Trends in the digitalization impact on the economic security of the region

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Abstract. This work aims at studying digitalization trends affecting the economic security of the region. The object of the study is a region considered from the perspective of economic security. The subject is digitalization trends that have a multidirectional impact on the economic security of the region. The main digitalization trends affecting the economic security of the region are identified: the development of the digital economy, including digital business models; increasing the importance of intangible assets and innovation potential; distribution of network forms of interaction among entities; formation of information threats to economic security; development of digital tools for managing the security of the region. During the study, the following effects for the economic security of the region were discovered: the emergence of new economic structures and development trends; the formation of threats caused by the development of digital technologies; the emergence of new opportunities and benefits from digitalization; the presence of threats that impede the development of digitalization at the regional level.

1 Introduction

Digitalization, which developed several decades ago due to the popularization of the Internet, has significantly influenced all spheres of public life. Moreover, the effects of this process are multidirectional. On the one hand, digital technologies create new opportunities for improving public administration, increasing the competitiveness of companies, and improving the quality of life of the population. On the other hand, digitalization has given rise to numerous threats to economic security, such as the release of labor, asymmetry of access of different categories of the population to the opportunities and benefits of digital transformation, cyber attacks, the spread of malicious software, damage and leakage of classified information.

There is a point of view in the scientific literature according to which digitalization is the process of converting analog information into digital format [1]. This approach is not entirely correct, since the conversion of information from analogue to digital form is more accurately reflected by the term digitization. Digitalization is a larger-scale process in which digitized information affects the economy, culture and other aspects of society [2]. As part of scientific research, it is often necessary to specify the object field of...
digitalization in order to focus on specific indicators of digital development. An example of this approach is the interpretation of digitalization as the use of technologies associated with Industry 4.0 [3].

Numerous theoretical studies contain many hypotheses about the positive impact of digitalization on various aspects of socio-economic development. At the same time, works based on mathematical methods lead to less clear results. An example of this is the correlation analysis between the Digitalization Index and a number of macroeconomic indicators, performed on the basis of statistical data from 27 countries of the European Union. The study showed a significant relationship between the Digitalization Index and GDP per capita, gross domestic expenditure on R&D, as well as enterprise expenditure on R&D. At the same time, no significant relationship was found between the Digitalization Index and the values of GDP and gross value added [3]. Another study, carried out on the basis of statistical data from Russian regions, showed the presence of a significant interdependence between the levels of digital and innovative business development. However, no significant relationship was found between the level of digitalization and the dynamics of the gross regional product of the Federal entities. The reasons explaining these results were cited as low innovative activity in most Russian regions, as well as the high value of interregional differentiation in the implementation of innovations in business processes [4].

2 Materials and Methods

This publication is a theoretical work, the purpose of which is to study digitalization trends affecting the economic security of the region. During the study the following methods were used: complex, comparative, functional and cause-and-effect analysis, synthesis, abstraction, systematization and structuring. The object of this study is a region considered from the perspective of economic security. The subject is digitalization trends that have a multidirectional impact on the economic security of the region. In the course of this study, we will define the economic security of the region as the state of protection of the socio-economic system of the region from various threats.

3 Results and discussion

The authors’ analysis of the scientific literature [5-25] made it possible to establish that the main trends in digitalization affecting the economic security of the region are the following:

- Development of the digital economy, including digital business models
- Increasing the importance of intellectual capital and innovative potential
- Distribution of network forms of interaction between subjects
- Formation of information threats to economic security
- Development of digital tools for managing the economic security of the region

Next we will consider these trends and characterize them.

