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## CONCEPTUAL AND METHODOLOGICAL ASPECTS OF MANAGEMENT OF THE DEVELOPMENT PROCESS OF THE ARMS SYSTEM OF THE STATE'S ARMED FORCES WITH DYNAMIC CHANGES IN EXTERNAL AND INTERNAL FACTORS IN CONDITIONS OF UNCERTAINTY OF THE SITUATION AND THE MANIFESTATION OF RISK FACTORS

*The article considers the basic provisions of managing the development of the state's armed forces' armament system in modern conditions at the conceptual and methodological level. It is proposed to use a management technology that combines methods of program-targeted planning of the development of weapons and military equipment (WME) and methods of situational analysis in the process of implementing programs for this development in the presence of factors of uncertainty and the manifestation of risk signs.*

**Keywords:** *problem situation, uncertainty and risk factors, situational analysis, situational task, resource reserve, automated control technology, control system.*

### INTRODUCTION

The potential capabilities of the armed forces of a state to perform their tasks are largely determined by the level of their technical equipment, which is embodied in the weapons system as the material and technical basis for the

combat power of the armed forces and support of troops (forces) in a combat-ready and combat-capable state.

As it is known [1], the armament system of the armed forces can be considered as a reasonably organized, subordinate to their tasks and structure set of mutually agreed and complementary in terms of functions and combat (functional) capabilities of samples (complexes, systems) of weapons and military equipment of various types and purposes (combat vehicles, combat control equipment, combat and logistical support) designed to provide technical support for the effective conduct of operations (combat actions) by armed forces (groups of troops, forces) under a unified command and operational control in wartime and to perform their tasks in the context of daily activities, peacekeeping and other operations.

Thus, the armament system of the armed forces can be considered as a unified complex dynamic organizational and technical system of defense purpose, which is focused on ensuring the effective performance of tasks by the armed forces, and which is the object of management in the process of its development.

Substantiation of the concept of development of the state armed forces weapons system in the program period and in a somewhat longer perspective, operational and strategic, tactical and system technical requirements for it and its structural components, as well as shaping and determining its parameters are key tasks that are solved in the period before the program-targeted planning of the development of WME, preparation of the draft of the relevant state target program aimed at ensuring the fulfillment of the tasks of comprehensive technical equipment armed forces.

Solving the problem of acquiring defense products to re-equip the armed forces with new and advanced models of weapons and military equipment is currently one of the priority areas of activity in the military-technical sector of the defense sector [2].

This necessitates the urgent implementation of balanced, more effective and purposeful activities and works supported by the organizational structures of state and military administration in the program-targeted planning of the development and acquisition of WME for the comprehensive and sustainable equipping of the armed forces in the program period and in a somewhat longer perspective when signs of uncertainty in the internal and external situation and risk factors appear.

The object of consideration and management in this case should be the process of sustainable formation, placement and execution of orders, procurement and supply of combat and support equipment necessary for state defense needs. The key principle of building such a system of activities should be the principle of integration (unity), which implies the use of the feature of balanced integration of activities and works in managing the development of complex technical systems for military purposes. Such a requirement can be effective in the conditions of stable manifestation of geopolitical, military-strategic, scientific, technical, economic and other forecast factors of the expected external situation over time.

The classical methodology of program-targeted planning (PTP) is quite effective in conditions of predictability and

stability of the internal and external situation, when long-term forecasts are possible, containing the necessary initial data for quantitative research in the presence of reliable operational and strategic scenarios with the necessary levels of solving the main tasks of implementing programs and plans for the development of weapons and military equipment.

In today's conditions, this requirement turns out to be very difficult to fulfill or even, in some situations, practically impossible. The main reason for this is the instability and volatility of geopolitical, military, economic, social and other conditions, the expansion of the range of uncertainty and risk factors, the growing dynamics of change and the nonlinear nature of the processes taking place. As a result, there is incompleteness, inaccuracy, fragmentation and contradictions in the technical and economic input data used in planning.

As a result, these circumstances lead to relatively low reliability of forecasts of the conditions for the implementation of programs for the development of the WME and to decrease in the sustainability of the planning documents being formed, even in the short term.

Thus, it can be argued that there is a contradiction in practice between the depth of reliable forecasts of macro indicators of programs for the development of WME and the conditions for their implementation, which are set by the planning time interval in accordance with the requirements of the legislation governing the process of classical planning and management of WME development.

This was the objective reason for finding new ways to solve it and improve the efficiency of managing the development of WME in general. At the same time, WME development management remains an integral part of capacity development programming [3] and it is considered expedient to preserve all the main methodological components and principles of the program-targeted approach to solving WME development problems (planning from needs to tasks, end-to-end planning for the entire life cycle

of WME samples, planning from tasks to resources, the criterion «effect – resource costs», program slippage in time, etc. [2], supplementing them with software and tools within the WME development management system, adequate to the new conditions of activity in the military-technical sector of the defense industry.

The question arises as to what these tools should be in order to obtain the desired positive effect from their application. However, the principles of the PPP contribute to the purposefulness, reality, expediency and adaptability of plans to the fullest extent only in conditions of internal and external stability of the situation, but do not provide a sufficiently tangible positive effect in the real and rapidly changing conditions of today, although their use in managing the development of WME should not be completely rejected.

