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DIGITALIZATION AS THE FACTOR OF THE IMPROVEMENT OF QUALITY OF MANAGEMENT IN THE ORGANIZATIONS OF THE INVESTMENT-AND- CONSTRUCTION SPHERE

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Abstract: *The construction industry is characterized by the low level of digitalization in spite of the fact, that it has considerable potential. Digitalization in construction can bring significant results, connected with the improvement of the quality of process management in construction, as well as the qualities of final construction products. The purpose of this research is the determination of expectations of the Russian construction industry representatives, concerning the effects, which can be received thanks to the implementation of digital technologies in the organizations, working in the investment-and-construction sphere. The research is carried out with a method of the sociological poll.*

As a result of the carried-out factor analysis the authors proved, that there is the interrelation between the respondents' expectations and the type of activity of their organizations. This factor was the most significant one. The age of the organization and its scale had an insignificant impact on the expectations.

Keywords: *digitalization; investment-and-construction sphere; poll; results of digitalization; expectations of respondents*

1. Introduction

Nowadays digitalization became the natural way of the development of all the industries and spheres of activity thanks to the wide circulation of information technologies. Information technologies have a considerable impact on the development of the organizations (Kobilov et al., 2022; Aptikasheva & Mishura, 2023; Basulo Ribeiro et al., 2023; Bouwman et al., 2018). That consists not only in the the translation of data in the digital form and the possibility to operate with those data (to store, process, transfer, analyze), but also in the need to

reconstruct the business processes according to the use of digital instruments in the production and providing processes. The use of information technologies allows to accelerate many processes, to increase the accuracy, to provide collecting and analysis of information for making the justified managerial decisions, and to increase the cost efficiency as well (Arsic, 2020).

In spite of the fact, that digitalization and digital transformation is capable to yield considerable results and to increase the performance and cost efficiency, various industries are involved in these processes at the different levels. The construction

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industry (or speaking more widely, meaning the set of the organization types, involved in the processes of creation and the subsequent operation of real estate objects, we can call it the investment-and-construction sphere) is one of the industries with the smallest extent of digitalization (Guo, 2023; Schnell et al., 2023; Prebanić & Vukomanović, 2021) despite the considerable potential in this direction and also the availability of actual need for the digitalization (Zulu et al., 2023), as the investment-and-construction projects are characterized by complexity, huge information saturation, the need of interaction of various participants and their simultaneous access to the information on the project and on any changes in the project. Digitalization the construction industry in Russia in general has the same trends, as the construction industry in the world does, and lags behind in the process of the digital technologies implementation (Abdrakhmanova, 2021; Skolkovo Moscow Schools of Management, 2018; Centre of competences of the "Digital Technologies" federal project, 2018).

The researchers incline to the conclusion that digitalization in the investment-and-construction sphere means the implementation of building information modeling, BIM (Stojanovska-Georgievska et al., 2022; Glema, 2017; Kassem, & Louay, 2022). It is impossible to argue, that introduction of BIM, which represents the whole complex of tools and methods of management of investment-and-construction projects at all the stages of lifecycle is really the central aspect of digitalization in construction. Application of BIM allows to achieve considerable effects, such as improvement of quality of the project documentation (Razali et al., 2019; Sadek et al., 2019), increase in the accuracy of resource planning (Musonda, 2019; Huang, 2021), improvement of interaction among the project participants due to forming and use of the uniform digital source of information on the project and the use of technologies of joint operation (Hassan,

