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Digital Transformations and Economic Standards: the Key Questions to Bulgaria Posed by National Economy's Existing Potential

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Abstract

In this paper, we consider some of the major challenges that digital transformations (DTs) have posed to the economic management. Digital transformation is an imperative for modern companies to succeed. Other researchers identified some specific factors of companies' DTs success, among them incremental transformations, cost-effectiveness and sustainability of organizational changes (BCG, 2021). This identification stemmed from the microeconomic viewpoint by examining the experience of large companies, which operate in global markets. We welcome this identification. However, we argue that DTs success and benefits could and should be examined from other viewpoints too, especially, from the position of society, in particular, the community at a national level. We state DTs have not the same scope and role by regions and countries, as economic standards raise some barriers against this process. In other words, the parameters of socio-economic environment are one of the significant factors of the success of companies' DTs. We make a difference between the two major groups – the micro and the macro factors of DTs, based on an overview of ICT changing role over the latest three technological revolutions from industry 3.0 to industry 5.0.

To test our hypothesis, we conducted an empirical analysis based on the holistic approach (the macroeconomic perspective). We made a comparative analysis by country, starting from the viewpoint of the Bulgarian economy and thus turning the scope to the domestic socio-economic environment. We examined the position of the ICT sector and the role it plays for the community at large, especially, for consumer behavior in the recent decade. Several sub-hypotheses are tested. The output of the analysis allowed us to conclude, by now, that the increasing position of the ICT sector in the Bulgarian economy, which converging with general trends, is still not indicative of improvements in the economic and living standards of the country.

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Introduction

Digital transformations have no alternative, but their role and scope, and the benefits they bring to the community at large are not the same across regions and countries around the world. The aim of this paper is to outline, in regards with digital transformations, some of the key factors of success that stem from the parameters of a national economy. The methodology used stems from the system approach and the holistic approach to the economic functioning by bringing together the following two – the activity of companies and persons at an individual level, on the one hand, and the parameters of a national economy, on the other. The latter are the output of the former, but, at some specific moment, they turn into a driving force of the individual behavior.

To achieve the aim, first, a definition of digital transformations and a brief overview of the introduction of information and communication technologies (ICT) in the economy are presented. Next, the main difference between the two – success potential factors of a company's activity in digital transformations, on the one hand, and major shifts in the macroeconomic functioning driven by digital transformations, on the other hand – is under discussion. Finally, the output of an empirical analysis, which is based on the holistic approach (in our case, the macroeconomic viewpoint), is given and some comments are made.

The empirical analysis aimed to assess the role of industries, which directly contribute to the development and the implementation of ICT in the production and distribution, and in the economic management as well. These set the ICT sector of the economy (OECD, 2021; Eurostat[1]). The attempt is to define the position of the new sector in the national economies and its relevance to consumer behavior over the last years. For the purpose, we conducted a comparative analysis at a country level, by concentrating on the European economies, and additionally turned the scope mainly to those of the EU's member states. We examined the ICT sector from different viewpoints, specially, from the two main – the production and consumption activity of a society. In the light of the different perspectives, we worked with a sample, which varies from 13 to 30 countries depending on data available by year.[2]

Following the methodology, we used a set of indicators designed by Eurostat. To assess the role of the ICT sector in the production and management processes, we picked the following ones: the relative share of the sector in the national GDP, business expenditure on R&D in the ICT sector as a percentage of gross R&D expenditure of a national economy, the percentage of ICT personnel in total employment, digital integration of internal processes, and the percentage of enterprises' turnover on e-commerce in total turnover. To assess the role of the ICT sector to consumer behavior, we picked two main indicators, which treat individual behavior as a

[1] https://ec.europa.eu/eurostat/cache/metadata/en/isoc_ se_esms.htm

[2] The largest sample includes Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Hungary, Luxemburg, Malta, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, Switzerland, Iceland, Norway, and United Kingdom.

dependent on external environment features; namely, digital inclusion (measured by the frequency of internet access: once a week, including every day), and digital exclusion (percentage of individuals who never used the internet).

