Development of Digital Competencies in the Construction Sector Organizations in Russia

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Abstract: Digitalization is the main trend of economic and social development nowadays. The introduction of digital technologies in production causes a change in business processes and business models, that is, it leads to larger-scale results - digital transformation, which can significantly affect the efficiency of activities and the quality of the result. However, the implementation of the processes of digital transformation and the gradual transition to the digital economy also requires the presence of special competencies. This study analyzes the demand for digital competencies at Russian enterprises in the investment and construction sector. The analysis is carried out both in general for all enterprises of the construction industry, and for groups formed on the basis of the functions performed by organizations. It was revealed that the most popular in Russian organizations of the investment and construction sector are such key competencies of the digital economy as information and data management (in demand in 63.4% of organizations) and communication and cooperation in the digital environment (in demand in 47.9% of organizations). Critical thinking in the digital environment has the lowest popularity - it is in demand only – 25.9% of respondents. The analysis of the results, taking into account the type of activity of organizations (functions performed), showed that the type of activity of the construction sector organization has an impact on the key competencies of the digital economy that are in demand in such organizations.

1 INTRODUCTION

Digitalization has become a leading trend of economic and social development in recent years. The term "digitalization" is used in a variety of aspects: from the penetration of information technologies into the social sphere and private life of people to their impact on the pace of development of industries and national economies, the effectiveness of public administration, the development of international cooperation.

Conducting research in the field of digitalization should begin with clarifying the basic concepts. Thus, it is necessary to clearly distinguish the concepts of Digitization and Digitalization. Digitization involves simply Converting data to a digital format. That is, the data itself does not change during its digitization – its format and carrier change. Digitalization involves transforming your business processes for digital. In other words, digitalization concerns the management of various processes and involves the use of digital technologies to collect, process, analyze and store information within the framework of a particular process, which significantly increases the speed and efficiency of the process, as well as the accuracy of the results obtained.

Digitalization has become possible thanks to the deep penetration of information technologies, including the Internet, into our lives. 62.5% of the world's population (4.95 billion people) use the Internet, and the number of devices related to personal computing (analysts include personal computers, tablets, laptops and smartphones) is approaching 6.5 billion pcs.

In addition, digitalization has a serious impact on business and production – it makes it necessary to update equipment and software, use new digital technologies and tools, change business processes (Rachinger, Rauter, Ropposch, Vorraber, Schirgi,

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2018; Kraus, Durst, Ferreira, Veiga, Kailer, Weinmann, 2021). And in this case, we should already talk not so much about digitalization, but about larger-scale digital transformation processes that are associated with complex processes of transforming an organization's business processes based on the use of digital solutions and technologies. The result of such transformations is the formation of new, digital business models that ultimately increase the economic efficiency and competitiveness of organizations (Kane, Palmer, Phillips, Kiron, Buckley, 2015; Eller, Alford, Kallmuenzer, Peters, 2020; Li, Wu, Cao, Wang, 2019). Gradually, these processes acquire scales that allow us to talk not just about the digital transformation of individual organizations, but also about the digital transformation of economic sectors, and about the growing trend of the formation of a digital economy (Limna, Kraiwanit, Siripipatthanakul, 2022), in which digital data is a key factor in production.

The introduction of digital technologies by itself does not lead to a digital transformation of production and business. As already noted, it requires a change in business processes and business models, and this becomes possible only if the management and staff of the organization have the necessary level of digital competencies. Of course, a significant amount of digital competencies are acquired by people in the learning process. The presence of digital competencies, that is, knowledge and skills of working with digital technologies, is a necessary condition for obtaining education these days (Ilomäki, Kantosalo, Lakkala, 2011). Digital competence is based on basic skills in the field of information and communication technologies, i.e. on the use of computers (and their close analogues - tablets, laptops, smartphones) for extracting, evaluating, storing, producing, transmitting information, as well as communicating via the Internet (Ilomäki, Kantosalo, Lakkala, 2011). However, digital competence in the digital economy is considered somewhat broader than just the skills of working on a personal computer (for example, with text editors) or the skills of searching for information on the Internet (Konkurator, 2019). And the availability of such knowledge and skills is a necessary condition for the digital transformation of an organization and its active inclusion in the digital economy. As 5 key competencies of the digital economy, the training of which should become continuous throughout the life of a person, the European Commission has identified:

1)Information and data literacy;
2)Communication and collaboration;
3)Digital content creation;
4)Safety;
5)Problem solving.

