The procedure of losses management on the pre-design construction stage

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ABSRACT: This research article is aimed to assist for decision makers to make the first steps in loss management process on the pre-design stage of construction. The implementation of risk management instruments can help to assess the impact of each loss on the buildings erection and the possibilities to their elimination. The main purpose of such procedure is to improve the activities of the construction company, update efficiency and quality characteristics, increase productivity and reduce costs. Article briefly describes stages of loss management in lean construction.

THE LOSSES MANAGEMENT MODEL

The successful management of losses while the production of construction works is impossible without an adequate model, describing the whole process. The main purpose of its development is to obtain a clear sequence of decision-makers actions in determining the degree of influence of the losses on production processes and identify those whose impact is critical and must be reduced or eliminated altogether. In order to achieve this goal it is necessary: to understand the essence of the arising losses at construction site (the probability of their occurrence, the impact on the production processes); to develop the most effective ways of reducing the impact of each of them to an acceptable level or completely eliminate them; to implement interventions for the processing of losses according to the selected method. Therefore, the process of managing losses is a set of consistent targeted actions that focus on optimization of the construction process in the framework of maintaining the planned budget, reducing the duration of the works and along with the quality.

On the basis of the tools of risk management the following process was adopted of managing losses on a construction site that includes the main stages:

1) the definition of the situation on the construction site and development of plan, setting goals and objectives of the management of losses;
2) the analysis and documenting of the processes during the execution of construction works;
3) the detection and identification of losses, their distribution into 7 major groups according to the methodology of lean construction;
4) the assessment of the impact level of losses on the works production according to the analysis of the opinions of experienced experts;
5) processing of obtained results, the verification and development of responses on the most influencing losses, the calculation of the losses impact on production processes;
6) monitoring and control of the activities performed and changes.

At the first stage while the definition of situation and development of the management plan the clear structure of the process should be established, to describe the process of losses identification, assessment and processing, as well as how to control these operations. It is also need to know the input data of management process, i.e. the information set out in design and project documentation, calendar plan of construction, the scope of work, the composition of the teams

for the implementation of the main types of works, their description, the planned costs for construction, the planned timing of construction of the building and the assigned responsible managers who will be involved in the work. Based on this data, the project management staff should examine all construction processes which are planned from the normative point of view (the scope of work set forth in the construction rules and norms) and from the real, practical view, that is to determine the sequence of all possible operations on the construction of building "in nature". This stage should be based on their own experience and observations over the construction of similar facilities. The obtained data should organize and conduct their distribution by types of constructed structures.

The next stage in the process of loss management is the identification of losses, i.e. the identification of the operations having a negative impact on the course of production processes. The results of the analysis form the list of losses, which increase costs and construction time and further grouping by 7 types in accordance with the lean management methodology (Liker, 2013; Ballard, 2003; Koskela, 2000; Walbridge Aldinger Co., 2000; Womack, 2000). The result of this work will be the final list of identified losses during construction and installation works.

Next stage is the direct assessment of the losses impact. For this purpose it is necessary to collect data about the causes and consequences of the each of the identified losses occurrence, to determine which techniques should be used in assessment of their impact, to carry out operations of the assessment and to receive the results. The most applicable is the method of expert assessment, as the simplest and easiest (Sheremet, 2011). One of the important characteristics in this method is the criteria of competence that can be defined considering the following qualities: the work experience; the level and profile of education; the profile of work performed; the level of solved problems; the number and level of projects in which the expert participated (Kravchenko, 2010). The assessment of the losses impact is made on the basis of 3 indicators: the probability of occurrence of each loss, the impact on cost and the influence on time of construction (Grebneva, 2012; Fedoseev, 2012; Romanovich, 2015). The data is processed using the methods of mathematical statistics and econometrics.

During the processing phase the ranking of losses is performed according to the degree of their influence on the construction works progress according to the specified criteria. Thus, the ranked list of losses is obtained. Then the results are checked, and calculated integral indicator (coefficient) of the impact of losses on the construction progress. There are 3 main methods of its definition: additive, multiplicative and additive-multiplicative (Fedotov, 2006; Kaliszewski, 2016; Štreimikienėa, 2016). The significant drawback of additive and multiplicative transformations is the existence of unlimited opportunities of compensation (Anfilatov, 2006; Klahna, 2016). The cumulative coefficient of losses impact can be calculated by the formula 2.1:

$$K_{cum} = \sum_{j=1}^{n} K_j \cdot \sigma_j \tag{2.1}$$

where K_j = the value of the j-th integral coefficient of each of the identified losses, σ_i = the weighting factor of i-th loss index.(Beskorovayniy, 2005; Soboleva, 2012; Bolotin, 2010)

The integrated coefficient (indicator) of losses impact on construction site will look like the following:

$$K_{loss} = \frac{K_{cum}}{z} \tag{2.2}$$

where z = the multiplication of the maximum (minimum) value applied by each expert, respectively, for the probability of loss and impact level.