1. Digital transformation evolution and main changes in the economic guise

One of the most popular definitions of digital transformation used in business practice presents it as the integration of digital technology into all areas of a business, fundamentally changing how you operate and deliver value to customers; in turn, this integration drives a cultural change, which requires organizations to continually challenge the status quo, experiment, and get comfortable with failure.[3] However, it does not happen "in one fell swoop", as the experts of Boston Consulting Group argue (BCG, 2021).

The integration of digital technology into management and business operations became a popular practice more than five decades ago. By evolving, the process has set out several stages of digitalization up to date. Those directly correspond to the last three of the five known technological revolutions until now. In the tradition of the economic theory, the economy tends to go through a number of Industrial Revolutions (Perez, 2010; Perez & Soete, 1988), the latest one named as Version 5.0.

The beginning was when the technological revolution opened Industry 3.0 as a new stage of the economy's evolution (Sheth, 2018) and the first computer era was set forth. What was new in comparison to previous stages was the introduction of computers in production processes. Basically, Industry 3.0 is presented as "*the era of setting up more automated systems onto the assembly line to perform human tasks by using Programmable Logic Controllers (PLC)*" (Sheth, 2018); in other words, industrial machines are built on integrated circuits (Adeyeri, 2018). It is worth stressing that the use of computer machines took place in two directions, which seldom are delineated from each other. Digital technologies were steered directly to data processing in production methods, but they also entered another aspect of conducting economic activities – namely, into the management system. The recent aspect involves operations and processes that go beyond production methods and distribution, closely relating to the economic governance itself.

In 1974, in his book "Automated management system for the national economy" E. Mateev defined in a comprehensive manner the subtle difference between the *economy* as an object of governance and the *management system* as a subject of governance, by conducting an informative research in the field of automated management systems design. In this aspect, he identified man as a benchmark to distinguishing an economic activity from a production processes – the former being an element of the economic system (economy in the cybernetic aspect), and the latter being an application of a technical method, setting a technological system (Mateev, 1974, 1987). This identification is of key importance to interpret adequately the advantages and disadvantages of technological changes driven by digital transformations. It was made under the cybernetic approach to the economy (Mateev, 1974, p.7), which tends to consider

[3] The Enterprisers Project - see: https://enterprisersproject.com/what-is-digital-transformation

the management system separately from changes in the technological base of goods and services manufacturing. The growing need for data collection and data processing in the decision-making purposes led the way of digitalization of management operations. Information management systems were set in the late 70s to early 80s, being a subject of theoretical and empirical analyses. Among the pioneers of researchers in the field of information management systems (IMS) are Lyytinen and Hirschheim, who periodically examined the IMS success and failure factors and classified information management systems (Lyytinen, 1987; Hirschheim, at al. 1995).

By the 1970s, the Third Industrial Revolution had expanded the use of electronics and Information Technology (IT) to further automation in production. At around the same time, information management systems were set in business organizations. During the following three or four decades, manufacturing and automation advanced considerably thanks to Internet access, connectivity and renewable energy, and set the fundamentals of the Fourth Industrial Revolution. The main feature of the digitalization at the stage of Industry 3.0 was that even in place, the automated systems still relied on human input and intervention.

Industry 4.0 has revolutionized the organization of economic activity by changing the way of interaction between human and automated production systems. This is the era of "smart factories", which combine smart machines, storage systems and production facilities. The combinations of this kind allow autonomous exchange of information to trigger actions at some specific points and to self-control within the combination, without human intervention. In other words, this is a special technological system programmed by man. The economy of the Industry 4.0 era relays on several new technologies, among them, cyber-physical systems, the industrial Internet of Things (IIoT), cloud computing, and artificial intelligence playing the key role (Adeyeri, 2018; Sheth, 2018; Zakoldaev et al., 2019; BCG, 2021).

According to Sheth, the *Fifth Industrial Revolution* advent is led by a further increase of the automatization in manufacturing processes based on real-time data coming from practice. It will be driven by setting in the technological opportunities to customers to customize what they want. However, one great challenge here will arise in terms of the need to reconcile man and machine by finding ways to work together, aimed at improving the means and efficiency of production. Experts assume that under the Industry 5.0 era of production and consumption, specialized software like costing software for manufacturing can serve to optimize the costs of a new product, automating the cost process and accelerating the time to market on new products (Sheth, 2018; Zakoldaev et al., 2019). Namely in this dimension, the great advantages of Industry 5.0 is theoretically expected.

