MODEL FOR DETERMINING COMPETENCES OF EXPERTS IN THE FIELD OF MILITARY SCIENCE

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In addition to the fact that every science has its subject matter, theory, language and methods, it has to have its unique manner of determining the competence of experts in a certain field. This paper studies the manner of determining the competence of experts when the subject of research belongs to the field of Military Science.

To identify the influence of individual elements on the competence of an expert, a model has been formed to define the evaluation of the competence. In order to arrive at a final value of the significance of elements of expert's competence, different subjective methods were used founded on ranking method and Full Consistency Method (FUCOM), Combinative Distance Based Assessment (CODAS), Complex Proportional Assessment (CORPAS), Additive Ratio Assessment (ARAS) and Combined Compromise Solution (CoCoSo), as well as the operator Einstein weighted arithmetic average for the aggregation of group decisions. The concurrence of experts was achieved by means of concordance coefficient, while Delphi method was used for the experts surveying process.

The proposed model was tested on an illustrative example which proved the validity of the model and the possibility of its application in a real-life situation. This paper should provide assistance to researchers in the field of Military Science who use expert evaluation in their research.

Key words: *Competences, experts, Military Science, concordance, EWAA, FUCOM, CODAS, COPRAS, ARAS, CoCoSo*

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Introduction

To resolve the issue of decision-making, which is complex and interdisciplinary in its character, where it is necessary to process imprecise and ambiguous information, expert evaluation imposes as the sole acceptable solution, i.e. the engagement of expert in a certain field (Milićević, 2014, p. 11; Milošević & Marček, 2019; Jasikovac, 2019). The first studies that included expert evaluation appeared in the middle of 20th century in the field of clinical psychology (Phelps, 1977, p. 3) and in the years to follow, this manner of resolving problems became one of "the fundamental scientific methods for the analysis of complex non-formal problems" (Milićević, 2014: 11). The purpose of this method of evaluation is to arrive at more complete or new information about the problem of the research, in order to assist a decision-maker in decision-making process (Milićević, 2014, p. 11).

Numerous authors, apart from the previously mentioned, dealt with the expert evaluation in their research. Hence, Beach (Beach, 1975) in his study on the expert evaluation in the situation of uncertainty asks the question: "How does a highly motivated, experienced individual in an operational environment in his field of expertise, with appropriate feedback regarding previous predictions and decisions, performs inferential and decision-making tasks, and can his performance be enhanced in any way?" The answer to that question lays precisely in expert evaluation, i.e. providing assistance to a decision-maker by means of experts' opinion. Phelps and Shanteau (Phelps & Shanteau, 1978) assert that in different fields, when making decisions, "a decision-maker is expected to integrate information from several sources", or experts. In this research on expert measuring and mechanical combinations, Einhorn (Einhorn, 1972) speaks about the fact "that in situations where "objective" measures are not available, one has to use expert opinion and judgement". According to Helmer (Helmer,1967: 1), "there are many cases where decisions must be based, not on results of theoretic analysis, but on intuitive judgement of any experts on certain matter", both because of the lack of a unique theory on the matter, and because the problem that is to be solved "may include morale apart from factorial aspects, and with that, the preferences along with data".

According to Milićević (2014: 12), some of the fundamental notions in the field dealing with expert evaluation are: "expert, expertise, expert evaluation, methods of expert assessment, experts' assessment, expert opinion and other". According to Litvak (2004: 241 in Milićević, 2014: 12), the notion of an expert implies "a specialist in a concrete subject field who: possesses necessary knowledge and experience; who can evaluate the subject of expertise in the framework of his competence" and other, who is expected "to combine information obtained from several sources into a decision or evaluation" (Slovic, 1969), or "a professional qualified in the field" of research "who is competent to analyse, assess and give opinion on the basis of theoretic knowledge and practical experience related to the problem at hand" (Milićević, 2014: 74). According to Milićević (2014: 18), expert evaluation represents a procedure of "obtaining assessment of a problem on the basis of a group (or individual) opinion of experts". Methods of experts' assessments represent "determining expert opinion and the generation of required information on the basis of that opinion, and its analysis is conducted using logical and mathematical-statistical methods (Divina et al., 2019), or "methods of the organisation of work with experts and processing experts' opinions, produced in quantitative and/or qualitative form with a view of preparing information for decision making". According to Benini and associates (Benini et al., 2017: 16), expert opinions represent "opinions that experts give in the context of a decision". To aggregate expert opinions, meaning, or to observe the influence of each individual expert on the final decision, it is necessary to define the values (evaluations) of their competence.

The purpose of this paper is, by employing the method of multicriteria decision making and other ways of determining weight coefficient of criteria (elements of the evaluation of experts' competence), to define new ones, that will be based on expert opinions and their aggregation, when conducting research in the field of Military Science, acknowledging the specificities of this scientific field.

