ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

Volume 30 (1), 2021

Vladia Borissova[1]

DIGITAL TRANSFORMATION FOR DIGITAL COMPETITIVENESS AT A MICRO LEVEL

The development of digital technologies turned into the fourth industrial revolution – Industry 4.0, which is associated with the digitalisation of processes, big data, the Internet of Things, additive technologies – 3D printing, robotics, artificial intelligence. The digital transformation in business relations led to economic reformatting of logistical, production and trade processes in the global value chain and especially with regards to cross-border payments, production and trade. The present research fills the research gap concerning the relation between the preconditions for the digital transformation of industry, the economic effects from the reformatting of the global value chain and the related digital competitiveness of enterprises. The establishing of the relation and the identification of trends in the development of digital technologies and the global value chains is an indicator for the beginning of the transition from Industry 4.0 to the industry of artificial intelligence – 5.0.
JEL: A20; L1; O1; O14; O3; O33

Introduction

In order to conduct a research on the topic of digital competitiveness and in order to give a definition of this new for the theory and practice term, it is necessary to clearly establish the scope of the research field and to outline the existing relations with the new trends.

Digital competitiveness is a combination of two terms, each of which has its own meaning, specificities, economic and legal aspects. However, with their combination, the two terms outline the economic advantage on a micro level, i.e. the enterprise, on a regional level with the so-called transnational value chains, and on an international level with regards to the formation of the global innovation index. In this economic reality, intellectual property (IP) has an active role as a factor, and at the same time as a mean that is mediating these processes from the very creation of the digital medium, i.e. in the process of transformation of the product from analogue to digital form.

[1] *Vladia Borissova, Prof., Dr. at the University of National and World Economy – Sofia, e-mail: vborisova@unwe.bg.*

In the last 40 years Industry 4.0 was used as a term meaning this process and the on-going changes in production and distribution activities. Despite there being a lot of research conducted on the positive aspects of this concept, there isn't nearly enough with regards to the digital competitiveness and economic effects of the digital transformation of logistical, production, distribution and marketing processes in enterprises. One notable reason is the continuous dynamic development of digital technologies which creates difficulties in identifying the economic effects and deriving the digital competitiveness. Another reason is the potential, considering its pace of development, for Industry 4.0 to transform into Industry 5.0, which will bring about even more change in the functionalities of the value chain. Despite there being many unknowns, digital transformation leads to economic effects and forms the so-called digital competitiveness for enterprises from all sectors of the economy which use digital technologies in their activities, as well as for those that create them and are active in patenting.

The primary objective of this research is to explore the state of the art as well as the state of practice of Industry 4.0 relating to the digital transformation of the industry, the economic consequences of the value-chain transformation, by pointing out the specificities of digital competitiveness. The research fills the research gap that is left with relation to the economic reformatting of the global value chain and the associated with it digital competitiveness of enterprises.

The used methodology comprises of an analysis of data on patents and scientific publications. Patents and scientific publications provide particularly useful ways to track and analyse trends in digital technologies. They provide an appropriate source of data to analyse and draw conclusions as they are systematically collected in a structured publicly accessed databases - FAMPAT database provided by Questel (FAMPAT by Questel, 2018). By conducting an analysis and systematisation of data from economic researches of leading consultancy agencies (van Duin & Bakhshi, 2020); (AI Report, Deloitte, 2016); (Marr, 2016); (Marr, 2020); (Gartner, 2020) were identified the economic parameters of the digital environment and derived the trends in the reformatting of the global value chain in the production and trade processes in the economic turnover. The systematic analysis of national policies of industrially developed countries allowed for the identification and systematisation of the preconditions for the development of the economic transformation on a global level. Comparing the results of prior analyses helped derive the relation between the economic transformation and the digital competitiveness, allowing its identification with specific economic effects.

The research does not go into depth with regards to the technical details of the digital transformation. It is also limited with respect to the on-going changes in the social and cultural environment and the challenges facing the legal system. The research is limited to the global processes concerning the development of the software industry and the patent activity in the sector of digital technologies, including those related to artificial intelligence with regards to the so-called patent leaders, who through their actions have an effect on the global value chain. In order for the economic reformatting to have an effect on a national level, the research is limited to the identification of the changes in the business environment caused by the digitalisation of industry in Bulgaria.

I. INDUSTRY 4.0. = SOFTWARE DIGITAL INDUSTRY

1. From digitalisation to industry

The definition of digitalisation contains certain technical parameters describing the specificities of the carried actions in this process of transformation. This is a process of conversion, i.e. transformation of an analogue medium, as text, sound, video, signal, telephone impulse in a digital form though digital devices by the method of scanning of information. In this way, the scanned information can be used by processing, storage and transmission in a digital environment through digital technologies based on digital devices, computer networks, satellites, the Internet, social networks – WEB 2.0, web of knowledge – WEB 3.0 and artificial intelligence, to the end-user (Marr, 2018). The use of the information in a digital environment can be done at a time and place freely chosen by the end-user. The end-user can also choose the quantity and the type of information which he/she wants to use by creating his/her own information systems containing diverse compilations of different information which on their own represent a new type of packaged information or product. This opportunity makes the end-user a participant in the process of creation and distribution of products in an online environment. This is a characteristic that in traditional production is very limited due to the place of the end-user at the very end of the value chain.

The security and the protection of information (cybersecurity) are of vital importance for the functioning of this environment. The devices and the systems for the security of information, both on a corporate and a national level, are an essential part of the digital environment.

