

Multi-Criteria Optimization of Brigade Command Organization in the Process of Operational Planning of Military Operations

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Abstract

The paper presents an analytical overview of the aspects of organizing and functioning of the brigade command in the process of operational planning of military operations. The aim of the work is to offer and compare a new solution for the organization of commands of different levels (in this case, brigade commands) in the process of planning operations, while considering all aspects of the offered organization models. By identifying the possibility of improving the structure and functioning of the command, with the help of the analytical-hierarchical process (AHP) multi-criteria decision-making method, the procedure for choosing the best alternative in terms of the command organizational structure model and the brigade command work organization model, in the concretely considered situation, was presented. Model A, considered in this paper, is adapted to the NATO model of brigade command organization, model B is a modified basic model of brigade command organization, defined in our doctrinal documents. Based on the research, model B of the organizational structure is realistic and high-quality and represents the basis for redefining and improving the organization of the work of the brigade command in the process of operational planning of military operations.

Keywords: multi-criteria optimization, organization, brigade command, operational planning, military operations.

Multi-Criteria Optimization of Brigade Command Organization in The Process of Operational Planning of Military Operations

The process of operational planning of military operations at the brigade level is carried out by the brigade command in accordance with the established standardized operating procedures (SOP) within the command as an organization. The functioning of the operational planning process is conditioned by the organization of work within the brigade command as an organizational unit and an element of the brigade structure.

The essence of the problem that this paper deals with is finding such an organization of the work of the brigade command in the process of operational planning, which, based on certain set parameters (criteria), will represent a successful model of the implementation of the mentioned process.

The application of multi-criteria analysis methods in the process of organizing the work of the command has great application possibilities (Ardil, 2020, pp. 275–276). In this case, the application of the AHP method is presented, and two alternatives are ranked. The application of the AHP method makes it possible to consider the offered alternatives in relation to various criteria and as a final result we get a proposed solution that may be in conflict with the solution that is currently being applied. The results obtained were supported by a thorough research conducted with 12 respondents, whose competences were confirmed on the basis of a special competence assessment procedure.

Research that dealt with this issue dates back to 2008. Instructions for operational planning (issued by the Directorate for Planning and Development of the Ministry of Defense of the Armed Forces, issue no. 901-3, dated February 20, 2008, hereinafter: Instructions) brought a number of novelties that changed the general approach to planning operations. The basis for the creation of this document was similar doctrinal documents of NATO and the U.S. Army Corps: Guidance for operational planning NATO (Guidance for operational planning NATO) and Planning and production of orders in KoV USA (FM 5-0 Army Planning and Orders Production) (Gallis, 2003). Dilemmas and debates about their use value continue from then until today, and the positions of those who engage in the debate range from proposals to re-examine the validity and applicability of the operational planning process itself in our theory and practice to those who absolutely support the new approach in planning Operation.

The aforementioned led to the creation of several modified iterations of the mentioned Instructions up to the one from 2017, which is still in force today.

The very importance of the scientific approach when considering the issue of planning military operations initiated the military as well as experts in the field of management to address this topic through their own research and papers that were presented as part of the scientific conference entitled Project Management and Army Operations organized by the Military Academy in 2012. years. All papers were published in the magazine Military paper (winter/2012) and represent significant progress in this domain.

The most significant research on this issue was carried out as part of the preparation of papers for a scientific conference and the realization of the international scientific conference entitled The Influence of the Operational Environment on the Preparation and Execution of Operations, which was held in 2017, organized by the School of National Defense. At this gathering, part of the work was dedicated to the application of multi-criteria analysis methods in certain segments of planning and execution of operations, and the research results indicate a wide range of possibilities of applying these methods, but also the necessity of their application for the purpose of objectivity and quality of the decision made (Dumić, 2017).

The first model, model A as an object of comparison, is an adapted NATO model of brigade command organization (Gallis, 2003). This model represents a certain link of the NATO settings of the operational planning process, which the Serbian Army largely adopted as its own model and the practical application of that process in the organization – the brigade command.

The second model, model B, is a modified basic model of the brigade command organization that is defined in our doctrinal documents and instructions, and represents a response to the real need to improve the basic model, while at the same time remaining within the framework of the structure and capabilities of the organization of the Serbian Armed Forces.

Presentation of the Considered Models of the Organization of the Army Brigade Command in Operations

The Land Army Brigade (hereinafter LAB) is the highest tactical unit of the LAB, composed of modularly organized units of branches and services that are functionally connected to each other. The brigade is most often engaged to carry out operations as part of the KoV or independently. Its organizational structure is of an elastic type and ensures modeling depending on the type of operation (Generalštab Vojske Srbija [Generalštab], 2014, p. 8).

The brigade command is a part of the brigade, organizationally and formationally structured for the command and control of subordinate units from the brigade composition (Generalštab, 2017, p. 14). It functions as one specialized, coherent unit – a professional team, which bases its success in its work on the training of all its members and the coordination of work both between individuals and between bodies within it.

The command of the LAB is the bearer of the command and control system of the LAB. The prerequisites for its effective functioning are of a dual nature. The first prerequisite is the optimal dimensioning of numerous sizes and a properly set organizational structure of the command. Another prerequisite is a properly established organization of work, within that organizational structure, which implies an active and continuous, efficient process based on clearly defined competencies, connections and relationships, as well as communications within the command.

