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Does combat deployment experience affect the commander's decision-making process?

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***Abstract.* The paper presents the results of a study conducted in 2022. An attempt is made to determine whether commanders' perceptions of the importance of the mission's variables change as a result of gaining combat deployment experience. A critical assessment of the mission variables is the focus of the research, which examines the importance of these variables according to the tactical commanders who plan the operations. The methods used are expert judgment elicitation and statistical analysis. The results show that combat deployment experience appears to have only a minor impact on commanders' decision-making process. The ranking list developed using the input of the experts' group, which includes officers with combat experience, may serve as a basis for improving existing models for assessing the mission variables. In order to expand the collection of research data and increase the significance of the findings, the methodology used in the study could be applied to other expert groups outside the Bulgarian armed forces.**

Keywords: deployment, evaluation, experience, mission variables

I. INTRODUCTION

The dynamically evolving security environment and the expansion of combat domains increase the degree of uncertainty in military operations. These factors negatively affect the commanders' ability to make reasonable and robust decisions. The effect multiplies down the chain of command and often has critical consequences on the tactical level of operational planning. The need for a better understanding of the decision-making process and the way experienced commanders think when planning tactical operations arises. When applied strategies fail to produce results, the usual management practice is to focus on the first learning stage – concrete experience. As a result, it is often necessary to modify the strategy itself, with the intention of transforming it into an effective management framework [1].

What differentiates a good tactical decision from a bad one is the correspondence of the conclusions made from the analysis of the mission variables, compared to the reality of the operational environment. On the tactical level, this analysis is often done solely by the units' commanders and the success or failure of the operation greatly depends on their experience and planning skills.

The paper presents the results of a study in which two expert groups comprised of experienced military officers from the Bulgarian Land Forces give their judgment on the importance of the mission's variables when planning an operation on a tactical level. The main objective of the study is to find if combat deployment experience affects a commander's decision-making process. To achieve this task, the focus is placed on the difference in the way commanders with and without combat experience perceive the significance of the mission variables when planning an operation on the tactical level in conditions of uncertainty.

II. MATERIALS AND METHODS

The study uses the method of experts' judgment elicitation, which is suitable for researching topics where obtaining data through measurements and experiments is hard or impossible to accomplish.

The problems associated with this type of study are the reliability of the judgment of individual experts and the appropriate number of experts in the groups. A small number of experts does not ensure sufficient statistical reliability and stability of the assessment, and individual experts have a significant influence on the aggregated results, which increases the subjectivity of the assessment [2]. On the other hand, a large number of experts in a group creates difficulties in conducting the survey. The larger the group, the lower the degree of consensus, while at the same time, the difficulty of finding a sufficient number of competent experts increases. It is generally accepted that 8-15 experts are a viable number and that the optimal number of experts should not exceed 20, as the inclusion of more leads to a decrease in the achieved results [3].

The experts are selected based on the following criteria: to have a bachelor's or higher degree in military affairs, to

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be an officer with at least three years of experience; and to serve in a mechanized brigade.

These criteria have to ensure that the experts have a formal education in the field of the study, have completed no less than one full training cycle of the individual to battalion-level exercises, and have done so in the units that are most rigorously trained.

Two expert groups are formed. The first is comprised of 8 officers who have at least one deployment to a combat zone (G1) and the second includes 12 who have not been deployed (G2). The experts are then asked to fill out a survey sheet that contains a table in which they have to evaluate and rank the variables taken into account when planning a mission in accordance with their importance.

The experts give each element a rank, which is an integer value from 1 to $\boldsymbol{n}$. This way, each expert ($\boldsymbol{Ex_i}$) gives each element ($\boldsymbol{E_j}$) a specific rank ($\boldsymbol{x_{ij}}$). When all the experts in each group rank all the elements, the results are integrated into a matrix, as the one shown in Table 1 below. The elements presented to the expert groups for evaluation include: mission (V_1), enemy (V_2), terrain (V_3), own troops (V_4), adjacent units (V_5), supporting units (V_6), time available (V_7), weather conditions (V_8), daylight (V_9), and anthropogenic factors not included in the other variables (V_{10}).

When ranking the elements, all experts must use the same pre-established scale, the sum of all the ranks for each expert needs to be the same, and the experts have to give their judgment independently from one another.