In Russia, the content of these competencies was analyzed and based on them, proposals were developed for 5 key competencies of the digital economy, which are generally in line with those proposed by the European Commission, but have some semantic accents. The list of these competencies is fixed at the legislative level (Table 1):

Table 1: Comparative analysis of the key competencies of the digital economy according to the version of the European Commission and according to the version of the Russian regulatory framework.

Name of the competence (according to the European Commission)	**Relevant competence according to the version of the Russian regulatory framework**	**Features of understanding competence in Russia**
Information and data literacy	Self-development in conditions of uncertainty	From digital literacy for storing, managing and organizing digital data, information and content, the emphasis is shifted to continuous self-education and development and the search for means to solve various problems using digital technologies
Communication and collaboration	Communication and cooperation in the digital environment	The understanding of competencies generally coincides
Digital content creation	Creative thinking	The focus has shifted from creating and editing digital content to generating new ideas for using digital technologies to

		optimize processes
Safety	Critical thinking in a digital environment	From acquiring knowledge to protect devices, content, personal data and health, the focus has shifted to evaluating information, its reliability and the ability to make independent conclusions based on information
Problem solving	Information and data management	The understanding of competencies generally coincides, but the focus is shifted from solving business problems to general application in a general context

This study is devoted to the study of the most popular digital competencies at Russian enterprises in the investment and construction sector. It should be noted that the formation of the digital economy is a key direction of Russia's development, defined at the state level (the program "Digital Economy of the Russian Federation"). In the field of public administration, Russia in 2022 took 10th place in the World Bank's GovTech Maturity Index-2022 out of 198 countries. However, the introduction and effective use of digital technologies by industry and sphere in Russia is uneven. Thus, construction is one of the industries with a low level of digitalization (Abdrahmanova, Byhovskij, Veselitskaya, Vishnevskij, Gohberg, 2021). Gradually, the technological complexity of modern buildings and structures inevitably leads to automation and digitalization of many processes, which is reflected in the spread of Building Information Modeling (BIM) – a set of tools for digitalization of construction (Kisel, 2020).

The object of the study was the enterprises of the construction sector in Russia. Among them are organizations of various functional orientation, since the construction sector includes enterprises of various types of activity, and all of them are participants in construction projects, performing their functions. These are designers and architects, developers, investors and contractors, organizations performing control functions and many other types of organizations.

The subject of the study was to identify the main digital competencies in demand in the construction sector, depending on the type of activity of the organization. Accordingly, the hypothesis of the study is formulated by us as follows: the type of activity of the organization of the construction sector has an impact on the key competencies of the digital economy that are in demand in such organizations. The formed sample should be characterized as spontaneous. The sample size was 355 respondents - representatives of construction companies of various functional orientation (Table 2).

Table 2: Distribution of respondents by the main type of activity of the organization.

Principal activity	**Number of respondents**	**Share in the sample,%**
Architect	11	3.1
General Contractor	24	6.8
State/municipal institution	63	17.7
Developer	25	7.0
Construction manager	10	2.8
Educational institution (providing training for the construction industry)	10	2.8
Executive authority	66	18.6
Organization carrying out construction control	4	1.1
Contractor/Subcontractor	25	7.0
Designer	58	16.3
Manufacturer/supplier of building materials	4	1.1
Professional association	5	1.4
Forensic examination	2	0.6

Technical customer	22	6.2
Examination of project documentation	4	1.1
Operating organization	9	2.5
Investor	5	1.4
Other	8	2.3
Total	355	100

In order to achieve the purpose of the study related to the identification of the most popular digital competencies in the Russian enterprises of the investment and construction sector, depending on the type of activity of organizations, the consolidation of groups of respondents was carried out. The presence of a large number of small groups of respondents will not allow us to draw significant conclusions. At the same time, in addition to the list of respondents' activities presented in Table 1, there are those that are close in functionality. This means that employees of such organizations can perform similar work duties, respectively, they are required to have similar competencies (Table 3).