**The purpose of the article** is to substantiate the need (expediency) of introducing a situational approach to the process of managing the implementation of WME development programs in the presence of uncertainty and risk factors and to determine its role and place in preventing the development and solving emerging problem situations.

## RESEARCH RESULTS

Planning for the development of weapons and military equipment is a system of measures, works and targeted actions to develop programs and plans for achieving certain capabilities [3], focused on the coordinated development of the weapons system in terms of goals, resources, time and technical direction and ensuring the required level of comprehensive technical equipment of the armed forces in accordance with their tasks.

The main stages of strategic planning for the development of weapons and military equipment are shown in Fig. 1.

The WME development management system, like any management system, includes a managed subsystem (management object) and a control subsystem (management object, management subject) (Fig. 2) [4].

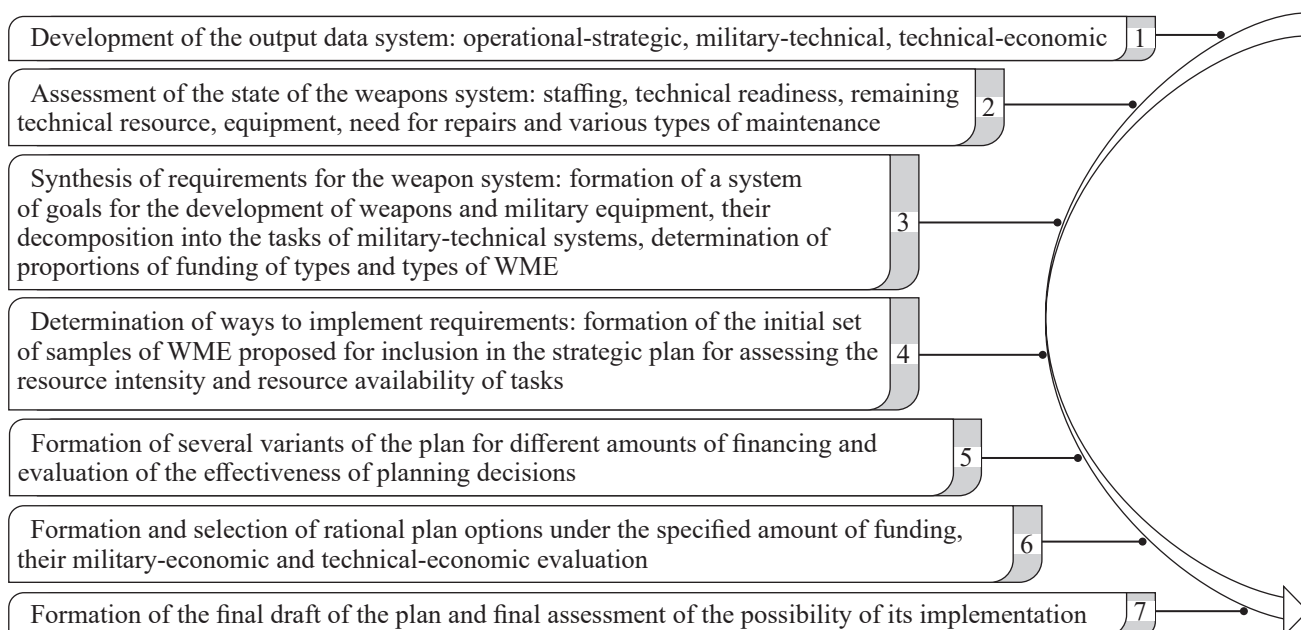


Fig. 1. Stages of strategic planning of WME development

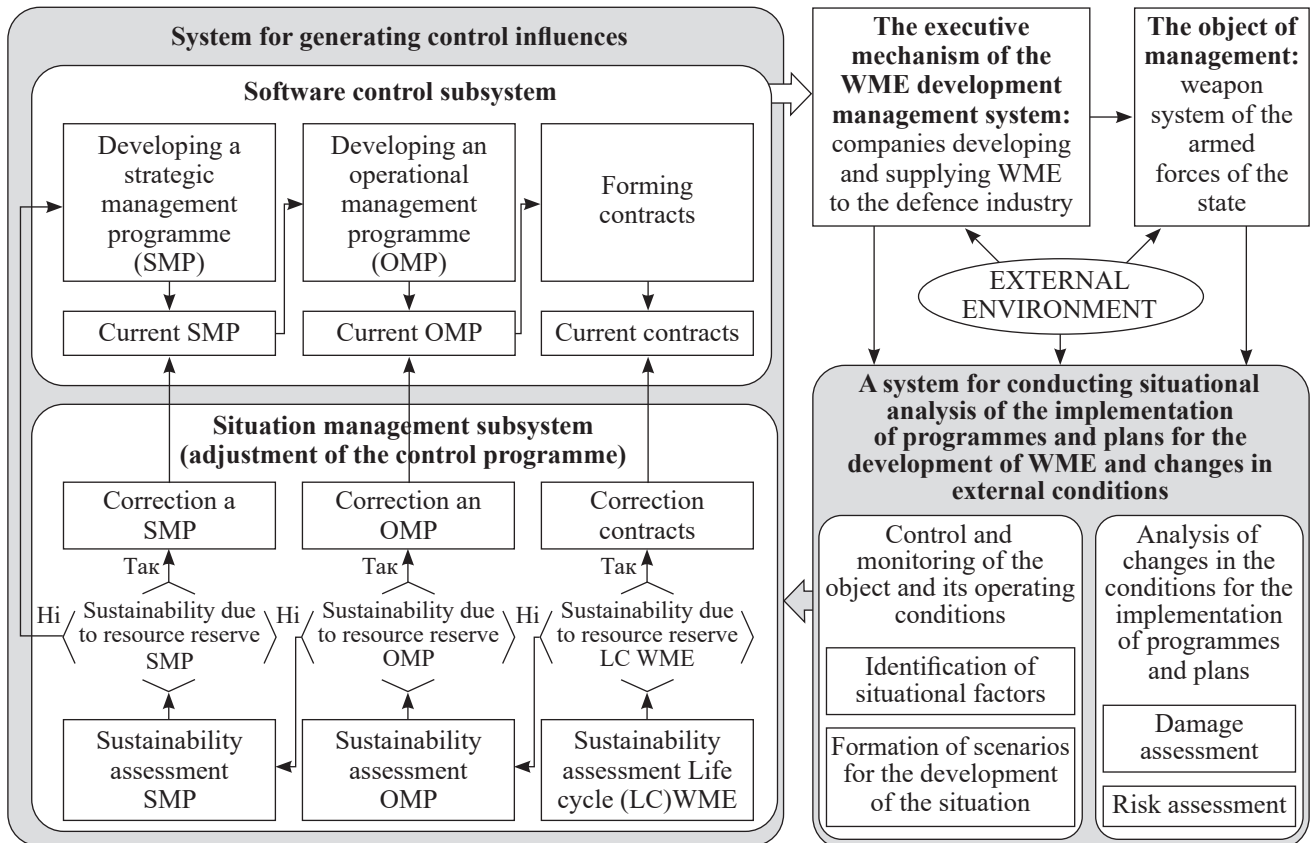


Fig. 2. Scheme of program and situational management of WME development

The above-mentioned contradiction in the practice of managing the development of WME can be achieved by supplementing the existing methods of solving management problems based on situational analysis to ensure timely resolution of problem situations in the process of implementing programs for the development of WME and supplementing program management with situational elements that provide information, organizational and technological capabilities to solve a set of emerging problem situations [5]. At the same time, the main methodological components and principles of the program-targeted approach to solving the problems of WME development should be preserved.

When substantiating and formulating WME development plans, various types of risks that may arise in the process of their implementation should be investigated and, accordingly, the development of planning documents should be based on the mandatory consideration of uncertainty and risk factors.

At the same time, in order to effectively manage the development of weapons and military equipment in modern conditions, it is necessary to carry out:

- continuous control and monitoring of changes in the level of a particular type of risk;
- analysis and synthesis of different scenarios of a particular situation and assessment of its impact on the state of all objects involved in the process of WME development;
- assessment of potential alternative opportunities to prevent negative changes in the situation;
- formulating a real-time solution to the problem situation that will minimize possible damage.