Problem description

Authors approach determining the competence (quality) of experts differently. However, not a small number of them agrees that the evaluation of competence consists of : objective evaluation, evaluation of argumentation sources and subjective evaluation (Đorović, 2003, p. 155, Božanić, 2016, p. 40; Kovačević, 2020, p. 119; Saković, 2021, p. 156; Bajrami, 2022, p. 193). Objective evaluation represents the influence of individual (objective) information about an expert on his competence. The evaluation of argumentation sources points to the manner in which certain factors influence his opinion. The third element of expert's competence relates to the self-assessment of the expert regarding the knowledge of the field of research and it represents subjective data.

In the majority of researches, and for the purpose of generating the final evaluation of expert competence (K) the following mathematical expression is used (Đorović, 2003, p. 155, Božanić, 2016, p. 40; Kovačević, 2020, p. 119; Saković, 2021, p. 156; Bajrami, 2022, p. 193):

$$K = w_d K_d + w_a K_a + w_s K_s \quad , \tag{1}$$

Where w designates the weight coefficient of each element of competence evaluation, Kd - objective evaluation, Ka - factors that influence the opinion generation and Ks - subjective evaluation.

In their researches, authors mainly use two approaches to the calculation of objective coefficient of competence (Kd). In the first approach (Milićević, 2014: 103) the calculation is done by using the expression (2):

$$K_\partial = \frac{1}{10}\sum_{i=1}^{9} C_i w_i \, , \tag{2}$$

Where Ci represents an individual trait of an expert, and wi represents weight coefficient of the individual trait.

The second, most often used approach (Đorović, 2003: 158; Božanić, 2016: 41) represents the calculation of objective competence coefficient by using the expression (3):

$$K_{\partial} = \frac{1}{10} \frac{\sum_{i=1}^{n} C_i w_i}{\sum_{i=1}^{n} w_i}, \tag{3}$$

Having in mind that authors, when determining the final competence of an authors, and when evaluating individual traits of experts, predominantly take over existing weight coefficients of competence elements (segments, criteria, traits), and that they can be determined through the engagement of other experts who used to deal or who deal with the methodology of expert evaluation (Milićević, 2014, p. 94), this paper aims to determine weight coefficients of elements of experts' competence evaluation and individual traits of experts, which make an objective evaluation, as well as to define new methodologies of determining final evaluation of experts' competence that will be adapted to researches in the field of Military Science. It is important to note that the subject of this work is not aimed at defining the validity of existing traits of individual competence, but it analyses their influence on the final evaluation of experts' competence, while the said validity is to be the subject of future research of the author.

To enhance the existing methodology of defining evaluation of experts' competence, a model is defined consisting of five stages, where each phase encompasses several steps that are necessary to be implemented in order to achieve the goal of the research (Figure 1).