2. The IP industry – The Software digital industry

The ability of digitalisation to provide access to information to many and different users at the same time and at a time and place chosen by them; to integrate heterogeneous information flows, to process, storage and transmit them using different business models for digital distribution, is the precondition for the formation of one of the fastest-growing creative industries – the software industry. This is an industry based on intellectual property, on its creation and management for business purposes.

Distinctive features of the industry are the rapidly developing technologies, highly qualified workforce, online management teams, virtual offices for the management of production and distribution processes, high revenue, transnational value chains. The industry is entirely created and functioning on human intellect and its intellectual achievements – intellectual property, software, hardware, integrated circuits, 3D printing, blockchain, Internet of Things and the look into the future that is Artificial intelligence (AI). Industry 4.0 provided an opportunity for digitalisation to form an industry from an integrated digital environment through many devices, technologies, and networks from all areas of the economy, to substantially change the economic environment through the creation of global value chains, the social environment through decreasing employment, highly specialised production, communication between machines, which may or may not involve a human intermediary.

This is an industry in which the rate of industrial advancement is everywhere and it is exponential – AI, robotics, Internet of Things, autonomous cars, 3D printing, nanotechnologies, biotechnologies, the science of materials, the storage of energy and quantum computers are just some of the areas where we see radical changes (Schwab, 2017). The software industry encompasses all areas of industry, greatly affecting the systems of production and management (see Figure 1).

Figure 1

Source: pixabay.com, pexels.com.

This is the industry of the new way of exploitation of natural resources, i.e. of the functioning of the mining industry, of production of intermediate goods in the processing industry through the use of improved communication and monitoring, self-diagnostics and analysis, though cybersecurity and control systems (Böhler, 2012). An industry in which production will move from automation to robotisation, where machines will be capable to conduct an analysis of the situation and communication with each other which will provide enterprises with opportunities for economies of scale, generation of revenue and relocation of human resources to other activities. One of the main goals of the industry is to achieve decentralisation of decision-making where cyber-physical systems are to be able to make decisions independently and to self-manage in their implementation (Karnouskos, 2012).

Cyber-physical systems[2] help human beings by performing activities that are impossible for humans because they are dangerous or physically challenging.

Human intervention in the operational independence of the machines is limited to existing conflicts in the decision-making and the implementation of the goals laid out in the program. For the implementation of the goals the industry continues its technological revolution by working on creating a copy of the real world through sensory data, which is done to guarantee information transparency in the communication between humans and machines,.i.e. in communication on the Internet via sensors between Internet of people and Internet of things (M2M – machine to machine). The visualisation of information is a precondition for the efficiency of people when making decisions regarding the elimination of existing conflicts (Ibid. Schwab, 2017). These unprecedented changes in the technological world lead to changes in the economy, society, and the individual. This is a convergence of the physical, digital, and biological world, a challenge, new reality, and a possible risk.

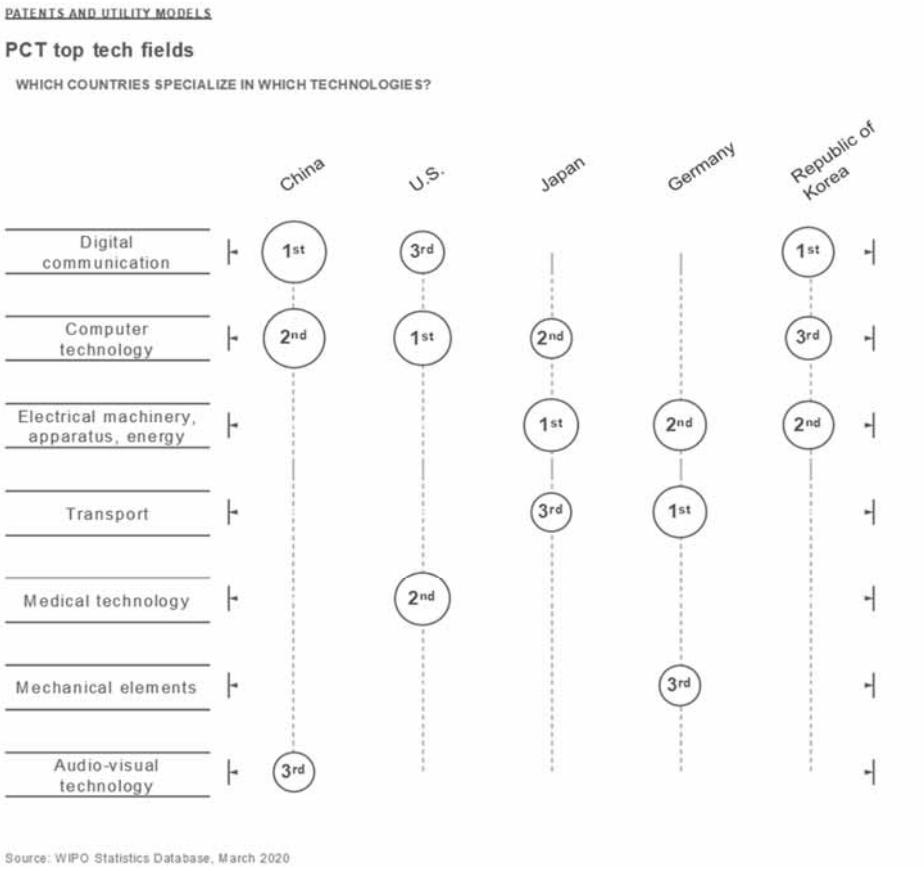
The patenting activity of enterprises in the digital sector is an important indicator for those economic changes. For example, with regards to patenting related to digital transformation and artificial intelligence, in 2020 enterprises from China and the Republic of Korea are active in filing for patents in the field of digital communication, while those from the U.S. filed most in the field of computer technology. For Japan, the top technology field of AI is electrical machinery, and for Germany it is transport. (Fig. 2) The unprecedented change in the tech world from the birth of digital technologies in the 1950s to 2018 is illustrated in the number of filed applications for patents related to them – 340 000. These patents form around 0,6% of all patents, which in total are 59,3 million until 2018 (WIPO, 2019) including:

- machine learning is an included functional application in the patents of more than 1/3 of all inventions (134 777 in 2018) and the filing activity has grown on an annual basis by 28% (in 2016 there are 20 195 patent applications filed, compared to 9567 in 2013);
- computer vision is an included functional application in 49% of all patents related to artificial intelligence (167 038 patents) and it has grown 24% on an annual basis (21 011 patent applications, 2016);
- robotics and control methods are included functional applications with the highest growth rate in patent application filing for the period 2013 – 2016, on average 55% annually.

The leaders in patent activity for digital technologies related to artificial intelligence, and in various fields, are IBM with 8,290 inventions, followed by Microsoft with 5930, Toshiba (5223), Samsung (5102) and NEC (4406) (see Figure 2).

[2] Cyber-physical system is a system in which information, software components are connected to mechanical electronic parts which communicate via one infrastructure for data, e.g. the Internet. The cyber-physical system is characterized by its high level of complexity. The formation of the system happens through wired and wireless networks between integrated systems. Areas of application can be: manufacture of medical devices and systems with high reliability, systems for care for the elderly, management of road traffic, network systems assisting the driving of vehicles, industrial systems for management of the automation processes, sustainable systems for management of the environment and others (Colombo, et al., 2014).

Figure 2



The funding in the field of digital transformation, primarily related to artificial intelligence in the USA alone for 2018 was to the amount of 46 billion dollars and the number of enterprises working in this field that received it was around 2868.

3. Elements of the digital environment and economic and social consequences

The elements of the digital environment are at the core of the value chain in the software industry and of Industry 4.0. Those are the devices and processes, the computer networks and their functional interactions which make up the global digital platform for the use of information in a digital form. Identifying the elements of the digital environment and their

characteristics will allow to determine the means with which to support and/or establish digital competitiveness. This is a complex integrated mix of independent elements which in their essence represent independent objects of intellectual property such as inventions, utility models, and technical, process and management know-how or trade secret. This specificity of the elements of the digital environment makes it by itself intellectual property, existing based on the management of IP rights of the elements that it is comprised of. That is why the main business models that are applicable in the software industry are the licensing models, including with types of use of protected IP under the conditions of open source[3] or public domain[4] (Lauren et al., 2008). The model of the open license is characteristic for the software industry and is justified by both the continuous intellectual dynamism in the field of digital technologies and by the necessity for access to created scientific research which can serve as a basis for additional research. The sharing of knowledge related to other technological developments creates opportunities for a diverse and dynamic environment.

In its entirety, the elements of the digital environment, according to some researchers (Ruessman et al., 2019), are nine, which is as many as the basic technologies that form the digital environment, and they are as follows:

- big data and analytics;
- autonomous robots;
- simulation;
- horizontal and vertical system integration;
- Internet of Things;
- cybersecurity;
- the cloud – a platform which is to unite all components of the digital transformation. This platform has to be accessible from any device, it has to have the ability to expand with the growing volume of data, and it has to be open for integration with different systems;
- additive manufacturing (3D);
- augmented reality, the so-called augmented and virtual reality – two popular technologies which can drastically change customer service, the training of employees, productivity and even the image of a company.

[3] The term open source is related to software products and it means software with an open code. This is a software for which the holder of the IP rights of the source code grants the rights for training, modification and distribution of the software to anybody and for any purpose (in other words – software with a license for open code). The software with open code can also be developed in a cooperative public way. Open source software is often compared to user generated content. The open source model generates a much more diverse scope of the design and the structure of the code.

[4] When a certain work is in the public domain, any interested party can use it for its own goals without the permission of the author and without paying remuneration.

According to other authors (Kondratiev, 2018), the digital environment is formed only from those technologies which have the biggest importance for the formation and functioning of the global value chains in the industry, namely:

- big data (its collection and evaluation for the optimisation of the costs and quality of production);
- Internet of Things;
- Robots and AI;
- Additive technologies – 3 D printing in the processing industries.

Considering that the leading interests of the research are the economic consequences of the digitalisation, the changes for business which occur and the specificities in its management for the identification and analysis of the so-called digital competitiveness, we will consider as main elements of the digital environment those elements that have a direct effect on the global value chain.

3.1. Big data and its dimensions for the economy

With consideration of the volume and the sources of information that goes in, is processed, stored and distributed, the digital formation of databases is always associated with the term "big". And they really are big because the information that goes incomes from all kinds of sources, from sensory devices to search engines and social media. Despite the fact that building a computer system that can maintain big data is a resource-intensive process, the low costs related to the processing and storage of data allows the applicability of this process in a large number of enterprises. This applies especially for those enterprises that participate in transnational business relations oriented primarily in the trade, where big data allows for the monitoring of foreign markets from a distance without additional investments in local representation. The creation and the maintenance of big data hide some risks, namely that the whole information is available and accessible online which raises the issue of unauthorised access and use, and therefore an infringement on personal and IP rights.