Digital transformation impact can be identified at any particular level and in any aspect of the organizational functioning, specially, in the way in which employees work, in the business processes working, in the process of data collection, analysis and use (Brainhub, 2021), in the process of developing and modifying a company's strategy (Tanushev, 2018). Nevertheless, from an economic viewpoint and therefore, to the economic management, the outcomes of the process are those of key importance. Let us now make an overview of the major outcomes

of digital transformation and the groups of factors which influence their magnitude.

2. Digital revolution outcomes in terms of the main economic principles and effects

In regards with the transition from Industry 3.0 to Industry 4.0, one of the major effects perused is to reduce the terms of production and supply process and to increase the quality of the manufactured item designing components. The expectations about humanless and paperless production are that these new features will help to increase the quality of market offerings (Zakodaev at al., 2019). According to software companies, thanks to digital transformation, companies have the opportunity to optimize operating costs as well as to increase process efficiency, namely not only through minimizing the operating costs but also by improving customer services, production planning and supply chain management. The opportunities, which Big Data gives, theoretically consist in the companies' access to rapidly growing huge amounts of data from various sources, based on which to derive precious information and to increase the ability to predict the market situation. All these allow companies to understand better their customers, and, on this basis, to add value and meet in a proper way the customers' needs.

It is worth emphasizing that for now, these effects, theoretically predicted, have not been proven entirely in practice. In developed economies, digital transformation is seen not as the future but the present. Nevertheless, could we admit this is also the case in less developed and developing countries? What would be the case of underdeveloped countries? Beforehand, it is clear that the three types of countries have different economic capacity and technological base, including scientific potential. For this reason, it is more realistic to expect that the socio-economic life in the three types of countries is predisposed to a different extent to full digital transformation, and respectively, it is at a different stage of "maturing" for taking advantages of digital transformation benefits.

For an international company which operates in a global market to be and remain competitive, it must go through this process; otherwise, it will lag behind the competition, which is continuously improving. Is this relevant to a small company which operates only in a local market? If that is the market in a developed region or country, the answer seems to be positive; but if this is the market in a developing or undeveloped region or country, to answer the question, we need a research.

According to BCG's experts, only about 30% of companies navigate a digital transformation successfully, and one of the major challenges to the organizational management is posed by the uncertainty, because new behaviors and expectations take place and evolve at warp speed. This is a new reality, which makes environmental changes difficult to navigate in. The Covid-19 pandemic has become a special factor, which additionally challenged the economic perspectives under a digital transformation process. In this regard, BCG's experts have identified several factors, which directly affect a company's experience in terms of digital transformations. In particular, the following ones. 1) To have an integrated strategy. 2) Not only top management but also the middle management to commit to the digital transformation. 3) To deploy and manage high caliber talent at the company. 4) To foster an agile management mindset that drives broader adoption and mission

oriented ways of working in the organization. 5) To monitor the progress towards defined outcomes. 6) To deploy a modular, cloud-based technology and data platforms, built in line with business needs. These factors relate to the microeconomic viewpoint, closely concerning the ability of organizational management to ensure that company's resource base will match the needs and the requirements of competitive markets under the specific industrial revolution 4.0. This issue is subject to organizational management under the strategic marketing concept (Hooley at al., 2017, p. 29).

The factors mentioned above are relevant mainly to large internationally based companies, which operate in global markets, especially, where industry 4.0 characteristics widely have been manifested. However, some of the key issues of digital transformation success relate to the processes and phenomena beyond the organizational management. We argue that there is another one great challenge to digital transformation success, which originates from the difference between countries and regions in terms of economic standards, welfare and quality of life. It is therefore appropriate that digital transformations success factors and outcomes be examined in the light of the benefits and harms of the community at large. Our starting hypothesis is that these outcomes will vary to a significant extent by country and region. Laffi and Boschma found that the probability of developing Industry 4.0 technologies is higher in regions that are specialized in Industry 3.0 technologies than in those specialized in some other kind of technologies (Laffi and Boschma, 2022).

