for small open economies that have an urgent need to accelerate their economic growth and reduce the income and living standard gap with developed countries?*

The results of relevant research have confirmed that the potential for accelerating economic growth exists also in underdeveloped and transition countries, small and open economies, by investing in the transfer and application of technologies and knowledge from developed countries, which base their growth on their own innovations and technological progress, which is more expensive and slower process. It is about the so-called iron law of convergence or the catching-up effect, which allows countries that create and implement an appropriate approach to technology transfer and application from more developed countries a convergence rate of about 2% per year. One of the studies listed in this paper found that ICTs in the period 1995-2001 in the V4 group of countries and Slovenia contributed to the growth of production and productivity more than in the developed countries of the EU15, and thus convergence, i.e. catching up with the EU15 countries. In contrast, in the remaining three analyzed CEE countries, ICT contributed significantly lower to production growth than in the five leading CEE countries, and also lower than in the EU15 countries, as a result of which ICT did not enable convergence in these three transition economies or the catching-up effect. On the contrary, the gap in the level of development and income has deepened. Transfer and application of knowledge and technologies from developed countries is possible through foreign direct investment (FDI), as one of the modalities of inclusion in global value chains. The countries that aspire to faster growth and successful convergence should create and implement their own approach, which will provide appropriate positioning at the beginning and/or end of global value chains, in order to maximize added value. This means one should consider that legality and the fact that initial activities in the value chain represented by the "smile curve" are research and development and design, and the final ones are marketing and services, those that provide the highest added value, its creation and retention.

However, it would be wrong to expect that ICT will be able to be used productively in any country, branch or activity, or company, without providing appropriate preconditions. These preconditions necessarily include changes, i.e. reviewing and adjusting economic policies at the macro level, changes in the structure, organization and business models at the micro level, improving the level of knowledge and ICT skills of the workforce. The experiences of countries that have been successful in this field so far, indicate that continuous and consistent improvement of economic, institutional and regulatory infrastructure must be provided at the macro level, in order to accelerate economic growth and productivity growth, based on technological progress and its application, in modern conditions and embodied in ICT - their diffusion and application. In this context, economic policies, which seek to maximize the benefits of ICT and Industry 4.0, must focus on creating a favorable business environment, open borders for trade, increasing foreign capital inflows and spending on human capital, improving law enforcement efficiency, strengthening macroeconomic stability, as well as the promotion of competition in the labor market.

The key conclusion that emerges from the results of relevant research is that all countries, which aspire to faster economic growth in modern information or society and knowledge-based economies and paradigms of Industry 4.0, and especially small and open economies, should create and implement policies that encourage greater use of ICT in all sectors, branches or activities, including the public sector, and create an economic and institutional environment in which the business sector will invest more in ICT.

Facing the current and especially future challenges of strengthening the competitive position imposes as a strategic goal the digitalization of production and business processes based on Industry 4.0 technologies, the creation and application of new business models in the real, financial and public sectors. This strategic goal imposes obligations for companies, governments, universities and the education system as a whole, science, researchers and research centers, financial and other institutions, to develop national research and innovation systems, in order to create their own technological and innovative potentials, and transfer and successful application of current and new technologies, which can be a factor in the convergence of developing countries and small open economies, i.e. reaching the level of development and income in developed economies and societies, and therefore the determinants of sustainable economic growth and development.

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САВРЕМЕНЕ ТЕХНОЛОГИЈЕ КАО ДЕТЕРМИНАНТА ОДРЖИВОГ ЕКОНОМСКОГ РАСТА И РАЗВОЈА МАЛИХ ОТВОРЕНИХ ЕКОНОМИЈА
– Потенцијали, изазови и могући одговори –

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САЖЕТАК

Савремено доба карактерише снажан развој и примјена информационо-комуникационих технологија (ИКТ) и Индустрије 4.0, које детерминишу значајне промјене у економији и друштву у цјелини, а посебно утичу на производне и пословне процесе, економски раст и развој, продуктивност, пословне моделе, потребне квалификације и вјештине радника, образовни систем, као и свакодневни живот људи. Захваљујући томе развијене земље већ остварују значајне ефекте у домену ефикасности, продуктивности, флексибилности, раста бруто домаћег производа (БДП) и животног стандарда, а постоје могућности и за мале отворене економије да креирају властите приступе у циљу убрзања раста и конвергенције са развијеним земљама. У супротном су могуће и негативне посљедице познате као дигитална подјела.

Циљ овог рада је да, на основу релевантне литературе и искустава појединих земаља, презентује потенцијале, изазове и могуће одговоре креатора економских и пословних политика усмјерене на примјену ИКТ и Индустрије 4.0 у малим отвореним економијама, какве су и земље Западног Балкана.

Рад је структуриран на сљедећи начин: *Уводне напомене* - елаборација теоријске основе, карактеристика и импликација ИКТ и Индустрије 4.0 на економију и друштво у цјелини; *Методологија* – преглед релевантне актуелне литературе; *Резултати* – презентовање основних потенцијала, изазова и могућих одговора малих отворених економија у функцији убрзања економског раста; и *Дискусија* – закључна разматрања и препоруке за могуће одговоре.

Кључне ријечи: *ИКТ, индустрија 4.0, иновације, економски раст, продуктивност, пословни процеси и модели, мале отворене економије*