3.2. Internet of Things and its effect on the economy

The Internet of Things is a form of communication M2M or machine to machine. The Internet of Things has a significant role in the realisation of the B2B model, since it functions on the principle of sensory devices capable to receive and process information and to have the received data transmitted to other devices or people. The Internet of Things allows for the planning of operations between suppliers, producers, distributors, and the consumers, and significantly decreases the use of so-called intermediate goods. The reason for this is that the technology allows for the marking of the good with an identifier which contains information about its origin, designation and use, which ignores the need for synchronisation of the product and information flows. The economic dimension of this technological effect is the optimisation of production and distribution, and the minimisation of costs, especially those related to transnational business relations. This technology too faces the issue of

cybersecurity in the digital environment with regards to the information flows and the big data in them.

3.3. Robots, Artificial Intelligence and their economic benefits

When we talk about robotisation, we should make the clarification that the focus is on industrial robots, i.e. machines that are a part of the production of certain goods. These machines have similarities and significant differences with artificial intelligence (AI). AI can analyse the surrounding environment and take actions which increase the chances of achieving certain goals (Russel et al., 2003). Such devices are called intelligent agents (Poole, et al., 1998), since they are created with the hypothesis in mind that a core human quality such as intelligence can be so clearly defined so as to be simulated by a machine. Precisely because of these differences, AI is rather a part of Industry 5.0 which has already started. In the next five years, the industries which will undergo a complete transformation because of AI are those that make instant money transactions. Consequently, AI will start managing completely retail, healthcare, production processes, transport, logistics, including storage activities and the delivery of products, until it enters every economic activity (Lee, 2019).

When these powerful algorithms begin acquiring basic human abilities, such as sight, speech and navigation, and their combination helps them complete more specialised tasks which are routinely completed by human experts, then AI will step outside the software industry, which will make the transition to Industry 5.0 (Tsirigos, 2019).

At this stage, AI is still used to apply predefined models which the system looks for in the data and automatically take certain actions if they are found, in case of the processing of too much data in a short time (for example chat-bots for customer service or for predicting machine failure in case of certain deviations in the received data). With regards to the robotised machines, things are much simpler. They execute complex and delicate operations, even such that are dangerous for people, they are multipurpose and more flexible in the production, they function in all conditions, without a specified hierarchical administrative structure. These qualities lead to their use in small and medium as well as big enterprises.

3.4. Additive technologies and the 3D printing as economic innovators

Additive technologies apply programs for computer modelling which allow personalisation of goods and their production not through the assembly of the separate parts, but through their computer modelling CAD. The process is preceded by a digital modelling of the object and its printing in a three-dimensional form with a 3D printer, using liquid and powder materials.

The advantage of the use of additive technologies is the opportunity to personalise the production in accordance with the requirements of the end-user. This also decreases the use of resources in production, which in turn leads to lower costs. These goods are not applicable for mass production but for small batches and with lower production costs. The produced goods can have a complex structure and be produced in a shorter timeframe than it would take a traditional production. The production is mobile and can be located even in places such

as aeroplanes, tankers (e.g. the aircraft carrier USS Essex, '14) where there is a need for timely availability of spare parts. This characteristic of the technology for some productions leads to contraction of the value chain since it combines some of its stages. It is very applicable in the fashion industry. An innovative approach in the application of the technology is the 3D printer with open source code which functions on the principle of self-copying. One, also, should not underestimate the application of the technology in medicine with the 3D printing of organs for biological species.

II. ECONOMIC PARAMETERS OF THE DIGITAL ENVIRONMENT

1. Reformatting the production and trade processes in the economic turnover

The digital environment led to reformatting of whole national economies and this affected transnational productions, which led to a contraction in the value chain with regards to the stages of production and trade. The economic relations in the digital environment changed into personalised production, fast trade, attraction of direct investments and new technologies, including the knowledge associated with them. Despite the undeniable advantages of the digital environment, in order for them to turn into a competitive advantage for the enterprise and the national economy, according to some authors (Laplume et al., 2016) the following preconditions are essential:

- the size of the national market;
- the level of economic development;
- the structure of the economy with regards to whether the mining and processing industries are developed – the relationship between competitiveness and the digital environment is better developed when the processing industry is developed because a deeper integration is achieved in the global value chain functioning in a digital environment, through the import and export of intermediate goods (Gereffi, 2014);
- the customs fees, participation in regional trade agreements, the level of infrastructure development, foreign investments, the participation of the relevant institutions.

For the purposes of the identification of the economic parameters of the digital environment and the social-economic challenges facing enterprises in 2018, a survey has been conducted with 1600 top management participants selected from 19 countries (Deloitte, 2018) The results of the study show that 87% of the participants expect a more stable future with less social disbalances, but two out of three respondents are of the opinion that business will have a much bigger impact than what is reflected in government forecasts. Around ¼ of the people interviewed are of the opinion that the enterprises that they manage have a big impact on key social factors such as education, sustainability and social mobility. The summarised results of the study show that for enterprises whose managers participated in the study the data collected from the used digital applications is used for specific intelligent solutions in the business environment, because the participants believe that the collected data creates many opportunities for new products, services, better customer service, new positions and business models. Despite that, ¾ of managers still apply traditional business operations and don't plan

to transform the business models or the business strategy of the enterprise. The remaining ¼ believe that the enterprises have crossed into Industry 4.0 As a main reason for the slow rates of the digital transformation of business models of enterprises, managers point out the challenges in finding highly qualified employees and the building of a working team. Another reason is that digital transformation and staffing are not priorities in the strategic development of the enterprise. The third reason mentioned by managers is that the enterprises managed by them will certainly generate value for the owner, but it is not clear whether it will have social dimensions and if yes – what might they be.

