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DEVELOPMENT OF THE COMPREHENSIVE METHOD OF SITUATION MANAGEMENT OF PROJECT RISKS BASED ON BIG DATA TECHNOLOGY

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Project implementation is often carried out under the influence of negative changes in the environment and circumstances characterized as crisis. Therefore, the processes associated with risk management, which is the object of this study, are becoming important. The topic of this study is to increase the efficiency of projects by adapting the project to crisis conditions, promptly developing and making effective management decisions. For projects, it is necessary not only to identify the current situation as risky but also to determine rational ways to achieve the project goals under crisis conditions. Therefore, a comprehensive method of situational project risk management based on the combined application of situational analysis methods, intelligent and expert methods, as well as Big Data technology, is proposed. Within the framework of the method, a project risk management model has been built in the form of a fuzzy situational graph, which would provide a choice of strategies that could contribute to overcoming a risky situation, as well as reduce the time to make effective management decisions in crisis circumstances. The result of this method is compliance with time constraints, reducing resource overruns and losses in the project, as well as adapting to rapidly changing circumstances and adequate response.

A comprehensive method of situational project risk management is characterized by solving the task toformalize management decision-making procedures and their information support, taking into account the availability of both structured and unstructured data. The proposed procedure for situational project risk management based on the use of Big Data technology can also be the basis of project management information technology and the corresponding decision support system

Keywords: comprehensive method, situational risk management, fuzzy situational graph, goal achievement index

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1. Introduction

In modern conditions, the dynamics of project implementation in various sectors of the economy are aimed at activating innovative technologies, which is accompanied by constant influences of factors of the external and internal environment. For projects that are implemented under conditions of uncertainty related to the instability of the modern economy, political situation, foreign policy, and other factors, it is important to ensure risk management in order to minimize or avoid it . Risk management in projects provides opportunities to take into account uncertain factors and consider all possible consequences of the alternatives on the basis of which the choice is made. The study of risks, their analysis, and consideration of the factors that cause them, the determination of possible losses, the development of measures to prevent the occurrence of a risky event are important tasks that are given considerable attention [1–3].

However, ambiguous situations arising in the project require real-time management. They are unpredictable in nature and affect the effectiveness of the project. In such cases, it is necessary to use situational management, which involves taking into account situational factors and making quick decisions. This will provide an opportunity to significantly optimize the use of available resources and lead to increased efficiency in general. At the same time, such models and methods are needed that will be adapted for use in project management under unstable conditions. This will contribute to the adaptation of development strategies to the strategies of the external environment by influencing the external environment and accelerating internal dynamics, as well as finding effective solutions in crisis situations in order to increase the efficiency of the project. Therefore, there is an important scientific task of situational risk management in a crisis situation, taking into account the influence of factors of the external and internal environment. This will ensure in practice a reduction in the level of risk, redistribution, and reduction of the negative consequences of the onset of adverse events, minimization of the negative impact of risks on the relevant performance indicators. Therefore, the study of situational project risk management is relevant.

2. Literature review and problem statement

Project risk management is aimed primarily at solving a complex complex task, the purpose of which is to increase the efficiency of project management as a whole. At the same time, the processes of taking into account risks, risky events, and risk assessment are of great importance. It is also necessary to study the conditions and causes of risky events, develop measures to reduce the likelihood of risk, avoid risk or reduce costs as a result of risk [1]. However, in most cases it is quite difficult to predict situations that may have negative consequences and affect the overall effectiveness of the project. Situational management concentrates on the fact that the need for different management methods is determined by a specific situation. Situational analysis represents complex technologies for preparing, making, and implementing management decisions, based on the analysis of a single management situation [2].

Traditionally, in the study of risk management tasks, they focus on automating the processes of identification and planning of risk response, as well as on determining the quantitative assessment of risks. Such studies are based on the method of PERT analysis [3], complex Monte Carlo calculations [4], expert methods [5], etc. Under conditions of instability and uncertainty, it is important to concentrate on crisis situations that may arise, adapt to external influences, accelerate the dynamics of management decision-making in a particular situation in order to reduce negative consequences.

Thus, in [6], risk management processes according to ISO/TR 24971:2020 standard, as well as typical methods of risk analysis and assessment adopted in the medical device industry are studied in detail. These methods include hazard analysis, failure tree analysis (FTA), failure regime and consequences analysis (FMEA), hazard and performance studies (HAZOP), risk tracking analysis to ensure the implementation and effectiveness of risk control. Unfortunately, these methods do not provide real-time results.