The qualitative solution of these tasks clearly requires the use of scientifically based methods and models of situational analysis and the application of advanced information technologies for data processing.

Based on the above provisions, we can conclude that there is a contradiction between practice and theory, which is the objective need for situational analysis in the process of implementing programs for the development of weapons and military equipment and the lack of appropriate methodological and technological support.

The contradictions in practice and between practice and theory indicate the relevance and necessity of solving the scientific problem, which is to develop methods for conducting situational analysis and solving problem situations for the purpose of reasoned solution of situational tasks in the process of implementing programs for the development of weapons and military equipment. Within the framework of this problem, the object of research is the technology of managing the process of WME development – a set of scientifically based methods and techniques for processing management information in order to make and implement management decisions, ordered by the time of execution.

The subject of the study is the methods of analysis, forecasting and solving problem situations in the process of implementing programs for the development of weapons and military equipment.

At the same time, the purpose of the research may be to increase the validity and efficiency of decision-making on solving problem situations in solving situational tasks in the process of implementing programs for the development

of weapons and military equipment based on situational analysis.

As a means of achieving this goal, the concept of situational analysis can be proposed and used for this purpose, which consists in:

- continuous control and monitoring of the dynamics of changes in the current situation, disclosure of patterns and trends in its development;
- timely identification of risk factors that cause problematic situations and a combination of events that increase the risk of their realization and development;
- synthesizing and analyzing alternative scenarios of the situation development (including problematic situations that have already occurred) as a result of the risk factors implementation;
- assessing the potential danger of a problematic situation for each risk factor and their various combinations, as well as possible damage as a result of its occurrence and development;
- identification of preventive management decisions under various scenarios of changes in the situation to prevent its occurrence and negative development (loss prevention);
- formulating management decisions to address an existing problem situation (minimizing damage).

