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Эвристические методы поддержки принятия решения в управлении проектами

Heuristic methods of decision support in project management

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Аннотация. *Статья посвящена вопросам использования неформальных методов в процессах обоснования выбора и принятия решений в проектной деятельности. Приведена классификация методов выбора, определена сущность проектной деятельности, ее принципиальное отличие от операционной деятельности. Показана значимость и ценность эвристических практик для повышения обоснованности проектного решения.*

Ключевые слова: процедура выбора, целевое обсуждение, экспертная оценка, жизненный цикл проекта, условия выбора, концептуальное моделирование проектной деятельности, системный подход, инвариантность

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Abstract. *The article is devoted to the use of informal methods in the processes of justification of choice and decision-making in project activities. The classification of selection methods is given, the essence of project activity is determined, its fundamental difference from operational activity. The significance and value of heuristic practices for increasing the validity of a design decision is shown.*

Keywords: selection procedure, targeted discussion, expert assessment, project life cycle, selection conditions, conceptual modeling of project activities, system approach, invariance

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Introduction. The problem of choice is of interest to researchers of various profiles. This interest in the methodology for justifying decisions made is due to the need for a preliminary assessment of possible losses from an unjustified decision and the variety of methods for justifying decisions made. The decision maker (DM), guided by certain criteria, his own and/or borrowed

experience, knowledge, makes a decision, hoping for "correctness," often without thinking about its validity. At the same time, modern science and research results offer a fairly diverse palette of methods for a scientifically based approach to choosing the optimal alternative from the set offered to a person facing the need to make a decision [1-3]. Paying tribute to the classics of domestic and foreign scientific thought, we note that ideas about assessing the usefulness of an activity and the possible risk in its implementation have a long history: in the 17th century – Huygens and Pascal develop mathematical models of gambling behavior in order to determine an algorithm that provides maximum benefit or minimizes the risk of loss; in the 18th century – D. Bernoulli publishes his ideas on a "new theory of risk measurement", the key word here being "measurement" [4, 5].

The choice can be viewed from the perspective of a descriptive approach; from the point of view of a constructive approach and from the position of a normative approach. The normative approach involves the development of norms, rules, and principles that provide quantitative justification for decisions made, taking into account behavioral factors. The development of probability theory and mathematical statistics led to the spread of a normative approach to the decision-making procedure, but did not ensure consistency in the development of a theory on *the quantitative justification* of decisions made.

The emergence of industry, military operations, and changes in the structure of socio-economic relations on the world stage at the beginning of the twentieth century created favorable conditions for the further development of the methodology for justifying choice.

The complexity of strategic operations in economics and industry, tactical and technical operations in the art of war, terminal operations in the management of production processes increases the degree of risk, thereby increasing losses from an incorrect decision. Formalization and modeling of the processes of choosing the optimal strategy of behavior are carried out by T. Saati, K. Arrow, O. Morgenstern. Domestic mathematicians of the school of A. N. Kolmogorov, Yu. V. Prokhorova and others made an invaluable contribution to the development of the theory of probability and statistical solutions, which, in fact, they became the fundamental basis of game theory, optimality theory, operations research, cybernetics, and systems analysis.

Operations research, as a science of quantitative justification of decisions, the foundations of which were laid by H. Taha, was developed thanks to domestic scientists E. Ventzel, N. N. Vorobyov [6], and the theory of fuzzy sets [7-10] supplemented the palette of justification tools selection of models that operate with fuzzy information and allow taking into account the preferences of the decision maker.

The relevance of the study is due to the fact that despite the large number of publications on problems related to project management, today there is no holistic picture that gives a comprehensive picture of the project management system as an object of modeling. Moreover, the terminological cocktail that occurs in publications does not allow for a correct differentiation of the concepts of "project activity", "product activity", "operational activity" and, as a result, reduces the value of practical recommendations for improving the efficiency of project management. The purpose of the article is to determine the conditions for the applicability of heuristic methods in project management practice; justify the feasibility of the integrated use of methods from organization theory, management theory and modeling methods to increase the validity of decisions made under conditions of risk and/or uniqueness of the situation.