In [7], the study of risks is based on the methods of descriptive statistics, correlation and regression analyzes. However, such studies should be based on accurate and well-defined data, which is quite difficult to obtain under conditions of uncertainty.

Work [8] considers modern methods of managing financial risks of the enterprise. These methods are based on the traditional procedure: risk evasion (or, otherwise, its avoidance); prevention and control of possible losses (risk absorption); risk preservation (risk acceptance); risk transfer. But the issues related to the adoption of operational decisions in risky situations remained unresolved. The advantages of risk management of robotic automation of processes are considered in [9], but the basis of this study is process control. This approach is also quite traditional and does not make it possible to respond quickly to changes. The cognitive approach applied in [10] provides opportunities to establish a causal relationship between risk factors and risky events, as well as risk control measures. However, this does not take into account the possibility of situations with the absence of statistical information about the possibility of a risky event.

Our analysis [3–10] showed that existing models and methods of project risk management in various industries do not provide opportunities for generating management decisions according to the current situation. Crisis situations in projects that arise under conditions of uncertainty are characterized by losses, overruns of resources, and affect the efficiency of the project. In most cases, in such cases, we have unstructured data of various kinds and nature. Therefore, to solve this problem, it is necessary to apply a combined approach, based on a comprehensive combination of situational management methods, intellectual and expert methods. This will make it possible to make decisions in a crisis, taking into account the influence of factors of the external and internal environment.

3. The aim and objectives of the study

The aim of our work is to develop an integrated method of situational project risk management, characterized by the combined use of situational management methods, intelligent and expert methods, as well as Big Data technology. This will provide an opportunity for dynamic management decision-making in the face of complex, crisis circumstances in real time to increase the efficiency of projects in various industries.

To achieve the set aim, the following tasks have been solved:

– to build and investigate a model of project risk management in the form of a fuzzy situational graph that will ensure the choice of a strategy that will contribute to overcoming the risk situation;

– to substantiate and investigate the procedure for situational project risk management based on the use of Big Data technology.

4. The study materials and methods

Project implementation is often carried out under the influence of negative changes in the environment and circumstances characterized as crisis. Therefore, the processes associated with risk management, which is the object of this study, are becoming important. Risk assessment, study of the conditions and causes of risky events, development of measures to reduce the likelihood of risk, application of measures to reduce costs as a result of the onset of risk is the essence of the risk management task. Given the changes in the environment arising from a variety of factors such as competition, politics, innovation, social, economic, market factors, risk forecasting contributes to improving the efficiency of the project. The effectiveness of the project is the predominant criterion in determining the direction of management actions.

Project risk management is a poorly structured problem, characterized by the inability to use methods and models based on an accurate description of problem situations. Therefore, to develop solutions in the course of project risk management, it is advisable to use methods and techniques based on the combined application of the situational approach [11], fuzzy logic, graph theory [12], as well as Big Data technology [13]. At the same time, models of logical inference and representation of knowledge are increasingly adapted to descriptions of complex systems, taking into account both hierarchicality and the possibility of a convenient object-oriented description of systems. For this purpose, the formal basis of logical inference and relational algebra is modified [14].

Risk management is one of the most complex classes of decision support tasks. A number of features of this class of problems do not make it possible to apply approaches to the development of methods based on the construction of models of control objects and their analysis [15]. Such properties are:

– high requirements for the quality and efficiency of management in the presence of a shortage of time for the development and adoption of management decisions;

– a large number of factors that are taken into account in the decision-making process, which is difficult and impossible to correctly formulate analytically;

– incompleteness, inaccuracy, and most often, inaccuracy of the information on the basis of which decisions are made;

– change in the quality of information in the decision-making process;

– qualitative nature of the description of situations and control decisions;

– the presence of a number of functional aspects of management;

– rapidly variable management goals;

– uniqueness of the conditions of specific decision-making tasks;

– the presence of qualitative and stochastic uncertainty when describing the results of control decisions;

– the need to take into account the consequences of management decisions.

Project risk management refers to such problem areas. Therefore, these features make it possible to substantiate the prospects of building a method based on a situational approach, the determining principle of which is the formation of not so much a model of the object itself as a model of its management.