In the development management system, it is necessary to implement a comprehensive information technology – a

regulated information process that determines the procedure for information circulation, its transformation, analysis and decision-making. When substantiating proposals for the annual plan for procurement of goods, works and services for defense purposes, it is necessary to form a set of plan options that best meet the intention of achieving medium-term and long-term goals and that provide different values of aggregate indicators for different projected amounts of allocations.

A rational version of the annual procurement plan for defense goods, works and services (Fig. 3) should be developed based on the results of the forecast and analysis of the consequences of its implementation and the nature of its impact on the state of the armed forces' weapons system and the defense industry.

In the process of implementing the developed planning documents, deviations from the planned results inevitably occur due to unforeseen influences. Therefore, when these deviations occur, it is necessary to make prompt decisions on their elimination (reduction). The main goal of operational management of the implementation of programs for the development of WME should include ensuring the achievement of the goals of WME development, defined in the strategic planning and specified in the process of implementing the strategic plan through the formation of defense procurement plans.

Crisis phenomena are usually the cause of a problem situation in the process of operational management, i.e. a

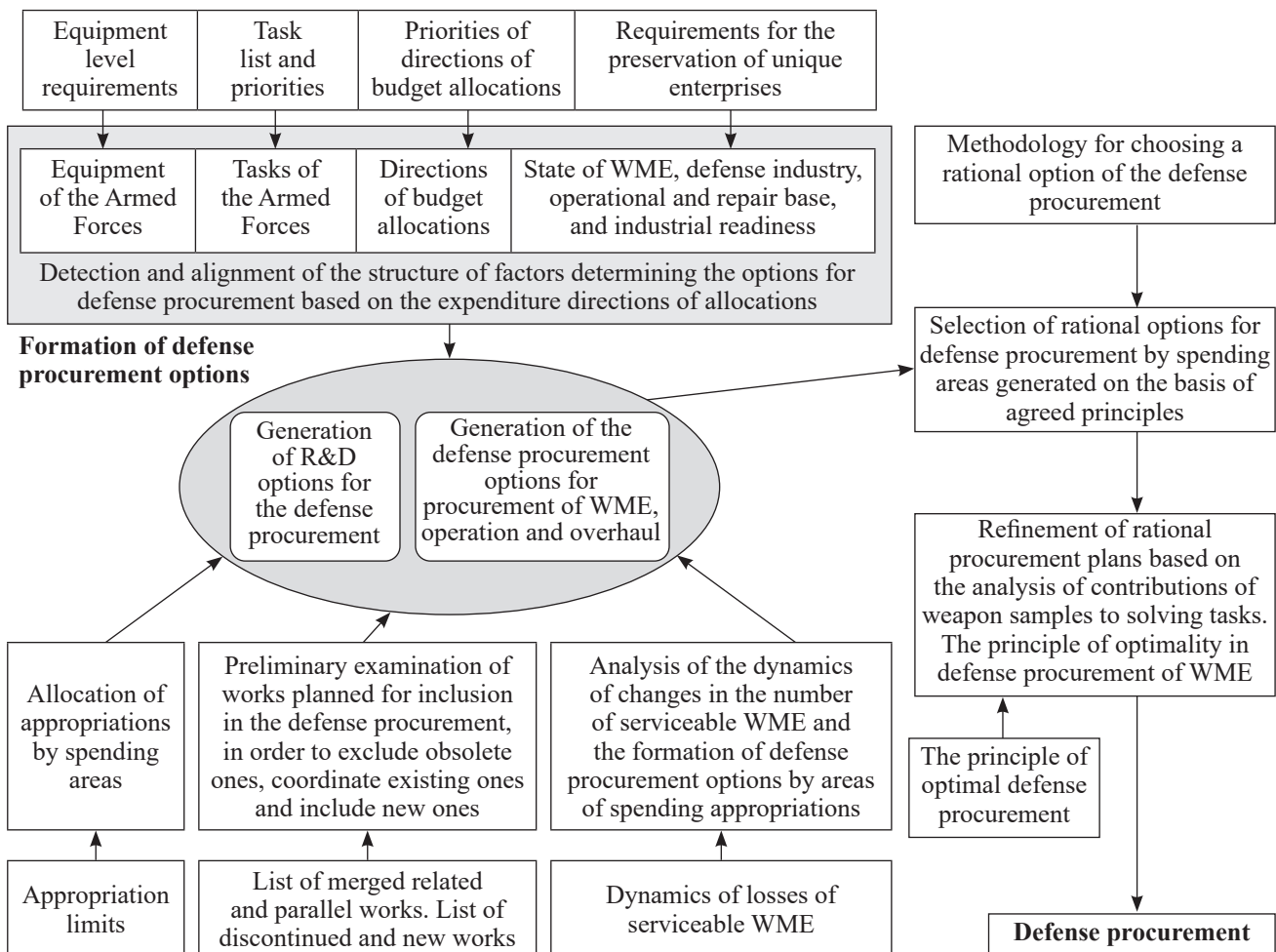


Fig. 3. Formation of a rational option for defense procurement of weapons and military equipment

situation in the state of the object of management in which there is a discrepancy between the required and realized values of target indicators. Tasks that have to be performed to resolve a problem situation are situational tasks.