The LAB command is organizationally profiled for the implementation of the operational planning process in accordance with the provisions of the Operational Planning Instructions, which allows freedom in shaping the command structure for planning a specific operation, in accordance with the objectives of the operation, assessment and requirements of the specific situation, but also in accordance with the organizational formation possibilities.

Model A – Organizational Structure of the Brigade Command in the Operational Planning Process

Model A of the organizational structure of the NATO brigade command (Figure 1) in the process of operational planning enables the quality work of the brigade command in the considered process. At the same time, he relies on an extremely demanding and complex structure of functions in the command and the most modern technological support in the planning of operations.

This model implies three levels of organization. The commander is at the head of the command, and the first level of organization is the commander's personal staff.

Model B – Organizational structure of the brigade command in the operational planning process

The modification of the model of the organizational structure implies its adaptation to the real conditions of military operations, enabling the current monitoring of the situation on the battlefield and a more efficient and effective

command work process (Generalštab, 2010).

Model B of the organizational structure of the brigade command (hereinafter Model B) was created with the idea of providing optimal results and was adapted to real possibilities, taking into account the capacities of the current organizational and formational structure of the brigade command of the Serbian Armed Forces, its technological capacities for work, as well as conditions and requirements planning operations (Figure 2).

This model of the headquarters organization of the command implies the formation of headquarters teams with clearly defined roles and tasks in the operational planning process (Generalštab, 2017).

The staff teams have the following composition:

- Staff Team 1: Chief of Staff, Operations Assistant and Support Assistant.
- Headquarters Team 2: B-1, B-4, B-6, B-8, B-9.
- Staff team 3: B-2, B-3, authority of VBA, VP.
- Staff Team 3 A: Team for the selection of objects of action (composition according to the decision of the assistant for operations).
- Staff Team 3 B: specialist staff officers.
- Staff Team 3 C: Team for creating the operational model (composition according to the decision of the Chief of Staff).
- Staff Team 4: Team for monitoring the situation in the operational environment (team leader, one member each of B-2, B-3, B-4 and B-6).

The mentioned model implies the formation of three hierarchical levels of work teams specialized for certain groups of work and directed towards a single goal, making the right decision for the use of the brigade in operations. At the first hierarchical level of headquarters teams is headquarters team 1, which should ensure continuity in command, situation monitoring and timely reactions to changes in the operational environment.

At the second hierarchical level are staff teams 2, 3 and 4. Staff teams 2 and 3 have a standard role in the operational planning process, as prescribed in the Instructions. In order to ensure the constant monitoring of the situation in the operational environment and the acquisition and selection of information about changes in the operational environment that affect the planning of the operation, in addition to the teams under the leadership of the assistant commander, within this model, the formation of a special team (headquarters team 4) is foreseen for monitoring the situation in the operational environment, but also for collecting, processing and distributing information to all actors in the process. The role of this team is to form a unique and current operational picture that

the commander can monitor at any time with the help of adequate command and information systems. Within the headquarters team 4 is the headquarters of the command and information system, which unites telecommunication and IT elements, as well as the Geographical Information System (GIS).

At the third hierarchical level, there are teams that are functionally linked to HQ Team 3 under the leadership of the Operations Assistant. In this model, the importance of the process of creating an operational model of the operation, which is continuous and subject to revision, is recognized. which requires the formation of a special team that would deal with that process and enable its comparative development with other steps in the operational planning process. In addition to this team, there is a team of specialist officers and a team for the selection of objects of action, which are directly connected to the headquarters team 3, which means that the exchange of information at this level is currently carried out without intermediaries. This type of organization enables staff team 3, which is most responsible for planning the operation, to have a constant insight into all relevant information related to the mentioned process and ensure its implementation.

In order to determine the value of the offered models, it is necessary to perform their comparison and evaluation, i.e. ranking. Comparison and evaluation of given models is best done using one of the methods of multi-criteria analysis as decision support. In the following chapters, the application of the Analytical Hierarchy Process (AHP) method is shown in the function of choosing the best model of the organizational structure of the command (Duncan, 1979, p. 65).

Multi-criteria decision-making method – Analytical Hierarchy Process (AHP)

Decision-making is often a complex problem due to the presence of competing and conflicting criteria among available alternatives (Ewing et al., 2005, p. 35). The Analytical Hierarchy Process (AHP) method was developed by Thomas L. Saaty and is a tool in decision analysis (Saatz, 1980, p. 22). It was created to help designers in solving complex decision-making problems involving a large number of designers and when there are a large number of criteria. Accordingly, the area of application of the method is multi-criteria decision-making, where based on a defined set of criteria and attribute values for each alternative, the most acceptable solution is selected, i.e. the complete distribution of the importance of the alternatives in the model is displayed.

The procedure for selecting alternatives using the AHP method can be

expressed using four basic steps:

- structuring the problem;
- definition of criteria;
- determining the weighting coefficients of the criteria;
- determining the solution to the problem.

Problem structuring consists of decomposing a certain complex decision-making problem into a series of hierarchies, where at the levels and sub-levels of the hierarchy there are criteria that, at the first level of the hierarchy, are related to the goal of the problem, and at each subsequent level they are linked to criteria at a higher level. A graphic representation of problem structuring with one level of hierarchy, where the letter K denotes the criteria and the letter A the alternatives, is presented in Figure 3.

The second phase involves defining the criteria related to the goal of the problem at the first hierarchical level, and if there are more levels, then they are also defined criteria for each subsequent hierarchical level. The decision maker usually defines the criteria himself, but it can hire experts in the subject area, who will evaluate the proposed criteria using certain methods and thus suggest to the decision maker whether the defined criteria are adequate or not.

