Digital Transformation in the Agrarian and Industrial Sectors of the Russian Regional Economics

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Abstract. The article displays the results of comparing the digitalization process in agrarian and industrial production. The objects of study are the companies of the eighty-two Russian regions. The information was obtained from open-access resources of the Russian State Statistics Bureau. The research aims at revealing the differentiation and the specific interconnection of digital transformation in agriculture and industrial production at the regional level. The observations prove the idea that the digitalization path and tempo depend on the unique regional conditions and the accumulated level of scientific and innovative potential. A controversy is revealed in the methodology of evaluating the digital maturity rate which was proposed by the Russian regulators for assessments at the federal and regional scale. The methodology implies equal weights of significance attributed to various sectors when measuring the regional level of digital transformation. Consequently, the socioeconomic context of the diverse regional systems is treated as a barrier to digitalization and an obstacle to intensive development. At the same time, it is a question of open discussion if digitalization of such peculiar sectors as agriculture and industrial production should be measured with similar methods.

1. Introduction

Digitalization is a key trend in the development of various spheres of economic activities. Recent research has revealed a problem of the uneven process of digital transformation in different sectors. As a result, it is necessary to reconsider the state programs of digitalization and the methods of perspective analysis underlying the roadmaps of the expected paths of development [1, 2, 3].

Academic resources include the evaluation of the specific tempo of digitalization [4] and the response of productivity growth to the adoption of digital technologies [5, 6] in services, manufacturing, food and agro production [7]. The pace of change and the obtained effects depend both on the original state of innovative and industrial development and the socioeconomic environment in the particular regional community [8, 9, 10]. The strategy of digitalization and the availability of competent specialists are significant factors influencing the outcomes of transformation [11].

The methods of evaluating the diversity of digitalization across sectors mainly rely on statistics of adopted digital technologies [12] and the specific choice of digital technologies in different spheres of economic activities. A multi-criteria method of comparative analysis is presented in OECD Science, Technology and Industry Working Papers where a taxonomy of digital intensive factors relies on indicators within three dimensions – technological, human, and market-oriented [13].
At the global scale, as Calvino et al. reveal, several sectors remained at a low scale of digitalization in the compared periods of 2001-03 and 2013-15. Among them are agriculture and food production. Such sectors as “Arts, entertainment and recreation” and “Scientific research and development” have a positive trend to higher digitalization. At the same time, such industrial production spheres of activity as “Computer, electronic and optical products” and “Machinery and equipment” lowered their level of digital intensity from “high” to “medium-high”, and “Human health activities” switched from “medium-high” to “medium-low”.

The dynamics of digitalization is heterogeneous both across sectors and across regions which proves the idea that digital transformation is “context-driven” and depends on the socioeconomic factors and the level of innovative and scientific development. This makes it impossible to borrow successful programs and roadmaps of digitalization as is, and in every case, the peculiar features of the regional economies have to be taken into account. The comparison of the transformation processes in agriculture and industrial production can prove the necessity to work out specific regulative policies for the economic sectors.

2. Materials and methods

In December 2020, the Russian Ministry of Digital Development proposed a methodology of measuring the level of digital maturity at the federal level (1):

\[ DM = 0.25 \times IT\text{specialists} + 0.25 \times IT\text{investments} + 0.5 \times I\_SM \]

where \( DM \) – digital maturity; \( IT\text{specialists} \) – the share of IT specialists in the total number of the employed; \( IT\text{investments} \) – the share of expenditures on digital solutions (2019\(^{th}\) level taken as the base of calculations, 100%; 2030\(^{th}\) is the target level, 200%); \( I\_SM \) – the index of sectors maturity.

The digital maturity at the regional level is measured in the basis of five sectors (2):

\[ DM\_r = 0.2 \times I\text{city} + 0.2 \times I\text{transp} + 0.2 \times I\text{health} + 0.2 \times I\text{ed} + 0.2 \times I\text{reg} \]

where \( DM\_r \) – digital maturity of the region; \( I\text{city} \) – index of digitalization in city administration; \( I\text{transp} \) – index of digitalization in transport and logistics; \( I\text{health} \) – index of healthcare digitalization; \( I\text{ed} \) – index of digitalization in education; \( I\text{reg} \) – index of digitalization of the state and municipal regulation procedures.

The index of sectors maturity is calculated as a simple average of several indicators, where the number of indicators and the target levels may vary across regions.

The proposed methodology implies equal weight of sectors in the integral index of the sectors’ digital maturity. A comparison of sectors according to similar parameters may display the controversy in measuring the weights of sectors as equal.

As a starting point of our research about the digital cross-sector diversity, we have chosen the comparison of the agrarian and the industrial production in the Russian regions. Raw data and analytical reports about the level of digitalization are taken from the open-access resources of the Russian State Statistics Bureau and its regional branches.