The results of the survey are interesting in terms of the degree of readiness of the business for technological change, and the following conclusions can be made. The transition of businesses in an entirely digital environment is a serious change for enterprises. The full potential for the transformation of business requires a broader vision for the implementation of intelligent, connected technologies, which is a major challenge. Because of that at the moment enterprises use digital technologies for the optimisation of traditional activities related to time and quality of execution (47% of the surveyed enterprises use innovative technologies to improve the effectiveness of employees).

The remaining enterprises are the ones which use the digital environment for the next step – the creation of new business models, determining new ways of production, delivery, and generation of added value.

According to the results in the Deloitte's report, the digital environment is revolutionary because it allows enterprises to capture real data, analyse it with the help of digital technologies and then to propel the informed action in the physical world. This continuous and cyclical flow of information, known as "physical-to-digital-to-physical", allows them to react in a real time to changes in the business environment. In addition, using the large collected volume of data, they can recognise models, simulate and model the potential future through scenarios and learn to even predict future changes. This can make them more adaptable to unexpected changes, more flexible to unpredictable ecological changes and better prepared to deal with challenges both internally and externally.[5]

2. Preconditions for development of the economic transformation

A characteristic of the digital environment is the fact that despite it being based on intellectual property, i.e. new technologies, it is not a work of one enterprise that has a monopoly on its use. Quite the opposite, it is a targeted state policy of industrially developed countries, led by Germany. In 2013 the German government was one of the first which mentions Industry 4.0 as a strategic goal for the development of the national economy. The so-called high-tech strategy presented in 2015 outlines a plan for the almost complete computerisation of the processing industry to a point where it won't need the help of humans. At present, the German government invests around 200 mln. euro (around 146 mln. British pounds, 216 mln. dollars

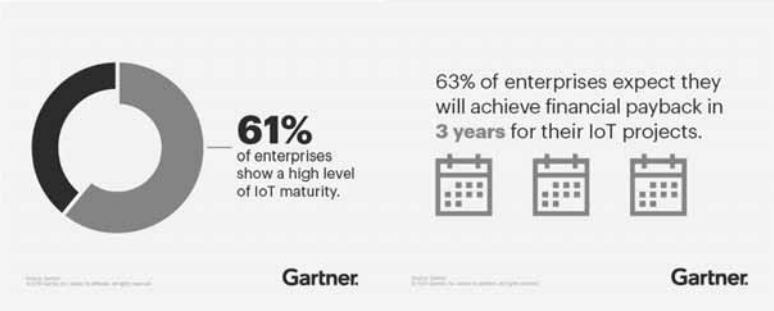
[5] See: https://cio.bg/analizi/2018/04/25/3433171_industriia_40_-_mechta_ili_realnost/

or 278 mln. american dollars) for the promotion of scientific research in academia and business.[6]

The national economy is an important precondition for the digital transformation of production in the USA, e.g. the non-profit organisation Smart Manufacturing Leadership Coalition (SMLC), with the representation of producers, suppliers, tech enterprises, government agencies, universities and laboratories, implements the national policy by working to create progress in the thinking related to digitalisation of business processes in the industry. The goal is to build an open, intelligent production platform for industrial network applications, which will allow production enterprises, with priority for SMEs, to have easy access to modelling and analytical technologies that can be personalised for their business needs.[7]

The motives for the implementation of a national policy for digital production are the improvement of productivity and the elimination of unproductiveness in all stages of the value chain, at reduced costs and with the use of data at a real time. Behind these motives, we have numbers that act as arguments and determine the value of this digital revolution, namely over 4 trillion dollars by 2020 market share[8] (see Figure 3).

Figure 3



Source: Gartner at: https://www.gartner.com/en/information-technology/insights/internet-of-things

According to a research, conducted by the consultancy company Gartner, the market for Internet of Things by 2020 is worth almost 3,7 trillion dollars.[9] The research shows that enterprises from around the world will take advantage of digital technologies which will

[6] In a speech of chancellor Angela Merkel in January 2015 at the World economic forum in Davos:
[7] https://www.kaldata.com/it-%D0%BD%D0%BE%D0%B2%D0%B8%D0%BD%D0%B8/%D0%BA%D0%B0%D0%BA%D0%B2%D0%BE-%D0%B5-%D0%B8%D0%BD%D0%B4%D1%83%D1%81%D1%82%D1%80%D0%B8%D1%8F-4-0-%D0%B8%D0%BB%D0%B8-%D1%82%D1%80%D0%B5%D1%82%D0%B0%D1%82%D0%B0-%D0%B8%D0%BD%D0%B4%D1%83%D1%81%D1%82-321987.html
[8] Data from KPMG
[9] https://www.gartner.com/en/information-technology/insights/internet-of-things

increase the earnings of the manufacturing sector with around 445 billion British pounds and will create around 175,000 jobs.

The implemented policies also presuppose the institutionalisation of the issue of the digital industry. For example, in Germany and the USA consortiums are being established with the task to deal with this issue, the German Dialogplattform Industry 4.0. and the American Industrial Internet Consortium, which will develop common standards for the so-called transnational intelligent factories.