Materials and research methods. The main research methods were the provisions of system analysis, management theory with the involvement of operations research models. When determining the conditions for the applicability of heuristics in project management practice, the methodology of expert assessments and game-based social simulation modeling was used.

Turning to such a multi-aspect topic as project management, the author proposes, in order to avoid ambiguous interpretation of terms, to use the following definitions of concepts contained in the corresponding State Standard [11]:

– project: a purposeful activity of a temporary nature intended to create a unique product or service. The implementation of the project is characterized by specific ways of organizing work and management;

– project management, project management: application of knowledge. skills, tools, and techniques to project operations to meet project requirements.

The composition and structure of project management stages in the classic version are as follows:

– project initiation: problem statement, problematization, conceptual modeling of the process and result;

– planning – the stage at which goals, objectives, deadlines, resources are determined; for project activities during planning, the key factors are the customer's requirements outlined in the technical specifications (TOR); for the operating room – utility function; for grocery – the quality of the product, facilitating its further entry into the market and/or promotion in the market;

– organization - the stage at which the composition of the team of performers is determined, their functionality, degree of responsibility, resources are distributed, behavioral strategies for achieving set goals, and possible risks are determined;

– monitoring, accounting and control;

– comparative analysis of current and planned states;

– alteration; if necessary, adjust the plan;

– completion - delivery of the project to the customer; for operational activities - assessment of efficiency in accordance with the previously specified utility function; for product activities – drawing up a plan for commercialization of a product/service.

It is obvious that at each of these stages the decision maker is faced with the problem of choice.

Choice, as an integral part of management, can take place under normal, standard conditions, under conditions of uncertainty, under unique or extreme conditions; There may be several electors (multilateral choice), the selection procedure can be repeated several times (selection, selection). Justification of decisions made can be done using different methods. It is proposed to carry out a facet classification of methods for organizing the selection procedure on the following grounds:

– *conditions* under which choices must be made; choice can take place under conditions of certainty or uncertainty/risk. Certainty is a state in which the selector has complete information about all possible foreseeable options. In such almost ideal conditions, it is necessary to determine an indicator by which the attractiveness of an alternative is assessed (criterion). Next, the selection procedure can be carried out using classical optimization methods [12]. Incomplete information creates a precedent for variability in outcomes when using one or another alternative. The focus of this study and the scope of the article do not provide a complete overview of the nature of uncertainty (objective, subjective, behavioral, probabilistic, etc.); our task is to determine the selection rules that will guide the selector in conditions of incomplete information about the factors influencing the result;

– *the nature of the situation* in which the elector finds himself; according to the type of situation, it is proposed to distinguish between a choice in a regular (standard) situation, a choice in a unique situation, a choice in an extreme (rapidly changing) situation;

– *by the number of electors:* the choice can be one-sided (individual) and multilateral (collective). In the process of multilateral choice, it is advisable to take into account the nature of the relations of the electors in terms of the distribution of the results of the choice: coalition choice, cooperative, corporate. For project activities, the factor of the number of electors is not significant, since their relationships are determined by the terms of the contract at the stage of project initiation;

– *selection methods*: selection can be criteria-based; based on expert assessments; using simulation methods.

From the point of view of management theory and the above classification of approaches to decision making, project activity is a process carried out under conditions of uncertainty, since a project is a unique set of works that has no analogues, both in terms of goals and objectives, and in terms of distribution mechanisms resources. The fundamental difference between project activities and operational activities is that an operation, as a purposeful activity of a person/team of people, has a conditionally permanent nature and is aimed at the production of a product/service; project activity is the implementation of a set of works in a specifically defined time period by a team of people united to work on this project. It is this feature of project activity, according to the author, that makes heuristic selection methods the most significant factor determining the effectiveness and efficiency of the project. Below are heuristic methods and a brief description of the idea underlying the method:

Method of analogies, associations – the use of personal/collective experience to solve a problem/task; the method does not require preparation from the participants, but is complex in terms of organizing the procedure.

The Delphi method is a correspondence survey of experts, essentially a collective anonymous expert assessment of a problem situation, with subsequent processing of the results; decision making is iterative; advantages of the method: independence of expert opinions, since the correspondence format reduces the influence of collective opinion on the expert; The disadvantage of the method is the absence of procedures that determine the degree of competence of the expert in the subject area proposed for discussion.

