United Digital Platform for Efficient Construction Development

A Ryzhkova¹, A. Ginzburg¹

¹Moscow State University of Civil Engineering, 26 Yaroslavskoe shosse, Moscow, 129337, Russia

E-mail: ryzhkovaAI@mgsu.ru, ginav@mgsu.ru

Abstract. Modern development of technologies allows the countries’ governments to create completely new approaches to doing business. Digitalization of industries allows to get rid of a counterfeit product, minimize the costs of resources: time, materials, labor and finances. Digitalization of the construction industry can become one of the key moments of the country's entire economy transition to the digital age, while ensuring sustainable development of cities. The construction has a high multiplier effect: one workplace in construction gives up to 15 jobs in other sectors of the economy. Sustainability of development can be ensured by reducing the costs of resources and improving the quality of products. The authors of the article consider the possibilities to create conditions for the sustainable development of cities through the sustainable development of the construction industry on the territory of the Russian Federation.

1. Introduction

Any life cycle of an object of capital construction can be represented in several stages:

- Pre-investment,
- Design,
- Construction,
- Operation,
- Utilization.

Market players - construction companies that specialize in certain types of services or goods, provide passage of each stage of the cycle. So according to the Federal State Statistics Service in the Russian Federation there are more than 182,000 legal entities working in the construction industry, only 3% of them are large enterprises, more than 82% are small and micro enterprises.

At the same time, conscientious and effective work of each market participant is the key to sustainable development of the industry, which becomes the basis for sustainable development of cities. Nowadays modern technologies allow the government to create the most comfortable conditions for the development and work of each industry’s participant, while requiring ones to work efficiently, which can be verified in real time.

For each life cycle stage of the capital construction object, its complexities and problems are typical, that’s why they could be solved by industry digitalization.

First of all, digitalization must solve the problem of lack of data: an increase in monitoring tracking points for each stage of construction, after that accumulating a certain data set, they can also be used to form clear (based on practical data) forecasts at the investment justification stage (pre-investment).
these actions will lead to a decrease of potential risks in the construction industry, and as a result to financial industry transparency.

More than that according to the Russian Federal State Statistics Service, in 2017 1138 fatal accidents occurred at work. What led to increased state control and increased responsibility, including criminal liability. Complex statistic data could help State to control mostly risky construction sites and objects.

2. Relevancy
The national program "Digital Economy of the Russian Federation", which has been actively implemented in the past year and a half, has caused a rise in the development of information solutions in various sectors of the country's economy. At the same time, it is very difficult for a business, especially in such a multiplicative sector as construction, to understand which solutions are critically important for it, which ones increase efficiency and which are not worth the money spent on them.

The development of a single open information platform that unites both the business, the state, and consumers of construction products (operational stage) will lead to an understanding of which industry really needs solutions, and which will not, will automate the most cost-intensive business-to-business relationship and make the transition to “Digital economy” with the most effective and not expensive resources (time, money).

3. Statement of the problem
The key existing problem of the effective development of the construction industry is the lack of information provided at each stage of the life cycle of a capital construction object:

- Pre-investment,
- Design,
- Construction,
- Operation,
- Utilization.

For the "Pre-investment" stage - such data will be a single database on the construction of similar projects in different regions of the country.

For the "Design" stage - data of typical nodes when building digital models of buildings (BIM)

For the "Construction" stage - data of monitoring tracking points for each work performed at the construction site

For the "Operation" stage, the data of sensors and devices from the housing and utilities sector, allowing to move to a preventive model of planned repairs and works.

Therefore, the key task of the research was to formulate an approach to consolidate the maximum amount of data on a single site based on the needs of using them by all industry participants: business, government, citizens (consumers of finished products), and also based on the need for automated digital solutions.

4. Materials and methods
The authors used a systematic analysis of construction industry and digital tools as the research approach.

The construction is considered by the authors as a system consisting of different parts that interact with each other and exchange the material resources, which ultimately leads to the construction products production at the specified time and with the specified at the initial stage quality.

The authors considered the construction object as an object passing mandatory and standard for all capital buildings stages: pre-investment, design, construction, operation, utilization.

5. Results
The authors in the research found that for each life cycle stage of the capital construction object a certain set of risk events is characteristic, they are presented in the form described below.