The values of r_j (j = 1, 2, …, n) show the sum of the ranks of all elements given by all the experts in each group, calculated using (1):

$$r_1 = \sum_{i=1}^{m} x_{i1}\,, r_2 = \sum_{i=1}^{m} x_{i2}, \dots, r_n = \sum_{i=1}^{m} x_{in} \qquad (1)$$

TABLE 1 RESULTS OF EXPERTS' EVALUATION

		RANKED ELEMENTS					
		E1	***E2***	***E...***	***Ej***	***E...***	***En***
EXPERTS				…		…	
				…		…	
	Ex...	…	…	…	…	…	…
	Exi			…		…	
	Ex...	…	…	…	…	…	…
	Exm			…		…	
				…		…	
$\overline{r_j}$		$\overline{r_1}$	$\overline{r_2}$	…	$\overline{r_j}$	…	$\overline{r_n}$

The experts rank the elements on the scale of 1 to10 and the result of the assessment is defined by the average values of the awarded ranks which are calculated using (2):

$$\overline{r_j} = \frac{1}{m} \sum_{i=1}^{m} x_{ij} \qquad (2)$$

When using the method of expert judgment elicitation, even with the most careful selection of the expert group, it is possible to get conflicting opinions, leading to insignificant results. The dispersion coefficient of concordance ($\boldsymbol{W}$) is most often used to assess the degree of agreement between experts' opinions. Its value expresses the relationship between the experts' opinions. The coefficient of concordance is a value that varies from 0 (complete discordance) to 1 (complete concordance), i.e. when $W = 0$, it means that there is no relationship between the rankings of individual specialists. A value of $W = 1$ indicates that all survey participants rank the assessed elements in the same way. The larger the value of W, the more significant the degree of confidence in the experts' evaluation results. The coefficient is calculated using (3):

$$W = \frac{12\sum_{j=1}^{n}(r_j - \bar{r})^2}{m^2(n^3 - n)} \qquad (3)$$

where:

W – coefficient of concordance

r_j – the sum of the ranks obtained by the elements in all rankings

$\bar{r}$ – the average sum of the ranks

n – number of ranked elements

m – number of experts

In order to interpret the resulting coefficient of concordance value of the two expert groups, the Kappa range of concordance is used [4]. It gives a clear interpretation of the results by comparing them to the scale of agreement shown in Table 2.

The calculation of standard deviation is a statistical analysis tool that allows the evaluation of the dispersion rate in the mean values of the variables generated by the expert groups. The greater the value of standard deviation the larger the dispersion and thus the intervals on the importance scale according to the experts. The small data sets allow for calculating the deviation for the entire population which is done using (4):

$$\sigma = \sqrt{\frac{\sum(X-\mu)^2}{N}} \qquad (4)$$

where:

σ – standard deviation

X – the value in the data distribution

μ – the population mean

N – the total number of observations

TABLE 2 KAPPA COEFFICIENT INTERPRETATION

Measurement of Observer Agreement for Categorical Data	
Kappa coefficient range	Interpretation
< 0,00	*poor agreement*
0,00 – 0,20	*slight agreement*
0,21 – 0,40	*fair agreement*
0,41 – 0,60	*moderate agreement*
0,61 – 0,80	*substantial agreement*
0,81 – 1,00	*almost unanimous*

III. RESULTS AND DISCUSSION

Using the described methodology, the average ranks of the variables given by the expert groups are shown in Table 3 below.

The coefficient of concordance for the first group calculated using (3) is:

$$W = \frac{12\sum_{j=1}^{n}\left(r_j - \bar{r}\right)^2}{m^2(n^3 - n)} = \frac{12 \times 3718}{8^2(10^3 - 10)} = 0{,}70$$

This shows a sustainable level of agreement in the G1 experts' opinion.

For the second group, the coefficient of concordance is equal to:

$$W = \frac{12\sum_{j=1}^{n}\left(r_j - \bar{r}\right)^2}{m^2(n^3 - n)} = \frac{12 \times 6770}{12^2(10^3 - 10)} = 0{,}57$$

When compared to the Kappa coefficient range it shows a moderate level of agreement between the experts of G2.

The higher value of W for the G1 experts gives greater reliability to their judgment on the importance of the mission variables.

The results of the rankings are graphically depicted in Fig. 1. The darker bars represent the average ranks given by the experts who have been deployed to combat zones (G1) and the lighter bars show the importance of the variables according to the experts who have no such experience (G2).