There are a number of methods that implement different ways of a situational approach. A significant group of methods is focused on the formation of an artificial language for describing situations and relationships between objects [16]. However, the construction of a semantic model of the control object and the processes occurring in it is not always justified. For many rather complex systems, this description becomes cumbersome. The process of creating a language is quite laborious and does not always lead to a positive result. Another group of methods is based on the representation of the situation in the form of a set of values of a fixed set of features [17]. When solving certain problems, these methods can be combined, but it is necessary to take into account a number of significant differences. For projects, it is necessary not only to identify the current situation and the corresponding set of management decisions but also to determine rational ways to achieve the project goals. Therefore, it is necessary to calculate the possible consequences of the sequence of control decisions a few steps forward. These tasks require the involvement of additional methods.

To implement such tasks, it is proposed to use a fuzzy situational graph (FSG), based on the methods of situational approach and fuzzy logic [18]. During the development of an integrated method of project risk management, the situations that arise are described in the form of a graph. The vertices of the graph correspond to risky situations, and the connections between the vertices correspond to the control solution. At the same time, the knowledge base does not contain explicit products that put control decisions in accordance with the situation. The sequence of control decisions transfers the system from the current state to the state described by the target situation (that is, the situation that is best in terms of achieving the corresponding situational goal), and is determined by deriving according to the graph. A comprehensive method based on FSG, which is used to manage risks in projects, will enable prompt assessment of the situation arising during the workflow and, based on it, the development of further strategic decisions. This is the main hypothesis of this seminal study.

A fuzzy situational graph is a certain structure that describes a possible set of states of the risk management system, represented by the nodes of the graph, and the ways of transition between them, the corresponding management decisions [19].

We implement the expert method by processing the opinions of experienced managers and specialists. Experts accompany their assessments with data on the probability of occurrence of certain events under conditions of uncertainty, which is some simplification. Also, expert assessments provide opportunities for obtaining the probability of (subjective) acceptable, critical, and catastrophic risks or simply assess the likely losses in decision-making. Subjective probability makes it possible to establish a connection between uncertainty and chance. This is relevant where we are talking about using the probability of risk in making management decisions that are assumptions made in the study.

In this regard, there is a need for combined application of situational management methods, intellectual and expert methods, which will contribute to the development of an integrated method of situational project management. The use of Big Data technology to develop an appropriate decision support system will provide opportunities to expand the functionality of processing unstructured data of various kinds and nature.

5. Results of the study of a comprehensive method of situational project risk management

5. 1. Project risk management model in the form of a fuzzy situational graph

Project risk management requires a reduction in the time of practical implementation of fundamentally new ideas and technologies, a significant change in the nature and dynamics of design and technological processes, flexibility, efficiency, and mobility of decision-making in crisis situations. In the course of formalizing the decision-making process in a risky situation, it is necessary to obtain an expression in which all the signs of a problem situation are taken into account, and in which the goal is related to the means of achieving it. Therefore, a comprehensive study is appropriate into risk management based on a situational approach. Building a fuzzy situational risk management graph will provide opportunities for making an optimal decision that will contribute to overcoming the crisis situation with minimal losses.

Using the methodology from [19] for constructing and analyzing a fuzzy situational graph, the situations, which represent the real state, are described through the criteria and indicators of the project's effectiveness [20] in the current period. If the situation does not correspond to the planned values of the relevant indicators, then there is a problem. The development of an action plan to eliminate the problem is the essence of the decision-making task. The edges of the graph correspond to management decisions that will contribute to the increase in the indicators of efficiency and exit from the crisis situation. Obtaining typical scenarios for the implementation of management decisions, the ability to describe typical situations through indicators and criteria of project effectiveness, the qualitative nature of the presentation of information characterize the project situation. Such properties of the class of problems under consideration allow us to talk about the possibility of applying a fuzzy situational approach and the fundamental possibility of constructing a fuzzy situational graph.

The construction of a fuzzy situational graph of risk management is carried out on the basis of the combined application of expert methods and fuzzy logic. As an expert method, the method of intelligent assault was chosen, which is often used to identify alternatives and discuss them. To conduct the study, a simple academic project in the field of information technology was taken as a basis.

An example of a fuzzy situational graph of project risk management is shown in Fig. 1 (risky situations, situational goals, and solutions are designated, accordingly, S_i^j, C^j, R_{ik}^j).

