

APPLICATION OF THE MATHEMATICAL MODELS OF COMBAT ACTIVITIES AND MEANS OF FIRE DESTRUCTIONS FOR TROOPS MILITARY OPERATION

Telman MIKAYILOV*, Azad BAYRAMOV**

*Ministry of defense of the Republic of Azerbaijan

**Armed Forces War College of the Azerbaijan Republic
Baku, Azerbaijan Republic

Abstract: *The article describes the history of mathematical models of combat activities and combat means of destructions, and their development paths of the use of troops in process of preparation of the operational activities. The possibilities of using mathematical models of operations (combat and fire destruction) in process of the preparation and conduct of operational preparations were considered.*

Keywords: *mathematical model, combat activities, destruction by combat means, activity of operational preparations, modeling of management.*

1. INTRODUCTION

One of the main mechanisms for the preparation and implementation of decision-making process and implementation of combat operations and destruction activities, as well as assignments to troops (forces) is applying of the computer information technologies, including geographical and video information technologies, mathematical models, information, information computing and computing complex application of issues. These are the main principles of automation of the troops (forces) and management of guns damage processes. These are gives much more opportunities to the commander of the troops and staffs of the command and control center

of troops to continuously getting an information, analyzing it, evaluating the situation and making decision.

Development of information and computer technology requires a qualitatively new approach to the application of mathematical modeling of combat activities and activities of guns damage in planning processes. The practice of applying mathematical models and information as well as data computing issues in the process of operational preparations determines the needs to clarify specific software requirements. The dynamic development of computing techniques, programming and telecommunication technologies makes a strong leap in he field of creating operational modeling

systems, and gives an opportunity to simulating combat operations in the process of operational preparation of troops and activities of firearms damage by computerized mathematical model [1]. So, the effectiveness of planning and management of combat operations is enhanced by improvement and implementation of mathematical modeling.

The urgency of the issue in this case is determined by the increased intensity of researches and supply of armed forces with information technology carried out in different countries [2]. The analysis shows that it is necessary to use mathematical programming to predict the operations by commander and command and control staff during operational preparation.

2. JUSTIFICATION OF THE APPLICATION OF THE MATHEMATICAL MODELING OF COMBAT ACTIVITIES AND FIREARMS DAMAGE

According with the instructions the main functions of the command and control posts are data collection, assessment, forecasting real condition and planning of operations. It is well known that the planning should be fairly clear, and here, mainly to intend the solution of computational issues. Miscellaneous mathematical prediction methods for assessment of the combat condition, prediction

its changes, comparative methods of rating planned activity of troops and its use are required.

The development of the methods of mathematical modeling of martial arts and firearms damage is the necessity of resolving the constant contradiction between the two contradictory tendencies [3]. This is to increasing the accuracy of the predicted results and to reduce the modeling time. This contradictions is due to the fact that the time of modeling according to the necessity of increasing the number of factors that are modeled for increasing the accuracy of the prediction and the number of factors to be taken into account. There are always research for the way to improve the relevance and efficiency of the problem during the modeling.

During operational preparations, for a more detailed assessment of the impact of contradiction to the nature of application models their division into the next stages can be noted:

- preparation of operational activity;
- carrying out operational activity;
- analysis of the results of operational activity carried out.

Depending on use purpose, it can be headquarters (HQ) and research operational models. As a rule, they are differ according to the used mathematical modeling apparatus, the degree of detailing

and the number of factors that are taken into consideration. Because of the form of description of the mutual contingency process of the parties involved in the conflict, mathematical models are divided into analytic and research [1]. HQ models typically use analytical imitation modeling, research model use random imitation modeling. It is imperative to achieve a reduction in the time of modeling, while maintaining the integrity of the results, in the course of operational precautionary measures, when it is time-consuming for mentally computing. For this reason, the use of headquarters models is more important [4].