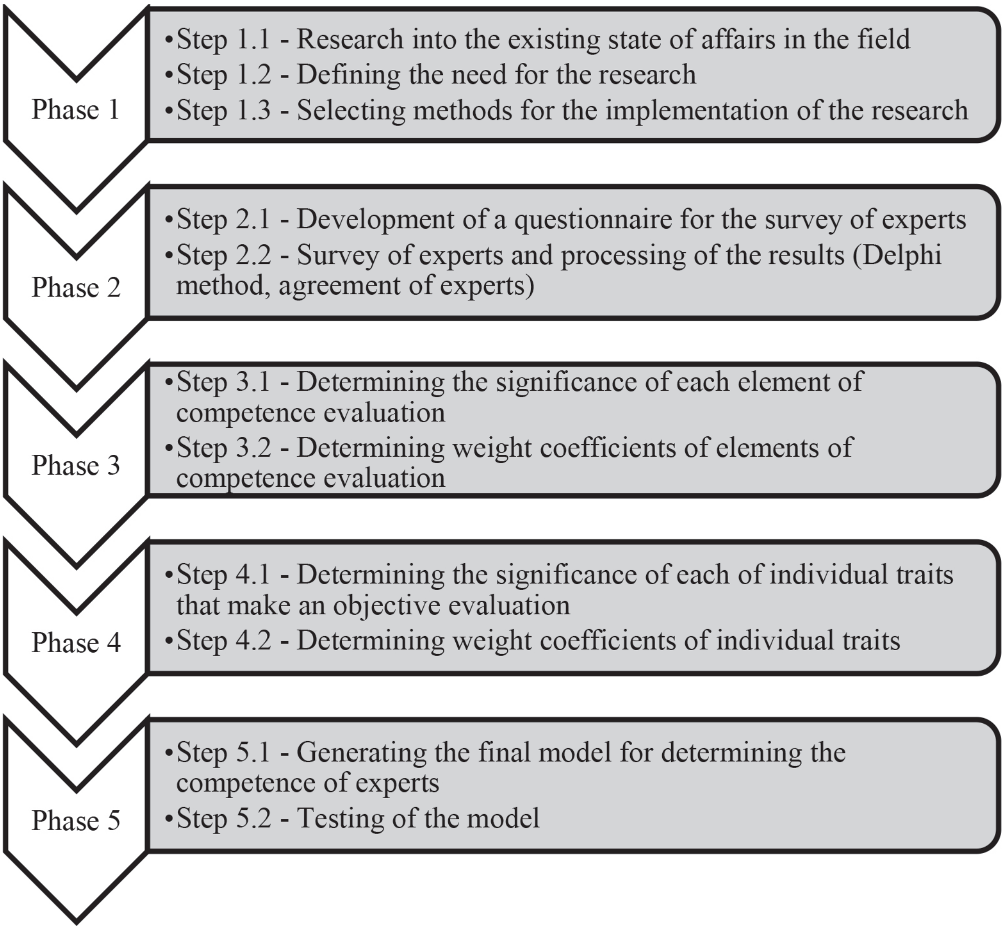

Figure 1 – *Model for determining the competences of experts that was used in the research*

Description of methods used

On the basis of the existing state in the field of research (Đorović, 2003: 155-160; Božanić, 2016, pp. 38-44; Kovačević, 2020, pp. 113-123; Saković, 2021, pp. 156-157; Bajrami, 2022, pp. 192-196) and the need to formulate the methodology for determining the competence of experts and their evaluations in the field of Military Science, the defining of the model that will treat this area was initiated. Following the phases and steps of the model presented in Figure 1, a questionnaire was produced for the survey of experts using Delphi method.

The Delphi method was created in the middle of 20th century in the RAND Corporation with a view of achieving consensus within an expert group (Dalkey & Helmer, 1963), i.e. "as a tool for the prediction of future events using a series of intensive questionnaires interspersed with feedback information of control opinion" (Custer et al., 1999). The method and the manner of its use is described in different studies (Linstone, 1985, p. 626; Mučibabić, 2003, pp. 110-112; Eret, 2017; Božanić, 2016, p. 45).

With expert evaluation, it is necessary to ensure the concurrence of experts' assessments. The analysis of the concurrence of experts' assessments, for the purpose of this work, is done through the application of the coefficient of concordance and determining the evaluation of the significance of the subject coefficient using $\chi 2$ distribution. The authors opted for this manner of testing the concurrence of experts because of the specificities of the problem of the research in the paper, and the number of experts who had taken part in the given research. Namely, if opinions of two experts are compared, correlation coefficient is used to determine their concurrence, while in the case of a greater number of experts, it is more appropriate to use the concordance coefficient (Podvezko, 2007; Milićević, 2014, p. 110; Chegodaev, 2010).

According to Podvezko (Podvezko, 2007), experts' opinions should be presented in a form of ranking, and if not, their preliminary ranking is necessary. In the continuation the application of this methodology for determining .

In a set of experts' assessments $D=\left\|d_{ij}\right\|,\ i=\left(\overline{1,m}\right),\ j=\left(\overline{1,r}\right)$, where i designates the number of elements that are evaluated, and j is the number of experts. If there are two same ranks in the ranking, both are represented as their arithmetical average. The concordance coefficient is directed towards the sum of ranks of a certain element that all experts have evaluated:

$$d_i=\sum_{j=1}^{r} d_{ij},\ i=\left(\overline{1,m}\right), \tag{4}$$

and the sum (S) is derived using the expression (5):

$$S=\sum_{i=1}^{m}\left(d_i-\overline{d}\right)^2, \tag{5}$$

Where the intermediate value is ($\overline{d}$):

$$\bar{d} = \frac{\sum_{i=1}^{m}\sum_{j=1}^{r} d_{ij}}{m} \quad . \tag{6}$$

If it is supposed that all the experts have evaluated all elements in the same manner, then the most significant element is ranked first, and the sum of ranks of this element in the evaluations of all the experts is equal r, while the sum of the second-ranked element has the value $2r$ and so on, while the sum of the last ranked element is rm, which represents an ideal situation of concordance. The sum of ranks m of the elements observed, evaluated by r experts, can be presented in the following manner:

$$\sum_{i=1}^{m} d_i = \frac{1}{2} rm\left(m+1\right), \tag{7}$$

Where the intermediate value is ($\bar{d}$):

$$\bar{d} = \frac{1}{2} r\left(m+1\right). \tag{8}$$

On the basis of the previously given, and the expression (5), the greatest possible value of the sum (S_{max}) is derived using the expression (9):

$$S_{max} = \frac{r^2 m\left(m^2-1\right)}{12} \quad . \tag{9}$$

The least value of the sum (S_{min}) would be derived if the sum of all elements evaluated by all the experts is equal, and then it is $S = 0$. On the basis of everything previously mentioned, the concordance coefficient (W) can be presented by the expression (10):

$$W = \frac{12S}{r^2 m\left(m^2-1\right)} \quad , \tag{10}$$

where the concordance coefficient, when there is the concurrence of experts' assessments, tends to the value *1*, while in the case of absolute non-concordance it has the value *0*.

