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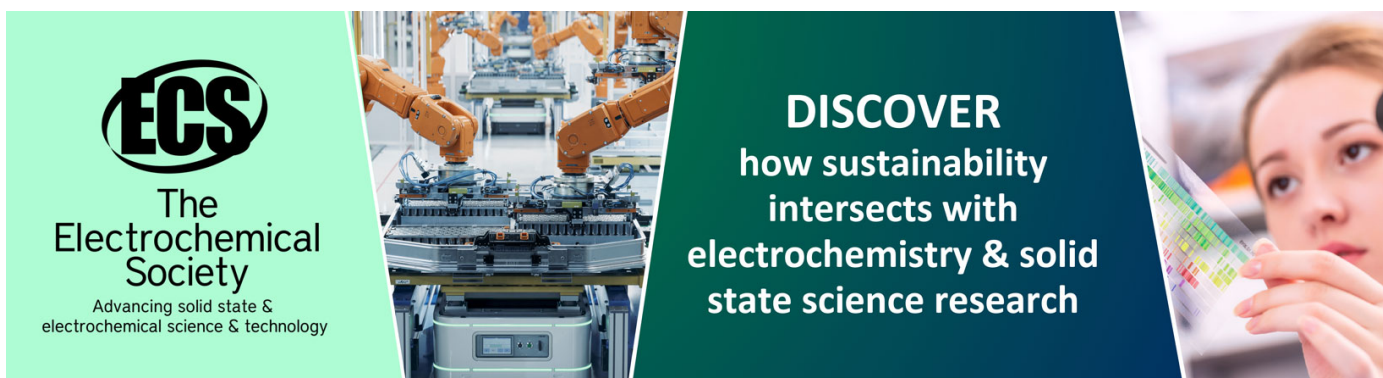
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## Lean construction – an effective management system in the construction industry

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**Abstract.** The paper discusses the possibilities and prospects of using methods and tools of lean construction to improve the arrangement of the construction business in the Belgorod region. Lean construction is considered as a system of innovative methods of process management in construction. The use of this system is an effective tool for optimizing the results of work: the time and cost of work is reduced by constantly improving the quality of the final product. Exploring the methodology and tools of lean construction, we can identify four main areas of use: employee engagement, cost reduction, optimization of construction processes, and loss prevention. The paper presents the results of using the concept of lean construction in foreign countries, as well as methods and tools aimed at involving employees in lean production, reducing costs and preventing losses, optimization, automation and informatization of the production process at the level of strategic and operational management. The specificity of the choice of tools and methods of work performed at all levels of management for the construction industry is determined. The application of the concept of lean construction is justified, which allows organizations to increase their competitiveness and business efficiency.

### 1. Introduction

In modern economic conditions, the basis for the success of a construction company is a high-level organization. The main quality is to know the responsibility of each employee in the value chain of the final product. The concept of lean construction provides these opportunities. It depends on each construction company how to use them, and currently the organization activities in the process of modern management will be effective if the management processes are modernized to improve the construction process and overall economic development in order to increase the scale and technical capabilities of the organization.

Currently, the country's construction companies face the task of optimizing organizational methods of construction management in accordance with the best world practices [1, 10, 11]. The stages of development for improving the organization differ due to significant gaps between them, so there is an

increasing need to implement modern management methods using the latest tools. One of these concepts is lean construction as a system of innovative methods for managing processes in construction. The use of this system is an effective tool for optimizing the results of work: the time and cost of work is reduced by constantly improving quality of the final product.

## 2. Materials and methods

The methodological basis of the research was a systematic approach to the research object, the principle of specificity, principle of development and the principle of objectivity. The study used methods of situational, structural and functional, economic and statistical, comparative analysis, tabular and graphical interpretation of empirical and factual information. The subject of the research is the concept, methods, tools and practice of using lean production in the construction industry.

The study of the concept of lean production and justification of the possibility and feasibility of its application in the construction industry was carried out on the basis of the Russian standard GOST R 56020-2014 "Lean production. Basic provisions and dictionary".