3.1 Development of the digital economy, including digital business models

Digital technologies penetrate all sectors of the economy and significantly transform them, forming a new reality called the digital economy. The digital economy is not a homogeneous entity; it is a structure combining different concentration levels of digital technologies and competencies. Within the digital economy (in the broadest possible interpretation of this concept), three levels are distinguished:
1) the digital sector, which includes exclusively the production of information and communication goods and services (companies engaged in the production of software and hardware, IT consulting, etc.);

2) digital economy (in the narrow sense), which involves types of economic activity entirely based on the possibility of using digital technologies (companies based on digital platforms);

3) digitalized economy, as a set of all types of economic activities, one way or another related to digital technologies (companies carrying out activities that are possible without digital technologies, but using them to increase their own efficiency) [5].

The use of platform solutions in the economy has led to the emergence of digital business models, the distinctive features of which from traditional analogues are an increase in the speed of interaction, a decrease in operating costs and a decrease in the impact of spatial restrictions. However, digital business models require higher costs at the entry stage into the industry due to the cost of creating and launching digital platforms [6]. The scientific literature also expresses concerns about the threat of bankruptcy of companies using traditional business models, as well as the replacement of human labor with industrial robots and artificial intelligence technologies [7]. On the other hand, there is an increase in jobs among existing professions and the emergence of new specialties due to the process of development of the IT industry and the industries serving it [8]. Ultimately, the impact of digital transformation on overall employment growth will depend on the specific conditions of place and time. For example, a study conducted on the basis of the Northwestern and Central Federal Districts of the Russian Federation showed that the process of creating new jobs in the field of IT technologies dominates over the process of replacing human labor with machines. The reason for this situation is the low innovative activity of organizations, in particular regarding the introduction of digital technologies [9].

The level of the digital economy development in the regions directly depends on the state of the digital infrastructure, the introduction of digital technologies by business and the demand for the use of these technologies from consumers, as well as on the mastering digital competencies by the population. Disproportions in these aspects of digital development between the constituent entities of the Federation, also referred to as the digital divide or digital barrier, are a serious threat to economic security at the regional level. The digital divide exacerbates the already significant disproportions in socio-economic development between the regions of the Russian Federation, making living and doing business in outsider regions even less attractive. A study of the digitalization of Russian regions showed that interregional differences between the minimum and maximum values according to the criterion of digital infrastructure development are 1.6 times. A higher rate of differentiation between the leading region and the outsider region was found in terms of the level of digital literacy of the population, and amounted to more than 2.1 times [10]. The solution to the problem of the digital divide for lagging regions must be comprehensive, aimed at both developing the supply of digital products and the demand for them. If the growth of digital supply can be achieved through the development of the infrastructure necessary for e-commerce and e-government, as well as government incentives for the digital transformation of business, then the increase in digital demand primarily depends on improving the standard of living and digital literacy of the regional population.

3.2 Increasing the significance of intellectual capital and innovation potential
Big Data, artificial intelligence, distributed computing, digital twins, and additive manufacturing make it possible to create unique innovative products at lower costs and at greater speed than in the past. As a result, there is a shift in competition towards R&D, which increases the importance of intellectual capital and the innovative potential of the company, region, and country as a whole. Innovation potential means the ability of an organization to transform ideas and knowledge into unique new products that are in demand in the market [11].

In scientific literature, the following components of innovation potential are identified: corporate culture, a set of resources (financial, intellectual, organizational capital), competence in the use of opportunities provided by the market and interaction between internal and external actors of the innovation process [12]. The level of innovation potential of a region is unconditionally influenced by the quality of the innovative potential of organizations located on its territory. In addition, a significant role in ensuring the innovative potential of the region is played by:

- scientific, technical, production, and financial capabilities for the full cycle of creating innovations and their commercialization within the region;
- the policy of regional authorities to stimulate innovation in the region;
- the presence of institutionalized structures for training and retraining of highly qualified specialists;
- demographic and professional-educational structure of the population;
- the system of interaction between government authorities, educational institutions, and commercial organizations in the field of innovation, as well as other factors.

One of the significant components of innovative potential is intellectual capital. This concept is widely used in the scientific literature and involves a significant number of approaches to understanding its structure. According to one of the most generalized approaches, intellectual capital consists of two components: human and structural capital.