Determining the evaluation of the significance of concordance coefficient, for the number of elements evaluated by the experts $m \le 7$, is done using previously defined tabular values $\chi 2$ distribution, on the basis of the degree of freedom and confidence (Milićević, 2014, p. 111; Podvezko, 2007), while the number of elements evaluated by the experts $m > 7$, is determined using $\chi 2$ расподеле, distribution, according to the expression (11):

$$\chi 2 = Wr(m-1) = \frac{12S}{rm(m+1)} \tag{11}$$

with the degrees of freedom $m-1$ (Podvezko, 2007).

If there are values of elements with same ranking, their value becomes the value of arithmetical average of the both, and the value of $\chi 2$ distribution is defined in accordance with the expression (12):

$$\chi 2=\frac{12S}{rm(m+1)-1/(m-1)\sum_{j=1}^{r}T_j}, \qquad (12)$$

Where the indicator of tied ranks (T_j) is derived using the expression (13):

$$T_j=\sum_{p}^{H_j}\left(t_p^3-t_p\right), \qquad (13)$$

where H_j is the number of equal ranks of j^{th} expert, and t_p designates the number of equal ranks in the expert group.

If the tabular value of the critical distribution $\chi_{kr}2$, by a degree of freedom $m-1$, (Podvezko, 2007), less than the value $\chi 2$ which is derived by using the expression (11) or (12), then the experts' assessments are in concurrence, meaning that there is the consensus among the experts. The tabular values of the critical distribution can be derived $\chi_{kr}2$ by means of the software Microsoft Office Excel by using the formula (Elfeki, 2018):

CHISQ.INV.RT(probability,deg_freedom). (14)

In case that there is no concurrence of expert opinions, and yet their final concurrence is to be reached, the experts, whose opinions, notwithstanding additional harmonisation, significantly deflect from the opinion of other experts, are dismissed, and the calculation of concordance is repeated until the concurrence is reached.

The expert opinions are aggregated using EWAA operators (Deveci et al., 2023), expression (15).

$$EWAA\left\{x_1,x_2,...,x_j\right\}=\sum_{j=1}^{e}x_j^e\frac{\prod_{j=1}^{e}\left(1+f\left(x_j^e\right)\right)^q-\prod_{j=1}^{e}\left(1-f\left(x_j^e\right)\right)^q}{\prod_{j=1}^{e}\left(1+f\left(x_j^e\right)\right)^q+\prod_{j=1}^{e}\left(1-f\left(x_j^e\right)\right)^q}, \qquad (15)$$

where $\left\{x_1,x_2,...,x_j\right\}$ represents the set of expert opinions, where $q=1/e$ is when all the experts (e) have the same evaluation of competence, or $q=w^e$ when they have different evaluations of competence (w^e).

The value of weight coefficient of elements of experts' assessment is derived using FUCOM method (Pamučar et al., 2018). Because of simple mathematic apparatus and reliable output results, the method has been used so far in a large number of researches for defining weight coefficients of the criteria. More information on the method and its implementation in different fields can be found in (Pamučar et al., 2018; Božanić et al., 2019; Stević & Brković, 2020; Božanić et al., 2021; Ocampo, 2022; Radovanović et al., 2023).

The calculation of the weight of individual traits of experts, in the framework of objective evaluation, is done using subjective methods by the application of ranking, and by means of the following methods (Milićević & Župac, 2012): inverse weighting (IWM), centroid ranking (CRM), linear weight with variable direction coefficient (LWM), geometric weights (GWM) and rank sum (RSM). The final values of weights were derived by the aggregation of weights obtained through each of the abovementioned methods, using EWAA operator.

The specificity of the research problem conditioned the use of methods of multicriteria decision making CODAS (Keshavarz Ghorabaee et al., 2016; Alkan & Kahraman, 2024), COPRAS (Zavadskas et al., 2008; Mishra et al., 2024), ARAS (Zavadskas & Turskis, 2010; Chen et al., 2023) and CoCoSo (Yazdani et al., 2019; Badi et al., 2023) for the ranking of elements of individual traits of objective evaluation, while the final ranking was achieved through the aggregation of ranks of the given methods using EWAA operator (Deveci et al, 2023). The weight coefficients of elements of individual traits of experts were derived in the same manner as with the elements of objective evaluation.

While aggregating experts' opinions, the concurrence of experts was checked by the concordance coefficient. Experts' opinions that significantly deviated from the opinions of other experts were rejected.