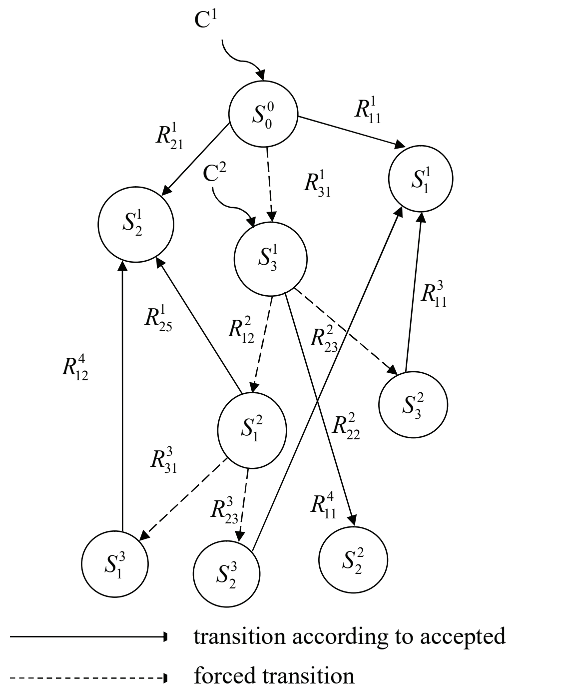

Fig. 1. Fragment of fuzzy situational graph of project risk management

The initial top S_0^0 of the fuzzy situational risk management graph indicates a risky situation that may arise under crisis conditions during the project. The edges R_{ik}^j correspond to decisions aimed at changing the risk situation and getting out of the crisis. The vertices S_i^j are the consequences of the implementation of the relevant decisions R_{ik}^j. The arrows indicate the situational goals C^j.

Construction and analysis of a fuzzy situational risk management graph is implemented on the basis of the following procedure:

– set the initial conditions for a risky situation based on fuzzy values of indicators and criteria for project effectiveness and the influence of environmental factors. Situational goals are established that are aimed at avoiding risk in a risky situation;

– decisions that contribute to the achievement of situational goals and the degree of implementation of each decision under crisis conditions are identified and discussed. The solutions depicted by the dotted arrow are forced. The degree of implementation of each decision is determined by experts on a scale [0, 1] taking into account the influence of external factors;

– somebody predicts and analyzes the situations-consequences of the implementation of relevant decisions corresponding to the vertices S_j^i of a fuzzy situational graph;

– situations are investigated – results and evaluation of project performance indicators is carried out. Based on the obtained values, the achievement of the situational goal is established. If a risky situation is obtained, the procedure is repeated.

Table 1 provides an example of a description of the initial risk situation S_0^0 and situations-consequences of decisions R_{ik}^j, given in Table 2, possible solutions R_{ik}^j are given in Table 3.

Table 1

Fragment of the situation table

Situation designation	Description of situations
S_0^0	The effectiveness of an IT project is assessed as low. According to the criterion of full readiness of IT, the project is assessed at a low level. According to the eligibility criterion, an IT project is rated as low. The acquired practical experience of project team members is assessed as average. As a result, the quality of the product is below average, which, with significant costs for the implementation process, will lead to a low assessment of the project's performance. Inefficient work with the customer. Inefficient use of the latest technologies
S_1^1	The effectiveness of an IT project is assessed as average. Obtaining a finished product that meets all the functional requirements of the Product Backlog is implemented in accordance with the established time limits
S_2^1	The effectiveness of an IT project is assessed as average. The tested product was obtained in accordance with the functional requirements of the Product Backlog, which is ready for promotion
S_3^1	The lack of well-defined product backlog functional requirements leads to team downtime. The absence of contracts affects the quality of staff work

Situational goals C^j, which are indicated in Table 1, are formed for a risky situation.

Table 2

Table of situational goals

Designation of a situational goal	Description of the situational goal
C^1	Avoid the risk of non-fulfillment of the order in time limits
C^2	Avoid the risk of exceeding the amount of resources

The choice of a strategy that will contribute to overcoming a risky situation will be demonstrated on the basis of the analysis of the proposed fuzzy situational graph of project risk management (Fig. 1). The situation is defined as final, that is, non-risk, if opportunities are provided to achieve the project goals (Table 4). We have different strategies characterized by a set of solutions aimed at avoiding risk. The task is to determine the strategy that is the riskiest and will lead to the onset of risk and which must be avoided in relation to the objectives of the project.

The degree of implementation of the risk avoidance strategy under crisis conditions for each project goal is calculated as the total impact of the degree of implementation of each decision:

$$\tilde{R}_i == \sum_{j=1}^{n} R_{ik}^{j}, \quad (1)$$

where n is the total number of decisions from the initial situation to the final one.

