Digital transformation of construction organizations

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Abstract. Construction sphere is standing at the threshold of large-scale transformation based on innovations and digital technologies. These changes will result not only in reduction of investment-construction project life cycle and improve their economic efficiency but will also force organizations to more widely evaluate their competitiveness and position in the market.

Purpose of this paper – analysis of theoretical approaches to digital transformation of the companies, revealing of specific features and problematic issues regarding certain transformations occurring in construction organizations, analysis of local and foreign experience of implementation of digital tools intended to improve efficiency of cooperation with clients, employment of new forms and methods of business process management, development and fulfillment of up-to-date business models. Digital systems enable the company managers to more profoundly comprehend the production process and its economic efficiency, regional features of markets and client demands.

1. Concepts of organization of digital transformation

Digital transformation is more and more frequently mentioned among critical factors intended to enhance organization competitiveness and successful development [1]. Nevertheless, currently there is no uniform understanding of essence and limits of using this concept and criteria of organization digital transformation assessment. Thoroughness of this term comprehending and interpretation is necessary not only to determine the theoretical topic but also to appreciate practical analytical investigations.

Earlier, Pathel and McCarthy [2], developing the concept of organization digital transformation, were often focusing on issues like e-commerce and e-marketing or, for example, e-literacy [3]. Nevertheless, modern scientific views are more and more frequently underlining complete renovation of business models and value creation logic in all branches of industry [4, 5].

According to some authors [6], organization digital transformations are taking place not through employment of particular innovative production and management tools but on the basis of digital development strategy. Currently, in order to elaborate proper development strategy, organizations make reference to opinion of experts having digital tools development and implementation experience. Summarizing the viewpoints of the core companies [7–9], it is possible to point out similarity of their way of comprehending the essence of digital transformations: digital transformation means adaptation to digital technologies impact and integrating them into organization's external interface and into ongoing internal processes.
Development and spreading of information-communication technologies was always increasing their impact on any part of socio-economic relations. Initially, the companies considered the information and digital technologies as an aid for developing the new product, raising labor productivity and simplifying some of the business processes. However, the deeper innovation technologies were entering everyday life, the more they affected subjects and objects of market relations. Figure 1 shows three stages of organization digital transformation evolution pointed out by S.J. Berman and R. Bell, IBM Institute for Business Value [9].

Figure 1. Evolution of digital transformation organization.

Organizations belonging to construction sphere take part in tangible assets exploitation; this is why only now they began to undergo most considerable digital and technological transformations in the recent decades. Changes initiated by such transformations will cause industry branch transformation, therefore, companies capable to observe such requirements will become leaders over the forthcoming decades.

2. Specificity of digital transformation of construction organizations

The construction industry has a high interdisciplinary influence and interaction. Transformation of organizations must improve their competitiveness in condition of digital economy formation [1] where socio-economic integrity is affecting all spheres of the public life. In view of this, strategy of construction companies’ digital transformation shall be based on 5 main principles:

- integrating digital platforms into existing ecosystem with a possibility of transparent information exchange among all construction market participants;
- rationalization and standardization of technological and business processes for the purpose of their digitization, transparent information exchange and implementation of production control and management systems;
- adaptation of organizational structure and personnel management system with a purpose to properly select specialists complying with digital transformation requirements;
- supporting of digital transformations aiming to ensure their socio-psychological comprehension by all organization employees and business partners;
- assessment of digital transformation investments efficiency must be based not on particular economic indices but on modification of organization financial-and-economic activities as a whole. At that, it is required to ensure objective evidence obtained with the use of digital tools and systems [10].

Digital corporate strategy shall be the corner stone of digital transformation. Digital transformation must provide a required or better quality of construction products with lower prices, within shorter
time periods and sufficient improvement of construction objects safety and energy efficiency. A lot of new demands put forward by the customers are already technologically accessible and the companies are leaning towards complete satisfaction thereof. As a consequence, organizations which avoid integrating into new digital ecosystem will compete with investment-construction activity participants who are already on the way. Namely growing expectations and demands of the clients, pricing action and competition are those key drivers which are promoting digital transformation of organizations belonging to construction sphere.