Table 3: Consolidation of groups of respondents by similar functionality.

The main activity of the respondent's organization	**Name of the enlarged group**	**The share of the enlarged group in the sample, %**
Architect	Designers	19.4
Designer		
General Contractor	Work executors	13.8
Contractor/Subcontractor		
State/municipal institution	Government organizations	17.7
Developer	Developers	10.4
Investor		
Construction manager		
Educational institution (providing training for the construction industry)	Universities	2.8
Executive authority	State	18.6
Organization carrying out construction control	Controlling organizations	8.5
Technical customer		
Examination of project documentation		
Operating organization	Operating organizations	2.5
Manufacturer/supplier of building materials	Other organizations	6.2
Professional association		
Forensic examination		
Other		

For further analysis, a group of other organizations will not be considered, since it contains organizations that are heterogeneous in functionality, and studying them in a group will not give the expected result. A separate study of organizations of different types of activities included in this group does not make sense because of the small number. Thus, a sample of 333 respondents is taken for further investigation of the distribution of responses in enlarged groups.

In the course of the study, respondents were offered a questionnaire containing questions concerning various aspects of digitalization and digital transformation. As part of this study, we will study the respondents' answers to 2 main questions concerning digital competencies:

1) What are the key competencies of the digital economy in demand in your organization?
2) Does your organization conduct employee training aimed at improving competencies related to digitalization (training in working with new software, using cloud technologies, specialized services, etc.)?

2 RESULTS

The distribution of respondents' answers to the question of which key competencies of the digital economy are in demand in their organization, as a whole, showed the following distribution of answers throughout the sample (Fig.1).

The competencies most in demand in the whole sample were "information and data management" (63.4% of respondents were selected) and "communication and cooperation in the digital environment" (47.9% of respondents were selected). The analysis of respondents' answers by enlarged groups shows that, depending on the type of activity of the organization, the competencies of the digital economy in demand in it also change (Table 4).

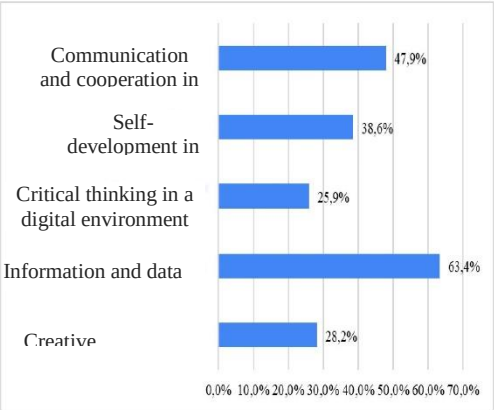

Figure 1: Distribution of respondents' answers to the question "What are the key competencies of the digital economy in demand in your organization?"

Table 4: Assessment of the demand for digital economy competencies by groups of respondents.

Groups of respondents	The percentage of respondents from the enlarged group who chose the answer option				
	Creative thinking	**Information and data management**	**Critical thinking in a digital environment**	**Self-development in conditions of**	**Communication and cooperation in the**
Sample average	28,2 %	63,4 %	25,9 %	38,6 %	47,9 %
Designers	18,8 %	58,0 %	29,0 %	39,1 %	46,4 %
Work executors	36,7 %	46,9 %	28,6 %	46,9 %	57,1 %
Government organizations	27,0 %	61,9 %	15,9 %	39,7 %	54,0 %
Developers	29,7 %	54,1 %	35,1 %	51,4 %	48,6 %
Universities	60,0 %	50,0 %	60,0 %	50,0 %	70,0 %
State	27,3 %	68,2 %	19,7 %	28,8 %	39,4 %
Controlling organizations	13,3 %	66,7 %	20,0 %	23,3 %	43,3 %
Operating organizations	22,2 %	88,9 %	44,4 %	33,3 %	44,4 %

For example, for a group of Designers, the competence "Creative Thinking" turned out to be the least in demand - in this group, respondents noted it less often than in the sample as a whole.

