Mathematical and mental modeling for ecological reconstruction of the environment of construction objects

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Abstract. It seems very timely and relevant mathematical and mental modeling for ecological reconstruction of the environment of construction objects because it is almost the first attempt to algorithmize, by analogy with artificial intelligence, the modeling processes for managing the activities of the decision-making Manager, and helps to algorithmize the decision-making processes by placing mental models in the conscious activity of the Manager, and mathematical models in his personal gadget for environmental reconstruction. For a simple case of ecological reconstruction, oral calculations are sufficient, or you can use a verbal (mental) model, in a more complex case, you will need a sheet of paper to analyze the problem, and in an even more complex case, you will need a computer for modeling, and finally, you can use a special optimization computer program. Any modeling is aimed at making adequate management decisions. Modeling using computer tools, including mobile gadgets (iPhones, smartphones, tablets, etc.) becomes a common stage in decision-making in all areas of activity, in managing any process and achieving the desired result. Therefore, the development of modeling methods and techniques, the principles of building mental and mathematical models, and the choice of means for their implementation, using modern software products, is of paramount importance today for supporting decision-making by a Manager, engineer, designer, designer, Manager, business analyst, etc. The problem of the innovation process in energy construction cannot be solved without using mathematical tools. The human brain is not able to predict all possible consequences of innovation in a timely manner, so forecasting and modeling the future and consequences of the innovation process requires simulation based on mathematical and mental modeling for its solution. Examples of models of ecological reconstruction of the environment of construction objects are given.

1. Introduction
Currently, the solution to the problem of optimizing the production process in various industries is determined by the use of logistics methods and logistics systems created on its basis. Environmental problems actualize a set of tasks for the development of methodological foundations for project management of environmental reconstruction of construction objects. Managing projects for the reconstruction of construction sites, taking into account environmental requirements, as a systematizing basis for optimizing decisions, is of crucial importance. In construction, a methodology for mathematical modeling of organizational production management structures and technological processes for construction of technically complex and unique construction objects has not yet been formed, which should be based on the logistics principles of organization and nature-like criteria for managing environmental reconstruction of the environment, as well as information supported by automated collection and processing of environmental data.
Modeling is the process of replacing an object under study with another object in order to obtain information about the properties of the original using a model, i.e. modeling is the representation of an object by a model to obtain information about this object by conducting experiments with its model. When modeling, it is necessary to strive to ensure that the model displays the investigated side of the object's functioning well enough. The requirement of adequacy is in conflict with the requirement of simplicity, and this must be remembered when checking the mathematical model of an object for adequacy. One of the main features of the classification of modeling types is the degree of completeness of the model [1, 2]. According to the degree of completeness of the model, they can be divided into complete, incomplete, and approximate. An example of the classification of modeling types is shown in the diagram Fig. 1.

![Diagram of Modeling Types]

**Figure 1.** Classification of types of modeling

### 2. Materials and Methods

The initial version of the mathematical model of the object is initially checked for the following questions:

- Are all parameters included in the model?
- Are there non-essential parameters in the model?
• Are the functional relationships between parameters correctly reflected?
• It is determined the constraints on the parameter values?

It is recommended to involve third-party experts for verification. Developers cannot objectively consider their mathematical model of an object and notice its weaknesses. A preliminary check of the mathematical model of the object allows you to identify blunders and errors. Then they start implementing the model and conducting research. The obtained simulation results are compared with the known properties of the studied modeling object. The following schemes are used to determine whether the created mathematical model of an object corresponds to the original one:
• comparison of the results of mathematical modeling of the object with experimental results for the object obtained for the same conditions;
• using close mathematical models of similar objects tested for reliability;

Areas of application of mathematical models and methods in the innovative field of energy construction and environmental safety of construction of thermal and nuclear power facilities are shown in Fig.2.