HQ models include mathematical models of operations designed to provide practical operation activity of command and control posts. There are two basic requirements:

- the ability to apply a real-time operation in accordance with the operational algorithm in the decision-making process;
- ensuring objectivity and justification of decisions taken to command and control of troops (forces) on the basis of comparison of the results of the alternative variants.

From the latter requirement seems that the headquarters model should have a comparative feature of the different decision options. Necessary conditions for this are the duplication of predictive results with

the startup data in the same database.

Random models can not provide this, except when the middleware results of the some models are handled by same way. This approach in the real is not practically used by headquarters.

From the scientific research experience of mathematical models in many countries, it can be seen that more detailed research models may be used when there is sufficient time to conduct and analyze operational preparations. The practical application of random models is not used because the comparison of the result of the decision its repeatability is very complicated. It is therefore more appropriate to use analytical headquarters models that use legitimate methods of imitation modeling of combat and fire-damage activities during operational preparations [4].

In some cases, the following factors should be clarified in terms of the correct understanding of the matter:

- adoption of the mathematical modeling terminology;
- classification of mathematical models and prediction methods;
- use and realize technology of contemporary mathematical models;
- basic methods and fields of application of mathematical models.

It identifies the mathematical model and computational issues of the automated control system of

troops, mathematical and software applications. The mathematical model of the operation (combat activity and firearms damage) – is a mathematical mindset and mentality system that allows the compiler to calculate the basic elements of the warfare models modeled in time and to calculate the edict value of the predictions and outcomes of the predicted combat phenomena [5].

The computational issue – is the result of mathematical dependences, algorithms and data for operational tactical (operational – strategic) or special calculations, which require the assessment of the conditions that might arise as a result of the intended activities [6]. For computational issues, as a rule, it is sufficient to use the appropriate dependencies without taking immediate time and spatial structure to the process considered. Mathematical models are not created without the imitation structure of the modeled action, with no time and space indices. In this sense, mathematical models are practically always imitated. Thus, simplification may be due to the nature of prediction methods used in calculating issues, headquarters and research models:

- computational issues use an analytical framework that directly describes the impact of the starting point on the outcome of the calculations;

- the headquarters models are generally based on the specific methods of imitation models;

- research models typically use random methods of imitation modeling.

In their function, models are divided into two groups: those are directly (descriptive) and optimistic. The first ones answer the questions “what will happen in this case,” and the second one “for this case what need to do”. The more illustrative models are applied in the military issue. The application of perspective models prevents the complexity of the issues created to find the optimal solution of a large number of factors. Also, it is becoming hard to use the obtained results. Here, the model should be understood as a support link of one the steps of a mechanism for the assessment of quality of taken decisions, but not as a direct order to use of troops.

Models can be used:

- directly composition of the specific program software of automated command and control systems of troops (ACCST);

- composition of Fixed and mobile special designed modeling centers (computerized combat activities and filling firefighting computer centers).

Headquarters mathematical models that provide functionality within ACCST specific software should provide automated information exchange with other systems and data bases of this system. The management interface

of modeling process should allow to effectively use staff models for officers of command and control staff

Different and sophisticated models depending on their functionality, can be used in a specific computer modeling center, not included in the ACCST specific program content. This is due to the following factors:

- more skilled professionals are required to handle complex models;
- complicated models, complexes and systems can form more technical requirements than the opportunity of resources of ACCST.

Computer centers of modeling of combat activity and firearms damage process being stationary and mobile can be equipped with a variety of compact computers. However, in this case, the terms of information compatibility between the computer center and ACCST must be observed.