Table 3

Fragment of the table of possible solutions

Designation of a solution	Solution description	The degree of implementation of the solution
R_{11}^1	To improve the overall efficiency of the IT project, it is proposed to streamline the Product backlog. Definition of Done set based on a clear list of requirements. To increase the level of practical experience of project team members by attracting developers of the highest category	0.4
R_{21}^1	Formation of the Product Backlog project in accordance with the latest trends in the development of technologies, attracting additional services for customers	0.4
R_{31}^1	Extensive process of project implementation based on the preservation of the current trend	0.2
R_{12}^2	Maintaining the trend that has developed regarding the formation of the Product Backlog and work with customers	0.4
R_{31}^3	Formation of Product Backlog based on the definition of clear functional requirements	0.5
R_{12}^4	Empowering project team members by increasing the level of competence and finding new customers	1

Table 4

Description of project objectives

Title	Description of project objectives
G_1	Achieve maximum profit.
G_2	Minimize project costs
G_3	Increase teamwork productivity

Each goal of the project G_l is characterized by the weight a_j, which determines its importance in relation to other goals and is determined by experts. The degree of the implementation of the strategy is determined in relation to each goal of the project. The calculated values are recorded in Table 5, illustrating an example of Fig. 1.

For each strategy P_i, the achievability index of project objectives E_i under crisis conditions is calculated:

$$E_i = \sum \alpha_j \tilde{R}_i, \quad (2)$$

which is indicated in the far-right column of Table 5. A set with a maximum index value $P_5 = \left(R_{31}^1, R_{12}^2, R_{23}^3, R_{11}^4\right)$ is defined as unacceptable. That is, it is a strategy that is the riskiest and that must be avoided under crisis conditions. Other options make it possible to avoid the onset of a risky event.

Table 5

Determining the riskiest strategy

Strategy	The end situation	Strategy structure	Project goals and scales (points)			Index of achievability of project goals
			$G_1/3$	$G_2/2$	$G_3/1$	
P_1	S_1^1	$\left(R_{11}^1\right)$	0.5	0.4	0.5	2.8
P_2	S_2^1	$\left(R_{21}^1\right)$	0.5	0.4	0.4	2.7
P_3	S_2^2	$\left(R_{31}^1, R_{22}^2\right)$	0.8	0.8	0.7	4.7
P_4	S_1^1	$\left(R_{31}^1, R_{23}^2, R_{11}^3\right)$	0.9	0.8	0.7	5
P_5	S_1^1	$\left(R_{31}^1, R_{12}^2, R_{23}^3, R_{11}^4\right)$	0.9	0.92	0.8	5.34
P_6	S_2^1	$\left(R_{31}^1, R_{12}^2, R_{13}^3, R_{21}^4\right)$	0.8	0.9	0.9	5.1

5. 2. Procedure for situational risk management

A comprehensive method of situational project risk management is characterized by the complexity of the problem of formalizing management decision-making procedures and their information support, taking into account the availability of both structured and unstructured data. Obtaining information for decision-making in project risk management requires processing significant amounts of data of various kinds and nature. The use of Big Data technology will ensure the implementation of a combined scheme for the formation of information flows and their transformation by immersion in an environment of the appropriate level, which has certain target guidelines and rules of benefits. When implementing such a scheme, certain advantages appear by combining two approaches: object and hierarchical. To describe situations, it is possible to use NoSQL databases, which will ensure the adaptability of the representation of unstructured data and immersion of information in different management levels.

In situational project risk management, the following factors should be taken into account:

– the negative consequences of mistakes in making a management decision and its implementation are sharply enhanced. In a risky situation, a radical change in the directions of decisions is possible and new opportunities arise, and those that existed before disappear, so mistakes in the choice and implementation of a management decision can be fatal;

– routine, familiar procedures and schemes do not work;

– alternative solutions may differ from each other in implementation strategies, used material, information, energy flows, participants, etc.

The procedure for situational risk management of projects based on the use of Big Data technology will be demonstrated using the following simulation model (Fig. 2).

Step 1. Process f_1 receives at the entrance a set of fuzzy values of indicators and criteria for project effectiveness and influences of environmental factors, as well as a set of situational goals. At the output of the process, we obtain a qualitative assessment of the risk situation. The transformations performed by the f_1 process are described mainly by the product rules IF-THEN. An example of rules that defines a risky situation as *"very high"* is:

IF (((project efficiency=low)
AND (level definition of done=low))
OR(...)
OR ((project efficiency=low)
AND (gained practical experience of project members=average))), THEN (risk of the situation=very high).