3. Empirical analysis outputs – the macroeconomic viewpoint to digital transformations success

The methodology of the empirical analysis aimed to assess the contribution of the ICT sector to the economic standard increase and innovation processes within a national economy. We used the correlation analysis to define the relation between the ICT sector growing position in the national economies, on the one hand, and the economic standard level of countries, on the other. Specially, we worked with Spearman's correlation coefficient and Pearson's correlation coefficient. In addition, we used several indicators of statistical dispersion to measure the extent to which national economies of the Europeans societies differ from one another in terms of digital transformations progress. We calculated a special index to define the role of the ICT sector for labour application changes.

To define the role the ICT sector has played in the national economy over the recent decade, we tested several hypotheses. *First hypothesis,* tested on the basis of data for 3 years in the 2009 – 2018 period, states out that, with a significance degree of 5% ($\alpha = 0.05$), there is no rank correlation between GDP per capita (measured at c. p.) and the relative share of ICT sector in GDP of a national economy. As $|t_{obs}| < |t_{crit\ value}|$ for the three observed years, there are no arguments to reject the null hypothesis – see tab. 1. To obtain a stronger measurement in this respect, we have calculated and verified statistically the Pearson's correlation coefficient. The output of this analysis proved the null hypothesis valid once again, as $|t_{obs}| < |t_{crit\ value}|$. This means that a relatively higher share of the ICT sector of an economy in the national GDP is not an indicator of a high economic standard. In this sense, a growing position of

the ICT sector still could not play the role of a measure of economic success potential and new opportunities for the community at large, in particular, at the country level.

Table 1. Statistical test for correlation between GDP per capita and the position of the ICT sector in GDP

Indicators \ Time	2009	2013	2018
H0: No rank correlation between GDP per cap (at c. p.) and the relative share of ITC sector in the GDP of a national economy.			
α	0,05	0,05	0,05
degree of freedom (n-2)	17	18	23
Spearman's correlation coefficient (rs)	**0,14737**	**0,00301**	**-0,04346**
H1	H1 ={pxy ≠ 0}	H1 ={pxy ≠ 0}	H1 ={pxy ≠ 0}
t obs	0,61432	0,01276	-0,20863
t critic value	1,74	1,73	1,71
Results	*H0 not rejected*	*H0 not rejected*	*H0 not rejected*
H0: No correlation between GDP per cap (at c. p.) and the relative share of ICT sector in the GDP of a national economy.			
Pearson's correlation coefficient	**0,00714**	**-0,08350**	**-0,06551**
α	0,05	0,05	0,05
H1	H1 ={pxy ≠ 0}	H1 ={pxy ≠ 0}	H1 ={pxy < 0}
t obs	0,02942	-0,35548	-0,31484
t critic value	1,74	1,73	1,71
Results	*H0 not rejected*	*H0 not rejected*	*H0 not rejected*

Source: own work based on Eurostat statistics of GDP per cap and the relative share of the ICT sector in the national GDP - https://ec.europa.eu/eurostat/web/main/data/database

The finding of no statistically significant correlation between economic standard level (here measured by GDP per capita) and the share of the ICT sector in the GDP is an essential one. It is of key importance especially to Bulgaria, as over the recent decade growing expectations have been placed to the ICT sector to revive the economic activity in the country and to contribute to a faster growth. In this period, Bulgaria has demonstrated a shifting position of the total ICT sector in the national GDP. Starting from 4.85% in 2009, the sector has reached 6.07% in 2018. Thus, Bulgaria moved from the 6th (among 19 countries[4]) to the 3rd place (among 25 countries[5]) in the ranking of countries by this indicator. However, at the same time, Bulgaria remained the country

[4] These are as follows: Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Spain, France, Croatia, Latvia, Hungary, Malta, Austria, Poland, Romania, Slovakia, Finland, Sweden, and Norway.

[5] Namely, the following: Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Greece, Spain, France, Croatia, Italy, Latvia, Lithuania, Hungary, Malta, Austria, Poland, Romania, Slovenia, Slovakia, Finland, Sweden, Iceland, Norway, and United Kingdom.

with the lowest GDP per capita in the EU, and even with a relatively lower index among a larger set of European countries. According to this indicator, Bulgaria inevitably ranks the last one in the arrangement of countries – respectively, at the position of 19 for 2009, the 20 for 2013, and the 25 for 2018.