The determination of the weighting coefficients of the criteria is performed by comparing the criteria in pairs using Saaty's scale (Table 1), which is considered the standard for the AHP method (Saaty, 1985, p. 27). The comparison of criteria is performed in pairs, and the results of the comparison of elements at a given level of the hierarchy are placed in the corresponding comparison matrices. For example, if n elements are compared with each other in relation to the corresponding element at the immediately higher level of the hierarchy, then when comparing element i in relation to element j , a numerical coefficient a_{ij} is determined using the Saaty scale and placed in the corresponding position in the matrix A :

$$A = \begin{bmatrix} a_{11} & a_{12} & \vdots & \vdots & a_{1n} \\ a_{21} & a_{22} & \vdots & \vdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \vdots & \vdots & a_{nn} \end{bmatrix}$$

The reciprocal value of the comparison result is placed in the position Q_{ij} to preserve consistency of reasoning. For example, if element 1 is slightly favored over element 2, in place Q_{12} matrix A would be number 3, and in place Q_{21} would be the reciprocal value $1/3$.

In the case of absolute consistency in the choice of criteria by the decision maker, the matrix A is equal to the matrix X ,

$$X = \begin{bmatrix} \frac{W_1}{W_1} & \frac{W_1}{W_2} & \dots & \frac{W_1}{W_n} \\ \frac{W_2}{W_1} & \frac{W_2}{W_2} & \dots & \frac{W_2}{W_n} \\ \frac{W_3}{W_1} & \frac{W_3}{W_2} & \dots & \frac{W_3}{W_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{W_n}{W_1} & \frac{W_n}{W_2} & \dots & \frac{W_n}{W_n} \end{bmatrix}$$

where W represents the relative weight coefficient of the element i .

There are several variants for further determining the vector of weighting coefficients from the displayed matrix, and they mainly relate to different mathematical models. Satty presented two techniques. The first involves summing the rows of the matrix of comparison results and normalizing the sums obtained, according to the following expression:

$$\sum_{j=1}^n \frac{w_i}{w_j} = w_i \left[\sum_{j=1}^n \frac{1}{w_j} \right] \quad i = 1, \dots, n \text{ (по редовима)} \quad (1)$$

The second technique involves summing the reciprocal values of the columns of the matrix of comparison results and normalizing the obtained sums, according to the following expression:

$$\sum_{i=1}^n \frac{w_i}{w_j} = \frac{1}{w_j} \left[\sum_{i=1}^n 1 \right] \quad i = 1, \dots, n \text{ (по редовима)} \quad (2)$$

In the next chapter of this work, through the processing of research results, Satty's technique was applied to determine the vector of weight coefficients w , which implies the normalization of the comparison matrix.

The last stage of application of this method represents the solution of the problem, that is, the determination of the value of each of the alternatives and, based on the obtained results, the selection of the best alternative. The procedure

for determining the best alternative is carried out analogously to the explained procedure related to the determination of criteria. Firstly, the values of the alternatives are determined in relation to each criterion separately through a matrix for determining the weighting coefficients, and then the obtained values of the alternatives are multiplied with the values of each of the criteria. The obtained values are normalized by rows by dividing the total sum of the values of one alternative in relation to each criterion by the number of criteria and in this way the values of the alternatives are obtained.

The complete procedure of applying this method will be practically shown in the next chapter through the processing and presentation of research results in the function of choosing a model of the organizational structure of the command in the process of operational planning in operations.

Evaluation of the model of the organizational structure of the brigade command using the AHP method

The conceptual framework of this research represents the formation of a model of the organizational structure of the KoV brigade command that would efficiently and effectively realize the process of operational planning in operations. The research realization process is shown in the form of an algorithm in Figure 4.

As the initial basis for the realization of model selection, a hierarchical decomposition of the problem solution was formed and criteria were proposed in relation to the goal, which in this case is the selection of an organizational structure model (Figure 5).

The criteria were defined based on the study of literature in the field of operations, command, operational planning and decision-making, as well as literature in the field of organizational theory and management theory (Jovanović, 2005, p. 65). The criteria that are defined in relation to the goal are:

- K1 – Risk management;
- K2 – Effectiveness of information flow within the command in the operational planning process;
- K3 – Monitoring of changes in the operational environment (reaction to changes);
- K4 – Defined work processes within the command (connections and relationships, coordination, communication, interchangeability, etc.);
- K5 – Decision-making within defined time frames (possibility of responding

to planning situations in limited time);

K6 – Current and realistic operational picture available to all participants in the process through the command and information system.

The alternatives considered in the research are models A and B of the organizational structure of the KoV brigade command in the process of operational planning in operations. The mentioned models are presented and explained in the previous chapter of this work.

The research was carried out by collecting and processing data, obtained by surveying 12 experts in the subject area, teachers from the School of National Defense whose narrower specialty is planning military operations, and who have adequate professional competence (hereinafter respondents), (the optimal number of respondents is from 10 to 15 as pointed out by Župac and Mučibabić) through a questionnaire (Župac, 2013, p. 52; Mučibabić, 2003, p. 111).

The methods are shown in the works: Đorović, B. (2003): Research on the design of the organizational structure of administrative bodies of the traffic service; Đorović (2000): Methods of experts and assessment of their competence; Milićević (2014): Expert assessment.