3. ESTABLISHING HEADQUARTERS MODELS OF COMBAT ACTIVITIES.

In recent years, great experience has been gained in the way to creating research models of Army operations. Gradually, this model has been upgraded and used in integrated and modern information technology to create a variety of military modifications of combat activities of troops and firearms damage operation. Scientists from the leading countries are working on updating the software, taking into account the experience of the latest

armed conflict. These models are actively used in management during operational preparations. It has been discovered that they have been over-sized and have been devoting much time to the initialization of the modeling. In this case, it seems to be necessary to develop more updated mathematical models that can be used directly in the preparation of operational preparations, teamwork and training exercises, as well as in the course of combat operations. Unlike research models, the development of the new models involved the creation of a mathematical apparatus of the model, the organization of data preparation, its incorporation into the system and the modification of the models.

The first deployed military operations headquarters model had many advantages, allowing 15 days of the military operation to be counted for 40 minutes by computer technology. The wide-range experience practice of this model in operational preparations has allowed it to plan further improvements and to identify tasks for creating new versions of the military operation model.

Further, improving the exchange of information among users of the model enabled the officials to directly control the process of modeling, adjust the decision-making process, divide the forces and tools during the operation, and re-group the second echelons and resources.

The model of the army operation is designed to predict the outcome of combat operations, as well as the options for effective use of forces and means of their troops during the preparation and conduct of the operation [1]. The Commander and his staff are able to draw conclusions from the main elements of the decision by analyzing and summarizing the modeling outcomes, the intent of the operation, the content of the tasks assigned to the troops, and the key questions of the interaction. The army Operation Model is widely used in command and staff exercises and exercises, practically used in the headquarters of all troops (military) as well as in military training and research institutions. Then the gained experience is used to create new headquarters model and issues.

Currently, information technology, reflective means, geoinformation systems and information base are developing at high tempo. All of them contribute to the creation and development of the new ACCST [5]. In such circumstances, the research team is instructed to create a model of combat operations and firearms damage activity models in the development of these technologies. Developed mathematical models are used in the ACCST special safeguard software for general operations. It is tendency that defines the characteristics of the

application of combat operations and mathematical models of fire-fighting in operational preparations.

The basic methodological principles of preparation and implementation of operational preparations of many countries are determined and information technologies are applied in the headquarters' activities in a complex form. As a rule, the use of the operation (combat operations and fire-fighting) models and other computational components in these activities is carried out by specially designated officers in the headquarters. This is due to the constant increase in the requirements for the specialization of officials in the governing bodies and the continuous improvement of the modifications of the modules.

Prepare a pre-trainee training program with the use of a generic operation model in operational preparations. During this period, the IT officers have been trained to work with the software makers in their respective headquarters. Such training is repeated every time before the training. In team headquarters games or exercises, the mathematical modeling team is codified in the governing points [5]. Also, the trained administrators are assigned specifically assigned specialists for methodological support for operational-tactical calculations and mathematical modeling.

In the course of operational preparations, the use of mathematical models and information-calculation issues is based on the indicators of combat capability, the strength and the means of fighting, the intent and the modeling of the decision in the headquarters games or events [6]. Calculation and modeling results of combat activities are submitted to the headquarters for analysis of the training. Considering the development of information technology and the provision of technical means, the computing-modeling complex that functions in a single database and navigation system can be in the next form.

The means of planning and decision-making are:

- mathematical model of air operations;
- calculation and modeling complex to ensure overall planning of firearms in the operation;
- mathematical model of the general operation;
- the calculation of the strengths and resources of the parties, operational and tactical intensity;
- complex of information-calculation issues on calculation of the time of preparation of the operation.

Reorganization planning tools:

- complex of information and computing issues to ensure strategic and operational resettlement of troops (forces);

- calculation of anchor (junction) anchor;
- a set of information computing issues to ensure the planning of transportation of troops (vehicles) by different means of transport.

Information support means:

- a specialized database and its means of communication;
- system of mapping and handling of the electron map of the area.

Just the practice of applying mathematical models and information-computing issues will allow them to form realistic requirements after training, make necessary corrections, and use them in the next operational preparations.