The second hypothesis was tested on a basis of data for 3 years in the 2010 – 2019 period. It states out that with a significance degree of 5% (α = 0.05), there is no correlation between Gross domestic expenditure on R&D (as a percentage of GDP) and Business expenditure on R&D in the ICT sector (as a percentage of total R&D expenditure). As $|t_{obs}| < |t_{crit\ value}|$ for the three observed years, there are no arguments to reject the null hypothesis – see tab. 2. This means that the ICT sector is still not a dominant one in the economy of the European countries. Therefore, we could not expect it will be a major driving force of the economic activities in the European societies over the forthcoming years. This is another finding, which is of special relevance to the Bulgarian case, as in the recent years, the activities of software programming seemed promising to foster innovations and the industrial restructuring of the domestic economy. Empirical test results state out, to the contrary, that the whole ICT sector of the Bulgarian economy is still weak to bring domestic innovation processes to another higher level. At the same time, the other sectors of the Bulgarian economy have remained unreformed, demonstrating weaknesses and less competitiveness in the national, and in the internal market of the EU.

Table 2. Statistical test for correlation between Gross domestic expenditure on R&D and Business expenditure on R&D in the ICT sector

Indicators \ Times	2010	2014	2019
H0: No correlation between Gross domestic expenditure on R&D (as a percent of GDP) and Business expenditure on R&D in ICT sector as a percent of total R&D expenditure			
α	0,05	0,05	0,05
degree of freedom (n-2)	19	17	20
Pearson's correlation coefficient	**0,2500719**	**0,3454777**	**0,08455180**
H1	$H1 = \{pxy \neq 0\}$	$H1 = \{pxy \neq 0\}$	$H1 = \{pxy \neq 0\}$
t obs	1,1258080	1,5179032	0,3794861
t critic value	1,73	1,74	1,72
Results	*H0 not rejected*	*H0 not rejected*	*H0 not rejected*

Source: own work based on Eurostat statistics of Gross domestic expenditure on R&D and Business expenditure on R&D in ICT sector - https://ec.europa.eu/eurostat/web/main/data/database

As to Gross expenditure on R&D as a percentage of GDP, Bulgaria demonstrates a relatively low position, falling into the group of the last five countries in the ranking. In 2010, being at the position of 20 (among 21 countries[6]), in 2014 at the position of 16

[6] Belgium, Bulgaria, Czech R., Denmark, Germany, Estonia, Ireland, Spain, France, Croatia, Italy, Lithuania, Hungary, Malta, Netherland, Poland, Portugal, Romania, Slovenia, Norway, United Kingdom.

(among 19[7]), and in 2019 at the position of 18 (among 22[8]). With respect to business expenditure on the on the R&D in the ICT sector as a percentage of total expenditures on R&D of a national economy, at a first glance, Bulgaria demonstrates a relatively stronger, especially, fast shifting position in the ranking. From the position of 18 in 2010 (among 21 countries[9]), it climbs to place 7 in 2014 (among 19 countries[10]) and drops to 13 in 2019 (among 22 countries[11]).

In the recent years, along with Bulgaria other Eastern European countries such as Croatia, Malta, Poland, the Czech Republic, and Slovenia have improved their positions in the ranking by business expenditure on the the R&D in the ICT sector as a percentage of total expenditures on R&D of the national economy. Nevertheless, this could not be perceived as a signal of strong economic activity revival in these countries. It seems to be more realistic to interpret this phenomenon as a consequence of TNCs invasion in less developed countries, rather than a great progress achieved by domestic ICT companies in the field of R&D operations. The major challenge to Bulgaria, which sill differs significantly from the other EU member states, including the countries from Eastern Europe, is that it has not yet managed to get closer, to a significant degree, to the average economic standards of the EU. For now, the bettering position of the ICT sector in the Bulgarian economy is still not an indicative one of improvements in the economic standard of the country.

