Smart technologies as a type of intangible assets of a construction organization and mechanisms for their implementation

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Abstract. The company's assets include intangible assets, a distinctive feature of which is the absence of physical assets. Today, it is becoming more obvious that the so-called tangible assets are not the only factor in ensuring the profitability of the organization, and that there are other types of them that do not have such a classic feature as a material substance, but can play a crucial role in the process of making a profit for the enterprise. The relevance of this topic is obvious, because in modern conditions, the formation of complete information about economic processes is almost impossible without information about intangible assets. Moreover, with the development of innovative technologies, organizations in the construction industry need to step forward and use such type of intangible assets as Smart platforms. This type of intangible assets allows construction companies not only to meet a high innovative level of development, but also provides a reduction in costs and generate more revenue.

The efficiency of any construction project depends not only on the level of technical competence and responsibility of the implementation agencies, but also from the quality control a huge number of interrelated and interdependent processes, as well as coordination of all project participants. In accordance with the development trends in all sectors of business, digital technologies are beginning to take an increasing place, the possession of which will eventually become a mandatory requirement for the implementation of each project. The construction industry is the most conservative with regard to the use of digital technologies. At the same time, it has a high potential for applying digital and innovative technologies.

In 2018, the president of the RF issued an instruction “on modernizing the construction industry and improving the quality of construction”, which is aimed at introducing digital technologies into the construction industry [1]. This project should ensure the digital transformation of the industry by 2024. Within the framework of this order, a set of measures “digital construction” is being developed, which are aimed at fulfilling this order. In the process of digitalization of construction, it is expected to reduce the cost and time for the construction of objects by up to 20% [2].

Digitalization of the construction industry is developing in many directions. Participants in the construction market are actively implementing digital information technologies that cover almost all business processes: recruitment, accounting, internal document management, planning, development and placement of advertising, customer search and support, procurement, production, work, services, monitoring of contracts, and many others.
Prospects for the development of digitalization consist in a radical transformation of industrial relations, the creation of a digital ecosystem, which is characterized by the following:

– all elements of the investment and construction system are present simultaneously in the form of physical objects, products and processes, as well as in the form of their digital copies (mathematical models);
– all physical objects, products and processes become part of an integrated it system due to the presence of a digital copy and the “connectivity” element;
– through the presence of digital copies (mathematical models) and being part of a single system, all elements of the investment and construction system continuously interact with each other in a mode close to real time, simulate real processes and predicted States, and ensure constant self-optimization of the entire system.

The key advantage of digital transformation is the implementation of the ability to automatically manage the entire system (or individual components), as well as its almost unlimited scaling without loss of efficiency, which allows you to significantly improve the efficiency of economic management (economic activities and resources of the country in various industries) at the micro and macro levels.

However, the construction industry does not fully realize the potential of implementing digital technologies. For example, project planning often remains inconsistent between the office and the field office and is often done on paper, without the use of digital devices. Also, contracts do not include incentives for risk sharing and innovation. The industry has not yet introduced new digital technologies that require prior investment, even if the long-term benefits are significant. R&D spending in construction is significantly lower than spending in other industries: less than 1% of revenue compared to 3.5–4.5% for the automotive and aerospace industries [3,4].

However, investment and construction projects are becoming more complex and large-scale, both in terms of construction volumes and investment. This means that traditional methods must change. It is obvious that the deep problems of the construction industry, such as lack of personnel and resources, will also require new ways of thinking and working. Traditionally, this sector has focused on incremental improvements, in part because many believe that each project is unique, that it is impossible to scale up new ideas, and that the introduction of new technologies is impractical. The McKinsey global institute estimates that the world as a whole will need to spend $ 57 trillion on infrastructure by 2030 to keep up with global GDP growth [5]. This is a huge incentive for construction industry actors to find solutions to transform productivity and implement projects using new technologies and improved methods.