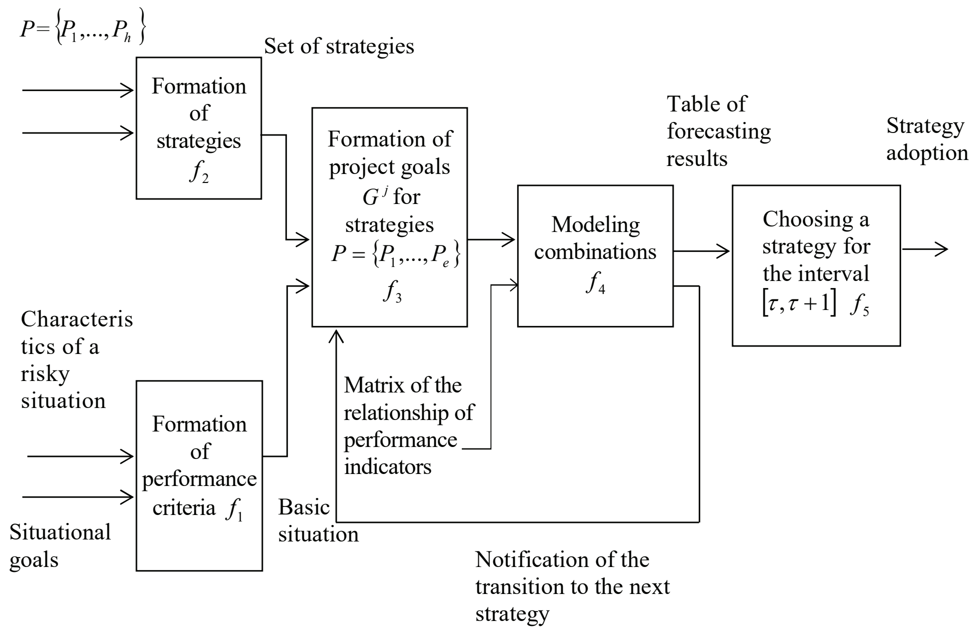

Fig. 2. The procedure for situational project risk management

Step 2. The process f_2 according to the final situation based on the set of solutions $R=\{R_1,\ldots,R_h\}$forms a set of strategies $P=\{P_1,\ldots,P_e\},e\leq h,$ taking into account defined situational goals. This process includes calculating the degree of implementation of the strategy, forming expert information about various solutions in order to avoid risks. This allows us, taking into account the chosen criterion of the effectiveness of alternative risk avoidance scenarios, to determine in a timely manner the need to implement measures to distribute and eliminate risk or minimize risk.

Step 3. The f_3 process for each goal G_j of the project combines all probable strategies $P=\{P_1,\ldots,P_e\},e\leq h$ of risk avoidance on the i-th interval. Modeling is carried out by an instantaneous (abrupt) change in the values of project performance indicators. Indicators, formed by the f_1 process (without taking into account the control expressed by strategies for the i-th interval), change into values that take into account all strategies $P=\{P_1,\ldots,P_e\},e\leq h$ for purposes G_j, for the i-th interval (issued by the process f_2).

Step 4. Process f_4 performs simulation of evaluating strategy options for final situations at the current interval. Its inputs are the initial situational conditions, taking into account the strategies $P=\{P_1,\ldots,P_e\},e\leq h$ (Table 5) and the weight of the project objectives. The degree of impact is estimated by numbers from the interval [0, 1] with the same boundary points.

The output of process f_4 is a table of projected indicators for achieving goals G_j of the project for each strategy P_i in accordance with the final situation at the end point of the interval (Table 5), taking into account the weight of the project goal, determined by experts.

Another way out of the f_4 process is to re-refer to the f_3 process if not all strategies are modeled.

Step 5. Process f_5 analyzes Table 5: for each graph P_i, the index E_i of achievability of the project objectives is calculated using (2). Next, the graph (strategy) is selected, the reach index for which satisfies the accepted criterion.

The results of simulation are the generation of strategies for overcoming a risky situation based on the obtained index of achievability of project goals (Table 5) and avoidance of the riskiest strategy. Imitation of the procedure is implemented taking into account the estimated data proposed and discussed by experts.

6. Discussion of results of the study of a comprehensive method of situational project risk management

Under crisis conditions, for the project risk management process, it is important to assess situations, manage the situation, and find an optimal management solution in the circumstances. This will provide opportunities to adequately and accurately assess the current risk situation, adapt to the situation, and make appropriate effective decisions that will contribute to the achievement of project goals, as well as avoid future crisis situations. And this increases the flexibility of the project and helps reduce costs in the project. In this formulation, a scientific problem is reported for the first time.

