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Determining the Main Resilience Competencies by Applying Fuzzy Logic in Military Organization

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Abstract: Military training programs have been developed to enhance soldier resilience competencies, which are necessary for soldiers to perform their duties effectively under stress. The ongoing military conflict in Ukraine and the experience of previous military missions abroad emphasize the need for effective training that helps soldiers recover quickly and continue their missions. However, selecting the most suitable resilience training program is challenging and the selection criteria need to be optimized to ensure the most needed competencies are considered. This study aimed to utilize a fuzzy MCDM method to establish the priority weight of decision-making criteria, identifying the core competencies necessary for soldier resilience training, and utilizing the fuzzy TOPSIS method to rank and select the most appropriate training program. The evaluation results were calculated using the MATLAB (R2020b) mathematical package developed by MathWorks. The application of the hierarchical MCDA model based on fuzzy sets theory indicated that mental agility is the most important competence in high-stress environments. The study found that the Mindfulness-Based Mind Fitness Training (MMFT) program, which is intended to regulate soldiers' emotions, had the highest rank among evaluated options according to the combined FAHP sub-factor fuzzy weights and alternatives evaluation conducted using FTOPSIS. The study provides valuable information on the selection of military resilience training programs.

Keywords: fuzzy logic; multi-criteria decision analysis; FAHP; FTOPSIS; resilience competencies; military organization

MSC: 03B52; 90B50; 90B90; 90C29; 90C31

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1. Introduction

The development of resilience competence in the military is based on the premise that resilience is not a fixed state, but rather an ongoing process of learning and adapting [1]. Considering resilience as an individual's capacity to adapt positively to stressful situations creates both ambiguity and uncertainty when selecting the most ideal resilience training program and deciding which competencies need to be trained for resilience. As a solution to this challenge, fuzzy logic can be applied.

This study addresses the efficacy of resilience competence-building programs in the military when preparing for an actual conflict environment. The ongoing conflict in Ukraine, characterized by active hostilities (2014–2015), trench warfare (2016–2022) [2], and a large-scale Russian invasion of Ukraine (2022 and ongoing) [2,3], underscores the need for long-term resilience among soldiers and raises questions about the effectiveness of resilience competency-building programs based solely on data from military training and missions abroad. The motivation for this research comes from the shortage of studies that address the challenge of evaluating the soldiers' resilience competence development based on fuzzy logic rules. Furthermore, there are no established guidelines for military organizations to identify and prioritize those resilience competencies which require attention.

A set of factors and sub-factors related to soldiers' resilience were collected, and weights were assigned to each using the input of Ukrainian and Lithuanian military psychologists. A range of reports in the literature support the importance of dispositional attributes, beliefs, attitudes, and coping behaviors in resilience building [4]. Competencies such as self-awareness, self-regulation, optimism, mental agility, character strength, and connection have been identified as crucial contributors to resilience [5,6]. Experts agree that the unique composition of these competencies is essential for the resilience of soldiers in different military environments. When using a single expert decision-making approach, the basic homogeneous pairwise comparison within an MCDM framework is insufficient to accurately capture a decision maker's true perception with adequate effectiveness and precision; therefore, more advanced methods must be employed [7,8]. As such, experts' decisions regarding which competencies to include in resilience training programs can be considered applications of multi-criteria decision making (MCDM). The analytic hierarchy process (AHP) MCDM model is mostly useful for obtaining and using the weightings of factors and sub-factors in decision making [9]. Since pure AHP models do not deal with uncertainty, fuzzy techniques need to be integrated into the AHP to overcome inaccuracy in decision making [10]. The application of fuzzy set theory leads to higher accuracy in the analysis of human cognitive processes, converting linguistic judgments into fuzzy pairwise comparison matrixes [11]. The application of fuzzy set theory to the AHP to find the best solutions to compose training programs is increasing with research on curriculum development [12] and its use in distance learning [13,14]. Hybrid models continue to be researched, and techniques such as the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) are used for explaining military problems. Several studies have used the AHP with the TOPSIS for multi-criteria decision making for military research purposes, including selecting new military personnel for the Indonesian Air Force [15], evaluating air combat effectiveness [16], and selecting military training aircrafts for the Spanish Air Force Academy [17]. However, while these studies have used the AHP, ANP, or TOPSIS to calculate the weights of criteria, these methods have not yet been applied in the context of soldiers' resilience competencies and skill selection. To address this gap, this study uses a fuzzy TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) technique, which is proven to lead to the best alternative that is closest to the optimal solution according to the criteria specified [18,19]. Therefore, the use of hybrid multi-criteria decision-making methodology in this study provides a more robust and comprehensive approach. By employing the fuzzy analytic hierarchy process (FAHP) to determine the fuzzy weights of factors and sub-factors, and the fuzzy TOPSIS to select the best training program among similar options, we intended to select the most appropriate training program for enhancing soldiers' resilience competencies and skills.

The primary objective of this study was to use a fuzzy MCDM method to identify the main competencies required for soldier resilience training, and the fuzzy TOPSIS method was applied to rank and select the most suitable training program. The application of fuzzy logic rules allows for a holistic approach and generates considerably clearer outcomes compared to traditional statistical models [8,20,21]. Aimed at assessing resilience competencies, the integration of fuzzy sets theory for resilience competencies assessment can be deemed as the goal of this research, which included: (a) assessing the relative importance of competencies and skills using FAHP; (b) modelling competencies and skills' values using fuzzy sets theory; (c) defining the overall index with fuzzy operators; and (d) identifying soldier resilience training programs that effectively promote soldiers' resilience in an actual combat environment by applying fuzzy TOPSIS. By applying the fuzzy MCDM methodology, objectivity was achieved in selecting which competencies to develop in army resilience training programs. The results of this study are crucial to developing more appropriate resilience building programs that lead to increased effectiveness among soldiers.

2. Preliminaries

2.1. The Fuzzy Sets Theory

Zadeh [22] first introduced the theory of the fuzzy set to deal with vagueness of human judgment. The fuzzy set (FS) is focused on the reasonableness of uncertainty due to inaccuracy or vagueness. The FS theory and fuzzy logic are now known as effective mathematical tools for multi decision criteria modeling and provide a major support for vague data analyses [23]. FSs allow partial membership and fuzzy numbers can be described by a specified interval of real numbers, each with a position of relationship between zero and one [24]. Concrete characterizations are used to describe fuzzy numbers. Typically, to explain fuzzy numbers, two definitions can be used.

Definition 1. *Let N ∈ F(R) be entitled a fuzzy number if* $x_0 \in R$ *exist such that* $\mu_N x_0 = 1$, *where for any α ∈ [0, 1],* $A_\alpha = x, \mu_{A_\alpha}(x) \geq \alpha$ *is a closed interval. All fuzzy numbers are characterized by F(R) sets, where R represents the set of real numbers.*

Definition 2. *A triangular fuzzy number (TFN) is designated following the specific design of number N = (l, m, u) and membership function* $\mu_N(x)$*: R →[0, 1]:*

$$\mu_N(x) = \begin{cases} 0, & x < l, \\ \frac{x}{m-l} - \frac{l}{m-l}, & x \in [l, m], \\ \frac{x}{m-u} - \frac{l}{m-u}, & x \in [m, u], \\ 0 & , x > u. \end{cases} \quad (1)$$

where $l \leq m \leq u$, *l is the lower and u is the upper value of the N, and m is the middle value of N. The set of elements* $\{x \in R | l < x < u\}$ *are supporting N. Therefore, by agreement, when l, m, and u are equal, N is a non-fuzzy number. In this study, the decision makers' assessments were collected by linguistic values, but for decision analysis, the triangular fuzzy numbers shown in Table 1 were used.*

Table 1. The triangular fuzzy numbers for pairwise comparison matrix.

Linguistic Value	Triangular Fuzzy Number	RTFN [1]
Elements are equally important (EI)	(1,1,1)	(1,1,1)
One element is equally moderately important to another (EMI)	(1/2,1,3/2)	(2/3,1,2)
One element is less important than another (WI)	(1,3/2,2)	(1/2,2/3,1)
One element is moderately more important than another (MI)	(3/2,2, 5/2)	(2/5,1/2,2/3)
One element is moderately more important than another (MSI)	(2,5/2,3)	(1/3,2/5,1/2)
One element is more important than another (SI)	(5/2,3,7/2)	(2/7,1/3,2/5)
One element is much more important than another (VSI)	(3,7/2,4)	(1/4,2/7,1/3)
One element is much, much more important than another (VS)	(7/2,4,9/2)	(2/9,1/4,2/7)
One element is entirely more important than another (ES)	(4,9/2,9/2)	(2/9,2/9,1/4)

[1] Notes: RTFN = reciprocal triangular fuzzy number.

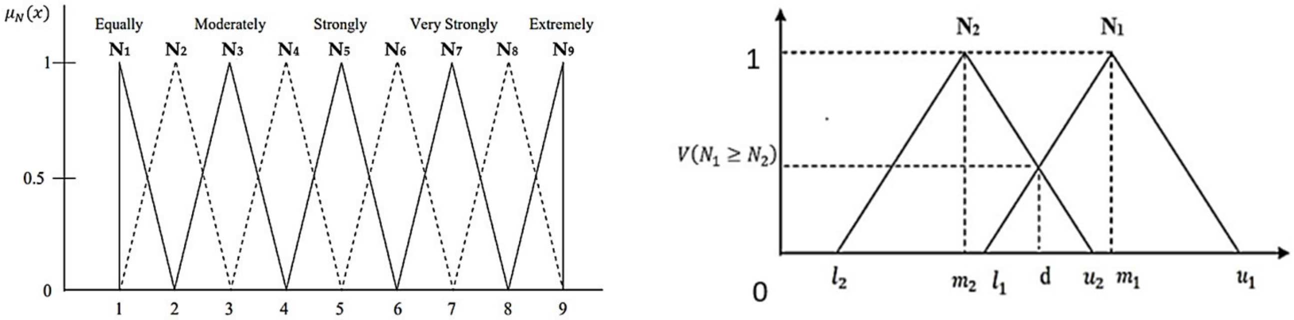
To define two triangular fuzzy numbers $N_1 = (l_1, m_1, u_1)$ *and* $N_2 = (l_2, m_2, u_2)$, the main [18] operational laws can be used (see Table 2).

Table 2. The operational laws used with triangular fuzzy numbers.