3. Economic transformation and competitiveness

The digitalisation of the industry means, in essence, an economic transformation, which always outlines those elements of the transformation process that create the competitiveness for enterprises. In the course of this research, a large part of those elements were underlined (increase in productivity, decrease of the costs for labour, raw materials, personalisation of the production, increase in direct investments, improvement of the distribution, international market expansions, etc.). Competitiveness will be expressed in:

- establishing control over the processes of merging of goods and services in one product, the so-called intelligent product;
- participation in the global production chains of the processing industry, while avoiding the production and consumption of intermediate goods, the so-called intelligent production;
- use of highly qualified employees for the management of intelligent factories and the processes within them;
- automation of the production and delivery in the so-called intelligent factories;
- creation and application of new business models, the so-called hybrid business models with an accent on personalised production and consumer efficiency. With the model, the consumers participate in the value chain in the role of providers of information for the personalisation of the product, and in some cases participate in the production process (Bogers et al., 2016).

All these economic effects create certain competitiveness which, however depending on the specificities of national legislations, markets and business practices is different, both for the enterprises in different sectors and for the enterprises in different countries. In this sense, the competitiveness is expressed in the so-called upgrade in the value chain. In essence, this is an economic upgrade which is defined as a process of transfer of economic agents, players, participants (enterprises, workforce) from low value-added productions to high value-added productions. The digital environment and the trends in production and trade in it differentiate four versions of such an upgrade depending on the national economy of the given country, and on the cross-border nature of the value chain, i.e. the international interconnectedness of production and/or the trade activity of the enterprise, such as processes in other enterprises at a territorial distance.

- Improvement in the production process by the use of digital technologies with influence over production costs;
- Improvement of the product and its delivery – type of innovation production;
- Functional improvement, i.e. identification of niches in the value chain with less competitors (e.g. the enterprise holding rights for the trademark Nike reoriented its production not towards product diversity but towards increasing of the design options of the products, and the enterprise Acer which started branding its production chose a similar solution);
- Improvement of the product range (e.g. Nokia and Krups, the former reoriented from the production of shoes towards the production of mobile phone technologies, and the latter from the production of military technology towards coffee machines. (Ruessman et al., 2015)

It is noticeable that besides the two traditional models for an upgrade, related to the digital industries, another two models have formed which, however, are based mainly on the creation and use of IP (industrial designs, trademarks, etc.). We should note that digital technologies allow for the development of competitiveness not only on the level of production but also with regards to logistics, employee productivity and improved customer experience.

III. WHAT DOES THE DIGITALISATION OF THE INDUSTRY MEAN FOR BULGARIA?

The digitalisation of the industry in Bulgaria means that "Production operations are combined with the newest information and communication technologies, and the driving force behind this development is the rapid digitalisation of the business world and society as a whole. The trends in production processes are more personalisation of the products which means that production lines must adapt easily and automatically to orders, and also have to be able to compensate for the individual production units that are at a standstill. The new opportunities for management of factories will give opportunities for faster reactions."[10]

In this sense, the production in the digital industry should be based on:

- strategic importance – it is the expansion of the meaning of the term "improvement of the product or the production" through digital technologies, namely, this is the development and application of whole new business models;
- intelligent factory – this is integration and self-regulation of the processes in the value chain with an accent on productivity. Big data is generated, which creates a burden for the information systems and requires serious investment in their construction. With regards to distribution the accent in on the digitalisation of processes linked to outside partners and big clients, which requires a large-scale digital integration for the purposes of creating digital networks for the generation of added value;

[10] Borissov, B., head of „Engineering“ – Festo production EOOD, see: https://www.tbmagazine.net, 08 January 2018

- intelligent operations – the digitalisation of the processes allows an integration of operations on both horizontal and vertical levels (in essence this is the integration of the production systems inside the enterprise) of the value chain;
- intelligent products – those are physical objects, equipped with information and communication technologies, through which they communicate with the surrounding environment, record it using sensors, and offer different functional applications to be added. They provide information for the exact condition and place of the product in the production or trade process, in real time;
- highly qualified employees – they help mediate the transformation but only when they possess the necessary qualification (engineers, ICT specialists). The investments related to completing the professional qualification of employees are significant investments for the enterprises.

The digital technologies are already available in Bulgarian. In 2019 the Bulgarian enterprise Allterco (the technology that made the enterprise successful is a children's watch with smart technology called MyKi) successfully completed an initial public offering of shares on the Bulgarian stock exchange by which it collected over 2 million leva of capital and it turned in the second tech company that is publicly traded in Bulgaria. Another Bulgarian high-tech company is Melissa Climate. It uses the Internet of Thing for smart devices aimed at energy efficiency at home.

Big data and information, their processing and distribution help in the finding of innovative solutions with the use of Internet of things – inventions and innovations, improved existing products through the use of IP, such as trademarks and industrial designs. Such innovative examples are Echo and Alexa, which turn household appliances in an intelligent management system. Considering consumer sentiment, a good example is the printed tag sensors on Johnnie Walker bottles. Therefore, the competitiveness in a digital environment is expressed in:

- new products and services – renovation of products and services, creation of new ones and introduction of innovations;
- automation of processes – optimisation of business processes, increase of the effectiveness of work and improvement of the decision-making process;
- lower costs;
- better interactions with clients – improvement of the service and creation of a unique consumer experience;
- more successful marketing.