The selection of persons for the survey was made on the basis of their professional and scientific qualifications in relation to the subject area, and their competence was confirmed by analyzing the obtained data on the respondents.

After defining the group of respondents, their competence was assessed. The assessment of competence was performed by calculating the coefficient of competence (K), which includes three aspects of assessment, namely: 1) objective assessment (K_d); 2) assessment of the source of argumentation (K_a) and 3) subjective assessment of connoisseurs (K_s).

Such a formulation was created on the basis of the Dobrova method, a model for the selection and evaluation of experts in the federal authority for science and technology and the like.

The calculation of the competence coefficient is performed according to the expression:

$$K = q_1 K_d + q_2 K_a + q_3 K_s \quad (3)$$

where is:

$$q = 0.6$$

$$q = 0.25$$

$$q = 0.15$$

Objective assessment (K_d) is a representative of the contribution of

individual parameters to his competence. The dominant individual parameters are usually: level of education, total length of service, functional duty, length of service in the current functional duty, published scientific and professional works, participation in projects, professional activity outside the workplace, official evaluation and received awards. These parameters have been modified in accordance with current research.

For research purposes, the following individual parameters were defined for the calculation of the objective coefficient of competence (K_d):

- P1 - total working experience;
- P2 - participation in combat operations;
- P3 - level of education;
- P4 - previous duties;
- P5- current formation place;
- P6- published scientific and professional works;
- P7- participation in the preparation of documents from the subject area;
- P8- implementation of teaching in the subject area;
- P9- implementation of teaching through simulations.

The objective coefficient of competence was calculated using the expression (Božanić, 2017, p. 41):

$$K_d = \frac{1 \sum_{s=1}^f p_s t_s}{10 \sum_{s=1}^f t_s} \quad (4)$$

where is:

p_s – the level of importance of the connoisseur's constituent s-th characteristic,

t_s – the weight that determines the relative importance of the connoisseur's s-th trait, within limits

[0, 1] (for this model $t_2 = t_6 = t_7 = 0.5$, and for the others value is 1),

f – is the number of characteristic (for this model $f=9$).

Through the evaluation of the source of argumentation (K_a), the respondent determines the degree of influence of a certain source on his opinion. This impact is evaluated as high, medium, low or no source impact. According to Dobrov, if $K_a = 1$ then the degree of influence of the source is high, if $K_a = 0.8$ then the degree of influence of the source is medium and if $K_a = 0.5$ then the degree of influence of the source is low (Milićević, 2014, p. 47). The degree of influence of the source of argumentation was evaluated according to the modified Table 2.

In the subjective evaluation (Ks), the respondent evaluates himself in the knowledge of the specific research problem. Grading is done with grades from 1 to 10. These grades are multiplied by a coefficient of 0.1 and thus a subjective assessment is obtained. After the values of the defined coefficients were determined, the obtained results were included in expression (3) and competence coefficients were obtained for each of the respondents. Competence ratings of 12 surveyed experts in the subject area are shown in Table 3.

After the decomposition of the problem solution and the definition of the criteria, the weighting coefficients of the criteria were determined using Satty's scale by comparison in pairs. The results were normalized across the comparison matrices and are shown in Table 4.

To the final values of the weight coefficients of the criteria ($w_1, w_2 \dots w_6$) it was arrived at by the method of averaging the results of connoisseurs through geometric means (Geometric Mean Method [GMM]) using the expression (Zoranović & Srđević, 2009, p. 724):

$$w_i = \prod_{k=1}^K [a_i(k)]^{b_k} \quad (5)$$

Where is:

w_i – weight value of the coefficient,

$a_i(k)$ – the value of the weighting coefficient for each k-th expert where $k=1, \dots, K$,

b_k – additively normalized competence coefficient of the k-th expert.

The values of the weighting coefficients of the criteria are shown in Table 5.

After determining the weighting coefficients of the criteria, analogously to the previously presented methodology for determining the weighting coefficients of the criteria, the weighting coefficients of the alternatives were determined. Respondents evaluated models A and B in relation to each criterion individually, using Satty's scale.

The obtained results were normalized, and the final values of the weighting coefficients of the alternatives in relation to the criteria were reached using the method of averaging the results of experts using geometric means (GMM). The final values of the weighting coefficients of the alternatives are shown in table 6.

As a final step, the additive normalization of the results was performed

in relation to the values of the weighting coefficients of the criteria (Table 7), and the final values of the alternatives were obtained (Table 8 и 9).

Gradient sensitivity analysis criteria values

Gradient sensitivity analysis is a very useful tool that can be used to establish and then graphically present the dependence of the value of alternatives in relation to a change in the value of one of the criteria. It is most often carried out in relation to the criterion that has the highest value, and therefore has the greatest impact on the considered alternatives.

In this case, the most important criterion is K2-Efficiency of information flow within the command in the operational planning process.

Step 1 of the analysis is shown in table 10. The table shows how the values of the criteria change and how much these values contribute to the change in the value of the criterion K2 in the range from 0 to 1, in a range that increases by 0.1.

Step 2 of the analysis is shown in table 11. The table shows how the values of the alternatives change and how much those values are in return for the change in the value of the criterion K2 in the range from 0 to 1, in a range that increases by 0.1. The graphic representation is given in Figure 6.

The results of the conducted research clearly indicate a significantly higher value of alternative B, that is, the model of the organizational structure of the brigade command, which was offered and analyzed in the paper. All experts in the subject area who participated in the research gave preference in the largest number of segments (in relation to the criteria) to model B,

From the above, it can be concluded that the considered model B of the organizational structure is relevant, realistic and of high quality and as such represents the basis for considering the redefinition of the work organization of the brigade command in the process of operational planning in the instructions and rules that regulate the mentioned area.