The studied comprehensive method of situational project risk management based on Big Data technology is based on the combined application of situational management methods, intelligent and expert methods, as well as Big Data technology. The fuzzy situational graph (Fig. 1) clearly demonstrates the choice of strategy that will contribute to overcoming the risky situation under crisis conditions. The construction of an index of achievability of project goals (2), which is formed on the basis of a fuzzy situational graph (Fig. 1), makes it possible to study a set of promising and adapted to the situation solutions. Rapid response to changes in the situation for the project under study under crisis conditions affects future performance indicators after a certain period of time. This makes it possible to make the necessary management decisions in "real time", which makes it possible to reduce possible costs. The use of Big Data technology contributes to the processing of unstructured and heterogeneous data describing the situation, as well as modeling situations as consequences of decisions made.

The simulation model of the situational risk management procedure (Fig. 2) clearly demonstrates the choice and decision-making in the project and is part of the proposed integrated method. Evaluation of the effectiveness of this method was carried out for an academic example of a project in the field of information technology based on the study of the qualitative and quantitative impact of the degree of strategy implementation on the index of achievability of project goals with the involvement of experts. The calculations are based on a conditional change of 1 % of the average value of the argument under consideration, with a fixed value of other arguments in each situation of the project, which was discussed by experts. This provided an opportunity to increase the efficiency of the project by 5.12 %.

The integrated application of situational management methods, intelligent and expert methods, as well as Big Data technologies for project risk management, in contrast to [6–10], has a number of the following advantages:

– a reasonable reduction in the time for the development and adoption of management decisions due to the proposed index of achievability of project goals;

– application of fundamentally new methods and approaches, including intellectual ones, to risk management that affect results and take into account the uniqueness of the conditions of specific decision-making tasks;

– application of new methods of analysis, storage, and provision of qualitative information, on the basis of which decisions are made;

– the use of fundamentally new decision-making models contributes to the formation of an optimal information image of their consequences;

– development of new information technologies, including intelligent ones, which allow us to solve problems of identification, forecasting, optimization, and risk management of projects.

Expert methods provide information in situations where we have information of a qualitative nature, and the use of other methods is impossible. The correctness of the choice of the analyzed information plays a decisive role in assessing the situation. However, the use of expert methods depends on the competence of experts and methods of expert survey. The uncertainty that arises when assessing the situation and choosing strategies to achieve the goal forces the use of subjective assessments in the analysis of situations and options for choosing strategies based on his knowledge, experience, and interests. Therefore, the experience and qualifications of the expert are important, which is a limitation of this comprehensive method. To improve the procedure for selecting experts and conducting an expert survey is the development of this study. The use of statistical methods, as an alternative to expert methods, will ensure the receipt of experimental data but will not provide an opportunity to take into account information of a qualitative nature.

The study was based on a simple academic example of a project in the field of information technology, which provided an opportunity to specifically illustrate the proposed procedure for situational project risk management, which may be a disadvantage of this study.

A comprehensive method of situational project risk management based on Big Data technology ensures prompt management decision-making in risky situations in projects implemented under crisis conditions. The result of applying this method is to increase the efficiency of projects by avoiding overspending of resources and losses in the project by 5–15 %, adaptation to the conditions of the external environment, as well as prompt and adequate response in crisis circumstances.

The proposed comprehensive method of situational project risk management can be the basis of project management information technology and the corresponding decision support system. This will expand the intellectual capacity to support management decision-making in projects. This direction is the subject of further research.

7. Conclusions

1. A model of project risk management in the form of a fuzzy situational column has been built, which will ensure the choice of a strategy that will help overcome the risk situation. This model clearly demonstrates the development of decisions and the definition of an index for achieving project goals on the basis of which operational management decision-making is carried out, as well as the definition of a future strategy.

2. A comprehensive method of situational project risk management based on Big Data technology is developed on the basis of combined application of situational management methods, intelligent and expert methods, as well as Big Data technology. The result of applying this comprehensive method of situational project risk management is to increase the efficiency of projects by reducing project losses and overspending resources.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study and the results reported in this paper.

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Data availability

All data are available in the main text of the manuscript.