TABLE 3 MEAN VALUES OF THE RANKINGS

Variable	G_1 mean value	G_2 mean value
V_1	8,5	8,3
V_2	9,1	8,8
V_3	7,1	6,5
V_4	7,8	7,7
V_5	5,4	5,8
V_6	4,9	4,5
V_7	4,8	4,3
V_8	2,5	4,0
V_9	2,9	2,5
V_{10}	2,1	2,6

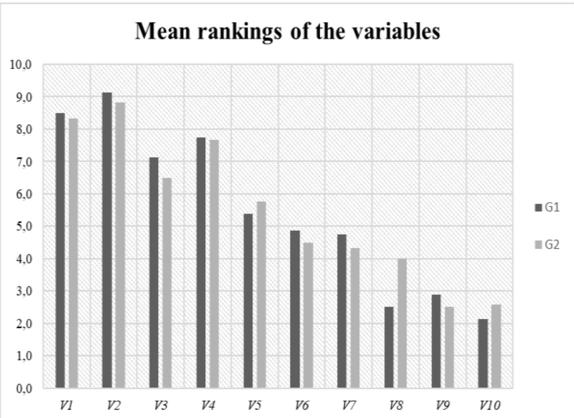

Fig. 1. Mean rankings of the variables in the planing process.

According to the experts in G1, the mission variables that are considered in the planning process are ranked by importance in the following order:

1. Enemy (V_2)
2. Mission (V_1)
3. Own troops (V_4)
4. Terrain (V_3)
5. Adjacent units (V_5)
6. Supporting units (V_6)
7. Time available (V_7)
8. Daylight (V_9)
9. Weather conditions (V_8)
10. Anthropogenic factors not included in the other variables (V_{10})

The second group's ranking list has the following order:

1. Enemy (V_2)
2. Mission (V_1)
3. Own troops (V_4)
4. Terrain (V_3)
5. Adjacent units (V_5)
6. Supporting units (V_6)
7. Time available (V_7)
8. Weather conditions (V_8)
9. Anthropogenic factors not included in the other variables (V_{10})
10. Daylight (V_9)

The comparison between the two lists shows very minor differences, which come in the last three positions. The most notable discrepancy comes from the perception of importance of daylight (V9) for planning operations on the tactical level. The G1 experts rate it above the impacts of weather conditions and the anthropogenic factors and the G2 experts place it at the bottom of the list as being the least significant. This indicates that the officers without combat deployment experience do not consider the limited availability, the extra weight, and the restricted field of observation of night vision sights and equipment as problematic, which is highly indicative.

Looking at the mean ranking values given to each variable by the expert groups shows that the intervals between variables placed consecutively on the two lists of importance differ by a margin of more than 10% in one of the instances. This indicates that the intervals on the importance scales of G1 and G2 are irregular and the dispersion in the mean values would be different. In order to get a numerical value, the standard deviation is calculated using (4). When applied to the data from the first expert group, the result is:

$$\sigma = \sqrt{\frac{58{,}093}{10}} = 2{,}410$$

The standard deviation for the mean values of the ranking of the variables by the second group equals:

$$\sigma = \sqrt{\frac{47{,}014}{10}} = 2{,}168$$

The difference might not seem significant at first, but when working with small data sets a rise in deviation by only 0,242 shows a higher distinction between the importance of the mission variables in the opinions of the G1 experts compared to those of G2 experts.

CONCLUSIONS

The results of the study show that there is no substantial difference in the way the importance of the mission variables is perceived by the commanders with and without combat deployment experience.

The substantially higher value of the coefficient of concordance of the opinions of the first expert group compared to that of the second, indicates a level of consensus among the officers with combat deployment experience. This fact gives their judgment greater credibility.

Being even marginally higher, the standard deviation in the mean ranking of the mission variables in the assessments of the first group shows greater intervals on the scale of importance from one variable to another, compared to that of the second group.

It might be argued that when pressed for time in conditions of uncertainty, commanders should focus on assessing the mission variables in the order in which they are placed by the experts of the first group.

The analysis of the data collected for the study showed that there is a difference, albeit a small one, in how commanders with and without combat experience rated the importance of mission variables and that their decision-making process was influenced by experience.

Each individual has a unique management style, expressed in their work process [5]. Officers in the armed forces are guided by the doctrines of their nations, which affects how they analyze information and make decisions. Expanding the research to include expert groups from the militaries of other NATO countries which have similar planning processes to that of the Bulgarian armed forces would increase the significance of the results of the study.

The results and the methodology of the study may serve as a base to expand the data on the topic and to create more accurate models for the decision-making process applied by military commanders on the tactical level of operations.

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