Operations with Triangular Fuzzy Numbers	Operational Laws	
$N_1 \oplus N_2, when\ N_1 = (l_1, m_1, u_1)\ and\ N_2 = (l_2, m_2, u_2)$	$(l_1, m_1, u_1) \oplus (l_2, m_2, u_2) = (l_1 + l_2, m_1 + m_2, u_1 + u_2)$	(2)
$N_1 \otimes N_2, when\ N_1 = (l_1, m_1, u_1)\ and\ N_2 = (l_2, m_2, u_2)$	$(l_1, m_1, u_1) \otimes (l_2, m_2, u_2) \approx (l_1 \cdot l_2, m_1 \cdot m_2, u_1 \cdot u_2)$	(3)
$N_1 \otimes \lambda, when\ N_1 = (l_1, m_1, u_1)$	$(l_1, m_1, u_1) \otimes (\lambda, \lambda, \lambda) = (l_1 \cdot \lambda, m_1 \cdot \lambda, u_1 \cdot \lambda), \lambda > 0, \lambda \in \mathcal{R}$	(4)
$N_1^{-1}, when\ N_1 = (l_1, m_1, u_1)$	$(l_1, m_1, u_1)^{-1} \approx (1/u_1, 1/m_1, 1/l_1).$	(5)

Assessment in the pairwise judgement with triangular fuzzy numbers is typically represented by membership functions. For this study, triangular numbers (N_1, N_3, N_5, N_7, and N_9)

were used to characterize the judgement from "equally important" to "entirely more important", and $N_2, N_4, N_6,$ and N_8 were used as the middle opinion values. Therefore, the membership functions of the triangular fuzzy numbers are $N_i = (l_i, m_i, u_i)$ where $i = 1, 2, \cdots, 9$ and where l_i is lower, m_i is middle, and u_i is the upper limit of the N_i fuzzy number. A graphical view of the membership functions is shown in Figure 1.



(**a**) (**b**)

Figure 1. Scheme of triangular numbers description: (**a**) membership functions of the triangular numbers; (**b**) intersection between N_1 and N_2.

The fuzzy degree of judgment can be represented by Δ where $\Delta = u_i - l_i = l_i - u_i$. Moreover, if the value of Δ is larger, it characterizes an upper fuzzy point of judgment. Additionally, if $\Delta = 0$, the result is a non-fuzzy number. Scholars [25] suggest that the Δ value has to be greater than or equal to one half. In this study, we took into account these scholars' suggestions.

2.2. Fuzzy AHP Method

The need to prioritize different decision variables can be determined by applying the triangular fuzzy numbers. The extended analytical hierarchical process (AHP) method was employed to define the absolute priority of weights constructed on triangular fuzzy numbers. Based on the scope analysis method, each object can be used to perform the corresponding scope analysis for each objective. If we define $X = \{x_1, x_2, \cdots, x_m\}$ as an object set and $T = \{t_1, t_2, \cdots, t_m\}$ as a goal set, then the n extent values for each object can be established in the following way:

$$N_{z_i}^1, N_{z_i}^2, \cdots, N_{z_i}^m, \mathrm{I} = 1, 2, \cdots, \mathrm{m}, \tag{6}$$

where

$$N_{z_i}^j = \left(l_{z_i}^j, m_{z_i}^j, u_{z_i}^j\right), j = 1, 2, \cdots, n \tag{7}$$

are the triangular fuzzy numbers (TFN), and extended AHP analysis consists of the following steps:

Step 1: The valuation of fuzzy imitation extents for the i-th object are determined according to the methods of a previous work [26]:

$$S_i = \sum_{j=1}^{n} N_{z_i}^j \otimes \left[\sum_{i=1}^{m}\sum_{j=1}^{n} N_{z_i}^j\right]^{-1}. \tag{8}$$

To obtain the expression $\left[\sum_{i=1}^{m}\sum_{j=1}^{n} N_{z_i}^j\right]^{-1}$, we must complete additional fuzzy procedures with n values of the comprehensive analysis, which is represented by Equations (9) and (10):

$$\sum_{j=1}^{n} N_{z_i}^j = \left(\sum_{j=1}^{n} l_i, \sum_{j=1}^{n} m_i, \sum_{j=1}^{n} u_i\right) \tag{9}$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n} N_{z_i}^{j}\left(\sum_{j=1}^{m} l_i, \sum_{j=1}^{m} m_i, \sum_{j=1}^{m} u_i\right) \tag{10}$$

Moreover, the inverse vector can be calculated by using Equation (11):

$$\left[\sum_{i=1}^{m}\sum_{j=1}^{n} N_{z_i}^{j}\right]^{-1} = \left(\frac{1}{\sum_{j=1}^{m} u_i}, \frac{1}{\sum_{j=1}^{m} m_i}, \frac{1}{\sum_{j=1}^{m} l_i}\right). \tag{11}$$

Step 2: The weight vector below every attribute, using the rule of the evaluation of fuzzy numbers, must be calculated. If we assume that $N_1 = (l_1, m_1, u_1)$ and $N_2 = (l_2, m_2, u_2)$ are the triangular fuzzy numbers, then the possibility that $N_1 \geq N_2$ is determined by

$$V(N_1 \geq N_2) = \sup_{x \geq y}\left[\min\left(\mu_{N_1}(x), \mu_{N_2}(y)\right)\right]. \tag{12}$$

When we can determine the pair (x, y) where $x \geq y$ and $\mu_{N_1}(x) = \mu_{N_2}(y) = 1$, the weight vector can be presented by the equation:

$$V(N_1 \geq N_2) = 1, \quad if\ n_1 \geq n_2. \tag{13}$$

When the pair $m_1 \leq m_2$ and $V(N_1 \geq N_2) = hzt(N_1 \cap N_2)$, the weight vector can be identified using Equation (14):

$$V(N_1 \geq N_2) = \mu(d) = \begin{cases} \frac{l_2 - u_1}{(m_1 - u_1) - (m_2 - l_2)},\ l_2 \leq u_1, \\ otherwise, \\ 0. \end{cases} \tag{14}$$

In Equation (14), the value of d can be described as abscissa of the point D; that is, the maximum connection among N_1 *and* N_2 (see Figure 1b).

Step 3: We must determine vector weights. The possibility of a fuzzy number being bigger than z fuzzy numbers $N_i (i = 1, 2, \ldots, z)$ can be verified by Equation (15):

$$V(N \geq N_1, N_2, \ldots, N_3) = minV(N \geq N_i). \tag{15}$$

We suppose that abscissa d of the point D can be represented by

$$d'(A_i) = \min V(S_i \geq S_k), \tag{16}$$

where A_i is the i-th component of the k-th level and $k = 1, 2, \ldots, n; k \neq i$. Moreover, if we have an n number of components at the k-th level, the weight vector of the k-th level can be determined by Equation (17):

$$W' = \left(d'(A_1), d'(A_2), \ldots, d'(A_n)\right)^T \tag{17}$$

Step 4: The normalized weight vector after the normalization procedure is characterized by Equation (18):

$$W = (d(A_1), d(A_2), \ldots, d(A_n))^T \tag{18}$$

where the weight vector W is representing a non-fuzzy number.

2.3. Consistency Checking

Mistakes made in representing preference relations in pairwise evaluations can lead to misleading judgments. Therefore, consistency checking and measurement of the lack are important themes in preference relations. In the conventional AHP, following scholars' suggestions [27], the consistency of the comparison matrix must be verified. However, many researchers [28–32] have not focused on the consistency examination procedure of the fuzzy AHP preference relation. This can be treated as a weakness of any FAHP that is developed or applied in these investigations. To address this drawback of the fuzzy AHP, other scholars [33,34] have resolved the consistency of fuzzy AHP priority relationships by substituting fuzzy position associations into their equivalent crisp multiplicative priority relationships, and then to check the consistency using Saaty's method. Here, the inconsistency rate of a matrix can be defined by the consistency index (CI) and consistency ratio (CR). According to the rule, if the CR is intolerable, the pairwise assessment should be reconsidered, and if $CR < 0.1$, the comparisons are acceptable, other than the inconsistent judgments, and the pairwise comparison should be revised [35]. The consistency ratio (CR) can be computed using Equation (19):

$$CR = \frac{CI}{RI} \tag{19}$$

where CI represents the consistency index, which shows the deviation from the stability, and RI represents the unplanned consistency index that can be obtained randomly from tables [36].

2.4. The Fuzzy TOPSIS Method

The Technique for Order Preference by Similarity to Ideal Situation (fuzzy TOPSIS) technique is an application of fuzzy logic and fuzzy sets. To conduct fuzzy TOPSIS analysis, the three main sets must first be determined: (1) alternatives $A = \{A_1, A_2, \ldots, A_m\}$, (2) evaluation criteria $C = \{C_1, C_2, \ldots, C_n\}$, and (3) decision makers $DM = \{DM_1, DM_2, \ldots, DM_i\}$. The consequence steps of the fuzzy TOPSIS algorithm can then be presented.

Step 1: Starting with the first step, we have to select the scale for linguistic variables and create the fuzzy rating of a decision matrix. Since the alternatives and criteria can be measured in linguistic terms, the triangular fuzzy numbers (TFN) characterized as linguistic terms by triangular scale can be chosen (see Table 3).

Table 3. Linguistic terms' connection with triangular fuzzy numbers' membership function.

FN [1]	Linguistic Terms	Triangular Scale (L, M, U) [1]
1	VL = Very Low	(1, 1, 3)
3	L = Low	(1, 3, 5)
5	M = Medium	(3, 5, 7)
7	H = High	(5, 7, 9)
9	VH = Very High	(7, 9, 9)

[1] Notes: FN = fuzzy number; L—lower value limit; M—middle value limit; U—upper value limit.

Step 2: Fuzzy linguistic assessments for the selections specified by decision makers and criteria weight must be given set fuzzy ratings by the kth decision maker for the ith alternative, and the jth criterion can be presented by the Equation (20):

$$\check{x}_{ij}^k = \left(a_{ij}^k, b_{ij}^k, c_{ij}^k\right) \tag{20}$$

w_j^k is the weight assigned by the kth decision maker to the jth criterion, which can be presented by the Equation (21):

$$w_j^k = \left\{w_{j1}^k, w_{j2}^k, w_{j3}^k\right\} \tag{21}$$

Step 3: The aggregated fuzzy scores for the alternatives can be calculated using Equation (22):

$$\check{x}_{ij} = \left(a_{ij}, b_{ij}, c_{ij}\right), a_{ij} = \min_k\left\{a_{ij}^k\right\}, b_{ij} = \frac{1}{l}\sum_{k=1}^{l} b_{ij}^k, c_{ij} = \max_k\left\{c_{ij}^k\right\} \tag{22}$$

The aggregated fuzzy weight for a criterion can be presented by Equation (23):

$$w_{ij} = \left(a_{ij}, b_{ij}, c_{ij}\right), w_{ij} = \underset{k}{min}\left\{w_{ij}^{k}\right\}, w_{ij} = \frac{1}{l}\sum_{k=1}^{l} w_{j2}^{k}, w_{ij} = \underset{k}{max}\left\{w_{j3}^{k}\right\} \tag{23}$$

Step 4: The aggregated fuzzy decision matrix is built as specified below:

$$\widetilde{D} = \begin{matrix} A_1 \\ A_2 \\ A_n \end{matrix} \begin{bmatrix} \widetilde{x}_{11} & \cdots & \widetilde{x}_{1n} \\ \vdots & \ddots & \vdots \\ \widetilde{x}_{n1} & \cdots & \widetilde{x}_{nn} \end{bmatrix} \tag{24}$$

where x_{ij} can be described as the aggregated fuzzy rating for the ith alternative.