For the "Work executors" group, the significance of key competencies was higher than the average in the sample, with the exception of "Information and Data Management". At the same time, the competence of "Information and Data Management" in comparison with the average value for the entire sample (63.4%) in this group is in demand only for 46.9% of respondents (the gap from the average value was 16.5%). But communication and cooperation in the digital environment turned out to be in demand in this group almost 10% more often than the average for the sample (57.1%).

State organizations may include enterprises of various types of activities, but there is an important distinguishing feature – the ownership rights to them belong to the state. This determines the significant features of management and decision-making, including those related to the introduction of digital technologies. There is also the specifics of the interaction of such organizations with counterparties. Therefore, despite the presence of various types of activities in this group of enterprises, they are considered a separate group. The significance of digital economy competencies in this group mainly fluctuates with minor deviations from the average values. Only the competence "Critical thinking in the digital environment" stands out - of all the selected groups, it is in the group "State organizations" that its demand is the lowest - 15.9%.

The specifics of the activities of developers, investors and construction managers (they make up an enlarged group of "Developers") have led to the demand for the competencies "Critical thinking in the digital environment" and "Self-development in conditions of uncertainty" at a higher level than the average for the sample.

Universities that train personnel for the construction industry can also be considered specific participants in investment and construction projects. In addition to the fact that it is on their basis that personnel training is carried out, they also often perform expert functions, as well as provide innovative developments for implementation. All the competencies of the digital economy turned out to be in high demand at universities, some – by a significant margin from the average value for the entire sample, and only "Information and Data Management" is in demand less often than others – in only 50% of cases (against 63.4% of the sample average).

The "State" group, represented in our study by government representatives, showed a rather low interest in the competencies of the digital economy. In three of the 5 key competencies (Critical thinking

in the digital environment, Self-development in conditions of uncertainty and Communication and cooperation in the digital environment) there is a noticeable lag from the sample averages.

In Controlling organizations, such digital competencies as Creative thinking and Self-development in conditions of uncertainty are least in demand, which, of course, is determined by the specifics of their activities based on the control of key project parameters - creative thinking is least involved in these processes. A high level of regulatory regulation by the industry minimizes uncertainty during control measures.

The specifics of the work of operating organizations make such competencies as Information and Data Management most in demand for them (the highest value among the studied groups is 88.9%), as well as Critical thinking in the digital environment (44.4%, which is second only to Universities with an indicator of 60%).

The development of digital competencies requires training in them. Such training is carried out in educational organizations, independently by employees of organizations, as well as in an organized manner – with the provision of an opportunity to improve qualifications from the employer. Despite the fact that staff training requires additional costs, the employer can thus regulate the pace of digital technology adoption, ensure relative uniformity of digital technology acquisition by employees. In general, any specialist, even after graduation, requires regular professional development and training, including those aimed at mastering the competencies of the digital economy. By conducting organized training of personnel, the organization significantly increases the pace of technology development (compared to mastering on its own – on the basis of self-study) and provides simultaneous professional development of the right groups of employees in the right periods.

In the course of the study, we asked respondents whether their organizations conduct employee training aimed at improving competencies related to digitalization (training to work with new software, using cloud technologies, specialized services, etc.). 62% of respondents answered this question in the affirmative (Fig. 2):

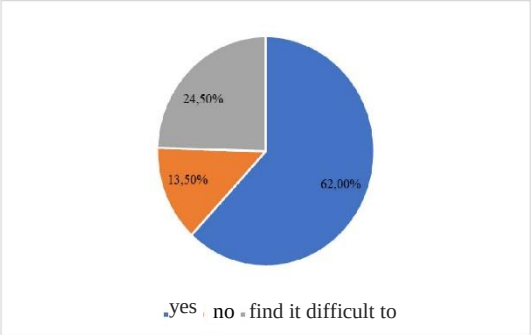

Figure 2: Distribution of respondents' answers to the question "Does your organization conduct employee training aimed at improving competencies related to digitalization?"