The introduction of elements of situational management can allow to move from the technology of program management of WME development to the combined technology of program and situational management, which most adequately meets modern conditions, since it provides a prompt response of the management system and its timely adaptation to changing conditions in the implementation of programs for the development of WME [5].

A problem situation that has arisen or is predicted in the process of implementing programs for the development of WME can be considered resolved only if the formulation and implementation of management decisions that eliminate the state of the object of management associated with the problem situation is carried out.

Situational analysis, which is carried out in the process of managing the development of weapons and military equipment, can be presented in the form of performing the necessary set of actions to scenario model the development of the situation, assessing the possibility and potential danger of a problem situation due to the implementation of risk factors and the level of expected damage, determining the available and required resource reserves and making management decisions on their basis to resolve the problem situation to prevent possible damage or minimize the level of damage already caused.

A scenario, as a means of describing the development of a situation, should reflect the processes of events and the relationship between them depending on time.

The most adequate apparatus for realization of forecasting the development of the situation can be attributed to the appropriate modeling on a computer. To this end, it is necessary to develop a mathematical model of the process, which should be based on the structure of a real functioning system of management of the development of weapons and military equipment. After linking the model to a real process, it can be used for the purposes of forecasting and simulating management, making decisions on solving a problem situation in the process of managing the development of WME.

This model should include such separate models as the model of the management object and models of all objects that define the problem situation. It should be aimed at solving research situational tasks and be adequate to them.

In general, it can be concluded that at present there is a significant difference in the achieved and required results in the field of WME development management. To eliminate it, it is necessary to conduct intensive research, both in practical and theoretical terms, taking into account the dynamic nature of operations (combat operations) [6].

Solving this scientific problem should be implemented taking into account the role and place of the situational approach in the overall technology of managing the development of WME. To do this, it is advisable to be guided, based on the peculiarities of the current conditions for the implementation of programs for the development of WME, by the following basic principles of the situational approach in operational management:

- scenario approach – development of a scenario for forecasting the development of the situation, determining the patterns and trends of its development;
- dynamism of the control cycle – correction of the control program in accordance with the forecast of a problem situation;
- redundancy – compensation of impacts based on the prompt formation of a reserve of resources at the expense of internal resources of the life cycle of a sample of weapons and military equipment;
- preventive – the use of pre-prepared options for solving a problem situation;
- efficiency – solving a problem situation before or in the process of its occurrence and development on the basis of automation of solving situational tasks.

When determining the role and place of the situational approach in the overall management technology, the process of managing the development of WME can be presented as a set of interdependent coordinated actions (events and works) aimed at achieving a well-defined goal: timely equipping the armed forces with the necessary WME models and ensuring the improvement of their tactical and technical characteristics, provided that the funds allocated by the state for defense needs are spent efficiently.

Conducting a situational analysis should include a set of steps shown in Fig. 4.

This sequence of stages of situational analysis and their main content allows us to build an appropriate information and logical scheme for conducting situational analysis in the process of implementing programs for the development of WME (Fig. 5).

This scheme is structured in 4 blocks:

- formation of scenarios and forecasting the development of the situation;
- assessment and recognition of the problem situation;
- selection of a strategy for solving a problem situation;
- formulation of a management scenario to resolve the problem situation.

For the qualitative solution of situational tasks, the methodological support should include the following methods: determination of situational factors characterizing the dynamics of the situation and risk factors; assessment of the degree of risk of a problem situation and the amount of possible damage; formation of specific solutions to prevent or resolve a problem situation based on the synthesis of the relevant management scenario.

The methods for solving problem situations in the process of implementing programs for the development of WME should also include methods for determining the required amount of resource reserve to compensate for uncertainty factors, assessing the internal resource reserves of the plan, determining the required amount of additional funds to eliminate temporary and quantitative and qualitative deviations and rational redistribution of funds between the plan's activities based on the internal resource reserve.

Resources include the supporting components of the activity, including performers, energy, power, materials, equipment, etc.

The reserve of resources is the stock of resources, which is defined as the difference between the required and

