

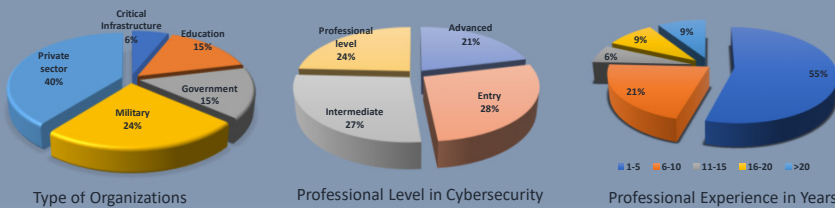
# Analysis of Event and Human Factor-Based Decision-Making In Cybersecurity Exercises Using MCDM

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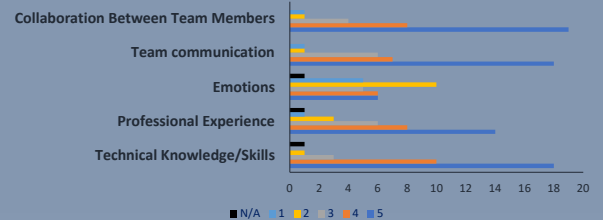
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**Summary:** This research aims to analyze the event-based decision-making of cybersecurity professionals during cybersecurity exercises, emphasizing the human factors. Data for this research were collected through surveys during the international cybersecurity defense exercise „Locked Shields 2024“ organized in Vilnius. The user profile, competence assessment data as well as emotional data framed by Plutchik’s model of emotions were collected. Criteria and decision-making options were identified. The AHP method was used to calculate weighting coefficients and prioritize the criteria. To deepen the analysis of decision-making, MCDM methods including SAW and TOPSIS were employed. The finding revealed the importance of human factors in decision-making and offered valuable insights for the enhancement of cybersecurity training programs.

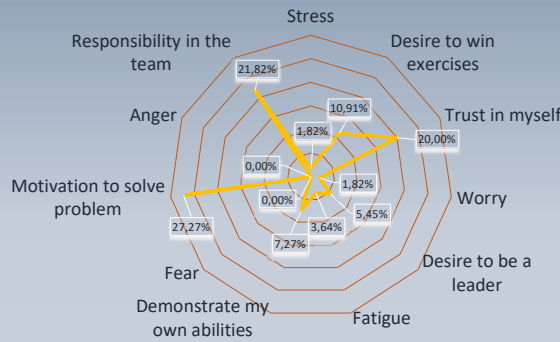
## ANALYSIS OF SURVEY RESULTS



## WEIGHTING COEFFICIENTS

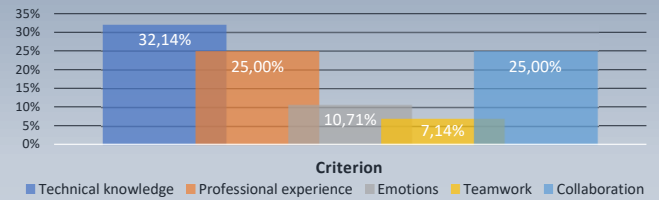


## HUMAN FACTOR WEIGHTS IN DECISION-MAKING



30% of respondents mentioned that emotions are important or very important in decision-making

## WEIGHTINGS IN DECISION-MAKING



## MCDM METHODS

Simple Additive Weighting (SAW) is method is based on finding a weighted sum of the performance on each alternative.

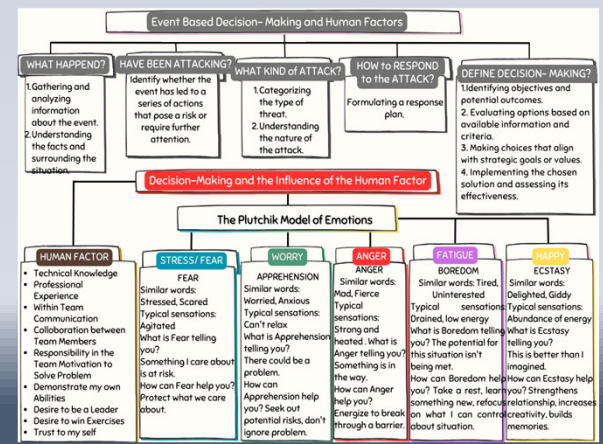
$$V_i = \sum_{j=1}^n w_j r_{ij}$$

TOPSIS method is based on the fundamental premise that the best solution has the shortest distance from the positive-ideal solution, and the longest distance from the negative-ideal one

$$S_i^+ = \sqrt{\sum_{j=1}^I (v_{ij} - v_j^+)^2} \quad S_i^- = \sqrt{\sum_{j=1}^I (v_{ij} - v_j^-)^2} \quad V_i = \frac{S_i^-}{S_i^- + S_i^+}$$

w - weighting coefficient; v - normalized value; i - alternative; V - preference  
S<sup>-</sup> - the negative ideal solution; S<sup>+</sup> - the positive ideal solution; v - the weighted and normalized performance rating

## HOLISTIC VIEW ON DECISION-MAKING IN CYBER SECURITY



Alternatives	Technical Knowledge	Professional Experience	Emotions	Within-Team Communication	Collaboration Between Team Members	V (SAW)	V (TOPSIS)	Ranking (SAW)	Ranking (TOPSIS)
<b>Military</b>									
Correct Decision - Making	4,50	4,25	2,00	4,25	4,25	1,32	0,66	1	1
Changeable Decision - Making	4,00	3,30	4,60	3,33	3,33	1,08	0,30	3	3
Wrong Decision- Making	4,00	4,00	2,00	4,00	5,00	1,27	0,60	2	2
<b>Government /Critical Infrastructure</b>									
Correct Decision - Making	4,67	5,00	4,00	3,60	4,00	1,55	0,71	1	1
Changeable Decision - Making	3,33	2,33	3,33	3,60	4,00	1,31	0,00	3	3
Wrong Decision - Making	4,00	4,00	5,00	4,00	4,00	1,55	0,64	2	2
<b>Private Sector</b>									
Correct Decision - Making	4,13	3,88	2,50	4,13	4,63	1,49	0,70	2	1
Changeable Decision - Making	4,50	3,25	2,00	3,50	4,50	1,35	0,00	3	3
Wrong Decision - Making	5,00	5,00	4,00	4,00	4,00	1,59	0,66	1	2
<b>Education</b>									
Correct Decision - Making	4,00	4,67	3,00	4,00	4,33	1,63	0,91	1	1
Changeable Decision - Making	4,00	3,50	1,50	4,00	4,50	1,53	0,09	2	2
Wrong Decision - Making	N/A	N/A	N/A	N/A	N/A	0,00	0,00		
Weightings	0,32	0,25	0,11	0,71	0,25				

## What Emotions Did you Experience During Cybersecurity Exercises?

