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PROCEEDINGS

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Discrete-event modeling of the critical parameters of functioning the products of infrastructure projects at the planning stage

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Abstract — In the article a thorough analysis of existing researches concerning models, methods and mechanisms of infrastructure projects implementation, research of critical parameters influence to the project products, their modeling is conducted. The modern tendencies of large infrastructure projects implementation, in particular their products such as multifunctional complexes, shopping and entertainment complexes, offices of large business centers are described. A thorough analysis of recent research and publications pointed to the relevance of the research question and modeling of the critical parameters of infrastructure projects products operation at different stages of their implementation, in particular at the planning stage. The main methods of discrete-event modeling are considered. The place of the proposed approach in the set of basic methods of the theory and its practical application to the analysis of the evacuation efficiency from the objects of mass stay of people is determined. During the simulation, new methods were used, in particular, the methodology of simulating a particular event - the evacuation from the object with mass stay of people due to a notice of substitution, and a technique for modeling the functioning life cycle of object with mass stay of people. Were used the simulation modeling tools for infrastructure projects based on the Anylogic multi-agent modeling environment classes that allowed to visualize the project management process. Carrying out system analysis in the study pointed to the urgency of the tools use for modeling the critical parameters of functioning the products of infrastructure projects at the stage of project planning, which will allow to issues a comprehensive approach to security of objects with mass stay of people and objects of critical infrastructures. To the direction of further research, we can include studies of critical parameters of functioning the products of infrastructure projects at the stages of realization and functioning of the project in operation.

Keywords — critical parameters; infrastructure projects; discrete-event simulation; phases of the project.

1. INTRODUCTION

Formulation of the problem. In the modern world of modern technologies rapid development, in the period of total globalization and informatization of all spheres of society life activity, the number of emergencies occurring on objects with mass stay of people, objects of critical infrastructures are

constantly increasing. These objects include shopping and entertainment centers, energy complexes, transport systems and other objects, where dangerous factors impact of emergency situations leads to the death or injury of a large number of people, has a negative impact on the natural environment.

Modern tendencies in large infrastructure projects implementation have one main feature - increasing capacity (visitors / hour) and constant massive stay of people. The products of such infrastructure projects are multifunctional complexes, shopping and entertainment complexes, offices of large business centers, etc. Extraordinary events in such premises are often accompanied by injuries and deaths of people. First of all, this relates to emergency situations, representing a real danger to a person within a few minutes after their occurrence and an intensive action that differs, on people of dangerous factors. The most reliable way to ensure the safety of people in such conditions - a timely evacuation from the object.

Each product of infrastructure project must have such a volumetric planning and technical implementation that the peoples' evacuation from the premises has been completed until the attainment of maximum allowable values of extreme event dangerous factors. In this regard, the quantity, size and constructive execution of evacuation routes and exits are determined depending on the required evacuation time, that is, the time during while people must leave the premises without having succumbed to dangerous life and health effects of dangerous factors. Data on the required evacuation time is the initial information for calculating the level of peoples' security during emergency events. Incorrect determination of the required evacuation time may result in incorrect design decisions and an increase in the cost of infrastructure project or in insufficient human security in the event of an emergency.

We will review the latest major emergencies, including the fire in the Trade Center "Winter Cherry" in Kemerovo city, Russian Federation, which, according to official figures, has claimed the lives of more than 60 people. The railway accident in Kanpur, India, where more than 150 people were killed as a result of the train's raining. The main causes of these and other emergencies that arose in objects with mass stay of people

may include mistakes made in the design planning, construction and commissioning of objects, failure to take into account critical parameters, violation of conditions and rules of their operation, human factors, etc. Since the consequence of all emergencies is the death of a large number of people, today the issue of research and modeling of critical parameters of functioning the products of infrastructure projects at various stages of their implementation, in particular at the planning stage, remains relevant.

Analysis of recent research and publications.

Implementation of infrastructure projects is a complex organizational and technical process requiring the application of fundamental rules of project, program and project portfolio management, the use of a systematic approach to managing such projects, a thorough analysis of project components and their impact on its implementation at different stages of the project life cycle. The questions of implementing complex organizational and technical projects, programs and project portfolios, assessing the risks of their implementation, studying their components and modeling safe parameters were carried out by leading domestic and foreign scientists, including S. D. Bushuyev, I. A. Babayev, N. S. Bushuyeva, V. A. Rach, O. B. Danchenko, Yu. P. Rak, V. D. Gogunsky, S. K. Chernov and others.

In particular, in his scientific works, S. D. Bushuyev examines complex approaches to the process of modeling the implementation of projects, programs and project portfolios and their adaptation to international standards on project management [1-4].

I. A. Babayev and N. S. Bushuyeva studied parameters of successful implementation of projects on the basis of genetic analysis [5-9].