Based on the data obtained, we analyzed the results taking into account the functional orientation of the organizations' activities – according to the previously identified groups (Table 5):

Table 5: Conducting organized training of employees in digital competencies by groups of respondents.

Group of respondents	**The percentage of respondents who claim that their organization trains employees in digital competencies**
Sample average distribution	62%
Designers	65%
Work executors	43%
Government organizations	70%
Developers	51%
Universities	70%
State	62%
Controlling organizations	77%
Operating organizations	67%

A comparison of the indicators of training organizations of their employees in digital competencies by groups of respondents with the average for the entire sample yielded the following results:

- the group "Work executors" showed the least activity in organizing training for employees - less than half of the respondents from this group – 43% – noted a positive response;

- the Developers group also showed a rather low result compared to the average - only half of them (51%) conduct organized training of employees

aimed at improving competencies related to digitalization;

- the group "Controlling organizations" showed the greatest activity in the organization of digital competence training.

3 DISCUSSION

In the course of reviewing the results of the study, readers may have questions related to grouping respondents into groups for analysis. We will give additional explanations about this here. As already mentioned, grouping respondents into groups based on the principle of proximity of the functional organizations becomes necessary in order to consolidate the groups of the main sample structure in order to obtain a meaningful analysis result. Moreover, despite the fact that many organizations of various types of activities participate in the practice of implementing construction projects, some of them are really close in their functions:

- designers and architects (the "Designers" group) work on the project of the construction object, determining both its external and structural characteristics;

- the general contractor organizes the activities of contractors (the "Work executors" group) for specialized and general construction works, as well as performs part of the work on its own;

- the activities of investors, developers and customers (Developers Group) are aimed at getting the maximum result from the project;

- organizations that carry out construction control, technical customers and organizations that perform the functions of examination of project documentation, despite the fact that they perform work of various directions, are precisely the controlling organizations. That is, all perform control functions, but the object of control is different;

- state organizations, universities and operating organizations are divided into separate groups. The association of operating organizations and Universities with other groups is impossible due to the specifics of the functions. And state organizations have specific features of activity determined by the form of ownership (this was noted above).

4 CONCLUSION

As a result of the conducted research, it was revealed that the most popular in Russian organizations of the investment and construction sector are such key competencies of the digital economy as information and data management (in demand in 63.4% of organizations) and communication and cooperation in the digital environment (in demand in 47.9% of organizations). Other competencies have significantly lower popularity, and the lowest indicator is Critical Thinking competence in the digital environment – it is in demand in only a quarter of organizations from the current sample – 25.9%.

The analysis of the demand for digital economy competencies by groups of respondents formed by the proximity of the functions performed by the organization in construction projects showed that the type of activity of the organization (the functions performed by it) affect which competencies are most in demand:

- creative thinking turned out to be most in demand at universities that train specialists in construction specialties (60% of respondents in this group noted this competence);

- information and data management is most required in operating organizations (88.9% of the group's respondents chose this answer);

- critical thinking in the digital environment has become the least sought–after competence among those considered, however, universities noted it in 60% of cases, operating organizations - in 44%. These are the best indicators for the sample. In state organizations, this competence took extremely low positions - 15.9%.

- self-development in conditions of uncertainty has become the most popular for a group of developers (51.4%) who assume the main financial risks of the project;

- communication and cooperation in the digital environment is in demand by universities and work executors (70% and 57.1%, respectively).

There is also a different attitude of organizations of different groups to the training of employees in digital competencies. According to the results of the analysis, it was revealed that the controlling organizations are the most active in this issue – 77% of respondents in this group claim that their organizations train employees in digital competencies. The respondents from the "Work executors" group are the least active – training is carried out only in 43% of the analyzed group.

Thus, during the analysis of the research data, it was possible to confirm the hypothesis that the type of activity of the construction sector organization has an impact on the key competencies of the digital economy that are in demand in such organizations.

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