USING INNOVATIVE GAMES TO BUILD KNOWLEDGE BASES IN SPATIAL RISK ANALYSIS

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Abstract

The article presents an approach to assessing risk management to ensure sustainable development of territories and businesses using artificial intelligence and gaming technologies for continuing professional education. Features of risk assessment related to ensuring effective development of territories and businesses are shown, in conditions of impossibility to apply statistical methods to determine the probability of occurrence of dangerous events and low degree of formalization of description of severity of their consequences.

The choice of a two-factor risk management model based on an expert approach to determining the likelihood of hazardous events and the severity of their consequences is justified. The problems of gaining expert knowledge are formulated and a method for solving them using innovative open-type games that have proven themselves in continuing professional education of managers in the process of solving complex semi-structured problems is proposed.

An approach to structuring expert knowledge in artificial intelligence systems is proposed. The structure of the project for the formation of knowledge bases for the analysis of spatial development risks has been formed.

Keywords: risk analysis, development of territories and business, innovative games, gaining expert knowledge, continuing professional education, artificial intelligence systems

I. Introduction

The most important component of the climate agenda in recent years is the management of climate risks with a shift in focus from mitigation to adaptation to climate change in the constituent entities of the Russian Federation and production systems.

These issues were discussed at the strategic session "Climate risks" at the beginning of 2024. Regional Context" in early 2024, where the ESG Alliance and Kept presented the methodology and guidelines for assessing risks associated with climate change. The innovation of the proposed methodology is that it is based on the PDCA management cycle, on which all international management standards are based, and a process approach is used to assess risks, allowing to identify the impact of climate change on each production process and the entire production system as a whole. The transition from risk identification and assessment to risk management, including strategic goal-setting, planning and continuous monitoring of the effectiveness of response measures within the framework of the chosen strategy, followed by work to improve activities at all system levels, is a key point in the methodological transition from plans for the social and economic development of the territory to their practical implementation at the business level (Figure 1).

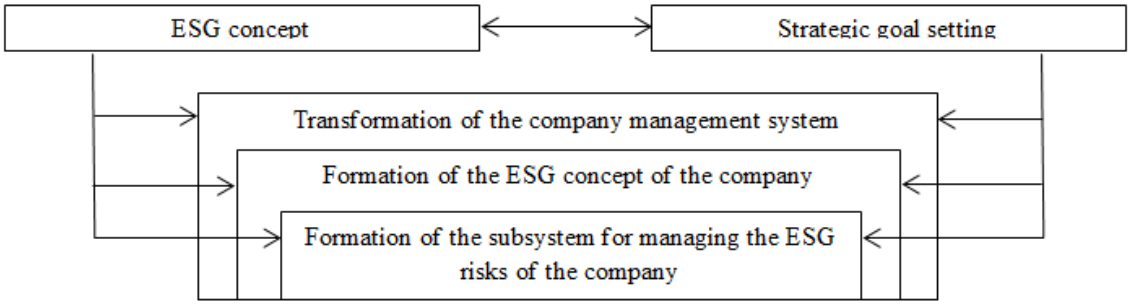

Figure 1: *Formation of the company's risk management subsystem within the framework of the sustainable development concept*

Risk management based on ESG principles with a focus on taking into account environmental, social and governance aspects in the activities of companies and assessing their sustainability and impact on the environment, society and internal governance structure [1] is part of the approach to sustainable development and the basis for the practical implementation of the climate risk management methodology. The ESG principles built into the company's management system, focusing on specific aspects of activities and investments, link the corporate strategy with the strategy of social and economic development of the territory.

According to the assessment of the professional community, the strategies for the social and economic development of the constituent entities of the Russian Federation and the action plans for their implementation, which should ensure "reducing the vulnerability of the country's national security system, economic entities and citizens due to changes in the global climate, the climate on the territory of the Russian Federation, the territories of neighboring states, in the adjacent waters of the World Ocean, as well as the use of favorable opportunities caused by these changes" [2], by the beginning of 2024 determined the system of operational and long-term measures to adapt territories to climate risks to no more than a "weak C" [3].