The maximum (minimum) value of indicator K_{cum} is equal the maximum (minimum) possible value of loss index $R_{c,t}$:

$$K_{loss}^{\max/\min} = \frac{R_{c,t}^{\max/\min}}{z} \tag{2.3}$$

When the value of integrated losses impact indicator is closer to 0, the level of losses impact on the construction site is lower and the efficiency of operations and productivity is higher. The approach to the value of 1 gives the decision maker a reason to concern measures of losses reduction and increase efficiency of production work.

By results of this stage the decision-maker receives the output data - the list of losses, segre-

gated by the level of impact on three main groups: loss with the high level impact, medium and low. The first two groups of losses require urgent measures of reducing and elimination. The losses of the third group can be removed by the development of organizational procedures. Measures to reduce the impact of losses or their elimination are developed specifically for each type of operations (Adler, 2009; Mazur, 2010; Maslov, 2010). If measures have not given expected result, then the decision on development of plans for elimination of the loss consequences or abandon the changes.

The process of losses management on a construction site is an iterative process. After making the changes, new losses can occur or the degree of influence of the existing ones can increase. Therefore, it is overwhelmed with operations on monitoring, documenting and control of ongoing changes. The main stages of the process are monitored and checked for compliance with applicable methods. It should be noted that monitoring provides more than basic role, as the documenting, though is one of the key processes in managing losses. However, without a process of monitoring and documenting the implementation of effective system loss management is impossible.

The model of losses control in the works production on the construction site with its major stages is shown on the Figure 1.

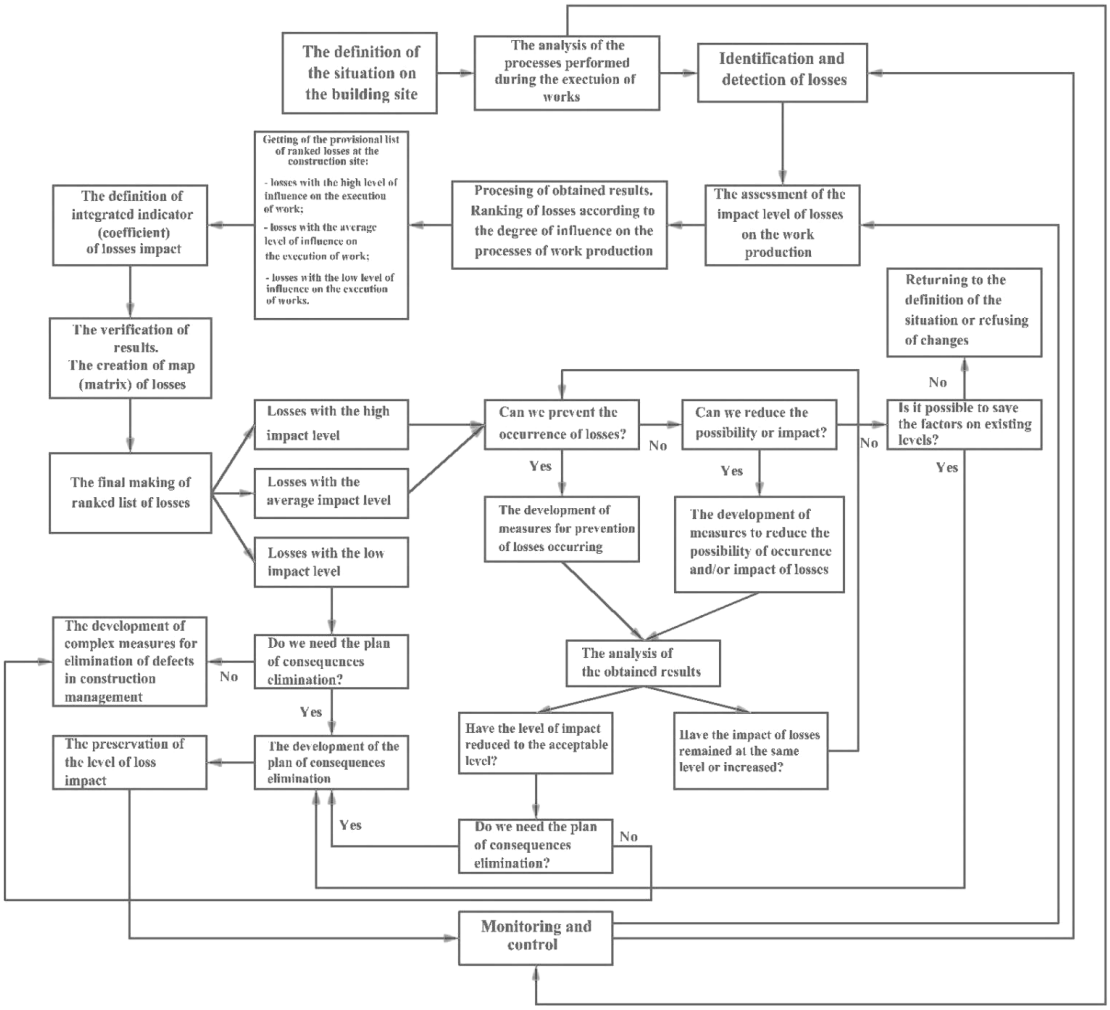

Figure 1. The principal scheme of losses management model.