Simulation modeling is the use of a simulation model as a simplified representation of the system under study in order to study its behavior under various conditions; as a tool for constructing simulation models of the decision-making process, as a rule, game-based social simulation modeling is used (cases, business, role-playing, situational and other games, the method of active sociological testing, analysis and control); To solve problems of a technical and technological nature, software tools are used (MATLAB, Simulink , AnyLogic, ARIS Platform and others

Commission method – collective expert assessment followed by voting; the main disadvantage of the method is the paradoxes inherent in voting [13]; It is possible to conduct it in a distance/correspondence format.

Brainstorming is the generation of ideas followed by structuring the list of received options for solving a problem, ranking and ordering according to a previously specified criterion.

Morphological methods, as a method of finding a solution, are quite often used in the procedure for justifying a choice; a detailed description can be found in [14].

Synectics is a method of collective search for a solution to a complex problem through a targeted search for analogies. The main disadvantage of the method is that the group of participants must be prepared both to solve problems proposed for discussion and to work in the format of collective creativity.

The scenario method is a method of expert assessment, the result of which is a description of the further development of the problem situation and an assessment of the expected results; the scenario may have a descriptive nature, compiled at the level of description, operating with qualitative categories; the scenario can be constructive in nature and operate with quantitative characteristics.

Targeted discussion is a collective method of searching for an optimal strategy in the space of solutions that were prepared in advance by the participants in the procedure.

A detailed description of this class of decision-making methods is quite widely presented in the scientific literature [15, 16].

Research results and their discussion. Returning to the life cycle (LC) of the project, we will determine the conditions for the applicability of the above methods for justifying

decisions made for the stages of the project at which it is advisable to use heuristic methods (Table 1).

Table 1 – Heuristics in the project lifecycle

Life cycle stage of the project	Purpose of the stage	Possible collisions	Conditions under which choices are made	Decision making methods
Project initiation.	Concretization of the project idea; coordination of the project model with the customer; building a conceptual model of the project.	Mismatch between the priorities of the customer and the contractor; variability of strategies for implementing the main idea of the project.	Behavioral and probabilistic uncertainty.	Commission method, priority ranking; decomposition: building a goal tree and a decision tree.
Planning	Drawing up a project plan: determining deadlines, allocating resources.	Determining the type of model used to draw up the plan: deterministic or probabilistic	Objective uncertainty _ lack of data on the duration of work and project stages.	Method of analogies. Method of expert assessments. Network planning. Targeted discussion. Software (JIRA, ADVANTA, MS Project, etc.)
Organization	Plan - a schedule for completing work on a project linked to a calendar: network diagram, Gantt chart.	The need to make changes due to the influence of external and internal disturbing influences (delays in deliveries, changes to technical specifications, illness of the contractor, etc.)	Subjective uncertainty associated with risks when choosing external stakeholders (suppliers, customers for other projects, etc.); when appointing executors.	Script method. Zwicky's morphological box. Targeted discussion.
Comparative analysis	Comparison of the actual state of the project with the schedule stated at the beginning of work.	The influence of external and internal disturbing influences, provoking deviation from the plan.	Uncertainty of an objective nature (force majeure circumstances; the influence of external factors on the composition and structure of the project team, etc.) of a subjective nature (incorrect assessment of the labor intensity of a stage, funding delays, change in the priority status of the project, etc.)	Script method. Simulation modeling. Morphological method of full field coverage.
Change management	Determination of the initiator of changes (customer, executor, etc.). Determining the algorithm for making changes.	The need to differentiate changes (forced, conscious, uncontrolled) and their impact on the progress of the project, on the timing and results, on the environment	The influence of behavioral factors: unpreparedness of performers for changes due to changes in the boundaries of responsibility, changes in roles in the project, etc. The need to redefine possible risks when making changes.	Aggregation of changes. Expert assessment of the feasibility and need for changes. Game-based social simulation modeling. Software (Bitrix-24, Kaiten, YouGile, etc.)