The analysis of the application and the degree of dissemination of ICT in the real sector of national economies in Europe confirmed our findings regarding the first two directions of examining the digital transformations by country. Over the recent decade, the application of ICT in the management systems of enterprises from the real sector of European economies has increased, as dispersion indicators reveal (see tabl.3, indicator 1). The coefficient of variation decreased between 2010 and 2019, nevertheless, the mean of the share of enterprises from the non-financial institutional sector of the economy (NFIS) that use the ERP software package to share information between different functional areas reached only 35% of all enterprises of this kind. In the case of Bulgaria, this proportion is still below the mean, and there is even no tendency for the distance to shorten over time. In 2019, the portion in question of the Bulgarian economy lagged behind by 12.3 percentage points. In addition, the position of Bulgaria in the ranking by this indicator has deteriorated, falling from place 23rd (among 30 countries[12]) in 2010 to place 27th (among 29 countries[13]) in 2019.

[7] For 2014, Ireland, France, Netherlands and Norway excluded from the sample of the 2010 for no data available, and Slovakia included for data available. Thus, the sample consists of Belgium, Bulgaria, Czech R., Denmark, Germany, Estonia, Spain, Croatia, Italy, Lithuania, Hungary, Malta, Poland, Portugal, Romania, Slovenia, Slovakia, and United Kingdom.

[8] For 2019, France and United Kingdom excluded from the sample of the 2010 for no data available, and Greece, Latvia and Austria included for data available.

[9] See footnote 7.

[10] See footnote 8.

[11] See footnote 9.

[12] The largest sample we work with for the purposes of the empirical analysis, which consists of 30 countries – see footnote 3.

[13] Iceland excluded for no available data for 2019.

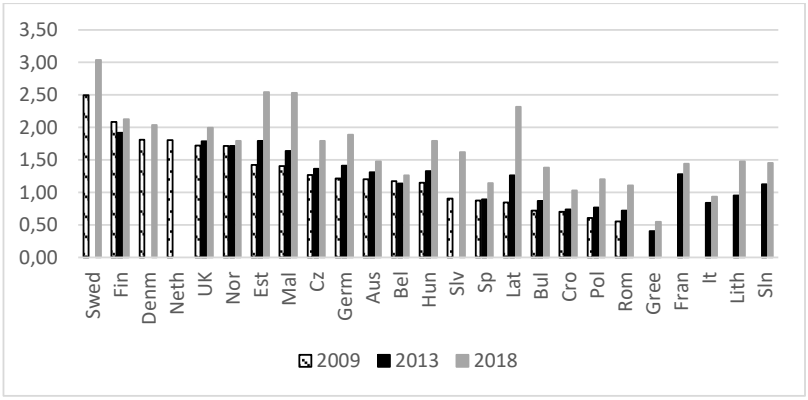
Regarding the position of e-commerce in the sales of enterprises from NFIS, data in tab. 3 are indicative of the fact that electronic sales still play a modest role for the real sector of the European economies. The mean of the share of turnover from e-commerce in enterprises' total turnover has increased by less than 5 percentage points over a decade; meanwhile the coefficient of variation is changing in different directions. This means that European economies have increased the role of e-commerce in distributing products and services from the real sector, but the process develops at a different pace by country. According to this indicator, Bulgaria has remained permanently on the penultimate position in the ranking. In addition, the figures of the national relative share of turnover from e-commerce in the total turnover of enterprises from the real business sector are very modest and unpretentious, reaching only about 4% by 2019.

Table 3. Measures of dispersion on ICT implementation in the real sector of the economy

Indices Years	Sample	X ave	σ	V=σ/X ave*100	R	Me	Rank of Bulgaria	Relative share of Bulgaria
1. In terms of the relative share of enterprises (from the Non-FIS of the economy) which have ERP software package to share information between different functional areas								
2010	30	19,9	8,8	44,1	34	20,5	23	11,0
2014	29	31,0	10,6	34,1	37	34	21	27,0
2019	29	35,3	9,5	26,9	39	34	27	23,0
2. In terms of the enterprises' total turnover from e-commerce sales as a percentage of the total turnover (only enterprises form Non-FIS of the economy)								
2010	27	12,9	5,9	45,4	23	14	26	2,0
2014	25	13,8	6,9	50,1	30	13	24	3,0
2019	28	17,6	8,4	47,6	30	17	27	4,0