The final evaluation of the competence of experts is derived using the expression (16):

$$K = w_o K_o + w_f K_f + w_s K_s, \tag{16}$$

where: o - stands for objective evaluation, f - stands for factors that influence experts' opinion, s - is subjective evaluation, weight coefficient of assessment element, and K - stands for the calculated value of each element. The objective evaluation consists of 10 individual traits, represented in the Table 1, while the elements of individual traits can be found in (Milićević, 2014; Božanić, 2016; Đorović, 2003).

Table 1

Individual traits of experts in the field of Military Science (adapted by the author according to: Milićević, 2014, pp. 99-103; Božanić, 2016, p. 41; Đorović, 2003, p. 155)

Individual trait of an expert
K_o^1 – Level of education
K_o^2 – Reckonable service
K_o^3 – Current duty
K_o^4 – Previous duties
K_o^5 – Published scientific and professional papers

Individual trait of an expert
K_o^6 – Expert activities outside working place
K_o^7 – Rewards received
K_o^8 – Average service evaluation
K_o^9 – Participation in combat actions
K_o^{10} – Participation in the performance of tasks related to the research problem

Factors that influence expert's opinion encompass sources that influence the expert, with the degree of influence, while subjective evaluation represents the self-evaluation of the degree of knowledge in the field of research. In the continuation of the paper, the research results are presented as well as a discussion on the obtained results.

Results and discussion

For the purpose of this paper, 25 experts were surveyed who dealt with expert evaluation in their research. They are former and present officers and professors of the Military Academy of the University of Defence in Belgrade, doctorate degree-holders in different fields, and different titles. They were requested to rank elements of evaluation, elements of objective evaluation and elements of each individual trait of an expert, and to define their significance in relation to the first-ranking element at each level.

After the survey results had been processed, by applying concordance coefficient, expressions (4)-(14), opinions of four experts were rejected because of a great deviation from opinions of other experts, which enabled reaching the concurrence. Further calculation was based on expert opinions of 21 experts $E=(E_1, E_2,...,E_{21})$.

Acknowledging the phases and steps of the proposed model, defining weight coefficient of elements of competence evaluation was carried out by means of FUCOM method. Analysing expert opinions, three groups of experts who shared identical opinion regarding the significance of the elements. For each of the groups, significance of elements was aggregated by applying EWAA operators, expression (15). Having in mind that the subject of the research is to define evaluation of expert competence, all experts were assigned the same evaluation value so that their opinion would have equal influence on the final decision. By defining weight coefficients of elements for each group and through the aggregation of derived values, also by means of EWAA operators, final values were defined of the weight of elements of competence evaluation (Table 2).

Table 2

The final values of the weight coefficients of the elements of the assessment of the competence of experts in the field of Military Science

Element of	Weight (w)
Objective evaluation (K_o)	0,418
Factors that influence the forming of opinion (K_f)	0,321
Subjective evaluation(K_s)	0,261

The derived weight coefficients differ in relation to previous researches, meaning that the influence of the elements of objective evaluation (which used to greatly influence the final evaluation - 60% participation in the decision), but the influence of other evaluation elements was increased, while the ranking remained the same. After defining the weight of fundamental elements of evaluation (Table 2) defining of the weight of elements of objective evaluation was carried out.

Having in mind that there is the concurrence of expert opinions regarding the significance (ranking) of individual traits that make an objective evaluation, which was calculated using concordance coefficient, expressions (4)-(14), subjective methods were used to calculate weight coefficients of individual traits for each expert. The values of weights of individual traits, for all experts, by methods, as well as derived values for each of the methods, were aggregated by means of EWAA operator, expression (15), through which the final ranking was obtained as well as the weights of individual traits of experts (Table 3).

Table 3

Rank of individual traits and their weights

Individual trait of an expert	LWM (w)	IWM (w)	CRM (w)	RSM (w)	GWM (w)	EWAA (w)	Rank
K_o^1 Level of education	0,125	0,199	0,189	0,145	0,198	0,171	1
K_o^2 Reckonable service	0,092	0,069	0,071	0,085	0,069	0,078	7
K_o^3 Current duty	0,095	0,073	0,078	0,091	0,076	0,082	6
K_o^4 Previous duties	0,113	0,112	0,124	0,123	0,126	0,12	4

Individual trait of an expert	LWM (w)	IWM (w)	CRM (w)	RSM (w)	GWM (w)	EWAA (w)	Rank
K_o^5 Published scientific and professional papers	0,1	0,072	0,082	0,1	0,078	0,086	5
K_o^6 Expert activities outside working place	0,086	0,057	0,056	0,074	0,051	0,065	9
K_o^7 Rewards received	0,075	0,046	0,039	0,056	0,035	0,05	10
K_o^8 Average service evaluation	0,085	0,071	0.066	0,074	0,064	0,072	8
K_o^9 Participation in combat actions	0,109	0,129	0,127	0,116	0,128	0,122	3
K_o^{10} Participation in the performance of tasks related to the research problem	0,12	0,172	0,168	0,136	0,175	0,154	2

As it can be seen in Table 3, rank (the significance) of individual traits differ in comparison to previous research. Though the trait “Level of education” still is the most significant, individual traits “Participation in the performance of tasks related to the research problem” and “Participation in combat actions” have, when compared to previous researches, increased their significance and now they are second and third-ranking traits, which is only natural, having in mind that the subject of research belongs to the field of Military Science.