Step 5: The fuzzy decision matrix normalization procedure is given below:

$$\widetilde{R} = \left[\acute{r}_{ij}\right]_{m \times n} = \begin{bmatrix} \widetilde{r}_{11} & \cdots & \widetilde{r}_{1n} \\ \vdots & \ddots & \vdots \\ \widetilde{r}_{m1} & \cdots & \widetilde{x}_{mn} \end{bmatrix} \tag{25}$$

where

$$\widetilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right); \quad c_j^* = \underset{i}{max} c_{ij} \text{ (benefit criteria)} \tag{26}$$

$$\widetilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right); \quad a_j^- = \underset{i}{min} a_{ij} \text{ (cost criteria)} \tag{27}$$

After that, the linear scale transformation is used, and decision matrix is normalized. This procedure helps to change the TFN interval to [0, 1].

Step 6: The weighted normalized fuzzy decision matrix (WNFDM) is designed.

$$\widetilde{V} = \left[\acute{v}_{ij}\right]_{m \times n} = \left[\acute{w}_j(.)\acute{r}_{ij}\right] = \begin{bmatrix} \acute{w}_1(.)\acute{r}_{11} & \cdots & \acute{w}_n(.)\acute{r}_{1n} \\ \vdots & \ddots & \vdots \\ \acute{w}_1(.)\acute{r}_{m1} & \cdots & \acute{w}_n(.)\acute{r}_{mn} \end{bmatrix} \tag{28}$$

Step 7: Now, the fuzzy positive ideal solution *(FPIS, A*)* and the fuzzy negative ideal solution ($FNIS, A^-$) can be computed. The computations of FPIS and FNIS can be completed using mathematical Equations (29) and (30):

$$A^* = \left\{\widetilde{v}_1^*, \widetilde{v}_2^*, \ldots, \widetilde{v}_n^*\right\} = \left\{\left(\underset{j}{max} v_{ij} | i \in B\right), \left(\underset{j}{\min} v_{ij} | i \in B\right)\right\}, (positive\ ideal\ solution) \tag{29}$$

$$A^- = \left\{\widetilde{v}_1^-, \widetilde{v}_2^-, \ldots, \widetilde{v}_n^-\right\} = \left\{\left(\underset{j}{\min} v_{ij} | i \in B\right), \left(\underset{j}{max} v_{ij} | i \in C\right)\right\}, (negative\ ideal\ solution) \tag{30}$$

where $\widetilde{v}_i^*$ characterizes the *max* value of i across all judged alternatives, and $\widetilde{v}_1^-$ is the *min* value of i across all the alternatives. B and C describe the positive and negative ideal justifications, respectively.

Step 8: The distances between alternatives are calculated. First, the fuzzy positive ideal result A^* and the distances between each alternative have to be calculated. Second, the distances between each alternative and fuzzy negative ideal result A^- are calculated. The distance between the FPIS and study alternatives and the distance between the FNIS and study alternatives can be computed by Equations (31) and (32), respectively:

$$d_i^* = \sum_{j=1}^{n} d(\widetilde{v}_{ij}, \widetilde{v}_j^*) \ i = 1, 2, \ldots, \text{m}; \tag{31}$$

$$d_i^- = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^-)\ i = 1, 2, \ldots, \mathrm{m}; \tag{32}$$

where d represents the distance between two fuzzy numbers. When two triangular fuzzy numbers, (a_1, b_1, c_1) and (a_2, b_2, c_2), are specified, the value among the two criteria can be computed by the Equation (33):

$$d_v\left(\tilde{N}_1, \tilde{N}_2\right) = \sqrt{\frac{1}{3}\left[(a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2\right]} \tag{33}$$

It can be noted that $d\left(\tilde{v}_{ij}, \tilde{v}_j^*\right)$ and $d\left(\tilde{v}_{ij}, \tilde{v}_j^-\right)$ are crisp numbers.

Step 9: The calculation of the closeness coefficient (CC_i) of each alternative judged in the study can be recognized by the computation procedure represented by the equation:

$$CC_i = \frac{d_i^-}{d_i^+ + d_i^-} \tag{34}$$

Step 10: Finally, the alternatives must be ranked according to the CC_i. The great value of closeness index shows a good performance of the alternative [37].

3. Empirical Case Study Methodology

The methodology proposed in this study was basically made up of three steps. First, the decision-making problem for soldiers' resilience assessment were defined. Then, soldiers' resilience competencies and skills were decided. Finally, the judgement hierarchy was produced. The MATLAB (R2020b) mathematical package developed by MathWorks was used to calculate the evaluation results. A detailed evaluation framework for the study based on a hybrid methodology is illustrated in Figure 2.

3.1. Competencies and Skills That Affect Soldiers' Resilience

Research-based principles were applied to define groups of competencies and skills of soldier resilience training. After a comprehensive review of soldier resilience training programs, 14 main skills were chosen. Moreover, these fourteen skills that affect soldiers' resilience competencies were grouped by six characteristics: namely, Self-Awareness $\left(\tilde{c}^1\right)$, Self-Regulation $\left(\tilde{c}^2\right)$, Optimism $\left(\tilde{c}^3\right)$, Mental Agility $\left(\tilde{c}^4\right)$, Strength of Character $\left(\tilde{c}^5\right)$, and Connection $\left(\tilde{c}^6\right)$ [1,5,38]. The hierarchical structure of the soldiers' resilience-building model was designed to represent competencies as main factors, skills as sub-factors, and resilience training programs as alternatives (see Figure 3).

Self-awareness $\left(\tilde{c}^1\right)$ can be represented by $\left(\tilde{c}^{11}\right)$ and $\left(\tilde{c}^{12}\right)$ [39]. $\left(\tilde{c}^{11}\right)$ refers to a soldier's ability to identify the thoughts that arise in relation to a specific active event and the potential consequences of these thoughts: to separate an event from thoughts and consequences (emotions and reactions), in order to better understand their behavior (reactions) in a specific situation. $\left(\tilde{c}^{12}\right)$ refers to a soldier's ability to identify beliefs and values that lead to overly strong emotions and reactions; to conduct an analysis of the negative, sad, depressing aspects of the situation; and to ask themselves: what can they do to change the situation, or is it necessary to discuss the situation with other people?

Self-regulation $\left(\tilde{c}^2\right)$ is represented by three soldier skills, $\left(\tilde{c}^{21}\right)$, $\left(\tilde{c}^{22}\right)$, and $\left(\tilde{c}^{23}\right)$ [40]. $\left(\tilde{c}^{21}\right)$ concerns a soldier's ability to understand the components of the seven-step goal setting process and apply the skill in planning steps to achieve personal and career goals.

$\left(\tilde{c}^{22}\right)$ refers to a soldier's ability to control their physical state, focus on what is happening, control their breathing, try to relax, and work with their thoughts (ATC). $\left(\tilde{c}^{23}\right)$ represents how well a soldier can shift his attention away from unproductive thinking (interrupting) and focus more on the task at hand.

Optimism $\left(\tilde{c}^{3}\right)$ can be characterized by $\left(\tilde{c}^{31}\right)$ and $\left(\tilde{c}^{32}\right)$ [41,42]. First, it is important to notice positive events, evaluate why they led to positive emotions, what they mean, and what actions of the person or others caused positive occurrences $\left(\tilde{c}^{31}\right)$. Second, $\left(\tilde{c}^{32}\right)$ concerns a soldier's ability to stop catastrophic thoughts; reduce anxiety; find a solution to a problem by defining the best, worst, and most likely desired outcome; and develop a plan to help them to achieve the most likely desired outcome.

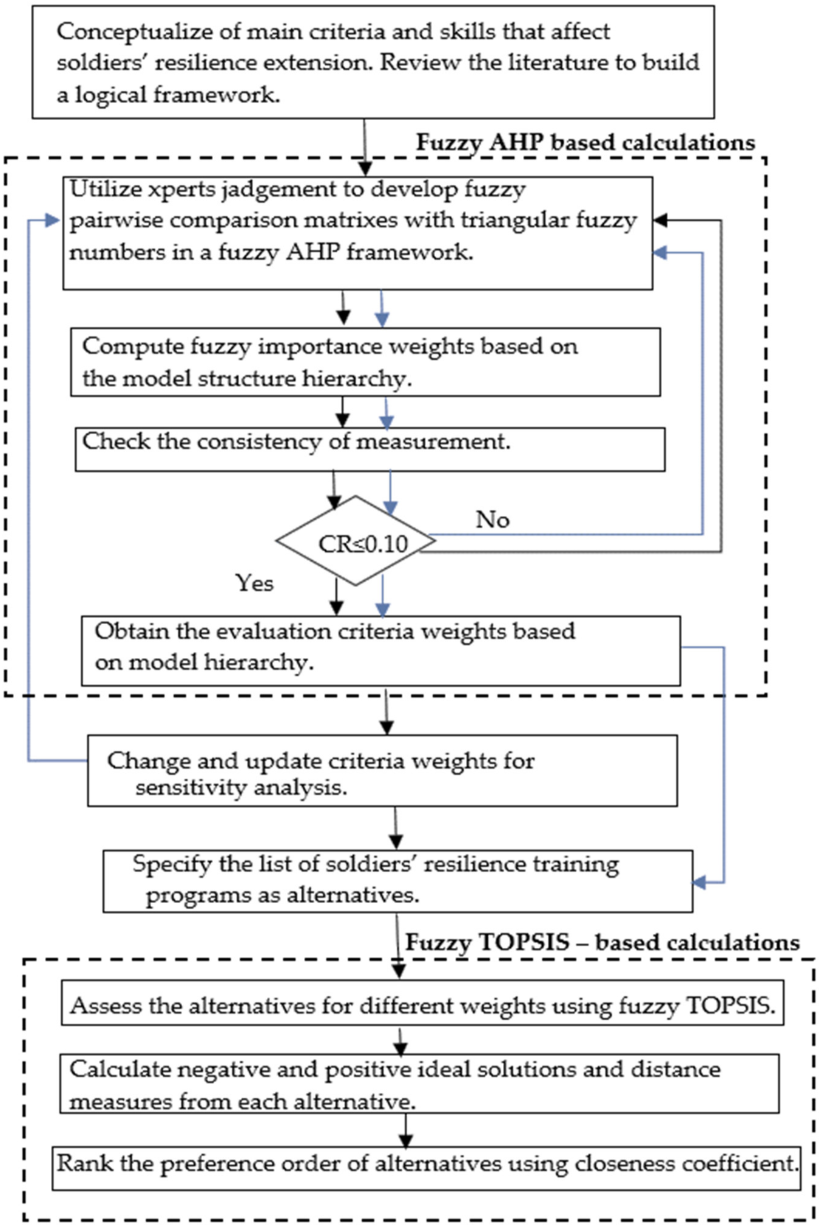


Figure 2. Assessment framework of soldiers' resilience building model.