3. Destinations and tools of construction organizations digital transformation

Technologies and tools used by organizations as well as their impact on business processes depend largely on digital transformation stage at which organization occurs. International consulting company Roland Berger developed a matrix of construction organization digital capabilities depending on its digital maturity (figure 2) [11].

![Matrix of digital capabilities of construction organization](image)

**Figure 2.** Matrix of digital capabilities of construction organization.

By virtue of this matrix we can identify seven destinations of digital technological transformations which are considerably affecting the production and business processes maintained by investment-
construction activity participants and which must be, therefore, reflected in construction organization digital transformation concept [1].

**Digital tools of the state-guaranteed order.** European Union Procurement Directive is stipulating (within the framework of “Europe-2020” strategy) a complete transition to digital procurement system by the end of year 2018. According to the said regulatory document, legislation of EU member states must be brought to a unified format and state-guaranteed procurement – to standardization and full-scope digitization [12, 13]. In Russia, proportion of procurements for construction organizations intended to perform civil construction works in compliance with 44-FZ reached 28% of total scope of state procurements in 2017 [13]. Thus, organization's digital transformation enabling it to cooperate with state customer services by means of information-communication technologies will not only make it competitive but will become a key factor allowing to increase market potential accessible for this construction organization.

**Materials procurement digital platforms.** Construction materials represent one of the main construction product cost element. Digital tools give the possibility of cooperating with considerable number of participants of investment-construction activities not only through auction competition but also by self-supporting retrieval of information in suppliers' digital catalogues.

**Optimization of logistics and construction organization processes.** Construction organization employees are spending only 30% of their working time for their primary activities. The remaining 70% are falling under various commitments, materials transportation, construction site and equipment preparation [8]. Employment of digital systems allows improving efficiency of working time utilization by collection and analysis of larger data scopes.

**Industrial robots and drones.** High efficiency of aforesaid technologies consists in considerable labor productivity growth achieved at the expense of prompt collection and processing of standardized information and execution of production tasks based thereon. Important task of this commitment is the process generating of stable information-communication system of cooperation with a possibility of quick upscaling without changing the architecture.

**Digital marketing and sales channels.** Average period of investment-construction project implementation is reaching 5 years [14]. Solutions taken at project initial stage are defining construction company activities in the midterm. Therefore, it is important to acquire as much information as possible about market, target segment and competitors at the stage of concept development. Employment of digital information acquisition services allows obtaining huge amount of information for analysis and project development. Digital sale channels will provide access to consumers, decrease costs of goods sold and thus improve project's investment attractiveness.

**Service digital tools.** Investments into after-sale maintenance tools increase value of cooperation between the company and the clients, allow to know more about clients’ demands ahead of competitors and to reduce time for decision making in regard of cooperation commencement. This is a very important aspect for the construction companies because due to specific character of construction products and services there is a considerable time period between occurrence or determination of demands and commencement of cooperation.

**Infrastructure of BIM-technologies.** Investigations show that growing organizations experience in using BIM technologies is accompanied by growing economic effect and investments profitability increase [15]. At that, it was observed that growth of efficiency took place owing to various factors as follows: decrease of contingency costs; accuracy of project costs calculation; decrease of cost estimate compilation duration; reduction of investment-construction project implementation period and others. Therefore, strategy of organization digital transformation must contribute to the promotion of information modeling technologies for entire aspects of organization activities through development of stable BIM technologies infrastructure.