References

1. Prokopenko, T., Grigor, O. (2018). Development of the comprehensive method to manage risks in projects related to information technologies. Eastern-European Journal of Enterprise Technologies, 2 (3 (92)), 37–43. doi: https://doi.org/10.15587/1729-4061.2018.128140
2. McCarthy, J., Hayes, P. (1969). Some philosophical problems from the standpoint of artificial intelligence. Available at: https://www-formal.stanford.edu/jmc/mcchay69.pdf
3. A Guide to the Project Management Body of Knowledge (2013). Project Management Institute, 589. Available at: https://ceulearning.ceu.edu/pluginfile.php/305454/course/overviewfiles/PMBOKGuide_5th_Ed.pdf?forcedownload=1
4. Benov, D. M. (2016). The Manhattan Project, the first electronic computer and the Monte Carlo method. Monte Carlo Methods and Applications, 22 (1). doi: https://doi.org/10.1515/mcma-2016-0102
5. Leha, Yu. H., Prokopenko, T. O., Danchenko, O. B. (2010). Ekspertni protsedury ta metody pryiniattia rishen v investytsiinykh proektakh. Visnyk ChDTU, 2, 69–73.

6. Verma, K. K., Ospanova, A. (2022). Risk Management. International Journal of Innovative Research in Science Engineering and Technology, 11 (12), 14315.
7. Odubuasi, A. C., Osuagwu, O. V. A., Oby, B. (2021). Effect of Risk Management Committee and Enterprise Risk Management on Performance of Banks in Nigeria. JETMASE, 3 (1), 222–233. Available at: https://www.researchgate.net/publication/366187232_Effect_of_Risk_Management_Committee_and_Effect_of_Risk_Management_Committee_and_Enterprise_Risk_Management_on_Performance_of_Banks_in_Nigeria
8. Petyk, L. O., Baskova, Y. S. (2022). The Problems of Financial Risks Management in the Risk Management System and the Methods for Solving. Business Inform, 10 (537), 181–186. doi: https://doi.org/10.32983/2222-4459-2022-10-181-186
9. Hong, Y. (Bright), Ly, M., Lin, H. (2022). RPA Risk Management: Points to Consider. Journal of Emerging Technologies in Accounting. doi: https://doi.org/10.2308/jeta-2022-004
10. Ladanyuk, A., Prokopenko, T., Reshetiuk, V. (2014). The model of strategic management of organizational and technical systems, taking into account risk-based cognitive approach. Annals of Warsaw University of Life Sciences – SGGW Agriculture (Agricultural and Forest Enginweering), 63, 97–104.
11. Ladanyuk, A. P., Shumygai, D. A., Boiko, R. O. (2013). Situational Coordination of Continuous Technological Complexes Subsystems. Journal of Automation and Information Sciences, 45 (8), 68–74. doi: https://doi.org/10.1615/jautomatinfscien.v45.i8.70
12. Lohani, A. K., Goel, N. K., Bhatia, K. K. S. (2010). Comparative study of neural network, fuzzy logic and linear transfer function techniques in daily rainfall-runoff modelling under different input domains. Hydrological Processes, 25 (2), 175–193. doi: https://doi.org/10.1002/hyp.7831
13. Lynch, C. (2008). How do your data grow? Nature, 455 (7209), 28–29. https://doi.org/10.1038/455028a
14. Bouchon-Meunier, B., Yager, R. R., Zadeh, L. A. (Eds.) (1991). Uncertainty in Knowledge Bases. Springer. doi: https://doi.org/10.1007/bfb0028090
15. Prokopenko, T. O., Ladaniuk, A. P. (2015). Informatsiyni tekhnolohiyi upravlinnia orhanizatsiyno-tekhnolohichnymy systemamy. Cherkasy: Vertykal, vydavets Kandych S.H., 224.
16. Taber, W. R. (1994). Fuzzy Cognitive Maps Model Social Systems. Artificial Intelligence Expert, 9, 18–23.
17. Chochowski, I., Chernyshenko, V., Kozyrskyi, V., Kyshenko, A., Ladaniuk, V., Lysenko, V. et at. (2014). Innovative energy-saving technologies in biotechnological objects control. Kyiv: Tsentr Uchbovoii Literatury, 240.
18. Zedeh, L. A. (1989). Knowledge representation in fuzzy logic. IEEE Transactions on Knowledge and Data Engineering, 1 (1), 89–100. doi: https://doi.org/10.1109/69.43406
19. Diestel, R. (2005). Graph Theory. Electronic Edition. Springer-Verlag. Available at: https://sites.math.washington.edu/~billey/classes/562.winter.2018/articles/GraphTheory.pdf
20. Prokopenko, T., Lavdanska, O., Povolotskyi, Y., Obodovskyi, B., Tarasenko, Y. (2021). Devising an integrated method for evaluating the efficiency of scrum-based projects in the field of information technology. Eastern-European Journal of Enterprise Technologies, 5 (3 (113)), 46–53. doi: https://doi.org/10.15587/1729-4061.2021.242744