By order No. 397 dd. June 28, 2024, the Ministry of Economic Development of Russia adjusted the Methodological Recommendations for the Development and Adjustment of the Strategy for the Social and economic Development of a Subject of the Russian Federation and the Action Plan for its Implementation, previously approved by order No. 132 dd. March 23, 2017, supplementing them with an emphasis on adaptation. The adjustments also affected the orders of the Ministry of Economic Development of Russia No. 267 dd. May 13, 2021 "On approval of methodological recommendations and indicators on adaptation to climate change" and No. 927 dd. December 28, 2023 "On approval of Methodological recommendations for assessing possible damage from the impact of climate risks, including recommendations for the formation of a list of climate-vulnerable objects in economic sectors, in the constituent entities of the Russian Federation and Methodological recommendations for monitoring and assessing the effectiveness and efficiency of measures to adapt to climate change."

However, despite the ESG Alliance's in-depth study of enterprise risk management issues related to climate change and the regulator's active position regarding the systemic consideration of climate and economic risks in the territories, the issue of developing tools for the practical application and replication of the proposed methods is acute.

II. Methods

The development of strategies for the social and economic development of the constituent entities of the Russian Federation and action plans for their implementation should be based on an analysis of data across all major climatic parameters and threats.

The Methodological Recommendations for the Development and Adjustment of the Strategy for the Socioeconomic Development of a Subject of the Russian Federation and the Action Plan for its Implementation propose using the results of scientific research, including publications from the Climate Center and official reports from Roshydromet, to forecast the dynamics of climate risks. It is assumed that "within the framework of the target scenario of long-term development, the main macroeconomic parameters of the development of a constituent entity of the Russian Federation, indicators of its social, sectoral and territorial (spatial) development for the long term can be determined, priority areas can be identified, including the development of human capital and social sphere, key sectoral complexes and types of infrastructure, scientific and innovative sphere and institutional environment, rational use of natural resources and ensuring environmental safety, adaptation to climate change, foreign economic and interregional cooperation, as well as territorial (spatial) development of a constituent entity of the Russian Federation" [4].

The assemblies of global climate models recommended by the regulator for calculating indicators of future climate change in the territory of the subjects of the Russian Federation and the family of scenarios of anthropogenic impact, the evolution of society and ecosystems, taking into account the goals and objectives of the long-term development of the subject, the internal conditions of its development, cause difficulties in practical use and require the involvement of specialists with competencies and experience in the field of climate modeling.

The regional strategies and company reports we studied generally do not use forecasting, but rely only on historical information contained in Roshydromet databases.

Since the use of statistical methods in the analysis of the effective development of territories and businesses is limited by the lack of representative samples, expert knowledge is also required to determine climate risks, firstly, when forming scales for assessing the probability of threats and the severity of their consequences, and secondly, when establishing the levels of the risk ranking matrix.

Building expert knowledge bases is hampered by the narrow specialization of experts and the high degree of individualization of their knowledge. Technically, the system integration of existing disparate knowledge is possible on specially created platforms. However, the problem of gaining expert knowledge has not yet been solved unless it is reflected in printed texts or electronic databases. There are two main difficulties in gaining expertise from specialists in relevant fields

- the reluctance to give unique knowledge to public databases due to the risk of reducing personal demand;
- the inability of an expert in some cases to build sound relationships between elements due to the "compiled" nature of the knowledge.

And if the first difficulty can be removed by motivational mechanisms, in the second case the problem is directly dependent on the complexity and uniqueness of knowledge about the vulnerabilities, risks and opportunities for spatial development (territory and related business) in the future. To solve the problem of building an expert knowledge base, innovative games (IG) can be used, which have proven themselves well in continuing professional education of managers in the process of solving complex, weakly structured problems.

The practice of using innovative games (innovative seminars) in continuing professional education (CPE) of managers and specialists allowed formulating the concept of innovative-project training of personnel (IPT), based on the following principles.

1. *Learning through activity:* the effectiveness of the learning process is significantly higher if its participants are engaged in solving their own problems during the learning process, and knowledge is given for a specific problem (the principle of "action-knowledge-action").
2. *Project-based organization of training:* training is a component of a real project and is aimed at supporting the process of its implementation; the result of training, along with new competencies, is the completion of a project task by a group (subgroups) (the "here and now" principle).