2023; Melzner, 2015) performance improvement (Poirier et al., 2015; Calvetti et al., 2020), security (Fagnoli & Lombardi, 2020), decrease in the level of waste (Pellegrini et al., 2021), etc. It also helps to make the justified managerial decisions (Nowak et al., 2016). All this finally affects the reduction of terms and the increase in the cost efficiency of the project (Sholeh et al., 2020; Lu et al., 2014). However, we would like to note in this research, that digitalization is not limited by only the introduction of BIM. It also includes other directions of digitalization of the primary productive activity, including application of IoT and blockchain (Dowsett, 2019; Farmer, 2016), as well as the digitalization of the auxiliary types of activity, such as personnel management and finance management processes, automation and digitalization of sales processes and post-sales service, etc. Speaking about digitalization in construction we mean not only digitalization of the production processes, but a rather integrated approach to the digitalization which is able to give a complex effect and will allow to increase the level of digital culture of all divisions of the organization, including those, which do not work in the BIM environment. Such approach will allow to increase the quality of management in the organization in general, without being limited by the improvement of the project quality or the final products quality (of construction works quality). That will be possible thanks to:

- the automation of the process of collecting, analysis and storage of information on the organization and its various aspects and processes; that will allow to increase the quality and speed of acceptance of managerial decisions considerably;
- providing the operated information access for all the participants of the processes and projects, who need it within the accomplishment of the labour functions; that will increase the quality of accomplishment of the employees' functions considerably;

- the decrease in the mistake probability and inaccuracy in planning and data analysis; that will increase the quality of planning and drawing up reporting and analytical information; that will lead to the decrease in the equipment downtimes, to more effective resource allocation and finally to the increase in the organization cost efficiency.

Studying of expectations of the representatives of the investment-and-construction sphere in Russia, concerning the effects which can be received from the implementation of digital technologies in their organizations, became the purpose of our research. The representatives of the Russian organizations of the investment-and-construction sphere of different functional orientation became the subject of the research. We did not limit our interest by the organizations, performing construction jobs directly, but included the representatives of all the organizations, participating in the implementation of investment-and-construction projects at different stages in the target audience of the research. The hypothesis of the availability of the factors, defining the expectations of respondents was made during the research. The type of the organization activity, its age and size (measured by the number of employees of the organization) were chosen from such factors. So, some tasks, solved during the research, can be set for the achievement of the goal of the research and for the check of the made hypothesis:

- 1) collection of data on the expectations of the representatives of the investment-and-construction sphere, concerning the effects, which can be obtained from the implementation of digital technologies in general (for all the organizations of the industry) and for their organization directly;
- 2) the analysis of data on the expectations of the representatives of the investment-and-construction sphere, concerning the effects, which can be obtained from the

implementation of digital technologies in their organizations;

- 3) identification of the availability or lack of interrelation among the expectations of the respondents and characteristics of their organizations, namely: activity type, age and size of the organization.

The results of the research can be used by the organizations of the investment-and-construction sphere during the implementation of digital technologies and planning of the implementation effect, taking into account the activity type, age and size of the organization.

2. Materials and methods

The research was conducted on the basis of methods of sociological research, namely, the selective correspondence direct poll in the format online questioning. The representatives of the Russian enterprises and organizations of the investment-and-construction sphere of different types of activity, including the authorities, whose job is connected with construction, as well as the educational institutions, which are engaged in training for the construction industry, became the target audience of the research (table 1). The selection volume included 355 respondents.

The application of the poll method allowed to achieve the main objective of the research, connected with identification of expectations of the respondents, concerning the implementation of digital technologies in their organizations.

As it was specified, the authors carried out a check of the hypothesis of the availability of the factors, defining the respondents' expectations from the introduction of digitalization in their organizations, within the research. The type of the organization activity, its size and age were defined as such factors.

Table 1. Distribution of the respondents according to their organizations' primary activity

Primary activity	Quantity of respondents	Share in the selection, %
Architect	11	3.1
General contractor	24	6.8
Public / municipal authority	63	17.7
Developer	25	7.0
Constructor	10	2.8
Educational institution (carrying out training for the constructor industry)	10	2.8
Executive authority	66	18.6
Organization exercising construction control	4	1.1
Contractor / subcontractor	25	7.0
Designer	58	16.3
Producer / supplier of construction materials	4	1.1
Professional association	5	1.4
Judicial examination	2	0.6
Technical customer	22	6.2
Examination of the project documentation	4	1.1
Operating organization	9	2.5
Investor	5	1.4
Others	8	2.3
In total	355	100