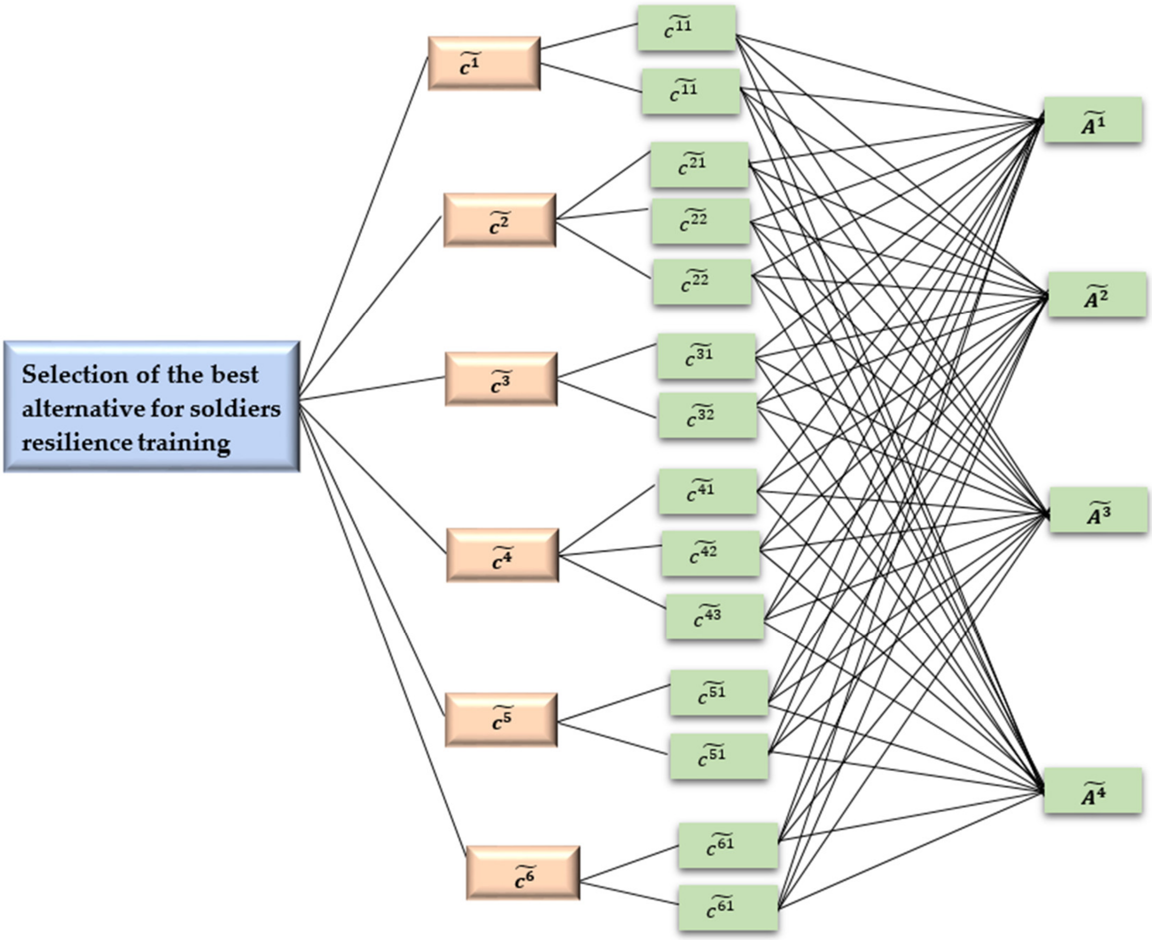


Figure 3. Hierarchical structure of soldiers' resilience-building model.

Mental agility $\left(\widetilde{c^{4}}\right)$ can be represented by three skills, $\left(\widetilde{c^{41}}\right)$, $\left(\widetilde{c^{42}}\right)$, and $\left(\widetilde{c^{43}}\right)$ [6,43,44]. $\left(\widetilde{c^{41}}\right)$ defines the ability to identify and correct unproductive (fast, superficial) thinking (thoughts), apply mental cues (mental signs), and answer essential (critical) questions about the soldier's self to clarify information, determine what was omitted, etc. $\left(\widetilde{c^{42}}\right)$ concerns a soldier's ability to carefully/thoroughly identify the cause of a problem and its solution strategies/methods, and how well a soldier can apply the six-step problem analysis and solution strategy, overcome the inertia of their thoughts, assess "confirmation bias" thoughts, and look at the situation "from the outside". $\left(\widetilde{c^{43}}\right)$ is a soldier's ability to stop unproductive thinking (thoughts) in order to focus more on the task at hand, emphasizing the event, its positive aspects, and a positive perspective.

Strength of character $\left(\widetilde{c^{5}}\right)$ can be represented by $\left(\widetilde{c^{51}}\right)$ and $\left(\widetilde{c^{52}}\right)$ [43,44]. $\left(\widetilde{c^{51}}\right)$ is important because a soldier must act within a team. Therefore, soldiers have to be able to identify the strengths of one's own character and those of others, and the ways in which these strengths can be used to achieve personal effectiveness and strengthen positive relationships with others. Moreover, $\left(\widetilde{c^{52}}\right)$ concerns how a soldier can identify their own and others' character strengths that help them to work in a team, overcome challenges, and be an effective leader.

Connection $\left(\widetilde{c^6}\right)$ can be represented by $\left(\widetilde{c^{61}}\right)$ and $\left(\widetilde{c^{62}}\right)$[6,43,44]. The $\left(\widetilde{c^{61}}\right)$ skill represents a soldier's ability to communicate clearly and respectfully and apply the IDEAL model, which ensures trust, clarity and the ability to control the communication process. $\left(\widetilde{c^{62}}\right)$ concerns a soldier's ability to give effective praise to promote excellence and motivate achievement, and to provide appropriate positive feedback to strengthen relationships with others. The structure of these competencies and skills is presented in Table 4.

Table 4. Competencies and skills as sub-factors that affect soldiers' resilience.

Competencies	Skills
1. **Self-awareness** $\left(\widetilde{c^1}\right)$	**1.1.** ATC. Separate the A (activating Event) from their T (thoughts) and from the C (consequences: emotions and reactions) $\left(\widetilde{c^{11}}\right)$. **1.2.** Detect icebergs $\left(\widetilde{c^{12}}\right)$.
2. **Self-regulation** $\left(\widetilde{c^2}\right)$	**2.1.** Goal setting $\left(\widetilde{c^{21}}\right)$. **2.2.** Energy management $\left(\widetilde{c^{22}}\right)$. **2.3.** Mental games $\left(\widetilde{c^{23}}\right)$.
3. **Optimism** $\left(\widetilde{c^3}\right)$	**3.1.** Hunt the good stuff $\left(\widetilde{c^{31}}\right)$. **3.2.** Put it in perspective $\left(\widetilde{c^{32}}\right)$.
4. **Mental agility** $\left(\widetilde{c^4}\right)$	**4.1**. Avoid thinking traps $\left(\widetilde{c^{41}}\right)$. **4.1**. Problem solving $\left(\widetilde{c^{42}}\right)$. **4.2.** Real-time resilience $\left(\widetilde{c^{43}}\right)$.
5. **Strengths of character** $\left(\widetilde{c^5}\right)$	**5.1.** Identify character strengths in self and others $\left(\widetilde{c^{51}}\right)$. **5.2.** Character strengths: challenges and leadership in themselves and in others $\left(\widetilde{c^{52}}\right)$.
6. **Connection** $\left(\widetilde{c^6}\right)$	**6.1.** Assertive communication $\left(\widetilde{c^{61}}\right)$. **6.2.** Effective praise and active constructive responses $\left(\widetilde{c^{62}}\right)$.

3.2. Training Programs for the Increasement of Soldiers' Resilience

In the present research, four different training programs focused on soldiers' resilience were chosen as alternatives. Descriptions of the four selected alternatives, whose primary target audience is soldiers, are presented below.

1. Army Center for Enhanced Performance $\left(\widetilde{A^1}\right)$ [45]. The Army Center for Enhanced Performance (ACEP) strengthens the mind–body connection in addition to the development of psychological resilience. There are six components of training that lead to improved performance [45]: (1) mental skills' foundations, (2) building confidence, (3) goal setting, (4) attention control, (5) energy management, and (6) integrating imagery. This program is based on applied sport, health, and social psychology. Target audience—primarily soldiers.

2. Battlemind (also called Resiliency Training) $\left(\tilde{A}^2\right)$ [46]. Resilience training (RT) is designed to provide comprehensive mental training. It is designed to prepare soldiers to maintain good mental health despite the challenges of military life, combat, and transitioning once home. Resilience is developed as a soldier's inner strength, enabling him/her to face the challenges of his/her environment with courage and confidence. The program is based on a range of psychological theories, including cognitive restructuring, positive psychology, occupational health models, posttraumatic stress, mindfulness, etc.
3. Mindfulness-Based Mind Fitness Training $\left(\tilde{A}^3\right)$ [47]. This training consists of attention and concentration exercises for mindfulness, situational awareness, mental agility, emotion regulation, working memory, and more. These exercises change the structure and function of the brain. Training is carried out prior to deployment and is designed to protect the mental health of the soldiers in situations in which they are under stress. Studies have shown that the training program is beneficial and has reduced levels of PTSD, depression, and anxiety in soldiers upon return from deployment.
4. Master Resilience Training $\left(\tilde{A}^4\right)$ [48]. Master Resilience Training (MRT) is a standardized resilience training program. It is based on cognitive-behavioral and positive psychology methods. The program is based on Ellis' Adversity-Consequences-Beliefs (ABC) model and its effectiveness has been proven through empirical research.