According to Zion Research [16], global market of digital transformations will increase from 150 billion $ in 2015 to about 430 billion $ by 2021 – i.e. average growth rate will exceed 19% (including services, hardware and software packages). Ernst &Young company [17] undertook the study of construction companies in North America, Europe and Pacific region with total revenues over 500
billion $. Respondents were representing companies constituting the entire construction product creation chain: developers, general contractors, construction materials and equipment suppliers, designers etc. Main attention during investigation was drawn by the following key destinations: digital strategy; digital transformation of leader and team; innovation support and development; digital tools and systems, cyber security. Almost 98% of respondents consider that digital technologies will play the key role defining future company survivability, however, despite this fact; only 25% of respondents are holding digital transformation programs while the most part thereof (67%) spend less than 1% of cash cycle for research and developments. For comparison, average expenses for research and development expenditures of 2500 world leading companies reach 3.8%. Figure 3 shows digital tools and systems used by organizations falling under investigations.

![Digital tools and systems used](image)

**Figure 3.** Digital tools and systems used.

Top line of this rating is occupied by enterprise resource planning system covering personnel management, assets management, financial management and oriented on continuous balancing and optimization of company resources through employment of specialized integrated software package [18] (ERP – 74%) and information modeling system BIM 3D & BIM 2D (jointly 79%). This is the proof of the fact that construction companies often lack qualitative data. Project life cycle stages require access to 2D and 3D data, financial-economic data, corporate data and resource management data. At that, all these data shall be linked between each other so as to ensure efficient implementation of the project.

4. **Problems associated with digital transformation of construction organizations**

Despite evident advantages and strong demand for digital transformation, many construction companies are using digital technologies fragmentarily failing to obtain full advantage of using them. Even where extensive and progressive innovation tools are being employed, this cannot fully integrate them into everyday company activities and considerably improve key financial-and-economic indices of this organization. Based on investigations held by McKinsey Global Institute [19] it is possible to
identify three factors which may contribute to successful implementation of digital transformation strategy maintained by the construction organization.

Adherence. Construction companies can take decisions to promote digital transformations under the impact of competitive struggle only for the purpose to demonstrate adherence to innovations. However, market leaders who investing into digital transformation and technologies are predicting pertinent expenses and planning assessment of their economic efficiency over short-term and long-term perspectives. It means that small companies often obtain lower results of their digital investments than expected; this may lower their motivation to continue financing especially in condition of budget pressure increase.

Declaration of value to employees. As a rule, new technologies are being tested in condition of pilot projects by a limited circle of specialists and employees of the construction organization. During such tests strong and weak points are identified, digital tools adaptation to the demands of particular company takes place. However, in case of large-scale implementation it is not always possible to explain advantages of new technology to an individual employee or ensure proper preparation. This is why employees in condition of construction site often consider digital tools as additional complications impeding the production process. Such misperception may arise due to the fact that software implementation in construction organizations is often initiated by organization-management mechanisms.

Compatibility. Implementation of new digital technologies ensures maximum efficiency where they are easily integrated into active corporate systems or systems cooperating with existing and potential partners of this organization.

5. Conclusions

By contrast with conventional company development strategies based on organizational and production capabilities, digital strategy must consider the concept-based changing of socio-economic cooperation principles and mechanisms of values, products and services creation and rethink business processes and sales promotion methods. Most part of modern scientists, analyzing the process of digital transformation organization, agrees that successful digital transformation is not representing the product of new technology implementation but rather creating conditions which enable the organization to use possibilities provided by new digital technologies [20].

Digital transformation of construction sphere exerts influence on the whole product value chain, therefore, employment of digital tools by entire participants of investment-construction activities becomes a mandatory constituent part of operational and production processes. In order to overcome these common problems of digital transformation the companies must change their operational model to comply with digital transformation strategy which includes the following elements:

- **Focusing on cooperation with client.** Digital approach must provide not only solution of particular operational or managerial task but concentrate on cooperation between client (physical person, legal entity or state) and organization.
- **Full package of digital advantages.** Companies will obtain maximum advantages if they use the combination of variety of digital tools: for instance, extended analysis of target segment and BIM design.
- **New management system.** Integrated management system will ensure new operating model stability. Stimulation and transparency of digital data system are important tools helping the managers to accelerate new technologies implementation.

**Digital education.** Cultural transformation and job training programs allow construction companies to use potential of human resources and make organizations more flexible. This provides the possibility to promptly adapt to changing marker conditions and clients demands.

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