Appropriate questions were brought into the questionnaire for structurization of the selection according to the named. The respondents needed to note the following characteristics of the organizations, which representatives they were:

1) age of the organization; the structure of selection according to the age of the organization (presented in figure 1),

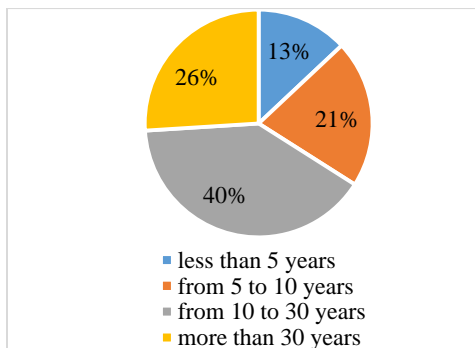


Figure 1. Structure of the selection according to the age of the respondents' organizations

2) size of the organization according to the quantity of employees; the structure of the selection according to the size of the organization (figure 2),

3) type of activity (according to the list, presented in table 1).

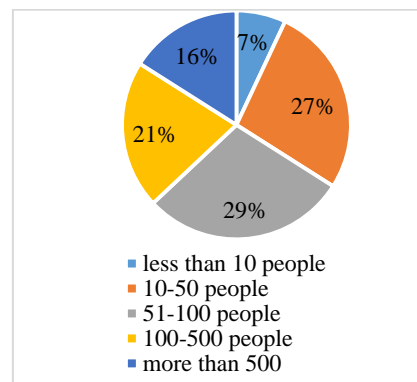


Figure 2. Structure of the selection according to the size of the respondents' organizations

Structurization of the respondents according to the type of activity led to the formation of huge quantity of groups; some of which turned out very small and that did it difficult to carry out further analysis concerning such small groups. The decision to integrate the groups of respondents according to the form

of activities using the principle of proximity of the carried-out functions was made for the verification of the interrelation between the factors and the result (table 2). So, we received larger groups of respondents for carrying out the analysis; that does the analysis results more significant.

Table 2. Integration of groups of the respondents according to similar functionality

Primary activity of the respondent' organization	Name of the integrated group	Share of the integrated group in the selection, %
Architect	Designers	19.4
Designer		
General contractor	Performers	13.8
Contractor / Subcontractor		
Public / municipal authority	State organizations	17.7
Developer	Developers	10.4
Investor		
Constructor		
Educational institution (carrying out training for the construction industry)	Universities	2.8
Executive authority	State	18.6
Organization exercising construction control	Controlling organizations	8.5
Technical customer		
Examination of the project documentation		
Operating organization	Operating organization	2.5
Producer / supplier of construction materials	Other organizations	6.2
Professional association		
Judicial examination		
Others		

The further analysis of the influence of factors on the respondents' opinion is carried out according to these integrated groups of respondents. Let us note, that the versatile organizations got into the other organizations group, their functions are not similar; this group cannot be estimated in the same way as others; data on the assessment of the impact of various factors on the expectations of the respondents of this group are provided for reference, they cannot considered as productive criteria.

Then the factorial analysis, allowing to estimate the availability of influence on the expectations of respondents, depending on the factors, defined earlier (age, size and type of activity of the organization) was carried out for the integrated groups on the

basis of results of the analysis of the respondents' expectations from the implementation of digital technologies. The results of the research are presented in the article.

3. Results

We asked two questions to assess the expectations of the respondents from the implementation of digital technologies:

1) What effects, in your opinion, can be received in the construction organizations as the result of digitalization and digital transformation? The respondents could choose from the offered list of possible answers or offer their own one. The following options were offered:

- acceleration of production processes (design, construction, etc.);
- increase in the flexibility and adaptability to changes in the external environment;
- improvement of coordination among the divisions;
- improvement of quality of the processes management and organization;
- increase in the work efficiency;
- reduction of the equipment downtimes;
- reduction of finance costs;
- improvement of the financial performance (profits, profitability);
- improvement of services or products quality.