4. Empirical Study Results

4.1. Data Collection Method

For this study, a cohort of 18 experts were interviewed using a pairwise comparison questionnaire. These experts were selected based on their professional competence, specifically their service experience in the field of resilience building, the length of their service in the military, and the completion of international missions. The 18 military psychologists involved in this study possessed extensive expertise in soldier resilience training, having continuously improved soldiers' resilience skills and post-deployment programming components. Eight of them were from Ukraine and ten from the Lithuania military area. Each expert conducted an independent evaluation by assessing six competencies and fourteen skills associated with soldier resilience through pairwise comparisons. In addition, these experts judged the four soldier resilience training programs. This study was conducted by researchers at the Military Academy of Lithuania in 2023.

4.2. Fuzzy AHP Analysis Results

The combined fuzzy analytic hierarchy process model was applied to measure the effect of critical resilience competencies in a two-level hierarchical structure. Accordingly, the fuzzy AHP model was performed using the following steps: (1) the Ukrainian and Lithuanian experts' verbal judgments were transformed into fuzzy weights that were connected with the triangular fuzzy number membership function specifications, as shown in Table 1; (2) the main criteria weighting was calculated; (3) the sub-criteria weighting was achieved. Following the analysis steps, the initial direct-relation matrixes were constructed for six resilience competencies and additionally for fourteen resilience skills. The Ukrainian and Lithuanian experts' opinions on the six main competencies presented in the initial direct-relation matrixes are shown in Table 5.

In the similar sequence, the matrixes of soldiers' resilience skills as sub-factors' of the resilience competencies were found and their corresponding fuzzy weights were computed. In addition, the consistency ratio (CR) coefficients were calculated to evaluate the consistency of the designed initial direct-relation matrixes.

Table 5. Experts' opinions on the six main competencies presented in the initial direct-relation matrix.

DM1							*DM2*						
CC	$\tilde{c}^1$	$\tilde{c}^2$	$\tilde{c}^3$	$\tilde{c}^4$	$\tilde{c}^5$	$\tilde{c}^6$	**CC**	$\tilde{c}^1$	$\tilde{c}^2$	$\tilde{c}^3$	$\tilde{c}^4$	$\tilde{c}^5$	$\tilde{c}^6$
$\tilde{c}^1$	(1,1,1)	(1,1,1)	(1,1,1)	(1,1,1)	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(3,\frac{7}{2},4\right)$	$\tilde{c}^1$	(1,1,1)	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(\frac{3}{2},2,\frac{5}{2}\right)$	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(3,\frac{7}{2},4\right)$	$\left(3,\frac{7}{2},4\right)$
$\tilde{c}^2$	(1,1,1)	(1,1,1)	(1,1,1)	(1,1,1)	$\left(1,\frac{3}{2},2\right)$	$\left(\frac{5}{2},3,\frac{7}{2}\right)$	$\tilde{c}^2$	$\left(\frac{2}{3},1,2\right)$	(1,1,1)	$\left(1,\frac{3}{2},2\right)$	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(\frac{5}{2},3,\frac{7}{2}\right)$	$\left(\frac{3}{2},2,\frac{5}{2}\right)$
$\tilde{c}^3$	(1,1,1)	(1,1,1)	(1,1,1)	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(\frac{3}{2},2,\frac{5}{2}\right)$	$\left(\frac{3}{2},2,\frac{5}{2}\right)$	$\tilde{c}^3$	$\left(\frac{2}{5},\frac{1}{2},\frac{2}{3}\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	(1,1,1)	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(\frac{1}{2},1,\frac{3}{2}\right)$
$\tilde{c}^4$	(1,1,1)	(1,1,1)	$\left(\frac{2}{3},1,2\right)$	(1,1,1)	$\left(\frac{5}{2},3,\frac{7}{2}\right)$	$\left(\frac{7}{2},4,\frac{9}{2}\right)$	$\tilde{c}^4$	$\left(\frac{2}{3},1,2\right)$	$\left(\frac{2}{3},1,2\right)$	$\left(\frac{2}{3},1,2\right)$	(1,1,1)	$\left(3,\frac{7}{2},4\right)$	$\left(\frac{5}{2},3,\frac{7}{2}\right)$
$\tilde{c}^5$	$\left(\frac{2}{3},1,2\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{2}{5},\frac{1}{2},\frac{2}{3}\right)$	$\left(\frac{2}{7},\frac{1}{3},\frac{2}{5}\right)$	(1,1,1)	(1,1,1)	$\tilde{c}^5$	$\left(\frac{1}{4},\frac{2}{7},\frac{1}{3}\right)$	$\left(\frac{2}{7},\frac{1}{3},\frac{2}{5}\right)$	$\left(\frac{2}{3},1,2\right)$	$\left(\frac{1}{4},\frac{2}{7},\frac{1}{3}\right)$	(1,1,1)	$\left(\frac{1}{2},1,\frac{3}{2}\right)$
$\tilde{c}^6$	$\left(\frac{1}{4},\frac{2}{7},\frac{1}{3}\right)$	$\left(\frac{2}{7},\frac{1}{3},\frac{2}{5}\right)$	$\left(\frac{2}{5},\frac{1}{2},\frac{2}{3}\right)$	$\left(\frac{2}{9},\frac{1}{4},\frac{2}{7}\right)$	(1,1,1)	(1,1,1)	$\tilde{c}^6$	$\left(\frac{1}{4},\frac{2}{7},\frac{1}{3}\right)$	$\left(\frac{2}{5},\frac{1}{2},\frac{2}{3}\right)$	$\left(\frac{2}{3},1,2\right)$	$\left(\frac{2}{7},\frac{1}{3},\frac{2}{5}\right)$	$\left(\frac{2}{3},1,2\right)$	(1,1,1)

Note: aggregated experts' opinions on six measurements, $\tilde{c}^1$ = Self-awareness, $\tilde{c}^2$ = Self-regulation, $\tilde{c}^3$ = Optimism, $\tilde{c}^4$ = Mental agility, $\tilde{c}^5$ = Strength of character, $\tilde{c}^6$ = Connection; DM1 = aggregated Ukrainian experts' assessment; DM2 = aggregated Lithuanian experts' assessment.

The global fuzzy weights of each of 14 skills were calculated using the value of a specific skill weight with the corresponding competence fuzzy weight. Calculated global fuzzy weights were used for ranking the best resilience training program by employing the fuzzy TOPSIS method. The global fuzzy weights based on the Ukrainian and Lithuanian experts' opinions are presented in Tables 6 and 7, correspondingly. Additionally, the ranks of the pairwise evaluation weights computed by fuzzy AHP for the six resilience competencies (see Table A1, Appendix A) and the fourteen resilience skills (see Table A2, Appendix A) were identified.

Table 6. Factor weight scores affecting soldiers' resilience levels based on Ukrainian experts' responses, established using the FAHP model.

Level 1	**Level 2**	***Global Fuzzy Weights***
Competencies' Fuzzy Weight	***Skills' Fuzzy Weight***	
W^1= (0.1397, 0.1907, 0.2404)	W^{11}= (0.5000, 0.5000, 0.5000)	$\hat{W}^{11}$= (0.0699, 0.0954, 0.1202)
	W^{12}= (0.5000, 0.5000, 0.5000)	$\hat{W}^{12}$= (0.0699, 0.0954, 0.1202)
W^2 = (0.1521, 0.1989, 0.2926)	W^{21}= (0.2602, 0.4357, 0.6597)	$\hat{W}^{21}$= (0.0396, 0.0663, 0.1003)
	W^{22}= (0.2659, 0.4100, 0.6897)	$\hat{W}^{22}$= (0.0404, 0.0624, 0.1049)
	W^{23}= (0.1103, 0.1543, 0.2220)	$\hat{W}^{23}$= (0.0168, 0.0235, 0.0338)
W^3 = (0.1331, 0.1950, 0.2590)	W^{31}= (0.5000, 0.5000, 0.5000)	$\hat{W}^{31}$= (0.0666, 0.0975, 0.1295)
	W^{32}= (0.5000, 0.5000, 0.5000)	$\hat{W}^{32}$= (0.0666, 0.0975, 0.1295)
W^4 = (0.1751, 0.2342, 0.3170)	W^{41}= (0.4898, 0.6253, 0.7732)	$\hat{W}^{41}$= (0.4898, 0.6253, 0.7732)
	W^{42}= (0.1348, 0.2056, 0.2950)	$\hat{W}^{42}$= (0.1348, 0.2056, 0.2950)
	W^{43}= (0.1296, 0.1690, 0.2577)	$\hat{W}^{43}$= (0.1296, 0.1690, 0.2577)
W^5 = (0.0757, 0.1073, 0.1606)	W^{51} = (0.5000, 0.5000, 0.5000)	$\hat{W}^{51}$= (0.0379, 0.0537, 0.0803)
	W^{52} = (0.5000, 0.5000, 0.5000)	$\hat{W}^{52}$= (0.0379, 0.0537, 0.0803)
W^6= (0.0562, 0.0740, 0.0967)	W^{61}= (0.5000, 0.5000, 0.5000)	$\hat{W}^{61}$= (0.0281, 0.0370, 0.0484)
	W^{62}= (0.5000, 0.5000, 0.5000)	$\hat{W}^{62}$= (0.0281, 0.0370, 0.0484)

Notes: W^1 = Self-Awareness, W^2 = Self-Regulation, W^3 = Optimism, W^4 = Mental agility, W^5 = Strength of character, W^6 = Connection.

4.3. Fuzzy TOPSIS Analysis Results

The calculated global fuzzy weights of the resilience skills were used as sub-factors weights for ranking the soldier resilience training programs using the fuzzy TOPSIS. To achieve the result, the following steps were performed: (1) developing the fuzzy decision matrix for the chosen alternatives and normalizing it; (2) computing the fuzzy positive and negative ideal solutions; (3) calculating the relative closeness and ranking the selected alternatives.

Table 7. Factor weight scores affecting soldiers' resilience level based on Lithuanian experts' responses, established using the FAHP model.