3
Pre-investment life cycle stage:
1. Lack of official statistics that discloses the amount of investor resources (time, money) at the next stages of the life cycle.
2. Lack of understanding of the list of the most likely potential "clean" risks at the design and construction stages typical for a certain type of buildings and structures.

Project life cycle stage:
1. Availability of a wide range of construction automated software products, including in the field of information modeling, however, used only as "smart" editors of project documents;
2. Presence of one-vector complementation of software products, which generally infringes on the development domestic software market;
3. Lack of accumulated statistical information, a "knowledge base" showing potential difficulties (risk events) for the design phase of each type of capital construction objects;
4. Lack of staff who can work with modern technological solutions;
5. Lack of national standards of information modeling;
6. Lack of a list of the best and most effective practices;

Construction life cycle stage:
1. The presence of a sufficiently high proportion of counterfeit products;
2. The presence of errors in the design, causing idle time of technology, manpower, leading to a breakdown in construction time and the total estimated cost of construction.

Operation life cycle stage:
1. Absence of unified official statistical information on companies operating in this segment;
2. Lack of a national standard for writing passports for the operation of facilities under construction;
3. Lack of unified information of the best and most effective practices;

The utilization life cycle stage:
1. Absence of official statistical economic, objective information;
2. Lack of unified information about best practices.

All construction industry participations these lost project up to 30% of the working time to find reliable information and data due to the lack of an integrated information and data exchange environment between the participants of the construction project.

Not automation data exchange requires much time for performing business processes and decision making. Applied by the project participants design information systems, calendar and network planning, ERP are not integrated with each other at the level of master data, values key attributes (for example, the number of units purchased in the General Contractor’s ERP does not coincide with the value in the consolidated procurement statement of the General Designer) and on level of data exchange information.

Lack of formalized digital business construction project management processes using BIM technologies and life cycle management systems with a description of roles, the entered and consumed digital information by the Customer-developer, Engineering companies, or the General Designer and the General Contractor, the Technical by the customer.

These problems could be solved by creating a united information space of the country's construction industry, which will not only be information place and a repository of current editions of regulatory legal acts and regulatory documents in machine readable format. It should be a smart algorithm that can receive process, analyze, structure data about each capital construction project, and be able to provide all necessary information for regulatory authorities, including full contractor’s chain.

Key principles of creating a single information space of the construction industry:
1. Association of all industry participants on a digital platform (companies, associations, associations)
2. Formation of the final list of types of industry participants.
3. Formation of key needs for each type of market participants: from the state, the market, the statistical information.

4. Creating a knowledge base of each type of participants

The authors of the article refer to a single information space as a digital platform that will automate all relationships between the state and business, including obtaining building permits, joining self-regulatory organizations. It should give the chance for companies electronic reporting on the services performed, on product quality, and also allowing to control manufacturers of building materials and tools in terms of the quality of their products.

United digital platform should allow companies to automate the process of transferring data to the state. The platform should allow companies also to automate the process of transferring data to the state. Thus, uniform standards of work should be adopted.

The data that should be transferring to the state:
- drawings of the project stage and working documentation;
- estimate documentation and procurement statements;
- calendar and network schedules of procurement and construction and installation works;
- purchasing lists of equipment and materials;
- data of logs of architectural supervision, requests of the installation organization for changes to the project, comments of construction supervision;
- virtual tours based on photos 360.

Finally, the state and construction industry’s participations could find the united digital platform be interesting in the fields:
- implementation of pulp and paper industry construction projects;
- the organization of a united space of relevant information and data on the construction object;
- verification and optimization of design solutions;
- verification and optimization of schedules of procurement procedures in accordance with the schedules construction and installation works;
- automation of the collection and processing of actual data on the progress of construction and installation works with the use of UAVs, laser scanning and mobile devices;
- integration and verification of compliance of data on the construction object in the information calendaring and network planning systems, ERP systems of construction project participants.

And this will help to solve the most likely and significant risks, while increasing the financial attractiveness of the industry.