Respondents had an opportunity to note several possible answers.

2) What effects are gained in your organization as the result of digitalization and digital transformation? The same list of possible answers was offered, however one point is added: "no one". The choice of "no one" answer means that the respondent does not see any prospects of changes and improvements of management quality and products quality as the result of implementation of digital technologies (concerning his or her organization). The respondents had an opportunity to choose several possible effects or to choose the answer "no one".

The following data were obtained as the result of the analysis (Figure 3).

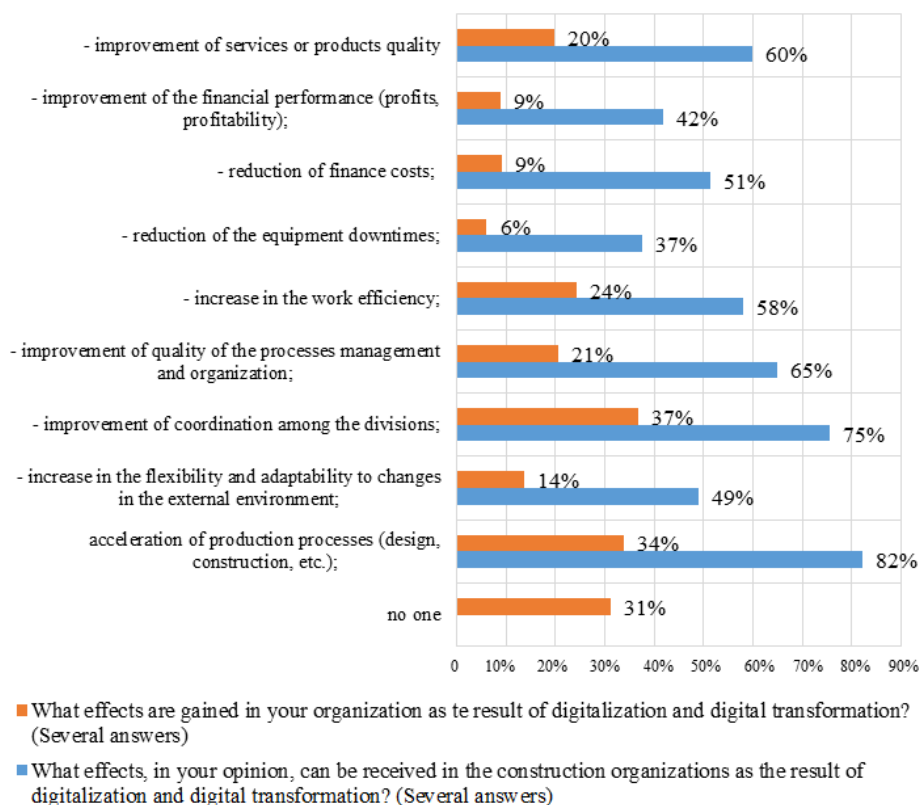


Figure 3. Distribution of answers of the respondents, given to the question "What effects, in your opinion, can be received in the construction organizations and directly in your organization as the result of digitalization and digital transformation?"

The received result was very interesting. The respondents in general estimate the processes of digitalization rather positively and consider, that significant effects can be gained as the result in their organizations: 83% of the respondents expect acceleration of production processes, 75% expect improvements of coordination among the divisions, 65% expect the improvement of management quality and the quality of processes organization, 60% expect improvement of the services or products quality, 51% expect the decrease in finance costs. However, the respondents do not connect these expectations with the organization, in which they work, directly. Those were expectations, concerning the organizations of the investment-and-construction sphere in general.