Level 1	**Level 2**	***Global Fuzzy Weights***
Competencies' Fuzzy Weight	***Skills' Fuzzy Weight***	
W^1 = (0.1377, 0.2578, 0.4361)	W^{11}= (0.4142, 0.5000, 0.8284) W^{12}= (0.2929, 0.5000, 0.5858)	$\hat{W}^{11}$= (0.0570, 0.1289, 0.3613) $\hat{W}^{12}$= (0.0403, 0.1289, 0.2555)
W^2 = (0.1167, 0.2182, 0.3877)	W^{21}= (0.2736, 0.4518, 0.6775) W^{22}= (0.2630, 0.4038, 0.6775) W^{23}= (0.1044, 0.1444, 0.2052)	$\hat{W}^{21}$= (0.0319, 0.0986, 0.2627) $\hat{W}^{22}$= (0.0307, 0.0881, 0.2627) $\hat{W}^{23}$= (0.0122, 0.0315, 0.0796)
W^3 = (0.0608, 0.1260, 0.2358)	W^{31}= (0.2679, 0.5000, 0.8038) W^{32}= (0.3094, 0.5000, 0.9282)	$\hat{W}^{31}$= (0.0163, 0.0630, 0.1896) $\hat{W}^{32}$= (0.1031, 0.0630, 0.2189)
W^4 = (0.1284, 0.2239, 0.4523)	W^{41}= (0.4542, 0.5772, 0.7079) W^{42}= (0.2320, 0.2989, 0.3980) W^{43}= (0.1050, 0.1238, 0.1580)	$\hat{W}^{41}$= (0.0583, 0.1292, 0.3201) $\hat{W}^{42}$= (0.0298, 0.0669, 0.1800) $\hat{W}^{43}$= (0.0135, 0.0277, 0.0714)
W^5 = (0.0479, 0.0830, 0.1472)	W^{51}= (0.6458, 0.7642, 0.8989) W^{52}= (0.2042, 0.2358, 0.2774)	$\hat{W}^{51}$= (0.0309, 0.0634, 0.1324) $\hat{W}^{52}$= (0.0098, 0.0196, 0.0408)
W^6= (0.0543, 0.0911, 0.1734)	W^{61}= (0.5798, 0.7143, 0.8697) W^{62}= (0.2367, 0.2857, 0.3551)	$\hat{W}^{61}$= (0.0315, 0.0651, 0.1508) $\hat{W}^{62}$= (0.0129, 0.0260, 0.0616)

Notes: W^1 = Self-Awareness, W^2 = Self-Regulation, W^3 = Optimism, W^4 = Mental agility, W^5 = Strength of character, W^6 = Connection.

As was mentioned before, in this study, we focused on four alternatives: (1) the Army Center for Enhanced Performance, (2) Resiliency Training, (3) Mindfulness-Based Mind Fitness Training, and (4) Master Resilience Training. Following TOPSIS methodology, the sub-factor $\tilde{c}^{21}$, which represents a soldier's ability to understand the components of the seven-step goal-setting process and apply this skill in planning steps to achieve personal and career goals, was marked as a non-beneficial attribute, whereas the other were beneficial. The conducted fuzzy TOPSIS analysis results are presented following the main analysis steps.

Fuzzy TOPSIS analysis began with defining the preference matrix of the four chosen soldier resilience training programs (alternatives) with respect to the 14 skills as sub-factors. For this, we used the linguistic values presented in Table 3. The experts' decision matrix on the four alternatives was constructed by following the linguistic preference of triangular fuzzy numbers characterized in Table 3. The preference matrix of the four alternatives for the 14 sub-factors expressed in linguistic terms is shown in Table 8.

Table 8. The preference matrix of the four alternatives for the 14 sub-factors, expressed in linguistic terms.

	$\tilde{c}^{11}$	$\tilde{c}^{12}$	$\tilde{c}^{21}$	$\tilde{c}^{22}$	$\tilde{c}^{23}$	$\tilde{c}^{31}$	$\tilde{c}^{32}$	$\tilde{c}^{41}$	$\tilde{c}^{42}$	$\tilde{c}^{43}$	$\tilde{c}^{51}$	$\tilde{c}^{52}$	$\tilde{c}^{61}$	$\tilde{c}^{62}$
$\tilde{A}^1$	M	VH	H	M	VH	H	M	VH	VH	VH	VH	H	VH	VH
$\tilde{A}^2$	M	M	VH	H	VH	M	H	M	M	M	VH	M	H	VH
$\tilde{A}^3$	VH	VH	M	VH	M	M	M	VH	VH	VH	L	L	L	M
$\tilde{A}^4$	M	M	M	M	M	M	M	M	M	M	M	VH	VH	M

Notes: descriptions of the linguistic terms are presented in Table 3.

Following the rules of the fuzzy TOPSIS method, the linguistic values were transformed into the corresponding triangular fuzzy numbers, and decision matrixes were normalized using Equations (25)–(27).

Next, Equation (25) was used to calculate the weighted, normalized fuzzy decision matrixes (WNFDM) for the two expert groups (Ukrainian and Lithuanian). The Ukrainian experts' data analysis result is presented in three tables according to the number of sub-factors (see Tables 9–11).

Table 9. Weighted normalized matrix for resilience competencies C^1 and C^2 by sub-factor.

DM1	c^{11}	c^{12}	c^{21}	c^{22}	c^{23}
A_1	0.023, 0.053, 0.09	0.054, 0.095, 0.120	0.013, 0.028, 0.060	0.013, 0.035, 0.082	0.013, 0.024, 0.034
A_2	0.023, 0.053, 0.093	0.023, 0.053, 0.093	0.013, 0.022, 0.043	0.022, 0.049, 0.105	0.013, 0.024, 0.034
A_3	0.054, 0.095, 0.120	0.054, 0.095, 0.120	0.017, 0.040, 0.100	0.031, 0.062, 0.105	0.006, 0.013, 0.026
A_4	0.023, 0.053, 0.093	0.023, 0.053, 0.093	0.017, 0.040, 0.100	0.013, 0.035, 0.082	0.006, 0.013, 0.026
DM2	c^{11}	c^{12}	c^{21}	c^{22}	c^{23}
A_1	0.019, 0.072, 0.281	0.031, 0.129, 0.256	0.011, 0.042, 0.158	0.010, 0.049, 0.204	0.009, 0.032, 0.080
A_2	0.019, 0.072, 0.281	0.013, 0.072, 0.199	0.011, 0.033, 0.113	0.017, 0.069, 0.263	0.009, 0.032, 0.080
A_3	0.044, 0.129, 0.361	0.031, 0.129, 0.256	0.014, 0.059, 0.263	0.024, 0.088, 0.263	0.004, 0.018, 0.062
A_4	0.019, 0.072, 0.281	0.013, 0.072, 0.199	0.014, 0.059, 0.263	0.010, 0.049, 0.204	0.004, 0.018, 0.062

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment; C^1 = Self-awareness with sub-factors c^{11} and c^{12}, C^2 = Self-regulation with sub-factors c^{21}, c^{22}, and c^{23}.

Table 10. Weighted normalized matrix for resilience competencies C^3 and C^4 by sub-factor.

DM1	c^{31}	c^{32}	c^{41}	c^{42}	c^{43}
A_1	0.022, 0.042, 0.078	0.022, 0.054, 0.101	0.381, 0.625, 0.773	0.045, 0.069, 0.126	0.101, 0.169, 0.258
A_2	0.029, 0.059, 0.130	0.037, 0.076, 0.130	0.163, 0.347, 0.601	0.058, 0.123, 0.295	0.043, 0.094, 0.200
A_3	0.029, 0.059, 0.130	0.022, 0.054, 0.101	0.381, 0.625, 0.773	0.045, 0.069, 0.126	0.101, 0.169, 0.258
A_4	0.029, 0.059, 0.130	0.022, 0.054, 0.101	0.163, 0.347, 0.601	0.058, 0.123, 0.295	0.043, 0.094, 0.200
DM2	c^{31}	c^{32}	c^{41}	c^{42}	c^{43}
A_1	0.005, 0.027, 0.114	0.034, 0.035, 0.170	0.045, 0.129, 0.320	0.010, 0.022, 0.077	0.011, 0.028, 0.071
A_2	0.007, 0.038, 0.190	0.057, 0.049, 0.219	0.019, 0.072, 0.249	0.013, 0.040, 0.180	0.005, 0.015, 0.056
A_3	0.007, 0.038, 0.190	0.034, 0.035, 0.170	0.045, 0.129, 0.320	0.010, 0.022, 0.077	0.011, 0.028, 0.071
A_4	0.007, 0.038, 0.190	0.034, 0.035, 0.170	0.019, 0.072, 0.249	0.013, 0.040, 0.180	0.005, 0.015, 0.056

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment; C^3 = Optimism with sub-factors c^{31} and c^{32}, C^4 = Mental agility with sub-factors c^{41}, c^{42}, and c^{43}.

Table 11. Weighted normalized matrix for resilience competencies C^5 and C^6 by sub-factor.

DM1	c^{51}	c^{52}	c^{61}	c^{62}
A_1	0.029, 0.054, 0.080	0.004, 0.008, 0.016	0.022, 0.037, 0.048	0.022, 0.037, 0.048
A_2	0.029, 0.054, 0.080	0.005, 0.011, 0.027	0.016, 0.029, 0.048	0.022, 0.037, 0.048
A_3	0.004, 0.018, 0.045	0.008, 0.018, 0.080	0.003, 0.012, 0.027	0.009, 0.021, 0.038
A_4	0.013, 0.030, 0.062	0.004, 0.006, 0.011	0.022, 0.037, 0.048	0.009, 0.021, 0.038
A_4	0.013, 0.030, 0.062	0.004, 0.006, 0.011	0.022, 0.037, 0.048	0.009, 0.021, 0.038
DM2	c^{51}	c^{52}	c^{61}	c^{62}
A_1	0.024, 0.063, 0.132	0.001, 0.003, 0.008	0.025, 0.065, 0.151	0.010, 0.026, 0.062
A_2	0.024, 0.063, 0.132	0.001, 0.004, 0.014	0.018, 0.051, 0.151	0.010, 0.026, 0.062
A_3	0.003, 0.021, 0.074	0.002, 0.007, 0.041	0.004, 0.022, 0.084	0.004, 0.014, 0.048
A_4	0.010, 0.035, 0.103	0.001, 0.002, 0.006	0.025, 0.065, 0.151	0.004, 0.014, 0.048

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment; C^5 = Strength of character with sub-factors c^{51} and c^{52}, C^6 = Self-regulation with sub-factors c^{61} and c^{62}.

Consequently, we computed the *(FPIS, A*)* to assess the fuzzy positive ideal solution and the $(FNIS, A^-)$ as fuzzy negative ideal solution. The FPIS, A* represents the maximum value of $\tilde{v}_i^*$ for soldier resilience training programs which were included in this study, while $\tilde{v}_1^-$ is the minimum value (FNIS). The FPIS, A* and FNIS, A^- were calculated using Equations (29) and (30). Due to the number of sub-factors (14 skills) and page layout, the calculated results are separated and presented in three tables. The investigation results of the Ukrainian (DM1) and Lithuanian (DM2) expert groups are shown in Tables 12–14.