The development of mathematical models of combat activities and fire-fired illnesses will allow the use of the next technologies consistently through their application in operational preparation requirements:

- modeling of combat activities and fire damage in a rectangular coordinate system on a topographic map background;
- automatic mapping of the characteristics of the area in map mappings with geoinformational systems;
- choosing a more efficient version of simultaneous operation with several modeling options and application of their own troops;
- integration of model database with different databases;

- information support within the computational-modeling complex of various models;

- forming a modeling model for the start-up of the data acquired from the previous stage for internal control by the operator;

- application of the model of co-ordination of the parties involved and the distribution of databases.

The mathematical models of operations have become a mechanism that allows the selection of a scientifically justified effective version of the application, in accordance with the operating conditions and the assigned task, forces and means in limited time.

The results of the modeling meet the criteria for selective evaluation of combat activities and the effectiveness of firearms. In this case, the considered option is the basis of the intent of the upcoming operation, and its separate elements can be considered as the basis of the contents of the tasks for the troops. With the development of the GIS, various software tools have been deployed to workplace headquarters. Collection of condition information, implementation of video conferencing, etc. at the same time with questions, constitutes the computational-analytical activity of the key roles of the managers. However, despite the successful implementation of the model in the headquarters, stationary computers

are located in computing centers and are far from operative management. Since direct users of the model are officers of the computing center, their assignment from the operating staff reduces the effectiveness of the model in the headquarters operation.

The following are the main reasons for this:

- lack of experience in the design and use of models of officials involved in computational and analytical activities in the military administration;

- spend a lot of time in the execution of proposals and suggestions from the governing bodies, because large-scale and very labor-intensive work is being done.

Mathematical models can be adapted directly to the user's needs, with a systematic approach to the development of the models. The model of the application of the other types of troops in the leading scientific research institutions is developed and developed [7]. This is a modular unit that combines the types of troops based on the general operation model. New computing modules are being developed that allow you to improve the accuracy of modeling processes. Along with the questions of the model of the general operation model for the new programming, the work is carried out in the following directions:

- development of the model management tools - the main module

that coordinates the sequence of the components of the model in accordance with operational tasks;

- development of appropriate modules for harmonization of types of troops between time and events;

- creation of database model and its integration into database of other calculation and modeling tools.

The model of the other type of force (type of force) is developed as a universal governance system that enables modeling of non-contact combat activities and fires, as well as modeling classic peer-to-peer operations.

4. CONCLUSIONS

Mathematical modeling of combat operations and firearms in the general operations, its development and use remains relevant. It is expedient that it is necessary to ensure the continuity and scientific accompaniment of the establishment process:

- in addition to good programmers, mathematicians and analysts, specializing practitioners should be involved in the design and implementation of models for combat activities and fire-fighting;

- ensure close interaction between the Western science and experts in the field of science on continuing work on the creation and development of armed conflicts models.

REFERENCES

[1] Mikayilov T.N., Bayramov A.A. *Modeling of objects fire destruction evaluation* // Herbi bilik. 2018, № 5, pp. 3-12.

[2] Vrakopulo V.N. *Application possibility of combat activities modeling for computer military games/* State of developing of the combat activities, Minsk, 2003, pp. 62- 67.

[3] Mikayilov T.N., Bayramov A.A. *The possibility of creating an automated control system of various military units.* // Advanced Information Systems. Ukraine. 2019, vol. 3, is.4. (In press).

[4] Sayfeddinov X.I. *Computer forms of efficient training* //Voennaya Misl, 2004, 7, pp. 2-11.

[5] Mikayilov T.N., Bayramov A.A. *The factors of enemy destruction fire in the single information space during combat operations.* // Journal of Defense Resources Management. v. 10, is.1(18) / 2019, pp. 121-130.

[6] Glushenko V.V., Glushenko I.I. *Development of manage solution. Forecasting – planning.* Moscow, NPS «Krilya», 1997,400 p.

[7] Grachev I.A. *Construction prinsiples of especial mathematical and manage software of troops* // Voennaya Misl. 2002. 2, pp.12-19.