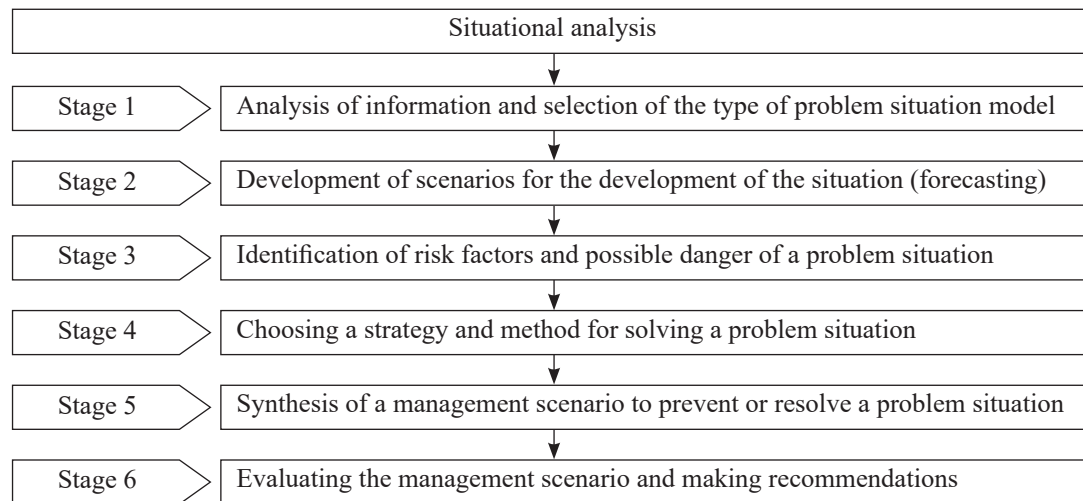


Fig. 4. Stages of situational analysis and their content

actual volume of activity components in the process of managing the development of WME. Taking into account the hierarchical structure of the WME development management system, the following hierarchy of resource reserves can be proposed by management levels:

- level of state administration – reserve of the current state budget;
- the level of the Ministry of Defense – a reserve by the level of solving strategic tasks, by the items of financing the development of the armed forces and their weapons system in the planning period, etc.;
- the level of general customers – reserve by tasks (operational, tactical, tactical), by programs (program sections in the part related to this customer), by types of WME, by complex-targeted programs, by cooperation.

Resource reserves can be defined as key factors for ensuring the sustainability of WME development management (plan sustainability).

Management of resource reserves consists in the implementation of a set of measures to determine the required volume, timely replenishment and use at the right time of the implementation of programs for the development of WME. The analysis of significantly changed conditions and the difficult predictability of their dynamics indicate the need to put forward new, more stringent requirements for the system of automated management of the development of weapons and military equipment. To implement them, appropriate software and tools for situational analysis and modeling are needed (Fig. 6).

The main task that arises during the development of software tools is the need to unite and combine in a single system such disparate elements as non-formalized human activity, mathematical models and formalized algorithms.

As requirements for the organization of modeling for decision-making on solving problem situations, the following can be considered:

- organization of iterative procedures with the possibility of step-by-step adjustment of initial data and decisions;
- use of information in convenient formats and volumes at each iteration;
- the possibility of making a clear, meaningful interpretation of each cycle of iterations and its result;

- the possibility of choosing a different degree of automation of operations in each iteration;
- convergence of the iterative procedure to the best solution for an acceptable number of iterations;
- natural calculation rhythm (response time, including input and output of data) when solving tasks;
- obtaining a decision in the required time, taking into account the real organization of the structure, the real capabilities of technical means for obtaining and processing information.

The general requirements that determine the viability of software and instrumental means of situational analysis are to ensure the ability to:

- obtaining rational solutions to prevent or resolve problematic situations while reducing labor and time costs;
- development, operational modernization and adaptation in the process of operation (expansion of the list of tasks, data, improvement and replacement of algorithms for calculating the values of indicators of the state of typical objects with more perfect ones, etc.).

In order to meet the listed requirements, software tools for situational analysis and modeling should serve as the basis of automated technology that implements a regulated iterative process of processing input information into output management decisions to solve a problem situation. When building this technology, it is advisable to use a package approach – forming a set of modules that cover the subject area of situational analysis and modeling in the process of managing the implementation of programs for the development of WME. The step-by-step iterative nature of the task-solving procedure for solving the problem situation is determined by the need for consistent adjustment of goals, means and methods of influence in solving the problem situation.

When choosing solutions, it is necessary to focus on their validity, compliance of the solution with the set goal, completeness of consideration of limitations. When developing software tools, it is necessary to be guided by such principles as purposefulness, reasonableness, iterability, content of information, control, etc. The basic stage of development of software tools should be the stage