V. D. Gogunsky in his research papers emphasizes the influence of the human factor on the implementation of project programs and integrated risk assessment [10-11].

O. B. Danchenko devoted her work to the development of risk classification and modeling of project deviations integrated management [12-13].

Yu. P. Rak conducted its research in the field of ensuring safe parameters of the functioning of objects with mass stay of people, objects of critical infrastructures and their protection from the negative impact of emergency situations [14-18].

V. A. Rach explored the processes of introducing innovations in project management and the reasons for the failures of their products [19-20].

S. K. Chernov in his writings explores the definition of the effectiveness of project implementation using a system of estimation of uncertainty [21-23].

However, scientific achievements received by scientists in the field of science and technology are quite difficult to adapt to the problems of developing models, methods and mechanisms for modeling the critical parameters of

functioning the products of infrastructure projects at the planning stage.

Therefore, today the actual task remains the solution of the scientific and applied task of discrete-event modeling of the critical parameters of functioning the projects products at the planning stage, among which the infrastructure projects occupy an important niche.

The purpose of the article is to find new approaches to discrete-event modeling of the critical parameters of functioning the products of infrastructure projects at the planning stage.

Research methods. The basis of the theoretical and methodological research forms the general scientific principles and fundamental principles of methodology of project, programs and project portfolios management. The research is based on the use of methods:

- system analysis - to study the subject area of functioning the products of infrastructure projects and to conduct a comparative analysis of existing models and develop new ones;
- modeling tools - for the formal and visual simulation of critical parameters of functioning the products of infrastructure projects at the planning stage and the study of the interaction of the project environment.

RESULTS OF RESEARCH

One of the main parameters that should be met by objects with a mass stay of people, including infrastructure projects is the safety of life of the population and territories. Since using infrastructure projects there is a constant presence of a large number of people in sufficiently limited areas, an important parameter of security is the process of evacuation of people from such objects in the event of an emergency or other threat to their life and health [24-25].

Sometimes the evacuation of people from infrastructure projects objects is a time that one person spends on moving from the most remote point of the object, and also, the time during which people must leave all levels of the building without having victim to life and health caused by actions of dangerous factors.

We consider the main methods of discrete-event modeling and determine the place of the proposed approach in the aggregate of the main methods of the theory and its practical application to the analysis of the effectiveness of evacuation of mass stay of people [26-29].

Modeling of each event in the lifecycle of an infrastructure project is a choice of one of a set of options considered: $E_i \in E$. In the general case, the number of options $E_1, E_2, \dots, E_n, \dots$ is infinite. However, in practice we are dealing with a limited number of options.

Each permissible variation of an event E_i due to different external conditions may correspond to different external states

F_j and results e_{ij} of the decisions. The set of events is described by a matrix.

As a result of the event e_{ij} , we consider the quantitative assessment, which corresponds to the version E_j and conditions F_j and characterizes the level of security of the system (utility, reliability, security, etc.). Such a result is called the social value of a product of an infrastructure project. In order to arrive at an unambiguous and possibly the best version of an event, when some of solutions E_j version may correspond to different external conditions F_j , it is necessary to consider the whole set of estimates e_{ij} . To do this, introduce the notion of evaluation (target) function. The task of the estimated function e_{ij} is to characterize all the possible consequences of a solution using one numerical value E_j . In this case, the matrix of solutions $[e_{ij}]$ is reduced to one column, and the process of decision-making - to find the option with the highest value of the result e_{ij} .

In Fig. 1 and Fig. 2 the results of critical parameters simulation of functioning the products of infrastructure projects are presented in two methods. The first technique (Figure 1) includes modeling a particular event - evacuation from the terminal due to a notice of substitution. The model has the ability to set obstacles during evacuation (for example, possible errors and drawbacks of design decisions at the stage of object planning). In the model presented in Fig. 1, the maximum number of visitors is 3305, all walls and partitions are marked as obstacles, and all possible evacuation outputs are specified. The method of evacuation in the simulation model is realized by specifying the target points (evacuation outputs) that are used in the built-in libraries classes of environment of multi-agent Anylogic simulation. This software allows you to specify a variety of input parameters, including the number of people, the number of evacuation routes, dimensional characteristics of the object, and using different algorithms simulates the necessary processes.

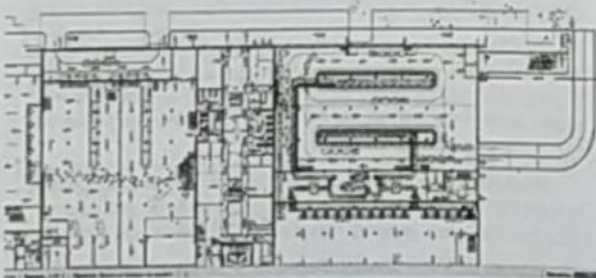


Fig. 1. Modeling the evacuation process from the airport

In the second case, presented in Fig. 2, the simulation was not a separate event, but a life cycle of functioning the object's

with the mass stay of people. The life cycle of the operation of the airport terminal is presented as a discrete chronological sequence of events during the day: arrival of passengers, passport and customs control, etc.