In the RF, the greatest attention when implementing digitalization technologies in the construction industry is given exclusively to building information modeling. This approach is not correct, because digitalization of construction is not only an information modeling of buildings, it is also the formation of electronic information systems for urban planning, digital libraries of standard elements, the creation of machine-readable regulatory documents, the introduction of Smart platforms in all business processes of a construction company.

The author of the article identified five areas of the Smart platform that will be practical and relevant for the subjects of the construction sector:

1. The implementation of surveying and geo-high resolution
2. next-generation 5-D BEAM Information modeling
3. Digital collaboration and mobility
4. Internet of things and advanced analytics
5. Modern construction materials

Let's look at each element of the Smart platform in detail. The occurrence of errors during geodetic works is the main reason for the delay of construction projects and excess of estimated costs. New technologies that combine high-definition photos, three-dimensional laser scanning and geographic information systems, thanks to recent improvements in unmanned aerial vehicle and unmanned aerial vehicle technology, can significantly improve the accuracy and speed of geodetic work. Advanced shooting techniques are complemented by geographic information systems that allow you to overlay
maps, images, distance measurements, and GPS positions. This information can then be uploaded to other analysis and visualization systems for use in project planning and construction.

The use of BIM technologies in construction has been supported and promoted by the government of the RF since 2010, but so far it has not been possible to achieve high results in this area. Today, the world's leading construction companies use a new generation of information modeling 5-D BIM. This is a five-dimensional representation of the physical and functional characteristics of any project. It takes into account the cost and schedule of the project in addition to the standard spatial design parameters in 3-D [6,7]. This also includes details such as geometry, technical characteristics, aesthetics, thermal and acoustic properties. The 5-D BIM platform allows owners and contractors to identify, analyze, and record the impact of changes on project cost and planning. To take full advantage of BIM technology, project owners and contractors must enable its use right at the design stage, and all stakeholders must adopt standardized design and data presentation formats that are compatible with BIM. In addition, owners and contractors should allocate resources to implement BIM and invest in capacity building.

The digitization process means moving from paper to real-time online information sharing to ensure transparency and collaboration, timely progress and risk assessment, quality control, and ultimately better and more reliable results.

One of the system-forming elements of the Smart platform is the joint work of all project performers. The main reason for low productivity in the industry is that it still relies primarily on paper to manage its processes and results, such as drawings, project drawings, purchase orders and supply chains, equipment logs, daily progress reports, and stamp lists. Due to the lack of digitization, information exchange is delayed and cannot be universal. This is why owners and contractors often work with different versions of reality. Using paper makes it difficult to collect and analyze data; this is important because in purchasing and contracting, historical performance analytics can lead to better results and risk management. Errors in the paper also usually cause disagreements between owners and contractors on issues such as construction progress, change orders, and claims management. Finally, paper trails just take longer. Based on this, contractors need to develop software within the company's intangible assets that runs in a cloud-based mobile field surveillance platform that integrates project planning, design, physical control, budgeting, and document management for large projects (Picture 1) [8,9].
### Design management
- Visualize drawings and 3-D models on-site, using mobile platforms
- Update blueprints in the field with markups, annotations, and hyperlinks

### Scheduling
- Create, assign, and prioritize tasks in real time
- Track progress online
- Immediately push work plan and schedule to all workers
- Issue mobile notifications to all subcontractors

### Materials management
- Identify, track, and locate materials, spools, and equipment across the entire supply chain, stores, and work front

### Crew tracking
- Provide real-time status updates on total crew deployed across work fronts, number of active working hours, entry into unauthorized areas, and so on

### Quality control
- Offer remote site inspection using pictures and tags shared through app
- Update and track live punch lists across projects to expedite project closure

### Contract management
- Update and track contract-compliance checklists
- Maintain standardized communication checklists
- Provide updated record of all client and contractor communications

### Performance management
- Monitor progress and performance across teams and work areas
- Provide automated dashboards created from field data
- Offer staffing updates and past reports generated on handheld devices