Table 12. Fuzzy positive ideal solution (FPIS, A*) and fuzzy negative ideal solution (FNIS, A$^-$) for the resilience competencies C^1 and C^2 by sub-factor.

DM1	c^{11}	c^{12}	c^{21}	c^{22}	c^{23}
FPIS, A*	0.0544, 0.0954, 0.1202	0.0544, 0.0954, 0.1202	0.0170, 0.0398, 0.1003	0.0314, 0.0624, 0.1049	0.0131, 0.0235, 0.0338
FNIS, A$^-$	0.0233, 0.0530, 0.0935	0.0233, 0.0530, 0.0935	0.0132, 0.0221, 0.0430	0.0135, 0.0347, 0.0816	0.0056, 0.0131, 0.0263
DM2	c^{11}	c^{12}	c^{21}	c^{22}	c^{23}
FPIS, A*	0.0443, 0.1289, 0.3613	0.0313, 0.1289, 0.2555	0.0137, 0.0592, 0.2627	0.0239, 0.0881, 0.2627	0.0095, 0.0315, 0.0796
FNIS, A$^-$	0.0190, 0.0716, 0.2810	0.0134, 0.0716, 0.1987	0.0106, 0.0329, 0.1126	0.0102, 0.0489, 0.2043	0.0041, 0.0175, 0.0619

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment; C^1 = Self-awareness, C^1 = Self-regulation; FPIS, A*= Fuzzy positive ideal solution; FNIS, A$^-$ = fuzzy negative ideal solution.

Table 13. Fuzzy positive ideal solution (FPIS, A*) and fuzzy negative ideal solution (FNIS, A$^-$) for the resilience competencies C^3 and C^4 by sub-factor.

DM1	c^{31}	c^{32}	c^{41}	c^{42}	c^{43}
FPIS, A*	0.0285, 0.0585, 0.1295	0.0370, 0.0758, 0.1295	0.3810, 0.6253, 0.7732	0.0578, 0.1234, 0.2950	0.1008, 0.1690, 0.2577
FNIS, A$^-$	0.0222, 0.0418, 0.0777	0.0222, 0.0542, 0.1007	0.1633, 0.3474, 0.6014	0.0449, 0.0685, 0.1264	0.0432, 0.0939, 0.2004
DM2	c^{31}	c^{32}	c^{41}	c^{42}	c^{43}
FPIS, A*	0.0070, 0.0378, 0.1896	0.0573, 0.0490, 0.2189	0.0453, 0.1292, 0.3201	0.0128, 0.0401, 0.1800	0.0105, 0.0277, 0.0714
FNIS, A$^-$	0.0054, 0.0270, 0.1138	0.0344, 0.0350, 0.1703	0.0194, 0.0718, 0.2490	0.0099, 0.0223, 0.0771	0.0045, 0.0154, 0.0555

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment; C^3 = Optimism, C^4 = Mental agility. FPIS, A*= Fuzzy positive ideal solution; FNIS, A$^-$ = fuzzy negative ideal solution.

Table 14. Fuzzy positive ideal solution (FPIS, A*) and fuzzy negative ideal solution (FNIS, A$^-$) for the resilience competencies C^5 and C^6 by sub-factor.

DM1	c^{51}	c^{52}	c^{61}	c^{62}
FPIS, A *	0.0295, 0.0537, 0.0803	0.0076, 0.0179, 0.0803	0.0219, 0.0370, 0.0484	0.0219, 0.0370, 0.0484
FNIS, A$^-$	0.0042, 0.0179, 0.0446	0.0042, 0.0060, 0.0115	0.0031, 0.0123, 0.0269	0.0094, 0.0206, 0.0376
DM2	c^{51}	c^{52}	c^{61}	c^{62}
FPIS, A *	0.0240, 0.0634, 0.1324	0.0020, 0.0065, 0.0408	0.0245, 0.0651, 0.1508	0.0100, 0.0260, 0.0616
FNIS, A$^-$	0.0034, 0.0211, 0.0736	0.0011, 0.0022, 0.0058	0.0035, 0.0217, 0.0838	0.0043, 0.0144, 0.0479

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment; C^5 = Strength of character, C^6 = Self-regulation. FPIS, A*= Fuzzy positive ideal solution; FNIS, A$^-$ = fuzzy negative ideal solution.

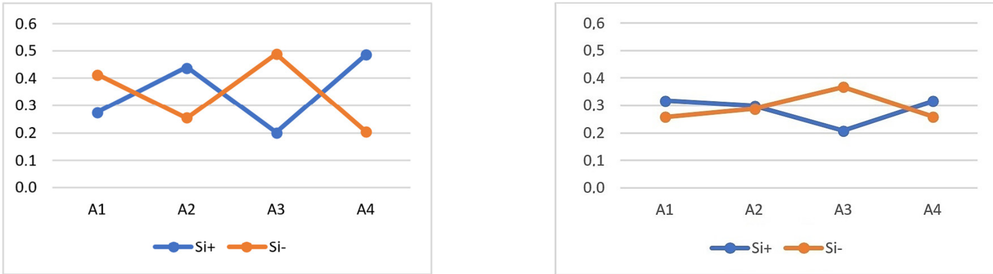
The distances between the four resilience training programs were assessed. The positive and negative ideal solutions and final ranking of each resilience training program are presented in the table below (see Table 15).

Table 15. Identified distances from positive FPIS to negative FNIS ideal solutions and final rankings of alternatives.

DM1					*DM2*				
Alternative	S_i^+	S_i^-	$^1CC_i=\frac{d_i^-}{d_i^+ + d_i^-}$	**Rank**	**Alternative**	S_i^+	S_i^-	$^1CC_i=\frac{d_i^-}{d_i^+ + d_i^-}$	**Rank**
A1	0.2759	0.4144	0.6003	2	**A1**	0.3172	0.2580	0.449	4
A2	0.4400	0.2544	0.3663	3	**A2**	0.2985	0.2876	0.491	2
A3	0.2015	0.4887	0.7080	1	**A3**	0.2078	0.3674	0.639	1
A4	0.4866	0.2040	0.2954	4	**A4**	0.3163	0.2595	0.451	3

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment. d_i^+ = distance between alternative and FPIS, S_i^+; d_i^-= distance between alternative and FNIS, S_i^-; CC_i= closeness coefficient of each resilience training program judged as an alternative.

To illustrate the soldier resilience training programs' rankings, the closeness coefficient was chosen (CC_i), and the graphical results are presented in Figure 4. The larger values of CC_i indicate the most preferred alternatives, and the alternative A3 marks the maximum (0.7080) value of closeness coefficient, whereas the alternative A4 marks the lowest value of 0.2954.



(**a**) (**b**)

Figure 4. The geometric distances from FPIS (di*) and FNIS (di⁻) of four alternatives reached as study result: (**a**) Ukrainian experts' opinion; (**b**) Lithuanian experts' opinion. A detailed description of presented values is shown in Table 15.

Based on the conducted research on soldier resilience training and the opinion analysis of Ukrainian and Lithuanian experts, a ranking of military resilience training programs was compiled. Lastly, a sensitivity examination was performed to evaluate the effect of the changed weights on dissimilar resilience competencies as factors, and between resilience skills as sub-factors.

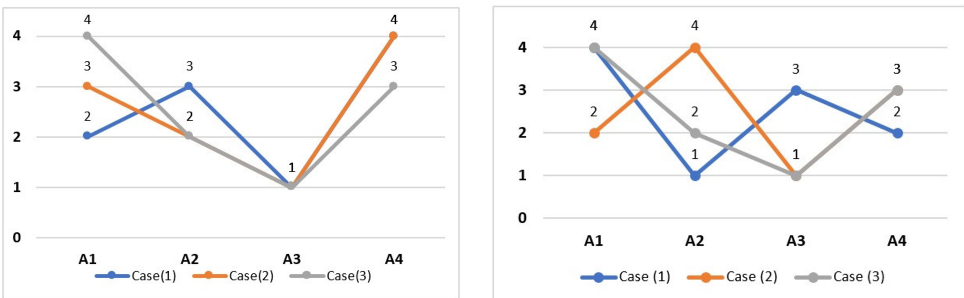
5. Sensitivity Analysis

The results of the final rankings let us identify that the best soldier resilience training program choice was A3 according to the Ukrainian and Lithuanian experts' judgement (see Table 16). Therefore, a sensitivity exploration was performed to evaluate the effect of sub-factors' weights on the best resilience training program choice. Consequently, the different sub-factors were eliminated, and dissimilar cases of analysis were conducted. The sensitivity evaluation analysis showed the dissimilar rankings for soldier resilience training programs. The investigation outcomes are presented in Figure 5 and Table 16.

Table 16. Resilience training programs' rankings identified under different cases analysis.

Alternative	*DM1*			Alternative	*DM2*		
	Case (1)	Case (2)	Case (3)		Case (1)	Case (2)	Case (3)
A1	2	3	4	**A1**	4	2	4
A2	3	2	2	**A2**	1	4	2
A3	1	1	1	**A3**	3	1	1
A4	4	4	3	**A4**	2	3	3

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment.



(**a**) (**b**)

Figure 5. A graphical presentation of the sensitivity analysis results: (**a**) analysis result for the evaluation of the Ukrainian experts' opinion; (**b**) analysis result for the evaluation of the Lithuanian experts' opinion.

The cases of sensitivity analysis were performed following a rank analysis using skills as sub-factors. The Ukrainian experts pointed out that the three mental agility competence skills were their top priorities (see Table A1, Appendix A). Therefore, we used these vital sub-factors and conducted three different case analyses:

- Case 1. The sub-factors 'Hunt the good stuff' $\left(\tilde{c}^{31}\right)$ and 'Put it in perspective' $\left(\tilde{c}^{32}\right)$ were eliminated, and the obtained ranking showed the altered result.
- Case 2. The sub-factors 'Avoid thinking traps' $\left(\tilde{c}^{41}\right)$, 'Problem solving' $\left(\tilde{c}^{42}\right)$, and 'Real-time resilience' $\left(\tilde{c}^{43}\right)$ were eliminated, as these skills (sub-factors) were identified as vital for Ukrainian soldier resilience training. The elimination of the mental agility training part produced the different rankings of the resilience training programs.
- Case 3. The sub-factor 'Avoid thinking traps' $\left(\tilde{c}^{41}\right)$ was eliminated, and consequently, a different ranking was achieved, because this skill was ranked as a top interest.