Fig. 2. Modeling the life cycle of airport functioning

In the model, in Fig. 2, parameters of the operation of the object, in particular passenger traffic, are set at 2000 passengers per hour.

CONCLUSIONS AND PROSPECTS OF FURTHER RESEARCHES

Carrying out system analysis in the study pointed to the urgency of the tools use for modeling the critical parameters of functioning the products of infrastructure projects at the stage of project planning, which will allow to get a comprehensive approach to security issues with objects with mass stay of people and objects of critical infrastructures. Some researchers studied the general principles of project design and management, project product acquisition, and other impacts of various parameters and risks on project implementation at different stages of the project life cycle, but the modeling of critical parameters of functioning the products of infrastructure projects remained unresolved.

As a result of our research, we have formed the following scientific results:

- to the direction of further research, we can include studies of critical parameters of functioning the products of infrastructure projects at the stages of implementation and commissioning of the project;
- planning, implementation and operation of infrastructure projects, programs and project portfolios require comprehensive application of the provisions of security-oriented management;
- the use of simulation modeling tools for infrastructure projects based on the Anylogic multi-agent modeling environment classes that allowed to visualize the project management process;
- during the simulation were used new methods, including methods:

- modeling a particular event;

- the evacuation of the facility of occupancy due to reports of bomb threats and methods of modeling the life cycle of the object with mass stay of people.