Conclusion

The organizational structure of the brigade command in the process of operational planning should be adapted to the capacities of the command and the characteristics of the operation being carried out. In support of this, the paper identified the key requirements for the optimal operation of the command and, based on the conclusions, formulated a model of the organizational structure

of the command that is significantly more efficient.

The transformation of the current command structure defined by the Instruction in the mentioned process was carried out in accordance with the need to plan the operation. The key advantages of the considered model are reflected in its adaptability to new circumstances in the operation and the actuality of monitoring all relevant influences from the operational environment. In addition, the mentioned model is flexible, respects the principles of organization theory and management theory, which is reflected in the maximum use of individual capacities of command members through their synergistic action.

The results obtained by the research unequivocally confirmed the better performance of the considered model compared to the model given in the Instructions. The respondents gave the greatest advantage to the mentioned model in the segment of the actualization of the operational image of the battlefield, information flow and defined organizational work processes within the command.

The contribution of this work is reflected in the presentation of a new approach to modeling the organization of work of the brigade command, based on the achievements of decision-making theory. This work confirms the possibilities of integrating science and practice in order to find the optimal solution. The frameworks in which the research was conducted are realistic, and the results reached are current and applicable in practice.

This approach to a complex problem such as the optimization of the functioning of the brigade command offers one of the possible solutions and indicates the need to continue searching for new solutions. Questions that should be addressed by further research in this area are related to consideration of the optimization of organizational work processes in different types of operations, as well as in commands of temporary formations, specifically operational groups.

Also, it is necessary to work in the direction of defining time references for the realization of sub-processes and processes in the operation of commands so that output results can be standardized in some way.

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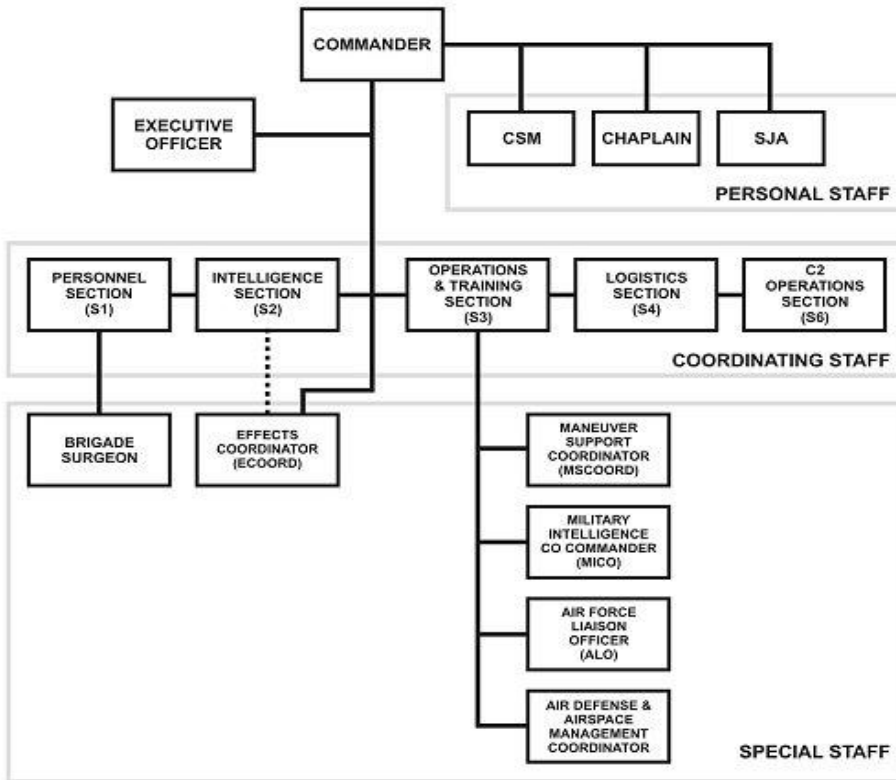
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Appendix

Figure 1

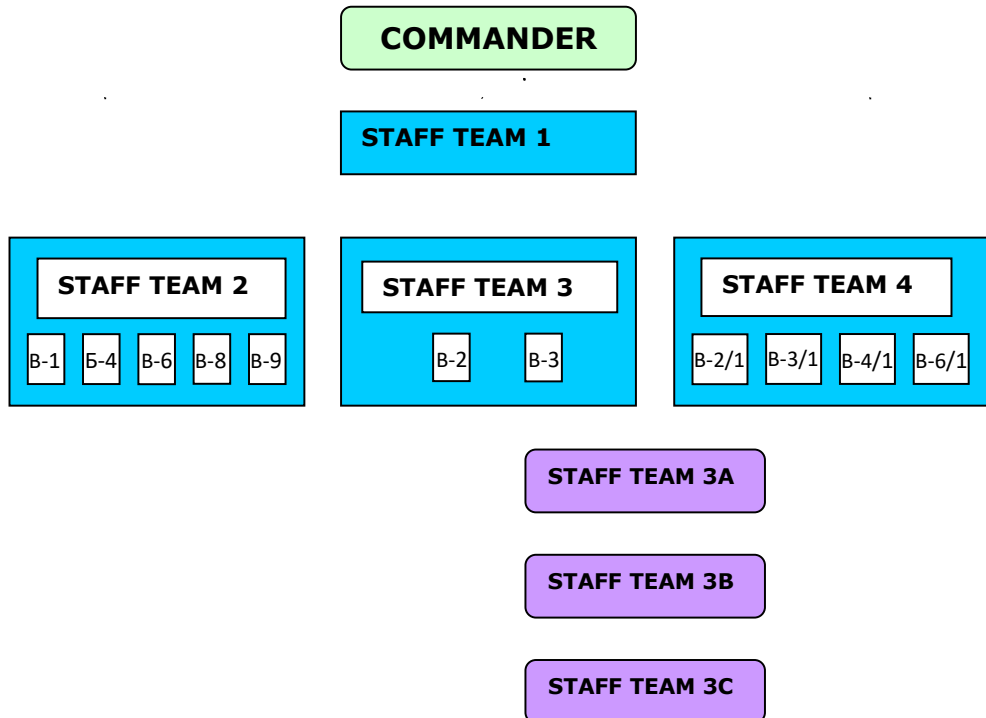
MODEL A of the organizational structure of the NATO brigade command in the process of operational planning in operations