The application of lean production philosophy, values, principles and tools is based on presenting the business as a stream of value creation for the consumer, flexibility, identifying and reducing losses, and continuous improvement of all activities at all levels of the organization, involvement and development of personnel in order to increase customer satisfaction and other stakeholders.

## 3. Results and discussions

The main goal of lean construction is continuous improvement. The concept of lean construction is borrowed from the theory of lean production. At the same time, the construction industry has adapted a number of lean methods to reduce losses and increase profits. The lean manufacturing system itself is not just a technology; it is a whole management philosophy that focuses all employees on development and achieving maximum results [2].

The practice of lean production includes many methods and tools for managing manufacturing. At the same time, 27% of the total number of employees involved in this process. This fact indicates that the system of lean production pays considerable attention to the formation of a common corporate goal, the creation of a lean culture at the enterprise (table 1).

**Table 1.** Methods and tools for involving employees in lean production.

Tools and methods	Function
5S	A tool that allows arranging the workplace of an employee efficiently, both linear and administrative
TQM	A method designed to improve the quality of organizational and managerial processes
Gemba	A tool aimed at involving administration in the production process
Hoshin Kanri	A tool that allows establishing communication between managers and ordinary employees quickly
Kaizen	A tool designed to combine employees' efforts to minimize costs

In addition, loss prevention is an important area in lean production. This toolkit account for a large share of tools (33%), as the main task of lean production is to optimize manufacturing processes in order to reduce costs and prevent losses (table 2).

Using lean production tools and methods, you can imagine the process as a value stream, identifying inefficient operations that should be excluded from the process, as the customer does not want to pay for them [3, 9].

To do this, they map the value stream and use loss analysis to determine the processes that need to be removed from the stream. Future enhanced flows should be taken into account when considering the question of the elimination or reduction of losses at the map of future flows.

**Table 2.** Methods and tools aimed at reducing costs and preventing losses.

<b>Tools and methods</b>	<b>Function</b>
«Just-in-time» PDCA	A method that allows fulfilling orders “just in time”, using raw material stocks and financial flows rationally
	A method that allows solving problems and making changes using a simple algorithm of actions
OEE	A method for detecting losses from improper use of machines and equipment
SMART	A tool that allows setting goals correctly, preventing production losses
Heijunka	A tool that allows planning the inventory, bringing the frozen assets to the minimum
Continuous flow	A tool that allows building the production process optimally, preventing downtime in the movement of material flows in it
Poka-Yoke	A tool aimed at protecting against errors leads to minimizing costs
Bottleneck analysis	A tool for identifying production bottlenecks
Muda	A tool that allows determining losses that lead to an improvement in the quality of employees’ work

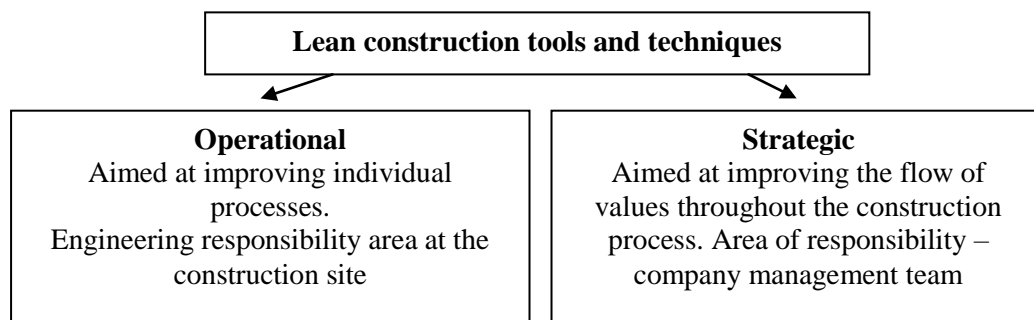
The remaining tools and methods of lean production (40%) are aimed at optimizing the production process, increasing productivity, automation and informatization in the company (table 3).