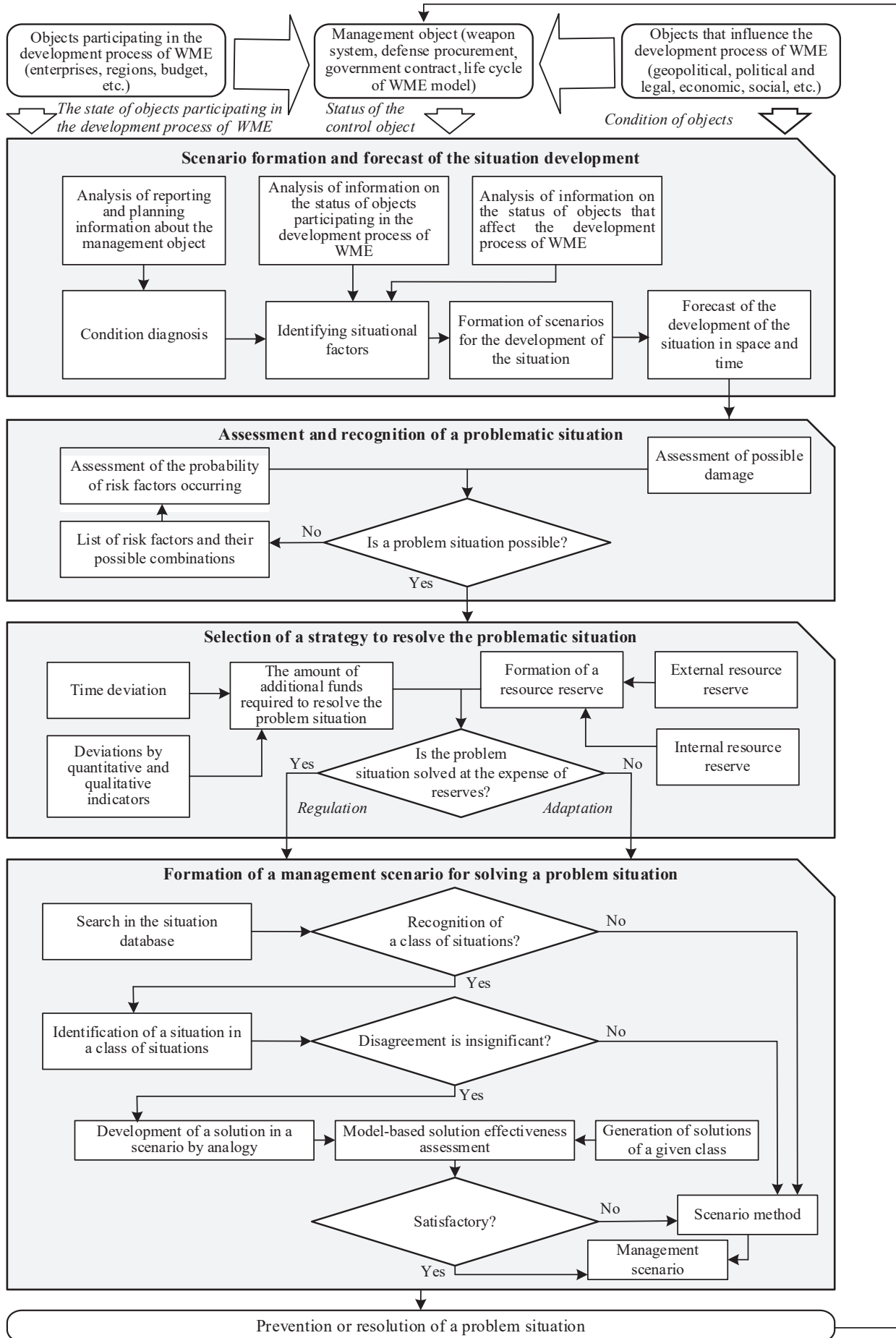


Fig. 5. Information and logic diagram of the situational analysis

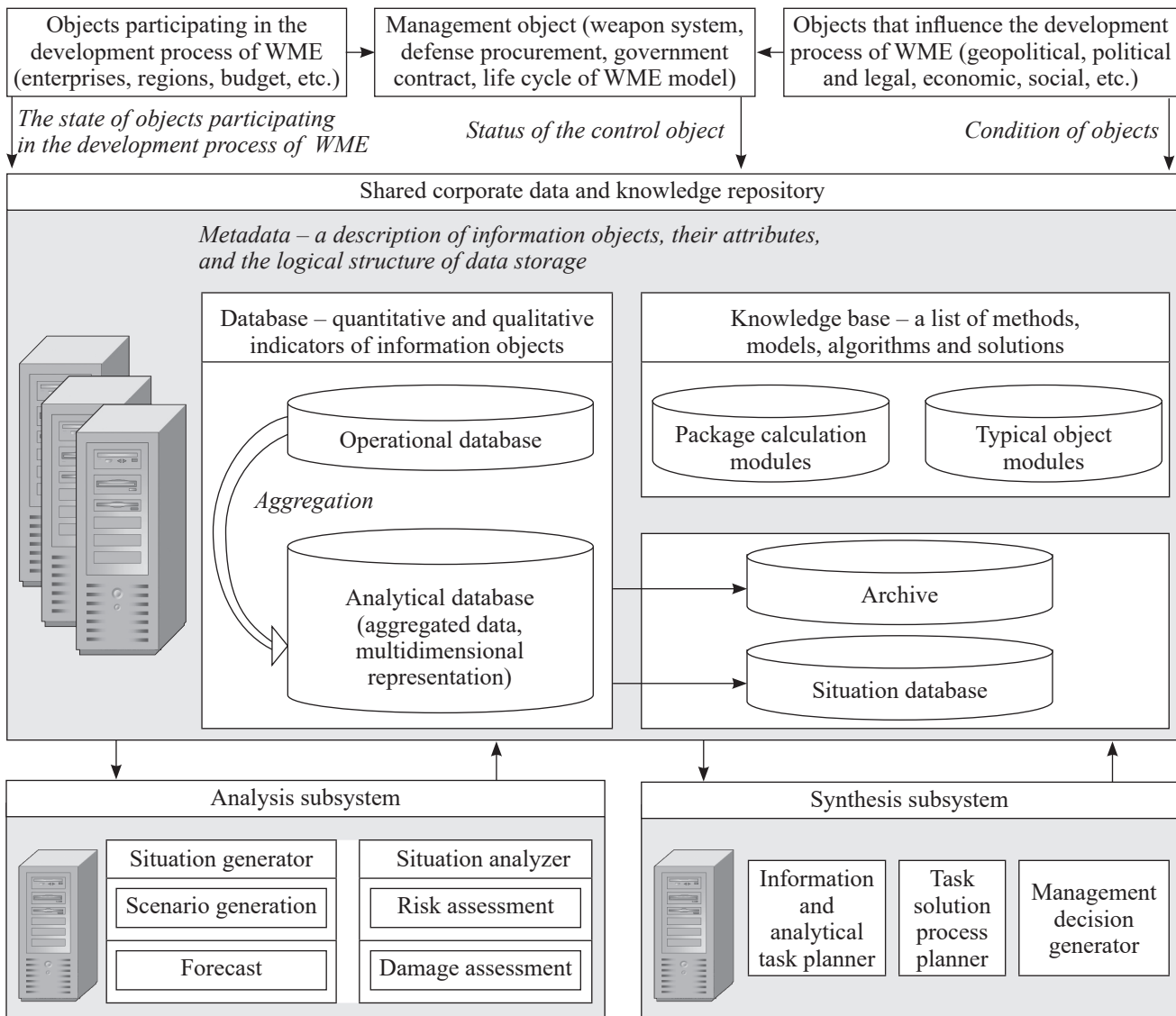


Fig. 6. Structural diagram of software and tools for situational analysis and modeling

of building models of typical objects that participate in the process of development of WME and influence this process and their implementation based on the use of software tools of situational analysis.

**CONCLUSIONS**

Management of the process of development of weapons and military equipment should be carried out by a management system consisting of a hierarchical structure of management bodies; systems of typical documents of different forecast depth; measures for substantiation, formation, control of implementation and adjustment of planning decisions; methods of scientific substantiation of management functions on the basis of their formation; information and legal space, mathematical and software tools, a program-situational approach to the implementation of programs for the development of weapons and military equipment within the framework of a single process of comprehensive technical equipment of the armed forces based on capabilities, taking into account the manifestation of uncertainty and risk factors, the dynamics of their change.

The methodical provision of situational analysis in the process of managing the development of WME should

include methods that allow: to determine the factors that characterize the dynamics of the development of the situation (situational factors); assess the risk of a problematic situation when they change, recognize problematic, unfavorable and critical situations; to produce specific decisions regarding their solution.

Also, the scientific and methodological apparatus for solving problem situations in the process of implementing programs for the development of WME should include methods for determining the required amount of resource reserves to compensate for uncertainty and risk factors, evaluating the internal reserves of plan resources, determining the required amount of additional means to eliminate deviations that have arisen, rational redistribution of funds between the works of the plan based on the internal reserve of resources.

Software-instrumental means of situational analysis should form the basis of automated technology that implements a regulated process of processing input information into output management decisions for solving problem situations. When implementing this technology, it is necessary to include: a system-wide data and knowledge