Note. Made by the authors.

Figure 2

MODEL B of the organizational structure of the LAB command in the process of operational planning in operations



Note. Made by the authors.

Figure 3

Hierarchical decomposition of decision-making problems using the AHP method

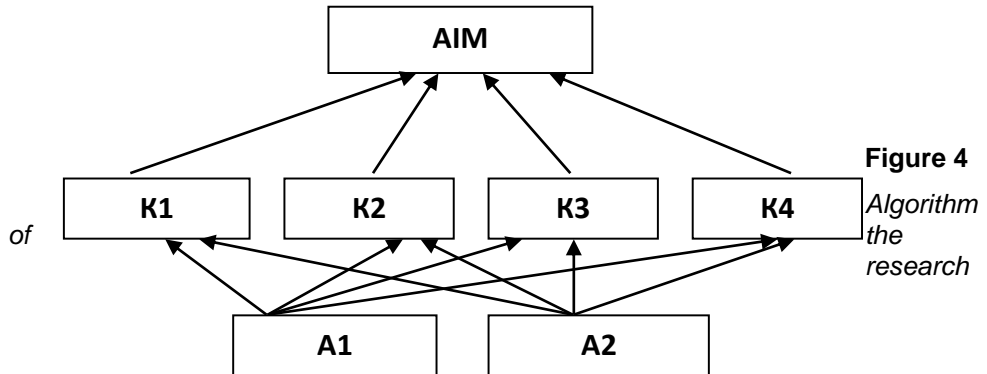
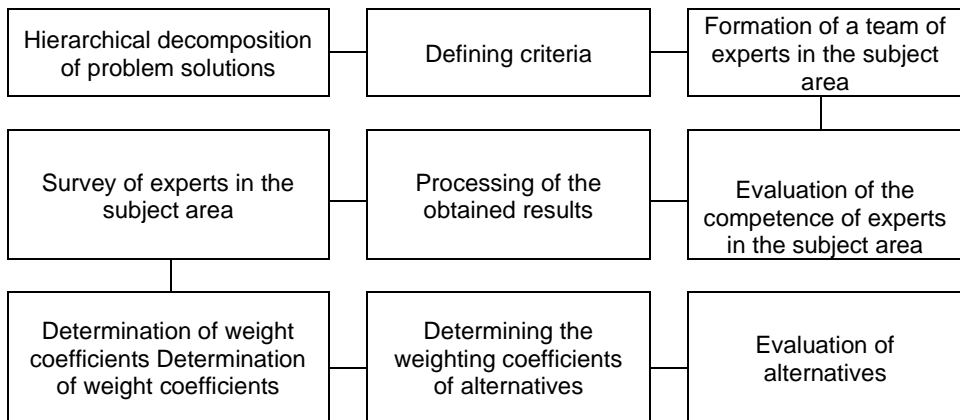