Project initiation. At this stage, the classics of project management suggest using conceptual modeling to determine the space of goals and expected results; Involving specialists of various profiles in the process of developing the concept provides the opportunity for self-determination in the situation, position and goals. The model can be presented in the form of a directed graph (Figure 1), hierarchical, in the form of a "tree of goals/states" (Figure 2); network (Figure 3); analytical (formula 1).

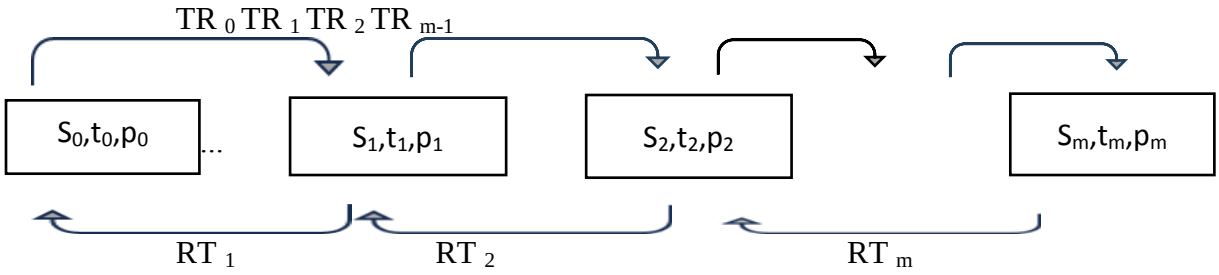

Figure 1 – The project model in the form of a directed graph

Conventions adopted in the model:

– S_0 – initial state of the project, S_1, S_2,…, S_m – state of the project at the first, second, etc. , final (m - stage);

– p_0, p_1, p_2,…, p_m – probabilities of the corresponding states (i =1, m);

– t_0, t_1, t_2,…, t_m – time/dates for the beginning and completion of the corresponding stages;

– TR_i – rules/conditions for the transition of the project from stage to stage;

– RT_i – reasons/risks of "reverse" transition.

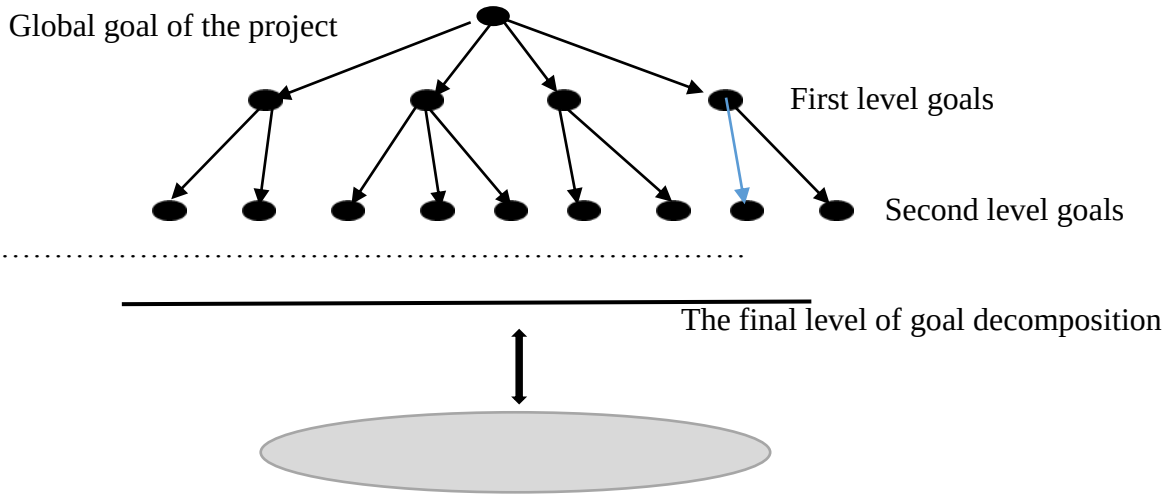

Figure 2 – Tree model of the hierarchy of project goals

A hierarchical goal model, complemented by a state model, allows you to build a model of probable risks/conflicts, thereby ensuring effective change management.