The Lithuanian experts pointed out that three skills, two of which belonged to the Self-awareness competence $\left(\tilde{c}^{1}\right)$ and one of which represented the mental agility competence $\left(\tilde{c}^{4}\right)$, were their top priorities. Consequently, we used these essential sub-factors and conducted three different case analyses:

- Case 1. The two sub-factors 'Separate the A (activating Event) from their T (thoughts) and from the C (consequences: emotions and reactions)' $\left(\text{ATC}, \tilde{c}^{11}\right)$ and 'Detect icebergs' $\left(\tilde{c}^{12}\right)$ were eliminated and the obtained ranking showed different ranking results for the four training programs.
- Case 2. The sub-factors 'Hunt the good stuff' $\left(\tilde{c}^{31}\right)$ and 'Put it in perspective' $\left(\tilde{c}^{32}\right)$ were eliminated and the obtained rankings showed different results.
- Case 3. The sub-factor 'Avoid thinking traps' $\left(\tilde{c}^{41}\right)$ was eliminated, and consequently, a different ranking was achieved, because the mental agility competence $\tilde{c}^{41}$ sub-factor was ranked as a skill of top importance.

Sensitivity analysis showed that the different weights of the resilience competencies and the skills used as sub-factors in this study lead to changes in the resilience training programs' rankings. The sensitivity analyses completed using different scenarios clearly illustrate the sensitivity of ideal rankings established based on military psychologists' opinions. After taking into account the differences in the specifics of the military services of today's Ukrainian and Lithuanian soldiers and the fact that several resilience training programs were chosen across different scenarios, the analysis showed the differences in assessment, program selection, and ratings.

In addition, to confirm the success of the assessment model proven in this study, the outcomes were matched with the ranking results of the traditional Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method and the grey relational analysis (GRA) method. The conducted calculation outcomes are presented in Table A3 (Appendix A). The ranking results of the soldier resilience training programs achieved by the model suggested in this study are not meaningfully dissimilar from the ranking outcomes of the traditional TOPSIS and GRA methods in general, for both DM1 and DM2. Table A3 shows that the results of the model developed in this study are close to those obtained by the traditional method, which indicates that the model developed in this study is useful and correct.

6. Discussion

The present study built upon existing research on competence training for resilience in militaries by utilizing a hierarchy MCDA model based on fuzzy sets theory. This model helped determine which competencies and skills should be included in resilience training programs to make them the most effective in a contemporary military environment. Previous studies [1,5,46,48–50] have identified sets of competencies and skills that are essential for solders to develop during the pre-deployment period to allow them to recover from stressful situations quickly and efficiently. Insufficient resilience training has been linked to a variety of negative outcomes, such as disturbed sleep habits, low energy, headaches, and other disorders [51].

The current study indicated that, according to experts from Ukraine and Lithuania, the MMFT (A3) is the most effective training program for fostering resilience in the pre-deployment period, which can help protect against harmful levels of stress. The validity and effectiveness of this program have been proven through rigorous research in neuroscience and stress physiology [52]. Previous studies have shown that this program increases an individual's tolerance in high-stress contexts, and that after MMFT training, soldiers' attention, memory, and sleep quality obviously improved [53]. In this study, the impact of MMFT as a form of resilience training was found to be significant by both Ukrainian and Lithuanian psychologists. The MMFT's maximum relative closeness coefficient was determined by Ukraine experts as follows: MMFT (A3)> ACEP (A1)>RT (A2)> MRT (A4). Furthermore, the maximum relative closeness coefficients of the resilience training programs were also identified according to the opinion of the Lithuanian experts, whose rankings arranged the resilience training programs in the following order: MMFT (A3)>RT (A2)> MRT (A4)> ACEP (A1).

The results of the current study contribute to the identification of the most important competencies that are relevant in today's military environment. Using sensitivity analysis on the Ukrainian experts' data, it was determined that mental agility competence, including the three skills 'Avoid thinking traps' $\left(\tilde{c}^{41}\right)$, 'Problem solving' $\left(\tilde{c}^{42}\right)$, and 'Real-time resilience' $\left(\tilde{c}^{41}\right)$, contributes most to solders' resilience in a real combat environment. Meanwhile, according to the assessment of Lithuanian military psychologists, who participate in training soldiers for military missions and training, the most contributing skills are 'ATC' $\left(\tilde{c}^{11}\right)$, 'Detect icebergs' $\left(\tilde{c}^{12}\right)$, and 'Avoid thinking traps' $\left(\tilde{c}^{41}\right)$. As can be seen from the results of this study, the necessary competencies and skills for resilience training are not identical between those for soldiers participating in conventional war and those intended for soldiers participating in military training and missions.

Following previous research that demonstrated the efficacy of MMFT in mediating stress reduction and improving psychological functioning [54], this study predicted that modifying the MMFT program could result in even greater effects on the development of resilience of participants.

The present study has several limitations that need to be considered when interpreting the findings. First, the experts selected for this study were from Ukraine and Lithuania, with very different geopolitical situations; therefore, the opinions of the experts may have been affected by these circumstances. Second, the study only examined resilience training programs based on different concepts, which may not cover all available military resilience programs. Third, the subjectivity of the experts' opinions introduces a level of uncertainty, which could be reduced by including more experts in the analysis. Given these limitations, caution is necessary when interpreting the findings. To better understand the quality assessment process, additional analyses could be conducted with a broader range of resilience competencies and more alternative resilience training programs.

7. Conclusions

Imprecise qualitative decisions regarding what the core competencies are for solders' residence building, and regarding what the most effective training program is, can be improved by applying the FAHP and the FTOPSIS as MCDM techniques. Apparently, the application of fuzzy AHP weights in fuzzy TOPSIS helps to reach farther realistic and reliable results. This study found that there were differences in preferences regarding resilience criteria and skills among well-known soldier resilience training programs. Therefore, the choice to apply MCDM techniques can be effectively used while ranking the best training program, given the existence of complex and imprecise constraints.

The sensitivity analysis carried out in this study provided valuable information on the impact of the soldier resilience training programs on the ranking process. Based on the results of the FTOPSIS and the sensitivity analysis, it was concluded that MMFT (A3) is the most effective alternative to resilience training for Ukrainian and Lithuanian soldiers. Overall, the findings of this study suggest that MMFT could be an effective tool for building soldiers' resilience and preparing them for the demands of contemporary military environments. In addition, according to the sensitivity analysis, MMFT attained the highest ranking according to the evaluation results of Ukrainian experts and was ranked top or third according to the opinion of Lithuanian experts.

The present study contributes to the existing literature by presenting MCDM-based solutions to address the issue of insufficient accuracy in capturing experts' decision making when selecting the optimal resilience training program for military personnel in high-stress environments. The MCDA model, based on fuzzy sets theory, highlights mental agility as the most critical competence. Since the current research focused solely on conventional resilience competencies included in the resilience training program, the list of competencies used here is non-exhaustive. Some of the competencies might be weakly expressed and underestimated by experts despite their relevance to resilience. Therefore, future research should incorporate additional resilience competencies in the evaluation, and alternative MCDM techniques such as PROMETHEE with fuzzy logic, interval numbers, or hesitant fuzzy sets should be explored.

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Appendix A

Table A1. FAHP criteria importance weight scores presented by the two expert groups.

[1] Sub-Criteria	Ukrainian Experts		[1] Sub-Criteria	Lithuanian Experts	
	[2] FAHP	Rank		[2] FAHP	Rank
$\tilde{C}^1$	0.1842	4	$\tilde{C}^1$	**0.2462**	**2**
$\tilde{C}^2$	**0.2077**	**2**	$\tilde{C}^2$	**0.2139**	**3**
$\tilde{C}^3$	**0.1895**	**3**	$\tilde{C}^3$	0.1251	4
$\tilde{C}^4$	**0.2344**	**1**	$\tilde{C}^4$	**0.2382**	**1**
$\tilde{C}^5$	0.1109	5	$\tilde{C}^5$	0.0823	6
$\tilde{C}^6$	0.0732	6	$\tilde{C}^6$	0.0944	5

Notes: [1] Criteria are presented in Table 3 as skills. [2] FAHP = pairwise comparison weights calculated for the criteria using the fuzzy analytic hierarchy process. Bold numbers represent three important ranks.

Table A2. The FAHP sub-criteria importance weight scores presented by the two expert groups.

[1] Sub-Criteria	Ukrainian Experts		[1] Sub-Criteria	Lithuanian Experts	
	[2] FAHP	Rank		[2] FAHP	Rank
$\hat{c}^{11}$	0.0539	5	$\hat{c}^{11}$	**0.1346**	**1**
$\hat{c}^{12}$	0.0539	5	$\hat{c}^{12}$	**0.1045**	**3**
$\hat{c}^{21}$	0.0389	6	$\hat{c}^{21}$	0.0967	4
$\hat{c}^{22}$	0.0392	6	$\hat{c}^{22}$	0.0938	6
$\hat{c}^{23}$	0.0140	9	$\hat{c}^{23}$	0.0303	11
$\hat{c}^{31}$	0.0554	4	$\hat{c}^{31}$	0.0661	8
$\hat{c}^{32}$	0.0554	4	$\hat{c}^{32}$	0.0947	5
$\hat{c}^{41}$	**0.3565**	**1**	$\hat{c}^{41}$	**0.1249**	**2**
$\hat{c}^{42}$	**0.1200**	**2**	$\hat{c}^{42}$	0.0681	7
$\hat{c}^{43}$	**0.1050**	**3**	$\hat{c}^{43}$	0.0277	12
$\hat{c}^{51}$	0.0325	7	$\hat{c}^{51}$	0.0558	10
$\hat{c}^{52}$	0.0325	7	$\hat{c}^{52}$	0.0173	14
$\hat{c}^{61}$	0.0214	8	$\hat{c}^{61}$	0.0609	9
$\hat{c}^{62}$	0.0214	8	$\hat{c}^{62}$	0.0247	13

Notes: [1] Sub-criteria are presented in Table 3 as skills. [2] FAHP = pairwise comparison weights calculated for the sub-criteria using the fuzzy analytic hierarchy process. Bold numbers represent three important ranks.

Table A3. Comparison of ranking results of different models.

Alternative	*DM1*					
	Fuzzy TOPSIS		TOPSIS		Grey Relational Analysis Method	
	Distance Closeness	Rank	Distance Closeness	Rank	Distance Closeness	Rank
A1	0.6003	2	0.7303	2	0.7375	2
A2	0.3663	3	0.3857	3	0.5881	3
A3	0.7080	1	0.7543	1	0.7557	1
A4	0.2954	4	0.1464	4	0.4700	4
	DM2					
A1	0.4486	4	0.3609	4	0.6145	4
A2	0.6387	1	0.7153	1	0.7102	1
A3	0.4907	2	0.6380	2	0.7047	2
A4	0.4506	3	0.4773	3	0.6490	3

Notes: DM1 = Ukrainian experts' assessment; DM2 = Lithuanian experts' assessment.

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