Source: own work based on Eurostat statistics of the main indices, https://ec.europa.eu/eurostat/web/main/data/database

In an attempt to define the role of the ICT sector for labour application changes in the European economies, we calculated an index by multiplying the following three variables: the rate of ICT personnel in total employment, the employment rate, and persons in the labour force (as a percentage of active persons in total population aged between 15 and 64 years). In this way, we try to define the position of the personnel with new skills and competencies, which fit the requirements of information and communication technologies, in the labour force of counties. The output of the quantitative analysis is shown in fig. 1, where a sample of European countries is presented for 3 years.



Source: own work based on Eurostat statistics of the main indicators used.
Note: The index of some countries not calculated for 1 or 2 of the observed years for no available data.

Figure 1. The ICT personnel in the labour force

As the figures show, by 2018 the ICT personnel still represented less than 3 percent of the European economies' labour forces. The mean of the index is at 1.66 for that same year, while the standard deviation accounts for 0.58 percentage points, representing about 35 percent of the mean. The national index of Bulgaria (1.38) is below mean, setting the country at the position of 17 among 24 countries in the ranking (see tab. 4). There is a special moment in the index we calculated, as it allows us to assess the position of personnel with skills and competencies, which fit the ICT requirements, in depth, beyond the current situation on the labour market at a specific moment (year) in time. As already explained, it defines the position of that personnel in relation to the labour force, not only to the employment.

As to the portion of the ICT personnel in the total number of employed, we have identified a tendency for it to increase over the recent decade. However, the figures of the indicator are still far from impressive ones, especially, as the mean shows. Over the recent decade, it has increased, but starting from the modest position at 2.72% in 2009 and reaching about only 3.15% in 2018 (see tab. 4).

Table 4. The position of ICT sector in the labour force and employment

Indices Years	Sample	X ave	σ	V=σ/X ave*100	R	Me	Rank of Bulgaria	Relative share of Bulgaria
1. Index of ICT personnel in the labour force (in percent)								
2018	24	1,66	0,58	35,0	2,49	1,55	17	1,38
2. ITC personnel in tot Employment (in percent)								
2009	20	2,72	0,88	32,3	2,88	2,81	18	1,7
2018	24	3,15	0,78	24,7	3,29	3,08	15	2,9

Source: own work based on Eurostat statistics of the main indicators used.

Bulgaria follows the common trends, demonstrating an increasing portion of ICT personnel in the total number of employed, which allowed it to improve the position in the ranking, starting from the place of 18 (among 20 countries) in 2009 and reaching the place of 15 (among 24 countries) in 2018. Of course, we could perceive these shifts as a signal of positive change in the characteristics of domestic labor force, as the growing share of ICT personnel has been accompanied by a general trend of employment rate growth, but also by an increase of the share of active persons aged between 15 and 64.

Finally, we turn the scope of the analysis to the role the ICT sector plays in consumer behavior in European societies. To define the position of the new technologies in the consumer decision-making process, we used two of the indicators that Eurostat designed and calculates every year. Namely, we worked with digital inclusion and digital exclusion of individuals by observing a sample of 28 countries[14] for 3 years.

As dispersion indicators reveal, in the 2011 – 2020 period, the share of individuals who use internet at least once a week, even every day, increased for the European societies. The mean reached the 86.7 percent (demonstrating an increase of 18.7 percentage points), meanwhile the range shrinking by staring at 54 to end at 28 percentage points. The coefficient of variance dropped from 22.1 to 8.7%. The median increased by outpacing the mean at some point in time (see tab. 5).

As to the case of Bulgaria, the country has registered relatively lower positions of the indicator, and even the lowest one, which brought it at the penultimate and ultimate position in the ranking of the 28 observed countries. Nevertheless, over time, a trend of an increasing relative share of people who use Internet at least once a week firmly has been formed so that at the end of the decade, this portion of the folks set about 69%.