Figure 2. Areas of application of mathematical models and methods in the innovative field of energy construction and environmental safety

The Manager can make management decisions without using computer gadgets without a guarantee of optimality (correctness, security, stability). A computer can't make any management decisions if it doesn't have artificial intelligence rights. As a rule, a computer or gadget with artificial intelligence prepares information for decision-making by the Manager. When formulating the task of
environmental safety in construction, it is necessary to establish the defined variables of the construction project that limit the resources of the environment, and to optimize the assessment of solution options.

To find the optimal solution options it is necessary to develop an optimization model having passed five stages:

1. Formulation of a research problem, or a problem of environmental safety of construction.
2. Development of a mathematical model of the investigated organizational structure (process system), or development of a mathematical model of the studied system "building object – environment".
3. Search for acceptable solutions and find the optimal solution, or solutions to the environmental safety of construction using this model.
4. Verification of the reliability of the model and solution, or the model and solution of environmental safety of construction.
5. Clarification of the decision in practice, or Clarification of the decision of environmental safety of construction.

For Fig 3 the algorithm for making informed decisions is presented.

When setting a task, the modeling object is examined, the modeling goal is set, restrictions are set, and forms of incoming and outgoing information are developed. When developing the model, the estimated number of acceptable solutions is determined after formalizing the goal of solving the optimization problem, which is associated with constraints and variables.

As an algorithm, a ready-made software product is selected, or its own program for solving the problem is developed on a computer, and the resulting solution is compared with real reality in order to establish the fact of solving a real problem, taking into account all the formalized restrictions and variables in the model.

**Figure 3.** Scheme for making informed decisions

To build a mathematical model that reliably corresponds to a real object, you must follow one rule that consists of three parts:
1. Select and differentiate the main properties (characteristics, parameters, indicators) from the secondary ones.
2. Consider only the main properties in the model.
3. Ignore secondary properties in the model.

Four rules are followed for solving optimization problems:
1. Tasks are set and solved in numbers.
2. The choice problem is considered as extreme.
3. The structure or system is evaluated by a specific criterion.
4. The best option is chosen in conditions of limited resources.

Combinations of different elements of the mathematical model lead to the existence of different classes of optimization problems, each of which requires its own method of solution, and therefore, different software tools for modeling are required in each case. Classification of mathematical models by elements is shown in Fig. 4

Figure 4. Classification of mathematical models by elements

The classification of mathematical optimization methods is shown in Fig.5.

Tasks are most often associated with finding the conditional extremum of the goal function with known restrictions on its variables.

In conditions of uncertainty, problems arise if there is no preliminary probabilistic assessment of possible solutions. In similar tasks a special approach is used to describe the evaluation of the preference of the selected strategies for selecting the optimal option.

Mental modeling puts quality of life first. It is a tool for achieving results, for achieving goals in your personal life, studies, career, and at work [10, 11, 12]. The methodology of mental modeling will give you much more than just a modern, convenient and comprehensive daily calendar, or a Microsoft Outlook program on Your computer [3, 4, 5, 6, 7, 8, 9]. The mental model of personal information will give you inspiration and methodological help in order to: achieve results, highlight the main thing, assess the situation as a whole and feel that You manage Your life, Affairs, leisure and inspiration, avoid fatigue and stress, get the most out of the use of personal time, increase the level of communication, increase creativity, create a basis for the distribution of labor, create a balance in life, create a more flexible and calm attitude to changes in life. Mental modeling is a method of writing a script for your upcoming life, and the Microsoft Outlook program on Your personal computer is a virtual means of displaying it for working out options [3, 4, 5, 6, 7, 8, 9]. Mental modeling is the key to your own effectiveness-a tool for discovering and supporting your abilities: 1) the ability to achieve results; 2) the ability to create an overall assessment of the situation and the structure of the environment.
3. Research results