repository as part of an operational and analytical information database, a situation database and a knowledge database. As a basic component of software tools, models of typical objects that participate in the development of WME and influence this process should be defined.

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#### КОНЦЕПТУАЛЬНО-МЕТОДИЧНІ АСПЕКТИ УПРАВЛІННЯ ПРОЦЕСОМ РОЗВИТКУ СИСТЕМИ ОЗБРОЄННЯ ЗБРОЙНИХ СИЛ ДЕРЖАВИ ПРИ ДИНАМІЧНІЙ ЗМІНІ ЗОВНІШНІХ І ВНУТРІШНІХ ФАКТОРІВ В УМОВАХ НЕВИЗНАЧЕНОСТІ ОБСТАНОВКИ ТА ПРОЯВУ ФАКТОРІВ РИЗИКУ

*У статті на концептуально-методичному рівні розглядаються основні положення управління розвитком системи озброєння збройних сил держави в сучасних умовах. Пропонується використовувати технологію управління, що поєднує методи програмно-цільового планування розвитку озброєння та військової техніки та методи ситуаційного аналізу у процесі реалізації програм цього розвитку в умовах наявності факторів невизначеності та прояву ознак ризику.*

*Стверджується, що має місце протиріччя в практиці між глибиною достовірного прогнозу макропоказників програм розвитку ОВТ та умов їх реалізації, які директивно задаються часовим інтервалом планування відповідно до вимог законодавства, яке регламентує процес класичного планування та управління розвитком ОВТ.*

*Виділено основні етапи проведення ситуаційного аналізу та розкрито їх зміст. Наведено склад програмно-інструментальних засобів ситуаційного аналізу та моделювання, орієнтованих на вирішення проблемних ситуацій, які виникають у процесі реалізації програм розвитку озброєння та військової техніки (ОВТ). Відображено положення про те, що ці програмно-інструментальні засоби мають складати основу автоматизованої технології переробки інформації, що надходить, в управлінські рішення щодо вирішення проблемних ситуацій.*

*Важливе значення надається формуванню резерву ресурсів для запобігання чи вирішенню проблемних ситуацій. Розглянуто інформаційно-логічну схему проведення ситуаційного аналізу в процесі реалізації програм та планів розвитку ОВТ.*

**Ключові слова:** *проблемна ситуація, фактори невизначеності та ризику, ситуаційний аналіз, ситуаційне завдання, резерв ресурсів, автоматизована технологія управління, система управління.*

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