The network model of the project, presented in Figure 3, is more flexible compared to the hierarchical model. In the context of the research topic, the author considers it possible to note the most obvious differences between the hierarchical and network models. The definition of functionality characteristic of a hierarchical model in accordance with the place occupied in the hierarchy in the network model looks like a distribution of responsibilities in accordance with the rating of the performer, his professional competencies and system of preferences. This approach ensures high interest among performers and allows the degree of responsibility to be determined

at the planning stage. The fundamental difference in the style of leadership and decision-making: from an administrative-volitional format to a collegial one with the involvement of experts.

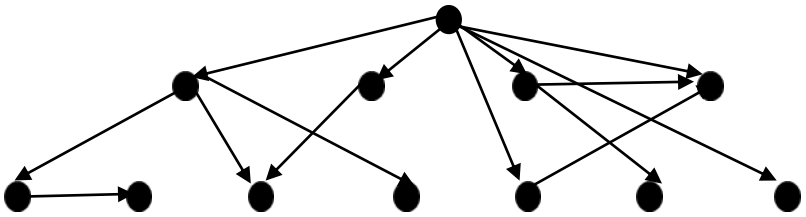

Figure 3 – Sketch of the network model of project activity

It is advisable to use a "network" type model that displays connections "everyone with everyone" to analyze real-life structures, since an "ugly" picture with many intertwinings gives food for thought, allows you to identify overloaded areas, duplication, etc. Built on the basis of a network the relationship matrix, as a result of modeling at this stage, is used at the planning stage.

The conceptual model in analytical form reflects the relationship between the global goal of the project, the conditions for its implementation, active and passive factors, and controlled variables.

$$W = F(A_i, dfa, dfp, x_j) \rightarrow extr \quad (1)$$

Here

– A_i – conditions for organizing and implementing project activities (informational, regulatory, financial, temporary);

– dfa - active factors (organizational capabilities, administrative resources, intellectual and labor resources, including qualifications of performers, wage fund; management methods);

– dfp - passive active factors (customer behavior: monitoring and feedback, communications; management support; market conditions; microclimate in the team; experience of the project manager);

– x_j - controlled variables;

– W is the global goal of the project;

– F -functional/type of dependency.

The result of conceptual modeling is a model that displays the initial state, the expected result, and the process of transition from the current state to the final state.

Planning. At this stage, taking into account the requirements/wishes/preferences of the customer set out in the technical specifications (TOR), the start and completion dates of the project and intermediate milestones are determined. The tools of this stage - a Gantt chart, a network diagram [17], seemingly have a deterministic nature and do not provide for variability. But this is ideal. The actual practice of project activities suggests that the use of deterministic models (distribution and assignment problem, equipment loading problem, etc.) is inappropriate due to the lack of experience and, as a consequence, relevant information about the algorithms for strategic and tactical planning of a unique project. The use of quantitative criteria at this stage (time to complete a stage, labor intensity of work, etc.) is also questionable due to the lack of standards, experience of similar work and / or the necessary statistical data. The presence on the market of many software products designed to automate project planning does not solve the problem, so it is necessary to develop your own tools using heuristic methods. Heuristics that allow you to generate solutions are "brainstorming", a commission method, they are used mainly at the strategic planning stage. Heuristics used to evaluate alternatives such as the ranking

method, the method of active sociological testing, analysis and control have found application in operational planning.

Organization, as a system-forming part of project management, involves a set of actions:

– defining a hierarchy of goals; methods: ranking, game social simulation; expert review;

– optimization of plans; methods: morphological; targeted discussion;

– performance analysis of performers; methods: testing, interviewing;

– identifying approaches to resolving non-antagonistic conflicts;

– Management of risks; methods: expert assessment for risk identification; ranking for risk assessment; simulation modeling for monitoring and control.

Change management. The need to make changes usually arises during the implementation of most projects. The reason is the uniqueness of the project, the probabilistic nature of communications, the influence of external factors, etc. The variety of methodological approaches to making changes to a project that is at the execution stage essentially comes down to a sequence of actions: awareness of the need to adjust the plan - analysis of the impact of making changes on the final result, including the "zero" alternative ("what will happen if you don't change anything?") – formation of a plan for making changes with identification of sources of financing and possible risks/losses – making changes, that is, returning to the *Planning stage.* Even with such a simple listing of the sequence of actions to adjust the plan, the following is obvious, in the author's opinion: the quality of planning affects the degree of risk and reduces the likelihood of the need to make changes.