Concerning their own organizations the expectation of respondents were much more pessimistic. No one from the offered options did not gained 50% of answers. Moreover, the answer "no one" became one of the most popular answers - more than 31% of the respondents consider, that the implementation of digital technologies in their organizations cannot brought any results. About 36% of the respondents expect the improvement of coordination among the divisions and 34% expect the acceleration of production processes. Possibly, the respondents are inclined to estimate the possible results of digitalization more crucially, as they have information from within their organizations and take into account the difficulties and barriers, characteristic of their organizations. The identification of the reasons of such pessimism of the respondents can be a subject of a separate research.

Then the factorial analysis, defining the existence or lack of influence of a factor on

the answers of the respondents was carried out in relation to the expectations of the respondents, concerning the results of digitalization in their organizations:

1. The analysis of the influence of the type of the activity of the respondent' organization on his or her expectations in relation to the results of digitalization.

The assessment of the importance of the factor "type of the organization activity" on the expectations of the respondent is presented in table 3.

The comparison of the expectations of respondents from the integrated groups (types of activity) proves, that this factor has a significant impact on the answers of the respondents.

For example, the representatives of the integrated group "Contractors", "State Organizations" and "Controlling organizations" do not wait any changes, caused by the implementation of digital technologies. The respondents from groups "Designers" and "Universities" noted the increase in flexibility and adaptability to changes of the external environment most often. The respondents "Developers" and "Universities" noted the improvement of quality of management and organization of processes more often than other groups, "Contractors" and representatives of "Controlling organizations" did it rarer than others.

"Developers", "Universities" and "Operating organizations" noted the increase in the efficiency of work as the potential result of digitalization more often than on average in the selection. "Contractors" gave the most modest assessment (only 12% of respondents of this group noted this possible result on comparison with the average on selection - 24.2%).

Table 3. Analysis of the influence of a type of activity of the respondent' organization on his or her expectations in relation to the results of digitalization, %

	No one	acceleration of production processes (design, construction, etc.)	increase in the flexibility and adaptability to changes in the external environment	improvement of coordination among the divisions	improvement of quality of the processes management and organization	increase in the work efficiency	reduction of the equipment downtimes	reduction of finance costs	improvement of the financial performance (profits, profitability)	improvement of services or products quality
Average distribution in the selection	31.3	33.8	13.5	36.6	20.6	24.2	5.9	9.0	8.7	19.7
Designers	23	39	23	38	19	26	3	6	7	38
Performers	43	33	6	29	12	12	6	4	6	6
State organizations	37	30	8	30	17	19	5	3	5	14
Developers	22	41	8	51	30	35	8	19	22	19
Universities	30	40	30	60	30	40	10	10	0	10
State	32	26	14	33	24	23	5	11	3	18
Controlling organizations	43	33	13	33	13	27	10	13	13	13
	22	44	0	33	22	33	11	22	11	22
Others	18	36	23	50	32	32	9	14	23	27

The reduction of finance costs is expected by "Developers" and "Operating organizations", who noted this effect in 19% and 22% of cases respectively (in comparison with 9% the average in the selection).

"Developers" also expect the improvement of financial performance of the projects, this answer was noted in 22% of cases in comparison with the average in the selection - 8.7%. The representatives of the "State" group, consisting of the staff of various authorities, estimate the prospect of the improvement of financial performance very modestly in only 3% of cases.

The improvement of services or products quality is generally expected by the representatives of the "Designers" group. Such result is quite explainable, as the improvement of the project documentation quality by many researchers and practitioners is noted as an important result of the implementation of digital technologies, namely BIM. The project documentation is the very product of the designers-organizations.

2. The analysis of the influence of the age of the respondent's organization on his or her expectations in relation to the results of digitalization is carried in table 4.