**Table 3.** Methods and tools of lean production for optimization, automatization and informatization of the production process.

<b>Tools and methods</b>	<b>Function</b>
Visual management	A tool for collecting information about all operations and processes
Standardize work	A tool designed to standardize all production operations and processes
Jidoka	A method of partial automation of machines and equipment that allows to identify problems and start solving them at the detection stage
SMED	Method for quick changeovers of machines and equipment, moving from their stop to the problem solving of equipment in operation
ISO	Global quality standards
TPM	A method that allows extending the life of machines and equipment by informing all employees of the production process about the rules of equipment maintenance
Kanban	A tool that allows arranging production on the “just in time” principle
KPI	A productivity indicator tool that allows assessing risks and achieving strategic goals in a timely manner
VSM	A tool that allows to identify processes that create and do not create value

	visually
TFM	A flow management method that relies on planning and managing operations and supply chains
Takt time	A tool that allows planning specific performance for different departments depending on orders

For the construction industry, to improve the quality of work, the choice of tools and methods is determined by the specifics of the work performed, which facilitate its implementation at all levels



**Figure 1.** Tools and methods of lean construction.

At the level of operational management, effective methods and tools for lean construction will be: 5S, standardization, mapping, submission of optimization proposals, and “pull” planning. At the level of strategic management, the most effective methods and tools are: information modeling, just-in-time deliveries, TQM, and a histogram of the value stream. The main activities in lean construction are: establishing the value of each specific product; identifying the value stream; support for the functioning of the value stream; “pulling” the necessary product by the consumer; continuous improvement. The effectiveness of this practice has been repeatedly proven in a number of countries of the world’s leading economies as a real tool for modernization, both for the construction process and for the company’s management as a whole (table 4).

**Table 4.** Results of using the concept of lean construction in foreign countries.

Country	Main directions of using the concept of lean production	Methods and tools of lean construction	The result of using the concept of lean production
Israel	cost reduction, employee engagement	Just-in-time, Kaizen, Kanban, 5S system, visual management, standardize work, TQM, TPM	A systematic and integrated approach to reducing costs and developing lean production, working with staff to create a “lean” culture
Austria			
Belgium			
USA	process optimization cost reduction loss prevention	Kaizen, Pull system, visual management <sup>2</sup> , standardize work and safety, LEED	Eliminating waste throughout the value chain

China	process optimization cost reduction employee engagement	Kaizen, Kanban11, Just-in-time, 5S system, visual management, standardize work, TPM, TQM, SMED	A comprehensive approach using proprietary methods to reduce the time of equipment changeover.
Great Britain	process optimization cost reduction	Kaizen, 5S system, Jidoka, SMED	supply chain management. creating long-term relationships based on increasing value while reducing core costs
SAR	loss prevention		
Italy	process optimization	Just-in-time, TPM, ISO, Kaizen, standardize work and safety	Focus on product quality, process standardization, and environmental care
Finland	cost reduction process optimization	Kaizen, Just-in-time, TQM, ISO	Emphasis on the choice of suppliers and the quality of raw materials, rhythmic work, speed of customer service