Conclusion. Informed choice is a task for which there is a rich palette of methods; it is proposed to consider consistency and invariance as the main conditions for the applicability of heuristic methods in project management practice. Mathematical modeling methods as a tool for justifying a decision, despite their attractiveness, have a significant "disadvantage": they require the decision maker to have special training in a given subject area or additional costs for attracting specialists in the field of operations research. Heuristic practices, which are based on informal modeling methods, do not impose such requirements on decision-makers, which has led to their spread and implementation in the processes of organization and project management. Domestic and foreign scientific publications covering the role and significance of heuristic methods for practicing managers, as a rule, provide recommendations on the application of the methodology to a specific subject area (industry, construction, education, etc.). The author makes an attempt to substantiate the need for a systematic approach to the development of invariant in relation to the subject area of the methodological foundations of the use of heuristic methods in the processes of choice justification.

ЛИТЕРАТУРА

1. Семенов С. С. Методы принятия решений в задачах оценки качества и технического уровня сложных технических систем. М.: Ленанд, 2016. 520 с.

2. Орлов А. И. Принятие решений. Теория и методы разработки управленческих решений. М.: ИКЦ «МарТ»; Ростов н/Д: Издательский центр «МарТ», 2005. 496 с.

3. Ширяев А. Н. Вероятностно-статистические методы в теории принятия решений. М.: МЦНМО, 2011. 144 с.

4. Воробьев Н. Н. Основы теории игр. Бескоалиционные игры. М.: Наука, 1984. 495 с.

5. Клименко И. С. Модели и методы управления. экономическая кибернетика: экономико-математическое моделирование. М.: КДУ, Добросвет, 2019. 186 с.

6. Кофман А. Введение в теорию нечетких множеств / Пер. с франц. М.: Радио и связь, 1982. 432 с.

7. Борисов А. Н., Крумберг О.А., Федоров И. П. Принятие решений на основе нечетких моделей: примеры использования. Монография. Рига: Зинанте, 1990. 184 с. URL: https://djvu.online/file/Ap0PpqQRQ56oz?ysclid=lox0md62x7925803456 (дата обращения: 03.09.2023).

8. Аверкин А. Н., Батыршин И. З., Блишун А. Ф, Силов В. Б., Тарасов В. Б. Нечёткие множества в моделях управления и искусственного интеллекта / Под общ. ред. Поспелова Д. А. М.: Наука, 1986. 312 с.

9. Нечёткие множества и теория возможностей. Последние достижения / Под ред. Р.Р. Ягера. М.: Радио и связь, 1986. 408 с.

10. Юдин Д. Б. Вычислительные методы теории принятия решений. М.: КД Либроком, 2014. 320 с.

11. ГОСТ Р 56715.5—2015. Проектный менеджмент. Системы проектного менеджмента. Часть 5. Термины и определения. Издание официальное. Москва, Стандартинформ, 2020. С. 9

12. Лукьянов Б. В. Математические и инструментальные методы поддержки принятия решений. М.: Русайнс, 2014. 94 с.

13. Грей К. Ф., Ларсон Э. У. Управление проектами: практическое руководство. М.: Дело и сервис, 2003. 528 с.

14. Klimenko I. S. Fritz Zwicki's morphological approach to the design of integrated protection systems for information and communication facilities // Modern Science and Innovations. 2021. No. 3 (35). P. 53–61.

15. Мулен Э. Кооперативное принятие решений: аксиомы и модели. М.: Мир. 1991. 464 с. URL: https://docs.yandex.ru/docs/view?tm=1700564196&tld=ru&lang=ru&name=mulen-1991.pdf&text (дата обращения: 05.09.2023).

16. Труды ИСА РАН: Математические модели социально-экономических процессов. Методы принятия решений. Численные методы решения. Экономические и социокультурные проблемы информационного общества. Управление рисками и безопасностью / Под ред. С. В. Емельянова. М.: Красанд, 2013. 124 с. URL: https://elibrary.ru/contents.asp?titleid=9176 (дата обращения: 21.11.2023).