The next step is to determine weight coefficients of the elements of each individual trait which was done in a similar way to defining the weights of individual traits, in the following manner:

1. first, (aggregated) ranks were defined that were determined by experts for each element using methods CODAS, ARAS, COPRAS and CoCoSo, where: in multicriteria model experts were defined instead of the criteria, evaluation of expert competence (as equal) were defined instead of weight coefficient of the criteria, and the criteria character (of experts) was of cost type.
2. then, the ranking, obtained using the method of multicriteria decision making, was aggregated using EWAA operators, expression (15), by which final ranking of the elements of individual traits was obtained;

3. after obtaining the final ranking, subjective methods (Milićević & Župac, 2012) were applied to determine weight coefficients of elements, whereat each of the methods was used, and the results that were obtained were also aggregated using EWAA operator. Through said aggregation, final values of the weights of the elements of individual traits of experts were obtained.

The final values of the weight coefficients of the elements of individual traits which make the objective evaluation are given in Table 4.

Table 4
Final values of the elements of individual traits (t represents the number of individual traits)

	K_o^1	K_o^2	K_o^3	K_o^4	K_o^5	K_o^6	K_o^7	K_o^8	K_o^9	K_o^{10}
K_o^{t1}	0,304	0,166	0,331	0,283	0,331	0,368	0,304	0,420	0,283	0,331
K_o^{t2}	0,207	0,124	0,166	0,194	0,224	0,244	0,207	0,271	0,162	0,223
K_o^{t3}	0,156	0,092	0,223	0,148	0,166	0,176	0,156	0,186	0,181	0,166
K_o^{t4}	0,121	0,331	0,124	0,092	0,124	0,126	0,121	0,123	0,098	0,124
K_o^{t5}	0,092	0,223	0,092	0,072	0,091	0,086	0,092		0,076	0,092
K_o^{t6}	0,070	0,064	0,064	0,117	0,064		0,07		0,106	0.064
K_o^{t7}	0,050			0,055			0,05		0,055	
K_o^{t8}				0,039					0,039	

After obtaining the value of the weights of all individual traits and their elements, it is necessary to calculate the value of the objective evaluation of an expert. The value of the objective evaluation (K_o) is calculated using the expression:

$$K_o = \sum_{i=1}^{10} K_o^i , \quad (17)$$

where the values of individual traits (K_o^i) are derived in the following manner:

1) for weight coefficients of individual traits K_o^4, K_o^6 and K_o^7:

$$K_o^i = \sum_{j=1}^{n} w_o^{ij} , \quad (18)$$

where n represents the number of elements of an individual trait, w_o^{ij} is the weight coefficient of each individual element;

2) for weight coefficients of individual traits K_o^1, K_o^2, K_o^3, K_o^5, K_o^8, K_o^9 and K_o^{10}:

$$K_o^i = \sum_{j=1}^{n} \upsilon_o^{ij}, \tag{19}$$

where n represents the number of elements of an individual trait, while υ_o^{ij} is modified value of the weight coefficient of each individual element, which is obtained by applying expression (20):

$$\upsilon_o^{ij} = \frac{w_o^{ij}}{w_o^{ij+}}, \tag{20}$$

where w_o^{ij+} represents the maximal value of weight coefficients of the elements of the individual trait of experts.

The overall evaluation of the competence of experts is derived using the expression (16). Values of factors that influence expert opinion K_f are obtained by adding defined weights of each element in the framework of the factors responding to the sources of influence on expert opinion (Table 5).

Table 5
Factors influencing expert opinion (adapted by the author according to: Milićević, 2014, p. 98; Božanić, 2016, p. 185; Đorović, 2003, p. 158)

	Degree of influence			
Source of the influence on expert's opinion	1 – high	2 – medium	3 – low	4 – no influence
Theoretical analysis	0,25	0,2	0,1	0
Experience (peacetime)	0,25	0,2	0,1	0
Experience (in combat actions)	0,3	0,2	0,1	0
Papers in the country	0,05	0,05	0,05	0
Papers abroad	0,05	0,05	0,05	0
Degree of development abroad	0,05	0,05	0,05	0
Intuition	0,05	0,05	0,05	0

The value of subjective evaluation represents the self-evaluation of an expert in terms of the knowledge of the research subject, which the expert adopts from the set $K_s \in \{0.1, 0.2, ..., 1\}$, where value *0.1* represents the lowest, and *1* the highest degree of the knowledge of the field.