Table 5. Digital inclusion and digital exclusion: measures of dispersion

Indices Years	Sample	X ave	σ	V=σ/X ave*100	R	Me	Rank of Bulgaria	Relative share of Bulgaria
1. Digital inclusion of individuals (frequency of internet access - once a week, including every day) – as a percentage of the total population								
2011	28	68,0	15,0	22,1	54	66	27	46
2015	28	76,6	12,1	15,8	45	75	27	55
2020	28	86,7	7,5	8,7	28	87,5	28	69
2. Digital exclusion (internet use: never) – as a percentage of the total population								
2011	28	25,0	14,0	56,0	49	25,5	27	46,0
2015	28	16,9	10,1	59,8	34	17	28	35,0
2020	28	8,9	6,0	67,1	20	8	28	21,0

Source: own work based on Eurostat statistics of the main indicators used.

[14] France and Iceland excluded from the largest sample we work with (see footnote 3), for no available data for some of the three observed years.

At the same time, in the 2011 – 2020 period, persons who never used internet decreased in number as a percentage of the total population (see table 5, indicator 2). The mean of relative share, calculated for the same sample of 28 European countries including Bulgaria, dropped down to 8.9 percent, meanwhile the range shrinking to 20 percentage points, and the median – to 8 percent.

As to the case of Bulgaria, the country ranks the last one according to this indicator. Only a decade ago, 46 percent of the population had never used the Internet. By 2020, the relative share of this group of people dropped to 21 percent, but still remains far above the average, outpacing the rank of the indicator. Therefore, despite the progress in applying the ICT in consumer decision-making, Bulgaria still demonstrates relatively modest features of information society.

The output of the empirical analysis allowed us to draw out at least three insights. It is worth emphasizing that these relate to the role that the ICT sector plays in the national economy and the community at large.

1. In Bulgaria, the parameters of economic and technical environment still play the role of an obstacle rather than of a foster of digital transformations in the consumer behavior model and the consumers' decision-making process.
2. With respect to the mentioned above, in the forthcoming years, the Bulgarian society lagging behind the standards of the modern information society will play the role of a barrier rather than of a driving force of digital transformations in the business model of local organizations.
3. The Bulgarian society and economy, in particular, domestic companies, still have a long way to go to take full advantage of digital transformations and Industry 4.0, specially, the benefits that Internet of Things provides.

Conclusions

Over the last decade, the ICT sector succeeded in extending positions in the Bulgarian economy, as some of the objective indicators show. However, a more detailed correlation analysis revealed that this trend does not lead automatically to improvements in the economic standard of the national economy, nor to a spread of benefits among all groups within a society. In the case of Bulgaria, there are enough arguments to conclude that the growth of the ICT sector has been driven mainly by external factors, closely related to globalized markets and production, rather than by successfully meeting the dynamic domestic needs. The latter refers to a wide range of forces, which ultimately relate to the satisfaction in dynamics of the main societal needs manifested in a country. However, regarding the economic and living standards, empirical analyses revealed that in the two first decades of the 21st century no significant progress was made in Bulgaria (Kiranchev and Genkova, 2021). Therefore, it is more realistic not to place too much expectation to the ICT sector to foster the economic activity in Bulgaria and to revive it after the world Covid-19 pandemic.

By the end of 2021, the Bulgarian economy and society succeeded in reaching relatively lower economic and technological standards, lagging far behind the average in Europe (especially, that in the EU). This specific feature of the Bulgarian socio-economic model poses some specific challenges to the economic management at a micro and macro level. On the one hand, it could play the role of an obstacle to the wide spreading of ICT in the

production and distribution activity, including marketing activities of local companies. On the other hand, unreasonable fostering of the ICT sector, including by the instrument of state policies and state aids, could not help to raise significantly the economic and living standards in the country. In other words, fostering the ICT sector and digital transformations in local companies should be in line with the economic objective laws and regularities, and adjusted to the real parameters of the Bulgarian economy and society. In this sense, comparisons between countries and societies, based on selected indicators, without taking into account the levels of economic and living standards, and the specific mechanisms of the socio-economic life within a country, is not informative enough.

From the above follows a third point. For the time being, benefits of ICT mainly theoretically outlined by now could be realized on a much smaller scale in Bulgaria – both for producers themselves and for consumers.

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