The mental model for achieving results consists of 4 stages: 1) determining your main goals; 2) determining the degree of importance of goals; 3) creating an information base for tasks in relation to personal resources; 4) creating links between the information base for tasks and Your free time planning [3, 4, 5, 6, 7, 8, 9]. You will significantly increase the likelihood of achieving your goals if you define them, write them in your mobile gadget, select individual goals and set deadlines.
Your iPhone, smartphone, or other personal gadget, configured and formatted according to the methodology of mental modeling of personal information, should be used in all areas of Your life: including at home, for example, for a list of products that you need to buy in a local Department store. An iPhone, smartphone, or other modern gadget can be used in the same way, both in production situations and in personal life. It can be successfully used by all, regardless of the position and type of activity.

**Figure 6.** The structure of the processes of mental model (and processes; b) structure.
The essence of the concept of mental modeling of the structure of personal information is to use information tools to direct the subconscious mind of a person to solve problems and achieve their life goals and / or goals of the organizational structure or system in which they exist.

Mental models and tools can be very different: from primitive notches in the tree, to the most complex information structures and technologies. The results achieved by a person depend mainly on their creative abilities, however, this does not mean that everyone can use the potential of their subconscious without the help of mental modeling of personal information. On the basis of the proposed methodology, which also uses existing logistics approaches, positive synergistic effects are obtained. The methodology of mental modeling gives every person a chance to realize themselves in life as they should [3, 4, 5, 6, 7, 8, 9]. For rice.6-a mental model is presented in the form of a cyclic process of alternating procedures: 1-Determining the main goals; 2-Determining the priority of goals; 3-Creating an information base for tasks; 4 - creating a link between the database for tasks and the calendar. For rice.6-b presents the structure of the sections of the mental model: "Telephone index", "Remember!", "Key areas", "Calendar", "Information", "Ideas", "Miscellaneous".

The mental model allows you to create a balance between what is possible and what inspires the Manager. A prerequisite for achieving Your goals is to use Your time to do things that lead to meaningful goals. It's about turning longer-term goals, intentions into action [3, 4, 5, 6, 7, 8, 9].

Each planning period should be considered separately. Therefore, you should have a separate plan for each period: a daily plan for the day, a weekly plan for the week, and so on.7 shows a scheme for combining the results of task planning from the key areas with time planning from the database of planning periods in the calendar.

![Figure 7. Information model for achieving results.](image)

The Calendar section should consist of 2 sections "A" and " B":
A. Current plans (main tab)
The main section Current plans is designed to keep under control all arrangements, meetings, trips, tasks and other things that are planned in the current order, but are not performed according to the usual rhythm of life [3, 4, 5, 6, 7, 8, 9].

B. Periodic graphs (secondary tab)
The Periodic charts section is an auxiliary section to the Current plans-like the "Remember!", which is auxiliary to Key areas [3, 4, 5, 6, 7, 8, 9].
Tasks entered in the periodic schedule are performed at the same time each day, week, month, or year. You can develop two schemes for persistent tasks: a weekly scheme and a yearly scheme. Both schemes can be used both in your personal life and at work. An example of a typical model of a permanent schedule for a week is shown in Fig.8.

![Figure 8](image)

**Figure 8.** A typical model of a permanent periodic schedule for a week

4. Conclusion and discussion
The planning period can take from a few minutes or less to several years or more. As a rule, this is a day, week, month, year, etc., and perhaps it will be weekends, quarters, as well as periods that cover
certain events, such as travel time, vacation, time to build a house or cottage, waiting time, time spent on a particular project or event.

Logistic principles of coordination and criteria for managing material and information flows of environmental reconstruction of the life environment, methods of functional modeling and models of the reconstruction process are proposed. The structure of information logistics systems, the Delphi development environment, syntactic debugging, semantic debugging, and testing of programs with an example of calculation are proposed.

The XX century was the century of formation of the theory of optimization management decisions that can be used in mathematical modeling of organizational production management structures and in environmental management of systems of technological processes of construction of technically complex and unique objects.

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