REFERENCES

- [1] Azarov M. Ya. Innovative mechanisms of development programs management / M. Ya. Azarov, P. A. Yaroshenko, S. D. Bushuyev. - Summil book, 2011. - 528 p.
- [2] Bushuyev S.D. Project Management. Fundamentals of professional knowledge and a system for evaluating the competence of project managers (National Competence Baseline, NCB UA Version 3.1) / S.D. Hushuyev, N.S. Bushuyeva - Edition 2nd - K. : "IRIDIUM", 2010 - 208 p.
- [3] Bushuyev S.D. Valuable Approach in the Management of the Development of Complex Systems [Text] / S. D. Bushuyev, D. A. Kharitonov // Management of the Development of Complex Systems. - 2010 - Vol.1 - P. 10 - 15.
- [4] Bushuyev S.D. Matrix technology for identifying organizational pathologies in project management [Text] / Bushuyev S. D., Kharitonov D. A., Yaroshenko Yu. F. // Management of the development of complex systems - K.: KNUBA, 2013 - №16.
- [5] Babaev I. A. Determination of the success of the project on the basis of genetic analysis [Text] / Babaev I. A., Hushuyeva N. S. // Proceedings of the National Academy of Sciences of Azerbaijan. Series of Physics, Mathematics and Technical Sciences, Informatics and management problems. - Baku: Publishing house "Science", 2006. - № 2. - P. 132 - 136.
- [6] N. Bushuyeva, I. Babaev, V. Yakovenko, E. Grisha, S. Dryuba and A. Voitenko. "Creative technologies for project and program management", p. 684, 2009
- [7] Bushuyeva N. S. Modeling of projects of restructuring and development of enterprises // News of Cherkassy engineering and technology institute. - 2000. - № 2. - P. 156 - 162.
- [8] Bushuyeva N.S. Methods and models of proactive management of organizational development programs: monograph. N.S. Bushuyeva. - K.: Science world., 2007. - 199 p.
- [9] Bushuyeva N.S. Proactive management of projects of organizational development in conditions of uncertainty [Text] / N.S. Bushuyeva // Project management and production development. - Lugansk: the view of East-Ukrainian national V. Dahl University, 2007. - No. 2 (22). - P. 17 - 27.
- [10] Gogunsky V. D. Human resources management for realization of production programs [Text] / Gogunsky V. D., Vaysnan V. A. // Herald of NTU "KhPI". - Subject. no. : "System analysis, management and information technologies". - Kharkiv: NTU "KhPI". - 2005. - No. 54. - P. 124 - 129.
- [11] Gogunsky V. D. Management of complex risks of the project of support of the emergency protection system of nuclear power plants [Text] / V. D. Gogunsky, T. V. Bibik, I. I. Stanovskaya // Modern Information and Electronic Technologies: Materials of the XIII Intern. scientific-practical. conf. 4-8 June 2012 p. - Odessa: ONPU, 2012. - P. 37.
- [12] Danchenko O.B. Classification of risks in projects [Text] / O.B. Danchenko // East European Journal of Advanced Technologies, Kharkiv, 2012. - No. 1/12 (55). - P. 26 - 28.
- [13] Danchenko O. B. Conceptual model of integrated management of deviations in projects [Text] / O. B. Danchenko, Semko I. B., Borisova N. I. // Bulletin of Cherkassy state technologist. university - Cherkassy: ChTTU, 2015. - №1 (15). - p. 62 - 67.
- [14] Rak Yu.P. Formalization of the subject area of the definition of "Object with mass stay of people" in the implementation of security-oriented projects / Yu. P. Rak, R. R. Golovatyy, D. S. Kobylkin // Bulletin of Lviv State University of Life Safety. - 2015. - No. 12. - P. 217 - 227.
- [15] Yu. Rak, O. Zachko, D. Kobylkin and R. Golovatyy. "Safe-oriented management of regional projects for the protection of critical infrastructures by means of the System 112", Project management and production development Scientific Bulletin, № 1(57), p. 44-55, 2016
- [16] Identification of projects in portfolios and programs of regional development in the field of emergencies / Rak Yu. P., Sachenko A. O., Zachko O. B., Paliy I. O. // Project management and manufacturing development. - 2011. - No. 4 (40). - P. 64 - 69.
- [17] Rak Yu.P. Information Technologies for Managing regional project portfolios based on the life safety office / Yu.P. Rak, O. B. Zachko, V. B. Fedan // Scientific Bulletin of UkrNIIPB. - 2010. - No. 2 (22). - P. 45 - 50.
- [18] Rak Yu. P. Designing automation systems for information selection at project-oriented management / Yu. P. Rak, O. B. Zachko, O. Yu. Mykytiv // The Bulletin of the East Ukrainian National University named after Volodymyr Dahl. - 2011. - No. 3 (157). - P. 106-110.
- [19] Rach V. A. Innovations in the project activity and the laws of "failures" of products / V. A. Rach, V. V. Kalyuzhny // Project Management and Production Development: Collection of scientific works- Lugansk: View of the East Ukrainian National University named after Volodymyr Dahl, 2007. - No. 3 (23). - P. 31-41.
- [20] Rach V. A. Portfolio management of the development of socio-economic systems. Part 1. Model for determining the benchmarking values of the indicator of a strategic goal using the theory of fuzzy sets / V. A. Rach, O. P. Kolyada // Project management and production development. - 2009. - No. 1. - P. 144 - 151.
- [21] Chernov S. K. Accounting of risks and uncertainties in organizational projects [Text] / S. K. Chernov // Project Management and Production Development: Collection of scientific works - Lugansk: View of the East Ukrainian National University named after Volodymyr Dahl. 2006. - No. 1 (17). - P. 41 - 44.
- [22] Chernov S. K. Determining project effectiveness using the uncertainty and risk assessment system [Text] / S. K. Chernov // Bulletin of Odessa National Maritime University: Collection of sciences works. - Odessa - 2006. - Vip.19. - P. 217 - 224.
- [23] Chernov S. K. Synergetic effect from project management in science-intensive production [Text] / S.K. Chernov // Project Management and Production Development: Collection of scientific works - Lugansk: View of the East Ukrainian National University named after Volodymyr Dahl, 2005. - №3. - P. 57 - 62.
- [24] A Guide to the Project Management Knowledge Project. - [4 th ed.]. - Project Management Institute, Inc. 14 Campus Boulevard Newtown Square, Pennsylvania 19073-3299 USA, 2008. - 464 p.
- [25] Quality management system. Basic provisions and dictionary (ISO 9000: 2000, IDT): SSTU ISO 9000: 2001. - [Effective from 2001-06027]. - K. : Statestandart of Ukraine, 2001. - 33 p.
- [26] Development of a simulation model of safety management in the projects for creating sites with mass gathering of people / O. Zachko, R. Golovatyy, A. Yevdokymova // Eastern-European Journal of Enterprise Technologies. - 2017. - Vol. 2, Issue 3 (86). - P. 15-24. doi: 10.15587/1729-4061.2017.98135, 2017)
- [27] O. Zachko. Methodology of security-oriented management projects of complex systems development (on an example of civil protection), p. 342, 2015 (in Ukrainian)
- [28] Safety management at the planning stage of projects with mass stay of people taking into account the category of complexity / O. B. Zachko, D. S. Kobylkin, R. R. Golovatyy // Bulletin of NTU "KhPI". Series: Strategic management, portfolio, program and project management. - Kharkiv : NTU "KhPI", 2018. - No 2 (1278). - P. 53-58. - Bibliogr.: 17. - ISSN 2311-4738.
- [29] D. Kobylkin. Structuration of the projects of automated system implementation of anti-crisis management in civil protection (as in System 112), p. 134, 2016