It is necessary for the evaluation of expert competence to be higher than 0.5, in order to state that the expert is competent in the field of research; otherwise, the opinions of this expert are not taken into consideration (Božanić, 2016, p. 44; Đorović, 2003, p. 160). Also, in order to use the evaluation of experts' competence, in different methods for the aggregation of group decisions, the evaluations obtained through a proposed methodology can be normalised by additive normalisation (Srđević & Kolarov, 2005), so that they meet the condition $\sum_{e=1}^{l} K^e = 1$, rwhere *e* is the number of experts, K^e is the evaluation of expert's competence, and *l* is the overall number of the experts. In the continuation of the paper, the testing of the proposed methodology is carried out for the purpose of validation.

Testing of the model

Let there be three experts in the field of $E = (E_1, E_2, E_3)$ who are identified to resolve a decision-making problem. The description of qualifications, factors that influence their opinion and subjective evaluation are given in Table 6. The first expert has maximal performance, the second minimal, and the third's performance is little above the average.

Table 6
Description of experts' qualifications, factors influencing their opinion and subjective assessment

	K_o	K_f	K_s
E_1	The expert holds a doctorate degree, with more than 30 years of work experience, currently serving as a Head of Department within the MoD; until the present, he was assigned to all duties at all levels of command and management, and he teaches at the Military Academy; he has published a book; he is the President of the branch board; he is a member of the Editorial board of scientific-professional journals and a member of a scientific council; he is a member of an association of experts, who participated in the drawing up of regulations governing the field of research; he has completed a course that lasted at least four mounts; he has participated in numerous symposiums and counselling as an author and lecturer; he has been rewarded at all levels of command and management, and at all levels, both national and international; his last service evaluation was 5,00; he was participating in combat actions for three years, performing activities related to the problem of the research; he has participated in peacetime exercises that were related to the subject of the research.	A high degree of influence of all sources on the expert's opinion.	1
E_2	The expert has completed a high vocational military school, and has been working effectively for three years; he performs the duty of a squad commander; he has been assigned as company quartermaster sergeant; up till now he has not published any papers, nor is he a member of any association, council and similar; he has not participated at conferences or counselling; he has not been rewarded so far, and his last service evaluation was 2.45; he has not participated in combat actions or exercises related to the subject of research.	There is no influence of any source on the expert's opinion.	0,1
E_3	The expert has completed the Command-Staff Course, with 25 years of work experience; he is currently assigned as a battalion commander; up till now, he has been assigned to all the duties up to battalion level, including the duty of deputy commander; he has published one paper at a conference; he is a member of the branch board and he has participated in the drawing up of regulations governing the field of research; he has participated in one scientific conference as an author and lecturer; he has been rewarded at all levels of command and management, including rewards from the Army Commander; his last service evaluation was 4.52; he was participating in combat actions for about three months, but the activities he performed were not related to the problem of the research; he has participated in 4-5 peacetime exercises related to the subject of the research.	Medium degree of influence of theoretical analysis and experience: medium degree of the influence of papers, international development and intuition.	0,8

On the basis of data given in Table 6, and through the use of expression (11)-(20), and values defined by weight coefficients of objective evaluation elements (Tables 3 and 4), the following values of the objective evaluation of the experts have been derived (Figure 2).

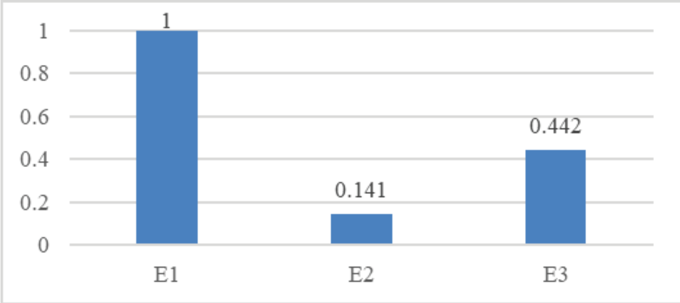

Figure 2 – *Values of the objective assessment of experts (K_o)*

Taking into account the data from Tables 5 and 6 the values are obtained of the factors influencing experts' opinions (Figure 3). Subjective evaluation (K_s) is given in the Table 6 for each expert.

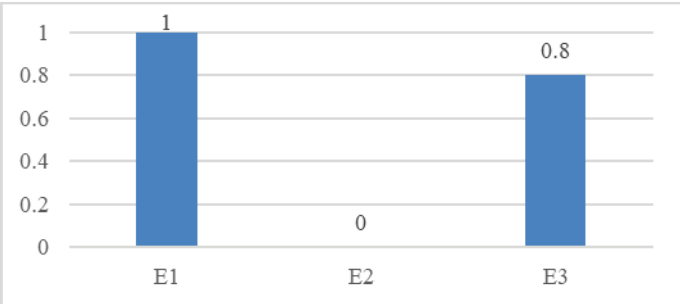

Figure 3 – *Values of factors influencing expert opinion (K_f)*

Through the application of expression (16) the final evaluation of experts' competence is obtained (Figure 4).