3. *The principle of representation sampling:* in practice, to implement a specific project, a team is formed in such a way that the solution to the problem is provided by a combination of all the necessary competencies. Accordingly, in the case of project-based organization of training, both for diagnostic tasks (analytical sessions) and for project work (project-innovation sessions), the group of seminar participants should be sufficient to collectively represent a "living" functional model of the type of activity that the project is aimed at.
4. *Immersion principle:* the training consists of a set of completed modules lasting from 1 to 3 days, during which group members are completely separated from their current work and immersed in the process of solving a specific problem within the project.
5. *Multitasking of training:* along with substantive issues, the training process addresses the issues of building effective interaction between team members (regardless of their status, age and experience), the issues of personal self-determination in relation to new ideas and solutions, and the development of new individual management tools.

Unlike business, role-playing, and simulation games, IG does not imply a known, pre-determined substantive result. This is a technology for organizing the process of solving complex semi-structured problems based on group dynamics. Here, teachers act primarily as consultants on the effective organization of collective work on the tasks set to the group, and only secondarily as the holders of substantive knowledge, which is given in very measured doses when a corresponding request arises [5].

The multitasking of the IN involves work in three planes, for each its own type of result is formed (Fig. 2):

- a meaningful solution to the task set, which can be a formed structure of knowledge about risks in a certain area, the main provisions of the development strategy of the region or company in the conditions of identified climatic risks, a process model of the activities for the implementation of the strategy, taking into account risks of appropriate levels, and more, depending on the projects being worked out;
- solving the problems of team interaction through building effective communications based on a process approach, regulations, and protocols;
- solving problems of personal ability by developing new personal tools and methods of working with a particular problem based on personal self-determination in relation to it and to the team of partners involved in this work.

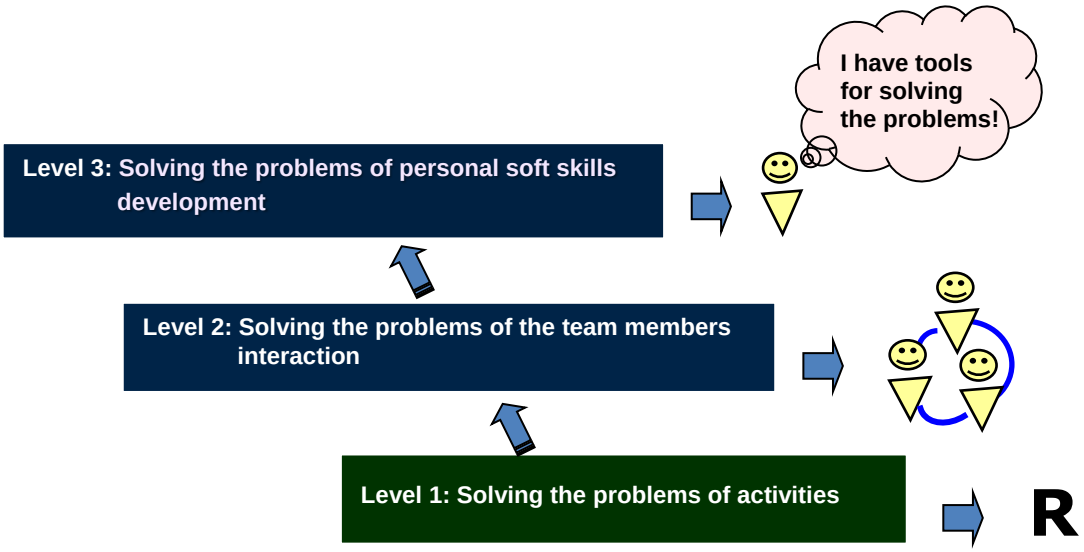

Figure 2: *Three types of outcomes of the Innovative Workshop*

Each plane uses its own methods and tools. Logical and technical tools in the substantive area, social and technical tools in the communicative area, and psychotechnical tools in the personal area.

A participant in the educational process gains an increase in knowledge on a given issue not only through communication with teachers, but also through intensive exchange of information in working groups. And unlike traditional forms of training, two additional results appear here (which are most valuable for working with experts) - these are the skills of organizational social and psychological management of a team of specialists with specialized knowledge, building effective communications with them, as well as new personal tools and methods for diagnosing unstructured problem areas.

III. Results

The organization of the process of gaining expert knowledge in the course of continuing professional education of the holders of this knowledge, built on the basis of the IPT concept, includes the following main stages.