The criteria of comparison of the two sectors include the demand for different advanced technologies in agriculture and industrial production (including food production). The data of 82 regions is aggregated to evaluate the proportion of organizations using digital security technologies and special software tools to solve different managerial problems.

3. Results

According to the demand evaluation of digital technologies in 2020 (table 1), the key digital technologies for industrial production are neurotechnologies and artificial intelligence (AI), robots and sensor technologies, SMART production, and wireless technologies.

For agriculture, the priorities lie in neurotechnologies, SMART production, and wireless technologies [14, 15].
| Table 1. The demand for digital technologies in 2020, million rubles |
|---------------------------------------------------------------|
| **Quantum technologies** | 84 | 91 |
| **Robots and sensor technologies** | 550 | 2200 |
| **Neurotechnologies and artificial intelligence (AI)** | 34944 | 11648 |
| **Technologies of SMART production** | 412 | 5047 |
| **Distributed ledger systems** | 26427 | 1915 |
| **Wireless technologies** | 21970 | 21970 |
| **Virtual reality (VR) technologies** | 869 | 2291 |

*(Abdrakhmanova et al., 2020), authors’ calculations.*

Agriculture and industrial production were compared according to the expected rate of change in demand for digital technologies in 2024, with 2020 as the base for comparison (figure 1). A 7-times growth in demand of the industrial production is expected for the distributed ledger systems.

**Figure 1.** Rate of change in demand for digital technologies in agriculture and industrial production, times (Source: (Abdrakhmanova et al., 2020), authors’ calculations.)

The basic conditions and enablers of digital transformation are such criteria as data exchange technologies, RFID, broadband Internet, and cloud technologies (figure 2).

**Figure 2.** Proportion of organization in the agrarian and the industrial sectors using technologies of data exchange, storage, and object identification (Source: Russian State Bureau of Statistics, authors’ calculations)
A considerable difference is revealed in the proportion of organizations having an Internet site and using RFID. A third of agricultural companies do not use broadband Internet, and few industrial and agrarian organizations consider it safe and convenient to use cloud technologies.

The problem of granting data security is a considerable barrier to the digitalization process in all the sectors of the economy. Several types of digital technologies have not penetrated the sphere of agricultural production which may cause potential risks of development: these are special technologies preventing unauthorized access of malicious programs, strong authentication tools, and spam filters (table 2).

Table 2. Proportion of organizations using digital security and special software tools, % of the total amount of organizations in the sector$^a$

| Criteria of comparison | Technologies | Agriculture | Industrial Production |
|------------------------|-------------|------------|-----------------------|
| Organizations using information security tools | Means of electronic digital signature | 72.7 | 83.6 |
| | Regularly updated antivirus programs | 64.6 | 83.7 |
| | Technical means of user authentication | 53.3 | 68.2 |
| | Software, hardware, preventing unauthorized access of malicious programs | 36.6 | 68 |
| | Strong authentication tools | 39.2 | 60.3 |
| | Spam filter | 30.6 | 61 |
| Organizations using special software tools | For the implementation of financial settlements in electronic form | 50.5 | 67.7 |
| | To solve organizational, managerial and economic tasks | 41.8 | 64.9 |
| | To provide access to databases through global information networks, including the Internet | 23.7 | 28.8 |
| | CRM-, ERP-, SCM-systems | 7 | 34.9 |
| | Educational programs | 6.1 | 16.2 |

$^a$Source: Russian State Bureau of Statistics, authors’ calculations.

The key advantages of digitalization are evaluated in different ways by the agricultural and industrial producers. Thus, in industry, it has become obvious that digitalization may cause a positive effect on the process of decision making and solving organizational, managerial, and economic tasks. CRM-, ERP-, SCM-systems are still rare in agricultural companies. Due to regulative support, the financial settlements have gone through the initial stage of digital transformation and have become widespread in both sectors.

4. Discussion
In some regions agriculture remains the dominating sector of the economy, and it is a question of discussion whether such territories need to keep up with highly industrialized territories at the tempo and level of digital transformation. The most noticeable difference lies in digitization of the business processes in production and organization of the information exchange in the company. Though, digital technologies of communication with the micro and macro environment are equally valuable for the two sectors.

Agricultural and industrial production are not only different in the tempo of digital transformation. Due to the specific business processes in these sectors, the strategic purposes of digitalization, the choice of digital technologies and the priority of their adoption differ. This needs to be taken into
account in the methodology of measuring the integrative indexes of digital maturity. The positioning of an agrarian or an industrial company at a certain maturity stage cannot follow a unified ideal model. In consequence, the set of measuring indicators should be appropriate to indicate positive changes in the technological development.

5. Conclusion
The results of the research displayed the differentiation of economic sectors according to several criteria. The achieved results of the digital transformation and the future trends in demand for the advanced technologies were analyzed on the basis of statistical data of the Russian regional agrarian and industrial sectors. Further research is necessary to elaborate adequate methodology of evaluating the digital maturity of regional economic systems.

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