Human capital is the totality of knowledge, skills, abilities, and moral values of an organization's employees. Structural capital includes relationships with customers, the organizational structure of the company, software and hardware, trademarks, patents, and other elements that, unlike human capital, may be the property of the company and are not characteristics of the individuals working in it [13]. We believe that intellectual capital at the regional level will have a similar structure consisting of human and structural capital. A distinctive feature here is the object of intellectual capital, represented not by a single company, but by a set of organizations in the region, including business, non-profit organizations, government and local governments, and public associations. It is noted that serious threats to the economic security of the Russian Federation in the field of intellectual capital are the low citation rate of scientific publications, the lack of specialists in the field of natural sciences and mathematics, and the small share of patents related to basic technological innovations [14]. These threats look even more serious taking into account interregional differentiation in the development of intellectual capital.

Let's consider the coefficient of inventive activity (taking into account submitted applications for utility models) in 2022 by the entities of the Russian Federation. (Table 1)

| Table 1. Coefficient of inventive activity (taking into account submitted applications for utility models) in 2022 by the entities of the Russian Federation. |
|---|---|---|---|
| Federal District | Coefficient of the Federal District | Coefficients of the constituent entities of the Federal District |
| | Federal entity | Min coefficient | Federal entity | Max coefficient |
| Central District | 2.91 | Smolensk region 0.56 | Moscow 5.58 | |
| | | | | |
Compiled by the author based on [15].

3.3 Distribution of network forms of interaction between entities
One example of networking at the regional level is the relationship between cluster members. The intra-cluster network is an open system interested in attracting new participants to enhance the synergistic effect of combining complementary resources and competencies. Modern innovation-active clusters are able to generate innovative products using all the advantages of industrial digitalization [18]. Such structures are distinguished by the introduction of digital information platforms, the transition to new business models and the joint implementation of innovative projects [26].

The issues of economic security of cluster associations are currently poorly developed in the scientific literature, much more attention is paid to the level of individual organizations, regions or the country as a whole. The economic security of a cluster is the state of the functioning environment of its participants, ensuring the growth of their competitiveness and efficiency of activities [19].

It is noted that the task of the regional authorities is to create a favorable business environment and use the available strategic resources for the development of cluster forms of organization in order to strengthen competitive positions and accelerate the growth of the region’s economy [20]. An equally important condition for the success of regional clusters and (or) implementation of cluster policy, weak involvement of employers’ representatives in the educational process of higher and secondary vocational education; disproportions in the level of readiness for networking both at the level of regions and municipalities; low innovative activity of organizations; lack of specialists with sufficient level of competence; the state of the logistics infrastructure of the region [20, 21]. Also, due to the interaction of threats to the economic security of the cluster with each other, it is possible to obtain a negative synergistic effect.

3.4 Formation of information threats to economic security

The introduction of digital technologies into business processes and the activities of state and municipal government bodies leads not only to positive consequences, consisting in saving production costs and increasing the efficiency of activities. Digitalization makes organizations vulnerable to various threats to economic security of an informational nature, such as cyber attacks, malicious software, unauthorized access and theft of media. The negative consequences of the implementation of various threats differ, but in general they amount to the violation of the integrity, confidentiality and availability of data. The economic and managerial negative effects here also include the need for significant financial costs for digitalization of the organization, a decrease in productivity and a decrease in the potential for cooperation due to restrictions imposed to protect information, as well as a shortage of specialists in the field of information security at small and medium businesses [22]. It is also noted that it is difficult to assess financial losses from information threats due to the frequent ignoring of minor information security incidents, which at the same time cause significant total damage [23]. Paying tribute to companies working in the field of cybersecurity and relevant government agencies, we believe that the key element in ensuring information security is the organizations themselves and the measures they take to prevent incidents. Among the latter, technical measures can be distinguished, consisting in ensuring the security of the digital infrastructure and information resources of the organization with software and hardware tools and organizational measures – the formation of a positive corporate culture, a clear delineation of job responsibilities and access rights, internal audit.
3.5 Development of digital tools for economic security management