1. *Selecting a topic* for improving the qualifications of holders of expert knowledge that would not only interest them, but would also involve their active involvement in diagnosing the problem and developing ideas for solutions in relation to the development of the chosen area. For example, having chosen the topic of developing a regional development strategy for IG, experts, working as part of a group of stakeholders, will participate in the analysis of the impact of the external environment on the sustainability of the regional economy, discuss the risks of adapting business and the region to climate change, generate scenario forecasts of the impact of risks on the sustainability of regional development and enterprise strategies, etc.
2. *Formation of the session structure of the IG* based on the decomposition of the topic into a sequence of tasks and planned results, group work on which will create conditions for the gaining of expert knowledge for the formation of databases in the relevant areas.
3. *Determination of the participants* based on the principle of representation sampling. Along with experts, the group shall include the representatives of government bodies responsible for this area, business leaders, systems analysts and other interested categories. In this work, systems analysts or knowledge engineers have a special function, which is to systematize all the information discussed based on the structure of the knowledge base.
4. *Process planning:* selection of methods and tools and development of the temporary structure of the seminar (timing).
5. *Preparing a team of moderators and systems analysts:* defining their functions in the work of the seminar, analyzing the expected results and discussing the necessary and sufficient conditions for obtaining them. Selection of necessary materials. Elaboration of technical requirements for extractable knowledge.

The IG organizational structure includes:

- presentation by the moderator setting a common task, a brief introduction to the content of each session and setting the tasks of individual sessions,
- information insertion of the leader and experts on emerging requests,
- subgroup work on the objectives for each session
- common discussions on the results of the work of the groups at each session with an expert analysis of the content,
- systematization of the results of discussions for each session by leaders and experts,
- reflective work of the seminar participants.

It is very important for the success of the work to correctly decompose the general topic into local tasks for discussion, to form the composition of focus groups according to the principle of equivalence and to ensure group dynamics both when working in focus groups and during the discussion. The total scope of work between focus groups is distributed in such a way that the

results are combined in a complementary manner. For example, groups can conduct an analysis of threats and their consequences by types of climate adaptation at the regional level or by industry specifics, expertly determining the likelihood of their occurrence and the severity of possible consequences. And it is preferable to coordinate scales for assessing the probability and severity of consequences during a general discussion - this will allow identifying a larger number of expert opinions and thereby increasing the reliability of the assessments.

The part of the work that is more effectively carried out on an individual basis, such as a financial assessment of the severity of consequences or justification of the cost of risk management strategy activities, is best transferred to the stage of individual revision of projects with reference to specific conditions.

The principle of forming focus groups at the stage of project work is based on the commonality of substantive tasks. Group dynamics are achieved through the correlation of common parts of the content and the building of connections between individual tasks during discussion.

Integrated use of IG together with information modules and consulting within the continuing professional education programs of managers and specialists, being steps of a real consulting and educational project, at the output of which developed forecasts, strategies, designed risk management systems or any strategic changes in the organization/entity formed the basis of innovation and project technology. The need to structure climate risks in conditions of high uncertainty, to develop costly measures to respond to them, including regulatory ones, and sometimes to revise the development strategy of a territory or organizations located there increases the responsibility for adequately adjusting the innovative project technology to solve the problems of gaining expert knowledge.

IV. Discussion

Strategic management of territorial development risks is inextricably linked with the business strategies of companies operating on the territory, which shall also identify and assess their risks, build strategies for responding to them and analyze the effectiveness of specific reactions with the subsequent improvement of the entire management cycle. The key point in the risk management system is a clear delineation of responsibilities in the risk management system, the development of a risk culture in the company and communicating to employees the importance of risk management in the organization. The considered innovative project technology in general and specific IG in particular in climate risk management can serve not only as a tool for gaining expert knowledge, but also facilitate the creation of risk coordinators within the community with the involvement of external experts in the field of risk management.

Climate risk management tasks are increasingly being considered as a subject of artificial intelligence systems, where rules and ontologies are powerful tools for structuring expert knowledge. The choice between them depends on the specific task and the available data and constraints. Structuring expert knowledge in artificial intelligence systems is a challenging task that requires a balance between accuracy, interpretability, and efficiency. The application of the proposed process for gaining expert knowledge contributes to the development of hybrid approaches to the design of artificial intelligence systems that combine the advantages of structured and unstructured methods.

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