Table 4. Analysis of influence of age of the respondent's organization on his or her expectations in relation to the results of digitalization, %

	No one	acceleration of production processes (design, construction, etc.)	increase in the flexibility and adaptability to changes in the external environment	improvement of coordination among the divisions	improvement of quality of the processes management and organization	increase in the work efficiency	reduction of the equipment downtimes	reduction of finance costs	improvement of the financial performance (profits, profitability)	improvement of services or products quality
average distribution in the selection	31.3	33.8	13.5	36.6	20.6	24.2	5.9	9.0	8.7	19.7
less than 5 years	26	34	23	47	30	36	11	13	9	30
from 5 to 10 years	29	42	8	35	21	24	6	8	15	21
from 10 to 30 years	34	29	13	35	17	22	4	6	8	19
more than 30 years	32	34	14	35	20	23	6	12	5	15

Data analysis, presented in table 4, does not allow to draw a conclusion on the availability of essential interrelations between the age of the organizations and expectations from the representatives in relation to the effects of digitalization. Such interrelation is not found for the groups "from 10 to 30 years" and "more than 30 years". However, it should be noted, that the representatives of the young organizations, operating in the market no more than 5 years, estimate possible effects of digitalization more positively; as a rule, they note positive effects more often than the representatives of other groups do. It should be also noted, that the acceleration of production processes as the potential effect of digitalization was noted by the representatives of the organizations operating in the market from 5 to 10 years most often (in 42% of cases while the average value in the selection is 33.8%).

3. The analysis of the influence of the size of the organization of the respondent (according to the quantity of employees) on its expectations in relation to the results of digitalization is presented in table 5.

As a result of the analysis it was revealed, that the representative of the microenterprises (with the quantity of employees less than 10 people) do not expect any changes in the organization, caused by the digitalization most often; they noted this answer almost in half of cases. The representatives of the large organizations (with the quantity of employees exceeding 500 people) consider the possible effects of digitalization most positively; their expectations are much higher, than the average value in the selection. Any steady interrelations between the factor of the size of the organization and expectations of the respondents were not revealed in other groups.

Table 5. Analysis of the influence of the size of the respondent' organization on his or her expectations in relation to the results of digitalization, %

	No one	acceleration of production processes (design, construction, etc.)	increase in the flexibility and adaptability to changes in the external environment	improvement of coordination among the divisions	improvement of quality of the processes management and organization	increase in the work efficiency	reduction of the equipment downtimes	reduction of finance costs	improvement of the financial performance (profits, profitability)	improvement of services or products quality
average distribution in the selection	31.3	33.8	13.5	36.6	20.6	24.2	5.9	9.0	8.7	19.7
less than 10 people	42	31	15	23	19	15	4	8	15	23
10-50 people	33	31	12	33	22	21	4	8	6	21
51-100 people	38	35	12	32	15	25	4	6	5	19
100-500 people	30	36	14	35	19	22	9	7	5	19

4. Discussion

The received results of the research deserve interpretation and even more detailed research in the future. So, the gap between the expectations of the respondents, concerning the results and effects of digitalization in the organizations of the investment-and-construction sphere and the organizations, in which the respondents work directly, became one of the most interesting results. The respondents expressed the expectation of considerable effects of digitalization in general and very modest expectations, concerning the organizations, in which they work specifically. Possibly, possessing information on the features of activity of their organization, they take into account some barriers on the way of digitalization. The resistance to the changes both from management and from employees, high load of the personnel, complicating development of new technologies by them, high level of bureaucratization of processes, etc. can be among such barriers. The identification of the

reasons of such divergence of the expectations and barriers on the way of digitalization is a perspective subject of further research for the authors of this article.

The results of the factor analysis, directed to the identification of the influence of the type of activity, size and age of the organization on the expectations of the effects of digitalization in general are explainable. So, as a rule, the young organizations (operating less than 5 years), are flexible and susceptible to new technologies, sometimes because they have young specialists in the working group, who managed the most modern technologies or ready to study them. As a rule, such organizations are not strongly bureaucratized, and are ready to use various instruments and methods of improving competitiveness for their development, including due to the improvement of management quality and efficiency and as well as quality or services product; that can be reached on thanks to the implementation of digital technologies. It is possible to

prove, that nowadays digitalization of activity of the organization is able to create steady competitive advantages on the basis of high-quality products and service as well as on the basis of leadership in costs, caused by the improvement of management quality (including the increase in the work efficiency, cost reduction, acceleration of production processes).