The scientific literature contains many publications devoted to the positive effect of the use of digital technologies in the production and management process at the level of individual companies. However, studies devoted to such effects on objects of a larger scale, such as a municipality, a federal entity (region) and a state are quite small. We would like to note that digital technologies have a high potential to increase the efficiency of managing the economic security of the region. Let us consider the prospects of digitalization at various stages of this process in Table 2.

Table 2. The use of digital technologies in managing the economic security of the region.

<table>
<thead>
<tr>
<th>Stages of managing the economic security of the region</th>
<th>Digital technologies</th>
<th>Digital technology functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring the economic security of the region</td>
<td>Internet of things</td>
<td>Data collection using sensors</td>
</tr>
<tr>
<td></td>
<td>BigData</td>
<td>Integration of information</td>
</tr>
<tr>
<td></td>
<td>Blockchain</td>
<td>Ensuring data security and system stability</td>
</tr>
<tr>
<td></td>
<td>Decision support</td>
<td>Analysis of the received data</td>
</tr>
<tr>
<td>Modeling the consequences of the development of threats to the economic security of the region</td>
<td>Digital twins</td>
<td>Modeling the development of a physical object (region, municipality), or a process within this object using their virtual copy</td>
</tr>
<tr>
<td>Adoption and clarification of management decisions aimed at countering threats to economic security</td>
<td>Decision support</td>
<td>Analysis of modeling results and development of management recommendations</td>
</tr>
</tbody>
</table>

The use of digital technologies in managing the economic security of the region is able to timely identify current threats, predict their development and find the optimal solution to neutralize each of them. At the same time, there are currently a significant number of factors preventing the full implementation of digital technologies in the management of economic security at the regional level. Thus, there is no consensus in the scientific community regarding the definition of the essence of digital double cities and the understanding of their key characteristics. In addition, questions concerning the model of data interaction between digital and real twins, as well as the general system of data integration that differ in the source of receipt, format, quality and level of detail, remain unprocessed [24]. It is noted that digital technologies used at the territorial level may be negatively affected by various cyber threats. Practical recommendations made by artificial intelligence may be incomprehensible to the user and skeptically perceived by them [25]. There is also a risk that Big Data and artificial intelligence technologies can be used for...
various social manipulations, such as compiling social ratings, virtual segregation of the population and restricting access to information to certain social groups [7]. All these problems require further fundamental and applied research on the use of digital tools in managing the economic security of the region.

4 Conclusions

Based on the results obtained, it is possible to decompose the digitalization trends affecting the economic security of the region into the following effects:

- the emergence of new economic structures (digital economy and digital business models) and development trends (increasing the role of intellectual capital and innovation potential in the socio-economic system, the formation of network forms of interaction between entities);
- the formation of threats caused by the development of digital technologies (high implementation costs, bankruptcy of companies with traditional business models, loss of jobs by people, aggravating the interregional socio-economic differentiation of the digital divide, threats to information security, as well as barriers and restrictions that slow down business processes taken to combat information threats);
- the emergence of new opportunities and benefits from digitalization (increasing the speed and quality of interaction between stakeholders, increasing the speed and quality of decisions, reducing current costs, reducing the impact of spatial constraints, the emergence of new jobs due to the development of the IT industry and its service industries);
- the presence of threats hindering the development of digitalization at the regional level (conceptual lack of elaboration of many theoretical and practical issues, resistance to digitalization due to distrust of technologies or fear of their unethical use, interregional differentiation in the development of innovative potential and intellectual capital, territorial disparities in the level of readiness for networking, low innovative activity of organizations, lack of competent specialists).

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