17. Клименко И. С. Индивидуальные стратегии в управлении проектами: модели и методы формирования. // Современная наука и инновации. 2023. № 3 (43). С. 46–57. https://doi.org/10.37493/2307-910X.2023.3.5

REFERENCES

1. Semenov SS. Metody prinyatiya reshenij v zadachax ocenki kachestva i texnicheskogo urovnya slozhny`x texnicheskix sistem. M.: Lenand; 2016. 520 p. (In Russ.).

2. Orlov AI. Prinyatie reshenij. Teoriya i metody razrabotki upravlencheskix reshenij. M.: IKCz “MarT”; Rostov n/D: Izdatelskij centr “MarT”; 2005. 496 p. (In Russ.).

3. Shiryaev AN. Veroyatnostno-statisticheskie metody` v teorii prinyatiya reshenij. M.: MCzNMO; 2011. 144 p. (In Russ.).

4. Vorobev NN. Osnovy teorii igr. Beskoalicionnye igry. M.: Nauka, 1984. 495 p. (In Russ.).

5. Klimenko IS. Modeli i metody upravleniya. ekonomicheskaya kibernetika: ekonomiko-matematicheskoe modelirovanie. M.: KDU, Dobrosvet; 2019. 186 p. (In Russ.).

6. Kofman A. Vvedenie v teoriyu nechetkix mnozhestv. Per. s francz. M.: Radio i svyaz; 1982. 432 p. (In Russ.).

7. Borisov AN, Krumberg OA, Fedorov IP. Prinyatie reshenij na osnove nechetkix modelej: primery` ispol`zovaniya. Monografiya. Riga: Zinante; 1990. 184 p. Available from: https://djvu.online/file/Ap0PpqQRQ56oz?ysclid=lox0md62x7925803456 [Accessed 3 September 2023].

8. Averkin AN, Batyrshin IZ, Blishun AF, Silov VB, Tarasov VB. Nechyotkie mnozhestva v modelyax upravleniya i iskusstvennogo intellekta. Pod obshh. red. Pospelova DA. M.: Nauka, 1986. 312 p. (In Russ.).

9. Nechyotkie mnozhestva i teoriya vozmozhnostej. Poslednie dostizheniya. Pod red. RR. Yagera. M.: Radio i svyaz; 1986. 408 p. (In Russ.).

10. Yudin DB. Vychislitelnye metody teorii prinyatiya reshenij. M.: KD Librokom; 2014. 320 p. (In Russ.).

11. GOST R 56715.5—2015. Proektny`j menedzhment. Sistemy` proektnogo menedzhmenta. Chast` 5.Terminy` i opredeleniya. Izdanie oficialnoe. Moskva, Standartinform; 2020. P. 9. (In Russ.).

12. Lukyanov BV. Matematicheskie i instrumental`ny`e metody` podderzhki pri-nyatiya reshenij. M.: Rusajns; 2014. 94 p. (In Russ.).

13. Grej KF, Larson EU. Upravlenie proektami: prakticheskoe rukovodstvo. M.: Delo i servis; 2003. 528 p. (In Russ.).

14. Klimenko IS. Fritz Zwicki's morphological approach to the design of integrated protection systems for information and communication facilities. Modern Science and Innovations. 2021;3(35):53-61.

15. Mulen E. Kooperativnoe prinyatie reshenij: aksiomy` i modeli. M.: Mir; 1991. 464 p. https://docs.yandex.ru/docs/view?tm=1700564196&tld=ru&lang=ru&name=mulen-1991.pdf&text [Accessed 5 September 2023].

16. Trudy ISA RAN: Matematicheskie modeli social`no-e`konomicheskix proces-sov. Metody` prinyatiya reshenij. Chislennye metody resheniya. Ekonomicheskie i sociokul`-turny`e problemy` informacionnogo obshhestva. Upravlenie riskami i bezopasnost`yu. Pod red. SV Emelyanova. M.: Krasand; 2013. 124 p. Available from: https://elibrary.ru/contents.asp?titleid=9176 [Accessed 5 September 2023].

17. Klimenko IS. Individualnye strategii v upravlenii proektami: modeli i metody formirovaniya // Modern Science and Innovations. 2023;3(43):46-57. (In Russ.). https://doi.org/10.37493/2307-910X.2023.3.5

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