Enterprises that have introduced the digital transformation in their businesses are 26% more profitable and their market value is 12% higher than the average for their industry.[11]

[11] Shopov, A., Digitalna transformaciya na biznesa, https://www.tbmagazine.net/statia/digitalna-transformaciya-na-biznesa.html, 10 April 2017

Those are also the plans of the Bulgarian government, which by adopting the "Concept of digital transformation of Bulgarian industry (Industry 4.0)" aims towards modernisation, automation and competitiveness of the Bulgarian economy in the medium to long term (2017-2030).[12] That way, by 2030, Bulgaria should be recognised as a regional centre of the digital economy through the implementation of products, technologies, business models and processes in the digital industry. The targeted areas of digital transformation are the digitalisation of business, the export orientation and competitiveness in the following headings:

- strengthening the relationship between science and industry in the country and accelerated integration of Bulgaria into European and international programs, initiatives and networks related to the development and implementation of Industry 4.0.;
- technological innovation of the Bulgarian economy through: introduction of standards, construction of infrastructure, development of specific mechanisms for stimulating the development and market introduction of technological innovations (new products, services and production processes) through the technologies of Industry 4.0.;
- building human, scientific, organisational and institutional capacity for the development of Industry 4.0 in Bulgaria (EC-EU, Doc. 32, 2019).

The implementation of the Concept will implement specific policies and measures for the digitalisation of the economy and the production sector, and will coordinate the policies, instruments and mechanisms in the different ministries, both between them and in accordance with the policies of the European Union in this field.

In conclusion, we can summarise that the businesses which can react in time to the digital transformation are destined for economic success, but how much would that cost in a social aspect? After all, the digital competitiveness is aimed at achieving economic effects. Its development is connected to the overcoming of serious social and cultural challenges such the limitation on personal freedom, including in the making of decisions about consumption of goods and services, the decrease in job opportunities, the security of data in the digital environment, the decrease of social skills compared to technical ones, the changes of the way we live, and the way we create and consume culture. Whether the digital industry will achieve a balance between the economic and the socio-cultural effects, probably only time will show. In any case, what is undeniable is that the digital competitiveness is a precondition for economic growth and wealth, both on micro and macro levels.

[12] Protocol decision № 37 from 30 August 2017 The Council of ministers approved „Concept of digital transformation of Bulgarian industry (Industry 4.0)“, as the basis for the development of a Strategy for the participation of Bulgaria in the fourth industrial revolution, see: https://www.mi.government.bg/bg/themes/koncepciya-za-cifrova-transformaciya-na-balgarskata-industriya-industriya-4-0-1862-468.html.

References

Artificial-Intelligence-Innovation-Report (2018). Deloitte, powered by Spring Wise at: https://www2.deloitte.com/content/dam/Deloitte/de/Documents/Innovation/Artificial-Intelligence-Innovation-Report-2018-Deloitte.pdf , accessed 2020.

Bogers, M.; Hadar, R.; Billeberg A., (2016). Additive manufacturing for consumer-centric business models: implication for supply chains in consumer goods manufacturing – Technological Forecasting and Social Changes, Vol. 102, p. 225-239.

Böhler, T. M., (2012). Industrie 4.0 – Smarte Produkte und Fabriken revolutionieren die Industrie. In: Produktion Magazin. 10. Mai 2012, Abgerufen am 5. September 2012.

Colombo, A.W; Bangemann, T.; Karnouskos, S.; J. Delsing, J.; Stluka, P.; Harrison, R.; Jammes, F. and Lastra, J. (2014). Industrial Cloud-based Cyber-Physical Systems: The IMC-AESOP Approach. Springer Verlag, 2014, ISBN 978-3-319-05623-4, Abgerufen am 7. Apr 2014.

Deloitte, (2018). The Fourth Industrial Revolution is here — are you ready?, available at: https://www2.deloitte.com/content/dam/Deloitte/tr/Documents/manufacturing/Industry4-0_Are-you-ready_Report.pdf, май 2020.

EC-EU, (2019). Monitoring progress in national initiatives on digitising industry, available at: https://ec.europa.eu/information_society/newsroom/image/document/2019-32/country_report_-_bulgaria_-_final_2019_0D321A4A-044E-25BE-662DADCE68FAF893_61229.pdf.

FAMPAT database provided by Questel available at: https://www.questel.com/wp-content/uploads/2016/04/FamPat-Rules.pdf, accessed 2019;

Gartner, (2020). research available at: https://www.gartner.com/en/information-technology/insights/internet-of-things.

Gereffi G., (2014), Global Value Chain Perspective on Industrial Policy and Development in Emerging Markets. 2014 // Duke Journal of Comparative & International Law, Vol. 24. Issue 3\2;

Kai-Fu Lee, (2019), Sinovation Ventures, WIPO Technology Trends, p. 23.

Karnouskos, S., (2012), Cyber-Physical Systems in the Smart Grid (PDF; 79 kB). In:Industrial Informatics (INDIN), 2011 9th IEEE International Conference on, Juli 2011. Abgerufen am 5. September 2012.

Kondratiev, Vl., (2018), The fourth industrial revolution and the globalisation, 30 january 2019, Geopolicy jurnal, vol. 6.

Laplume A., Petersen B., Pearce J., (2016). Global value chains from a 3D printing perspective // Journal of International Business Studies. Vol. 47 No. 5.

Laurent, St.; Andrew M., (2008), Understanding Open Source and Free Software Licensing, O'Reilly Media, ISBN 9780596553951, p. 4.