Figure 4
 Algorithm
 the
 research

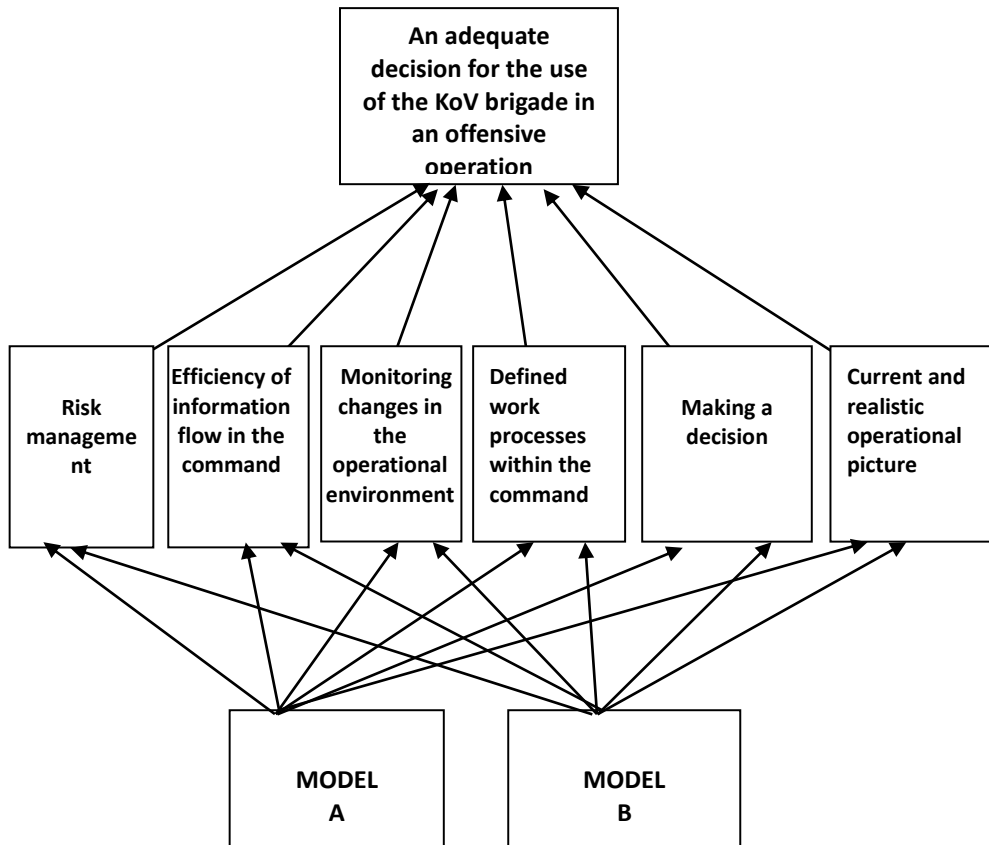
implementation process



Note. Made by the authors.

Figure 5

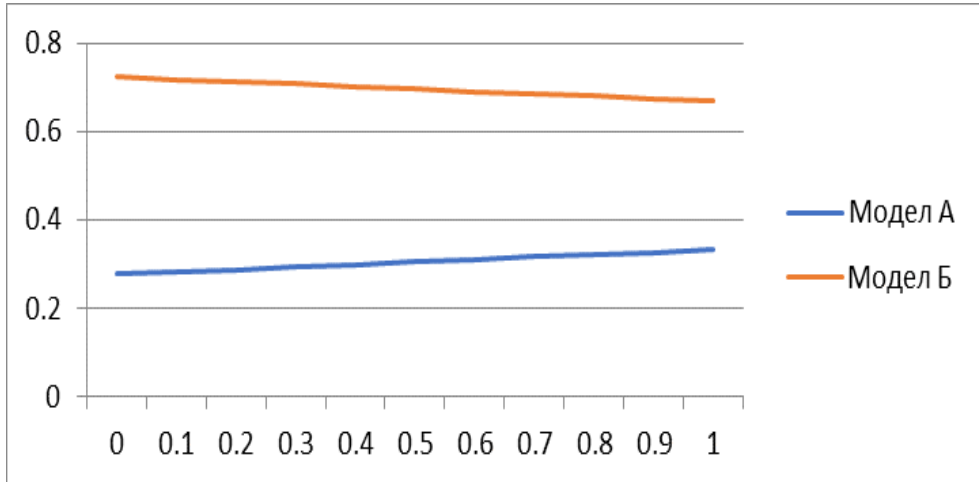
Hierarchical decomposition of problem solutions



Note. Made by the authors.

Figure 6

Graphical representation of gradient sensitivity analysis



Note. Made by the authors.

Table 1

Saaty's pairwise comparison scale

Importance	Definition	Explanation
1	Equal importance	Both activities contribute equally to the goal
3	Moderate dominance	Experience and judgment slightly favor one activity over the other
5	Strong dominance	Experience and judgment strongly favor one activity over the other
7	Demonstrated dominance	One activity is strongly favored and its dominance is demonstrated in practice
9	Extreme dominance	Evidence which favor one activity over another are of the highest possible order of affirmation
2,4,6,8	Inter values	When compromise is required

Note. Made by the authors.

Table 2

The influence of argumentation on the assessment of the competence of experts in the subject area

No.	Source of argumentation	Influence degree		
		1-high	2-medium	3-low
2)	Theoretical knowledge	0.3	0.2	0.1
3)	Teaching experience	0.3	0.2	0.1
4)	Literature	0.2	0.2	0.1
5)	Warfare experience	0.1	0.1	0.1
6)	Intuition	0.05	0.05	0.05
7)	Other	0.05	0.05	0.05

Note. Made by the authors.

Table 3

Competency assessments respondent

Respondent	Evaluation parameters			competence coefficient
	$K_d(0.6)$	$K_a(0.25)$	$K_s(0.15)$	
Y	0.504	0.250	0.150	0.904
Y	0.516	0.225	0.135	0.876
Y	0.484	0.250	0.135	0.869
Y	0.452	0.200	0.135	0.787
Y	0.476	0.225	0.105	0.806
Y	0.380	0.225	0.090	0.695
Y	0.484	0.250	0.135	0.869
Y	0.352	0.200	0.120	0.672
Y	0.464	0.225	0.120	0.809
Y	0.424	0.250	0.150	0.824
Y	0.508	0.200	0.120	0.828
Y	0.468	0.225	0.120	0.813
Coefficient of competence of the entire group of respondents				0,813

Note. Made by the authors.