References
[1] Ginzburg A, Ryzhkova A 2014 Accounting «pure» risks at the early stage of investment in construction projects with energy efficient technologies in use Applied Mechanics and Materials vol 672-674 (Trans Tech Publications, Switzerland) pp 2221-2224
[2] Rezakhani P 2012 Classifying Key Risk Factors In Construction, Universitatea Tehnică, Gheorghe Asachi din Iaşi Tomul LVIII (LXII) Fasc 2
[3] Volkov A 2001 System analysis in automatic designing of investment construction objects, Theses of International research-to-practice conference “Construction in XXI Problems and Perspectives”, Part “Informational technologies and modern normative regulatory in construction” MGSU (Moscow) 51–52
[4] Abdullayev Israfil oglu Gasim 2017 Methodological problems of assessment of organisational and technological reliability in construction management of linearly-extended structures Journal of Scientific Research and Development 4(1) pp 6-15
[5] Ginzburg A 2013 Queuing Systems in Management Construction Applied Mechanics and Materials vol 405-408 (Trans Tech Publications, Switzerland) pp 3352-3355
[6] Ginzburg A 2016 Sustainable Building Life Cycle Design 15th International Conference on Topical Problems of Architecture, Civil Engineering, Energy Efficiency and Ecology, TPACEE-
2016 Tyumen State University of Architecture and Civil Engineering: MATEC Web of Conferences vol 73 02018

[7] Ginzburg A V, LE I M 2018 Living Environment Information Modelling *International Scientific Conference Environmental Science for Construction Industry, ESCI 2018* Ho Chi Minh City; Viet Nam: MATEC Web of Conferences vol 193 05030

[8] Ginzburg A, Shilova L, Shilov L 2017 Modern standards of information modeling in construction *Scientific Review* vol 9 pp 16-20

[9] Kulikov V, Kagan P, Sukneva L 2013 Staging, formalization and typing of project procedures and processes of the industrial production *Applied Mechanics and Materials* vol 405-408 p 3343

[10] Volkov A, Chulkov V, Kazaryan R, Gazaryan R 2014 Cycle reorganization as model of dynamics change and development norm in every living and artificial beings *Applied Mechanics and Materials* vol 584-586 p 2685

[11] Volkov A 2014 General information models of intelligent building control systems: basic concepts, determination and the reasoning *Applied Mechanics and Materials* vol 838-841 p 2973

[12] Volkov A 2012 Intelligence of buildings: formula *Industrial and Civil Engineering* 3 p 54

[13] Volkov A, Sedov A, Chelyshkov P 2013 Usage of building information modelling for evaluation of energy efficiency *Applied Mechanics and Materials* vol 409-410 p 630

[14] Garyaeva V, Garyaev N 2014 Integrated assessment of the technical condition of the housing projects on the basis of computer technology *Computing in Civil and Building Engineering* Proceedings International Conference p 1336

[15] Volkov A, Chulkov V, Kazaryan R, Fachratov M, Kyzina O 2015 Possibility quantitative appraise components and guidance for constructional rearrangement of buildings attached to their confrontation *Advanced Materials Research* vol 1065-1069 pp 2585-2588

[16] Ryzhkova A, Ginzburg A 2015 Information system of risks analysis and management for construction projects with energy-efficient technologies in use *International Journal of Applied Engineering Research* 10(21) 41828-41830 2

[17] Kuzina O 2016 Components of functional information model of city environment reorganization in interactive mode *MATEC Web of Conferences* 73 p 07013

[18] Gumerova E, Gamayunova O, Shilova L 2017 The optimal decision of insulation in cladding structures for energy efficient buildings *MATEC Web of Conference* 106 p 06020

[19] Bargstädt H, Nasir A, Ignatova E 2014 Can BIM support better working conditions for low-skilled labor? *14th International Conference on construction applications of virtual reality CONVR* Published at Teesside University (UK, by Teesside University) pp 44-51

[20] Ignatova E, Kirschke H, Tauscher A, Smarsly K 2015 Parametric geometric modeling in construction planning using industry foundation classes *The 20th International Conference On The Applications Of Computer Science And Mathematics In Architecture And Civil Engineering Weimar Germany* (Bauhaus University Weimar) pp 68-75

[21] Ginzburg A, Ryzhkova A 2015 The most likely pure risk construction projects with energy efficient technologies in use *International Journal of Applied Engineering Research* 10(21) 42410-42418

[22] Ryzhkova A, Ginzburg A 2018 The possibilities of artificial intelligence to improve the organizational and technological reliability of the construction industry *Vestnik MGSU* vol 13 (112) p 42

[23] Kagan P, Kulikov V 2013 Information modelling of urban planning development *Applied Mechanics and Materials* vol 409-410 p 951

[24] Ryzhkova A, Ginzburg A 2018 Assessment of Construction Project «Pure» Risks *Materials Science Forum* 931 1245-1248