Marr, B., (2016). What Is The Difference Between Deep Learning, Machine Learning and AI? Forbs at: https://www.forbes.com/sites/bernardmarr/2016/12/08/what-is-the-difference-between-deeplearning-machine-learning-and-ai/.

Marr, B., (2018). The Key Definitions Of Artificial Intelligence (AI) That Explain Its Importance Forbs, at: https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/#5a2138b14f5d.

Marr, B., (2020). What Can 3D Printing Be Used For? Here Are 10 Amazing Examples, Forb, at: https://www.forbes.com/sites/bernardmarr/2020/07/24/what-can-3d-printing-be-used-for-here-are-10-amazing-examples/#2ff31baf4d69.

Poole, D. et al., (1998). Computational Intelligence: A Logical Approach. New York, Oxford University Press, ISBN 0195102703.

Ruessman M. et al. (2015). Industry 4.0. the future of productivity and Growth in Manufacturing Industries, Boston Construction Group, Boston, MA.

Ruessman, M. et al. (2015). Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries. Boston Construction Group, Boston, MA.

Russell, St. J. et al., (2003). Artificial Intelligence: A Modern Approach. 2nd. Upper Saddle River, New Jersey, Prentice Hall, ISBN 0-13-790395-2.
Schwab, K., (2017), Fourth Industrial Revolution (4IR).
Technology Trends, (2019) published by WIPO, available at: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf.
Tsirigos, A., (2019). NYU School of Medicine, WIPO Technology Trends, p. 21.
van Duin & Bakhshi, Part (2017), 1: Artificial Intelligence Defined, Deloiite. - At: https://www2.deloitte.com/nl/nl/pages/data-analytics/articles/part-1-artificial-intelligence-defined.html , accessed 2020.

Information sources

1. Literature and the media environment: online dictionary, see https://litmedia.wordpress.com/%D1%80%D0%B5%D1%87%D0%BD%D0%B8%D0%BA%D0%BE%D0%B2%D0%B8-%D1%81%D1%82%D0%B0%D1%82%D0%B8%D0%B8/%D0%B4%D0%B8%D0%B3%D0%B8%D1%82%D0%B0%D0%BB%D0%B8%D0%B7%D0%B0%D1%86%D0%B8%D1%8F, May 2020.
2. Industry 4.0. – Revolution or evolution? https://xn--80aahddubcb0awc4bnhip4t.bg/tema/industriya-4.0/industriya-4.0-revolyutsiya-evolyutsiya, May 2020.
3. https://geopolitica.eu/2018/174-broy-6-2018/2941-chetvartata-industrialna-revolyutsiya-i-globalizatsiyata, May 2020.
4. https://www.kaldata.com/it-%D0%BD%D0%BE%D0%B2%D0%B8%D0%BD%D0%B8/%D0%BA%D0%B0%D0%BA%D0%B2%D0%BE-%D0%B5-%D0%B8%D0%BD%D0%B4%D1%83%D1%81%D1%82%D1%80%D0%B8%D1%8F-4-0-%D0%B8%D0%BB%D0%B8-%D1%82%D1%80%D0%B5%D1%82%D0%B0%D1%82%D0%B0-%D0%B8%D0%BD%D0%B4%D1%83%D1%81%D1%82-321987.html, May 2020.
5. https://kultura.bg/web/%D1%87%D0%B5%D1%82%D0%B2%D1%8A%D1%80%D1%82%D0%B0%D1%82%D0%B0-%D0%B8%D0%BD%D0%B4%D1%83%D1%81%D1%82%D1%80%D0%B8%D0%B0%D0%BB%D0%BD%D0%B0-%D1%80%D0%B5%D0%B2%D0%BE%D0%BB%D1%8E%D1%86%D0%B8%D1%8F/, May 2020.
6. https://litmedia.wordpress.com/%D1%80%D0%B5%D1%87%D0%BD%D0%B8%D0%BA%D0%BE%D0%B2%D0%B8-%D1%81%D1%82%D0%B0%D1%82%D0%B8%D0%B8/%D0%B4%D0%B8%D0%B3%D0%B8%D1%82%D0%B0%D0%BB%D0%B8%D0%B7%D0%B0%D1%86%D0%B8%D1%8F, May 2020.
7. https://www.mi.government.bg/bg/themes/koncepciya-za-cifrova-transformaciya-na-balgarskata-industriya-industriya-4-0-1862-468.html, May 2020.
8. https://www.tbmagazine.net/statia/digitalna-transformaciya-na-biznesa.html, May 2020.
9. https://www.tbmagazine.net/statia/kak-internet-na-neshchata-mozhe-da-napravi-biznesa-po-efektiven.html, May 2020.
10. https://www.tbmagazine.net/statia/industriya-40-shche-izmestyat-li-mashinite-horata.html, May 2020.
11. https://www.tbmagazine.net/statia/zhyustin-toms-digitalnata-transformaciya-na-biznesa-i-trite-osnovni-spnki-pred-neya.html, May 2020.
12. https://www.tbmagazine.net/statia/roboti-svrzani-s-internet-na-neshchata-iot-ulesnyavat-zhivota.html, May 2020.
13. https://xn--80aahddubcb0awc4bnhip4t.bg/tema/industriya-4.0/industriya-4.0-revolyutsiya-evolyutsiya, May 2020.
14. https://cio.bg/analizi/2018/04/25/3433171_industriia_40_-_mechta_ili_realnost/, May 2020.