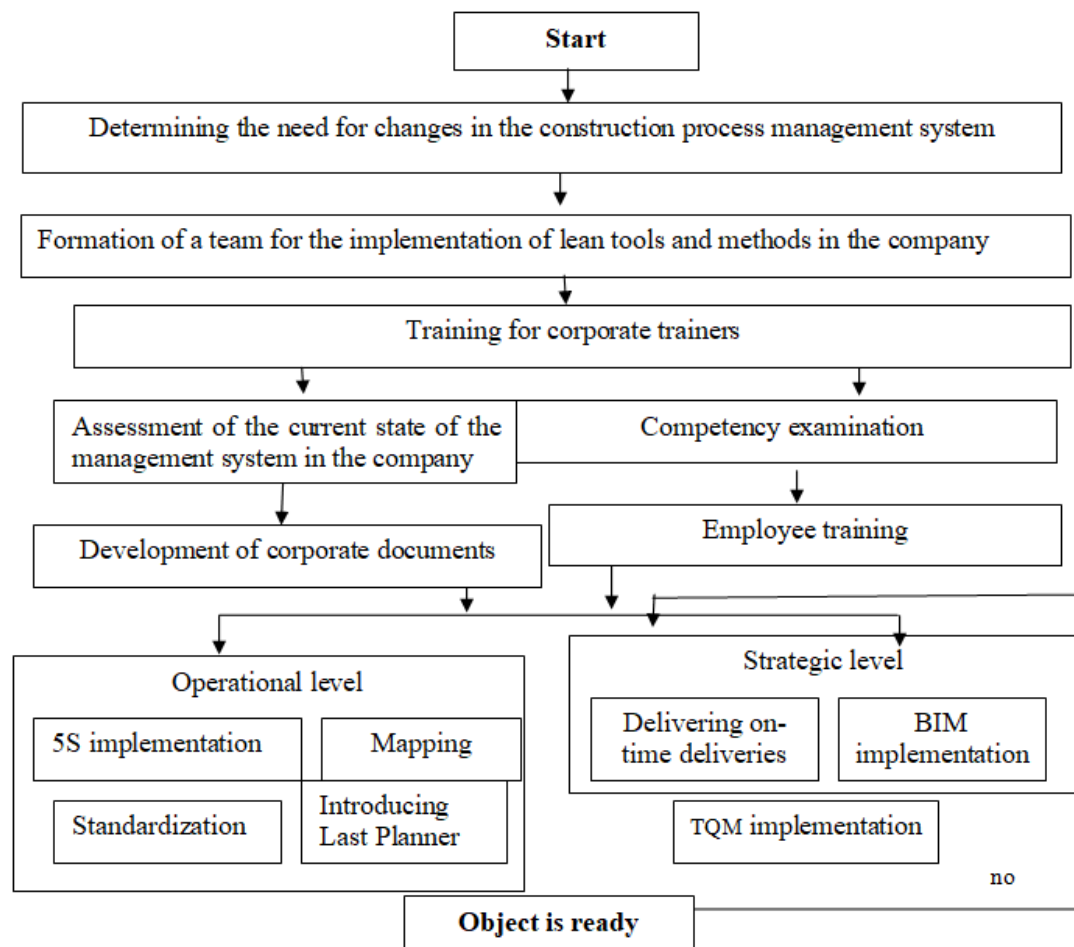
To date, some Russian construction companies have already applied the concept of lean construction [5]. However, many companies were not able to build the right work on the implementation of methods and tools of the concept of lean construction, so in the end they had to freeze their implementation. An analysis of the practice of Russian enterprises that initiated the introduction of the concept of lean construction, but did not implement it, shows that many of them make the same mistakes [8].

Firstly, thoughtless implementation of lean construction tools and methods leads to the fact that huge efforts are spent on eliminating all problems. Often, some of the tools can be implemented at a later stage, or they may not be needed at all.

Secondly, employees refuse to learn the principles of lean construction. An untrained person who works for a long time in one company often does not see any problems. However, this does not mean that there are no problems, so the process of implementing the concept of lean construction is delayed.

Thirdly, the implementation of the lean construction process is delegated to a group of employees. At the same time, the rest of the team does not participate in changes and actively opposes the introduction of innovations. It is necessary to involve all staff, actively demonstrating the benefits of changes – reducing labor costs and eliminating useless work.

Fourthly, management often neglects material incentives for participating in the introduction of innovations in the enterprise. Today, the reality is that without an understanding of personal gain, staff will not actively participate in changes. Employees should clearly know how they will be able to earn extra money, and this incentive is still the strongest.



**Figure 2.** Algorithm for implementing the concept of lean construction in construction companies.

Fifthly, management expects quick results from implementing the concept of lean construction. It is patience and consistency that is the secret to the success of change.