The representatives of large organizations estimate the prospects of digitalization more positively, as the implementation of digital technologies can have significant results, because of the scale effect within such organizations. For example, the acceleration of interaction and improvement of coordination among the divisions of the microorganization and large organization, certainly, will have effect, various on scale. The organization is larger, the interaction among the divisions can be organized more difficult, the processes in a large organization can appear especially bureaucratized. The implementation of digital technologies can simplify the processes in such a case, they can make them faster and more transparent.

The type of activity of the organizations has the strongest impact on the expectations of respondents, concerning the results of digitalization. Noting these or those effects of digitalization, the organizations, certainly, were guided by the specifics of the organization activity. For example, the designers organizations noted the improvement of products or services quality as the result of digitalization are more often than others, as the introduction of BIM allows to increase the quality of the project documentation considerably/ That is a well-known fact. Contractors (including general contractors and contractors) consider the effects of digitalization with obvious mistrust and pessimism. Perhaps, it is connected with the fact, that they imagine the digitalization directly on the construction site badly. The use of digital technologies for management of works on the construction site demands substantial increase of

contractors qualification. It, in turn, proves the need of their derivation from labour transactions for training and assumes the increase in the wage level as the logical consequence. However, the construction industry is hardly ready to such changes.

Operating organizations expect the acceleration of production processes, the increase in the efficiency of work and reduction of finance costs as the results of digitalization. It is explainable too as, for example, the applications during operation and carrying out the serving and repair work in the information model are reduced by information search about engineering and design features of a project, failure detection, etc. That means, that in general, the respondents, who noted the possible effects of digitalization, relied on the features of activity of the organization and really received benefits from digitalization. Such benefits in general coincide with those, that are described in scientific and scientific-and-practical literature.

5. Conclusion

The identification of the expectations of the representatives of the investment-and-construction sphere in Russia, concerning the effects of digitalization were chosen as the research objective. The following main results were obtained as the result of the analysis of data, collected by the means of the poll method:

1) the respondents noted the acceleration of production processes, improvement of coordination among the divisions of the organization, improvement of quality of processes management and organization, improvement of products or services quality as well as the increase in the work efficiency as the most important effects of digitalization, from 58 to 82% of respondents noted them. Such complex improvement of quality of management of the organization, should certainly have reflection in the financial performance as well; 51% of respondents announced the

potential cost reduction, 41% of the respondents noted the increase in profit and profitability;

2) the significant gap between the expectations of respondents, concerning the results and effects of digitalization in the organizations of the investment-and-construction sphere and in the organizations, in which the respondents work directly, was revealed. This gap averaged about 30-40% for each possible effect. The availability of such a gap proves, that despite the general positive relation to digitalization, the respondents see some barriers to the digitalization in their organizations. Studying of these barriers can become a subject of further research;

3) the hypothesis of the availability of the factors, defining expectations of respondents, was made. The type of activity of the organization, its age and size (measured by the quantity of employees) were named among such factors. The hypothesis was confirmed partially. It was established as the result of the carried-out factor analysis, that there is an interrelation between the expectations of respondents and the type of the organizations activity; this factor was the most significant. The age of the organization and its size had an insignificant impact on the expectations. However, the authors succeeded to draw a

conclusion, that the young companies, acting in the market less than 5 years, as well as the large organizations with the quantity of employees over 500 people consider the possible effects, which can be received as the result of organization activity digitalization, most positively. The expectations were differentiated poorly in other groups (both according to the age of the organizations and scale) and they are in the range of average values in the selection with insignificant fluctuations.

The results of the research can be used by the construction organizations during planning of implementation of digital technologies and projections of economic effect, as well as for the improvement of management quality. They will also allow to adjust the processes of the increase in the efficiency of activity at the level of the industry due to the purposeful managerial influences taking into account the specifics of the type of the organizations activity.

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