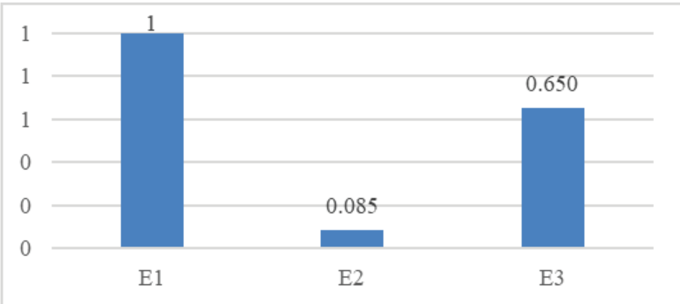

Figure 4 – *The final values of the experts' competence ratings (K)*

On the basis of the data from Figure 4, it can be deduced that expert 2 does not have sufficient competences to participate in the solving of the given decision-making problem, having in mind that his evaluation of competence is less than 0.5. The other two experts are competent.

Also, on the basis of the illustrative example, the suggested methodology was verified that is in relation to input data. The expert with maximal performance has the maximal value of competence evaluation, while the expert with minimal performance has the minimal evaluation value.

Conclusion

Starting from earlier researches conducted in the field of evaluation of experts, and the specificities of the field of Military Science, and through the analysis of the existing competence defining models, an improved and partially innovative model has been generated to calculate the evaluation of experts' competence. The model was developed through research that included the engagement of not a small number of experts who had been dealing with expert evaluation and application of different methods of multicriteria decision-making and other methods to determine weight coefficients of criteria and the aggregation of group decisions, as well as the methodology for determining the concurrence among experts.

The analysis of obtained results confirmed the need for the conduct of this research, given that certain elements of the evaluation of experts' competence specific to Military Science have had much greater influence on the final decision in comparison to the existing models. The suggested model was tested on an illustrative example, which proved the validity of the methodology.

It is possible to further enhance the presented model through the review of individual traits of objective evaluation, and their elements. The conclusion of this paper is that it is possible to use the existing manner of defining competence, but the presented model offers a better and clearer "image" of an expert. In addition, a conclusion is drawn that the said model can be used in real life situations where expert evaluation is applied and when the subject of research belongs to the field of Military Science.

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Summary

The research on determining the competences of experts in the field of Military Sciences represents a significant contribution to the understanding of the specificity and importance of expert evaluation in that field. Considering the complexity and seriousness of research problems in this area, it is necessary to have a clearly defined model for assessing the competences of experts in order to ensure the relevance and quality of research results.

First, it is important to emphasize that each scientific discipline requires its own approach, theoretical framework, language and methodology. In the context of Military Sciences, where researchers are often faced with complex questions and problems, it is crucial to develop a model that will adequately evaluate experts based on the specific requirements of this field.

This paper deals with determining the competences of experts in Military Sciences investigates the influence of individual elements on their competence. A model was created to define the assessment of expert competence, and research was conducted to identify the impact of each individual element. Various subjective ranking methods were used, as well as multi-criteria decision-making methods such FUCOM (Full Consistency Method), CODAS (Combinative Distance based Assesment), COPRAS (Complex Proportional Assessment), ARAS (Additive Ratio. Assessment) and CoCoSo (Combined. Compromise Solution), as well as the EWAA (Einstein weighted arithmetic average) operator for aggregation of group decisions.

To achieve agreement among experts, the Delphi method was applied, while the concordance coefficient was used to assess the degree of agreement between their ratings. All these steps enabled the formation of a valid model that was tested on an illustrative example, demonstrating its applicability in real life.

This paper represents a significant contribution to the scientific field of Military Science, providing support to researchers who rely on expert judgment in their research. The developed model not only provides a model for evaluating the expertise of experts, but also opens the door for further research and improvement of methodology in this area. The precise determination of experts' competencies contributes to a deeper understanding of military issues and to the improvement of security and efficiency in this key sector. The implementation of this model enables the systematic assessment of experts' competencies, providing a comprehensive approach to the complexity and specificity of Military Sciences. This research not only contributes to the improvement of expert evaluation, but also to a wider understanding and improvement of the field of Military Sciences. Its application encourages a more complete and efficient approach to the challenges facing this field, thus contributing to its further development and improvement.

Key words: *competences, experts, Military Sciences, concordance, EWAA, FUCOM, CODAS, COPRAS, ARAS, CoCoSo*