### Document management
- Upload and distribute documents for reviewing, editing, and recording all decisions
- Allow universal project search across any phase

| Design management | Scheduling | Materials management | Crew tracking |
|-------------------|------------|----------------------|---------------|
| • Visualize drawings and 3-D models on-site, using mobile platforms | • Create, assign, and prioritize tasks in real time | • Identify, track, and locate materials, spools, and equipment across the entire supply chain, stores, and work front | • Provide real-time status updates on total crew deployed across work fronts, number of active working hours, entry into unauthorized areas, and so on |
| • Update blueprints in the field with markups, annotations, and hyperlinks | • Track progress online | • Issue mobile notifications to all subcontractors | |

**Picture 1. Software aspects**

In fact, the digital collaboration and mobile solutions segment has attracted almost 60% of all venture capital funding in the construction technology sector [10]. One of the startups has developed apps for tablets and smartphones that allow you to make changes to design drawings and plan real-time transmission to local crews; photos of the site can be linked to construction plans. This solution supports a core set of documents with automatic version control and cloud access. Other companies offer mobile timekeeping, real-time cost coding, employee location detection, and logging and problem tracking.

As advanced users such as project managers, merchants, and operators implement real-time crew mobility applications, they can change the way the industry does everything: managing work and change orders, tracking time and materials, dispatching, scheduling, measuring performance, and reporting an incident.

The digital solutions segment described above is based on the Internet of things. On the construction site, the Internet of things allows construction machinery, equipment, materials, structures, and even formwork to “communicate” with a central data platform to collect critical performance parameters [11,12]. The Internet of things is the concept of a computer network of physical objects equipped with built-in technologies to interact with each other or with the external environment, which allows them to
collect, analyze and transmit data among themselves using software and technical devices. Let's look at the main applications of the Internet of things in the construction industry:

1. Monitoring and repair of equipment. Advanced sensors allow equipment to detect and report maintenance requirements, send automatic preventive maintenance alerts, and collect usage and maintenance data [13,14].

2. Inventory management and ordering. Connected systems can predict and notify site managers when inventory runs out and when orders need to be placed. Marking and tracking materials using NFC can also accurately determine their location and movement, and help coordinate physical and electronic inventory.

3. Quality assessment. “Smart structures” that use vibration sensors to test the strength and reliability of the structure during the construction phase can detect flaws and then correct them in advance.

4. Energy efficiency. Sensors that monitor environmental conditions and fuel consumption for assets and equipment can help improve energy efficiency on site.

5. Security. Wearable lanes can send alerts if drivers and operators fall asleep, or if a vehicle or asset is stationary or inactive for a set amount of time during shift hours.

All of the above applications are combined in a single platform, where devices and sensors that track and analyze all construction processes work in real time. This approach allows you to reduce not only the time of work and their labor intensity, but also their cost. Special attention should be paid to control. Already, large companies are using drones, GPS devices and all sorts of scanners in order to comply with plans, speed of construction of houses and the appropriate quality. End-to-end analytics will also affect the physical work of staff on the construction site [15].

The use of the above programs and tools is aimed at increasing the role of the organization's intangible assets. Competent and timely action on the implementation and use of IA significantly transforms the economic and industrial image of the organization [16]. By implementing the IA management cycle, an organization can increase the efficiency of its activities by making the most complete and rational use of information, reputation, and the knowledge that it has rights to use. It should be noted that IA is quite complete in relation to the economic turnover of the organization: they are used in sales and purchase transactions, they are subject to property claims, they are made as a contribution of legal entities and individuals to the share capital when purchasing shares of the company, they include their cost in fixed assets and amortize, including costs [17].

In modern realities, the use of Smart space in construction organizations allows you to reduce production costs, get additional income, increase the level of business reputation after its severe decline due to economic difficulties and get an investor or an important partner.

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