Table 4

Weighting coefficients of criteria

Respondent	K_1	K_2	K_3	K_4	K_5	K_6
	w_1	w_2	w_3	w_4	w_5	w_6
3)	0.060	0.240	0.288	0.150	0.088	0.168
4)	0.269	0.113	0.178	0.196	0.192	0.052
5)	0.173	0.025	0.155	0.408	0.180	0.059
6)	0.110	0.308	0.060	0.358	0.150	0.059
7)	0.109	0.330	0.118	0.329	0.079	0.080
8)	0.270	0.250	0.220	0.070	0.118	0.072
9)	0.033	0.325	0.218	0.145	0.084	0.195
10)	0.203	0.110	0.181	0.250	0.132	0.124
11)	0.162	0.215	0.144	0.051	0.265	0.163
12)	0.046	0.144	0.166	0.147	0.365	0.132
13)	0.189	0.208	0.098	0.045	0.280	0.180
14)	0.112	0.187	0.417	0.131	0.049	0.104

Note. Made by the authors.

Table 5

Values of the weighting coefficients of the criteria

K_1	K_2	K_3	K_4	K_5	K_6
w_1	w_2	w_3	w_4	w_5	w_6
0.143	0.202	0.186	0.189	0.165	0.115

Note. Made by the authors.

Table 6

Weight coefficients of alternatives

	T_1	T_2	T_3	T_4	T_5	T_6
MODEL A	0.273	0.332	0.140	0.425	0.303	0.217
MODEL B	0.727	0.668	0.860	0.575	0.697	0.783

Note. Made by the authors.

Table 7

Weighting values of alternatives and criteria

	T_1	T_2	T_3	T_4	T_5	T_6
MODEL A	0.273	0.332	0.140	0.425	0.303	0.217
MODEL B	0.727	0.668	0.860	0.575	0.697	0.783
$W_1 \dots W_6$	0.143	0.202	0.186	0.189	0.165	0.115

Note. Made by the authors.

Table 8

Additive normalization-procedure

	T_1	T_2	T_3	T_4	T_5	T_6
MODEL A	0.273x 0,143	0.332x 0,202	0.140x 0,186	0.425x0, 189	0.303x 0,165	0.217x0, 115
MODEL B	0.727x 0,143	0.668x 0,202	0.860x 0,186	0.575x0, 189	0.697x 0,165	0.783x0, 115
$W_1 \dots W_6$	0.143	0.202	0.186	0.189	0.165	0.115

Note. Made by the authors.

Table 9

The final values of the alternatives

	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	VALUE OF ALTERNATIVES (sum T ₁ ..T ₆)
MODEL A	0.039	0.067	0.025	0.080	0.050	0.025	0.285
MODEL B	0.104	0.135	0.160	0.109	0.115	0.090	0.715

Note. Made by the authors.

Table 10

Gradient sensitivity analysis of criteria-step 1

	K1	K3	K2	K4	K5	K6
w	0.143	0.186	0.202	0.189	0.165	0.115
	0.179197995	0.23308271	0	0.23684211	0.206767	0.14411
	0.161278195	0.20977444	0.1	0.21315789	0.18609	0.129699
	0.143358396	0.18646617	0.2	0.18947368	0.165414	0.115288
	0.125438596	0.16315789	0.3	0.16578947	0.144737	0.100877
	0.107518797	0.13984962	0.4	0.14210526	0.12406	0.086466
	0.089598997	0.11654135	0.5	0.11842105	0.103383	0.072055
	0.071679198	0.09323308	0.6	0.09473684	0.082707	0.057644
	0.053759398	0.06992481	0.7	0.07105263	0.06203	0.043233
	0.035839599	0.04661654	0.8	0.04736842	0.041353	0.028822
	0.017919799	0.02330827	0.9	0.02368421	0.020677	0.014411
	0	0	1	0	0	0

Note. Made by the authors.

Table 11

Gradient sensitivity analysis of criteria - step 2

K2	Model A	Model B
0	0.27613283	0.72386717
0.1	0.28171955	0.71828045
0.2	0.28730627	0.71269373
0.3	0.29289298	0.70710702
0.4	0.2984797	0.7015203
0.5	0.30406642	0.69593358
0.6	0.30965313	0.69034687
0.7	0.31523985	0.68476015
0.8	0.32082657	0.67917343
0.9	0.32641328	0.67358672
1	0.332	0.668

	a	b
Model A	0.05586717	0.27613283
Model B	-0.0558672	0.72386717

Intersection point:	400.71%
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Note. Made by the authors.

Višekriterijumska optimizacija organizacije komande brigade u procesu operativnog planiranja vojnih operacija

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Sažetak

Rad predstavlja analitičko sagledavanje aspekata organizovanja i funkcionisanja komande brigade u procesu operativnog planiranja vojnih operacija. Cilj rada je da se ponude i uporede nova rešenja za organizaciju komandi različitih nivoa (u ovom slučaju komande brigade) u procesu planiranja operacija, a da se pri tom razmotre svi aspekti ponuđenih modela organizacije. Identifikacijom mogućnosti unapređenja strukture i funkcionisanja komande, uz pomoć metode višekriterijumskog odlučivanja Analitičko-hijerarhijski proces (AHP), predstavljen je postupak izbora najbolje alternative u pogledu modela organizacione strukture komande i modela organizacije rada komande brigade, u konkretno razmatranoj situaciji. Model A, razmatran u ovom radu prilagođen je NATO modelu organizacije komande brigade, model B je modifikovan osnovni model organizacije komande brigade, definisan u našim doktrinarnim dokumentima. Na osnovu istraživanja, model B organizacione strukture je realan i kvalitetan i predstavlja osnovu za redefinisavanje i unapređenje organizacije rada komande brigade u procesu operativnog planiranja vojnih operacija.

Ključne reči: višekriterijumska optimizacija, organizacija, komanda brigade, operativno planiranje, vojne operacije