Sixthly, it is often not correct to involve consultants in the implementation of the concept of lean construction. It is necessary to avoid theorists, and to engage practitioners.

Seventhly, they shift the responsibility to the consultants. The most professional third-party expert will not do their job for the management and employees. It is necessary to have a personal interest and desire of all personnel to accept and then implement new technologies in construction.

Eighthly, there is often the optimization of operations and processes, which should not be. This is one of the most frequent and dangerous mistakes. Instead of wasting time and effort on optimizing useless processes, they should be eliminated.

Ninthly, employees are often afraid of optimizing the number of employees. Increasing efficiency and reducing costs will logically lead to a review of the staff number, but often enterprises do not go to the reduction, so all efforts to implement the concept of lean construction are slowed down [6].

We must admit that there are some companies that have introduced the concept of lean construction and improved their skills in organizing construction. The result of this work became the annual increase in productivity, reduced production cycle, increase the turnover of funds, and increase the level of customer satisfaction, development of personnel motivation system [4]. To ensure success in the implementation of the improvement program, an algorithm for implementing the concept of lean construction in modern construction enterprises is proposed (figure 2).

It should be noted that all of the above stages are designed for a continuous process, as training personnel in the principles of lean construction is the basis for identifying and solving problems to optimize construction processes [7].

#### 4. Summary

Implementing the concept of lean construction takes a long time, and many problems arise. At the same time, the use of this concept has significant material advantages and benefits over competitors. To eliminate the identified losses, as well as reduce costs, they need to use the created value stream algorithm. Thus, the proposed algorithm is effective, as the integrated use of the optimal set of methods and tools of the concept of lean construction, taking into account their logical and temporal ordering, will lead to a gradual improvement of management and construction processes and will become a key way for the company to survive in modern market conditions [7, 10, 12].

#### 5. References

- [1] Chernykh E A 2009 Operational planning and construction quality: domestic and foreign experience. *Quality management* **4** 270–279
- [2] Gorelik P I 2014 Lean construction as an innovative method of construction management *Construction of unique buildings and structures* **12(27)** 40–48
- [3] Chetaeva E A 2018 Foreign and domestic practice of using the lean production system *Vector of economy* **1 (19)** 55-60
- [4] Isakov I V 2019 Current state and features of production application in Russia and abroad. In the collection: Collection of selected articles on the materials of scientific conferences of the SRI “National Development” 256-264
- [5] Maysky R A, Ismagilova V S, Ismagilova A R 2016 Modern problems of development of the world experience of “lean production” in Russia *Bulletin of Economics and Management* **3(4)** 36-43
- [6] Popova E S 2016 Lean construction methodology as an innovative approach to managing the construction industry *Master's Journal* **1** 141-146
- [7] Parfenova E N Avilova Zh N 2018 Need for portfolio project management in construction *Bulletin of BSTU named after V.G. Shukhov* **1** 106-110
- [8] Doroshenko Yu A Klimashevskaya A A 2017 Analysis of the scientific and technical potential of enterprises in the construction materials industry in the context of assessing the need for technological modernization in the industry *Bulletin of BSTU named after V.G. Shukhov* **1** 214-218
- [9] Doroshenko Y A Malykhina I O Somina I V 2018 Problems and prospects of scaling of high-tech-business as an innovative investment driver of economic systems development *Espacios* **39(47)** 23
- [10] Doroshenko Y A Minaeva L A Avilova Z N Somina I V Leonova O V 2015 Socio-economic aspects of development of small innovative business in Russia *Journal of Applied Engineering Science* **13(4)** 293-298
- [11] Subbotin O S 2019 Building materials and technologies of modern housing: architectural and ecological aspects *Construction Materials and Products* **2(4)** 84 – 88
- [12] Manzhilevskaya S E 2019 Organizational and economic problems of ecological safety in construction *Construction Materials and Products* **2(4)** 73 –78

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