CONCLUSIONS

The presented procedure shows the methodology of losses management in the works production which includes all necessary steps. This new procedure presents new approaches in lean construction: the assessment of experts' competence level, method of experts' assessment, the

method for processing data of the survey; the calculation of integrated indicator of losses impact, which helps to assess the effectiveness of a construction project from the losses point of view; the methodology of checking the calculations by constructing the matrix (map) of losses, methods to reduce the impact level and eliminate losses were proposed, as well as monitoring of measures.It should be noted that the finished system of loss management is individual for each project. The measures to reduce and eliminate losses will be developed more carefully and detailed and the probability of goals successfully achieving will be higher.

REFERENCIES

Adler ,Yu., Shechepetova, S. 2009. Process description the business foundations for the system of economy of quality. *Standards and quality No. 2.*: 66-69.

Anfilatov, V.S. 2006. *The system analysis in management*. Moscow: Finances and statistics.

Ballard, G., Howell A.G. 2003. Lean project management. *Building Research and Information*. *Vol. 31. No. 2:* 119-133.

Belokorovin, E.A., Maslov, D.V. 2010. *Small business: ways of development*. Arkhangelsk: DMK Press.

Beskorovayniy, V.V., Trofimeko, I.V. 2005. Parametric identification of multiplicative models for multi-factor decision choice. *Proceedings of the Kharkov University of Air Forces named after Ivan Kozhedub conference. No. 5 (5)*: 74-78.

Bolotin S.A., Dadar A.Kh.2010. Оценка погрешности в аддитивном показателе качества календарного плана строительства The inaccuracy estimation of the additive quality indicator for the schedule of construction. *Bulletin of the Tyva state University. No.3:* 13-16.

Fedoseev, V. V. 2012. *Economic-mathematical methods and applied models.* Moscow: YUNITY.

Fedotov, Yu.V. 2006. Methods of constructing summary evaluations of complex production systems effectiveness. *Scientific reports No. 25(R)*. Saint-Petersburg: Grade school of management SPbSU.

Grebneva, O.A. 2012. *The theory of decision making*. Irkustk: IrSTU.

Kaliszewski, I., Podkopaev, D. 2016. Simple additive weighting - A metamodel for multiple criteria decision analysis methods. *Expert Systems with Applications.Vol. 54:* 155–161

Koskela, L.. 2000. *An exploration towards a production theory and its application to construction, PhD Dissertation.*. Finland: VTT Building Technology, Espoo.

Kravchenko, T.K. 2010. Expert evaluation in the decision-making process. *Actual problems of humanitarian and natural Sciences. No. 3:* 88-90. Moscow: Moscow state university.

Liker, J. 2013. *Dao Toyota: 14 management principles of the world leading company*. Moscow: Litera.

Mazur, I.I., Shapiro, V.D. 2010. *Quality management*. Moscow: High school.

Medineckienea, M., Zavadskasb, E.K. Björka, F., Turskisb, Z. 2015. Multi-criteria decision-making system for sustainable building assessment/certification. *Archives of Civil and Mechanical Engineering. Vol. 15, Issue 1:* 11-18.

Romanovich, M.A. 2015. *The increasing of organizational and technological reliability of monolithic housing construction on the basis of modeling the parameters of time schedule, PhD Dissertation*. Saint-Petersburg state university of architecture and civil engineering. Saint-Petersburg: SPbSUACE.

Sheremet, V. V. 1998. *Investment management: a guidebook for professionals and entrepreneurs*. Moscow: High school.

Soboleva E.V. 2012. Modification of the criteria for generalized utility in identification problems of multicriterion choice. *System Research & Information Technologies. No.3:* 58-65.

Štreimikienėa, D., Šliogerienėb, J., Turskisb, Z. 2016. Multi-criteria analysis of electricity generation technologies in Lithuania. *Renewable Energy. Vol.85*: 148–156.

Voronova, S.P. 2003. *The development of methods to assess investment and construction risks on the stages of the property life cycle. PhD Dissertation*. Saint-Petersburg: Saint-Petersburg state university of architecture and civil engineering.

Walbridge Aldinger Co. 2000. Lean Fundamentals. *Internal company document*. Detroit: Walbridge Aldinger Co.

Womack, P. J., Jones, T. D., 1996. *Lean thinking: banish waste and create wealth in your corporation*. New York: Simon and Schuster.