APPLICATION OF AHP AND TOPSIS METHODS FOR THE SELECTION OF INSTRUCTORS OF THE BRAZILIAN AIR FORCE

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ABSTRACT

This work aims to apply the AHP and TOPSIS methods for the selection of instructors in a post-training school of the Brazilian Air Force. The instructors who make up your faculty are selected from your own training classes. Sixty-seven candidates for the nomination of instructor were compared among the students graduated from the first Course for the Improvement of Officers 2021. Those selected would be able to perform the role of instructor in the School of Improvement of Aeronautical Officers. The students were evaluated in six criteria -the final day of the evaluations; the oral presentation of the course conclusion paper; the subjective evaluation of the Advisory Instructor of the Group Work; the subjective evaluation of the Course completion guide; the horizontal concept; and the evaluation of the Psychopedagogy Advisory. The AHP method was applied in the elicitation of the weights of the criteria; and TOPSIS was applied in the ordering of candidates. This implementation resulted in a list containing the prioritization of alternatives, which was compared with the actual choice of those indicated by the decision-taker, obtained in a consensus meeting. It was found that the candidates closest to the positive ideal solution (PIS) received a higher number of nominations, and those closest to the negative ideal solution (NIS) received more rejections.

Keywords: AHP, Personnel Selection, TOPSIS.

1. Introduction

The School of Improvement of Aeronautical Officers (SIAO) is responsible for the continued training of The Subaltern and Intermediate Officers of the Brazilian Air Force (BAF), enabling them to assume high-level advisory functions, composing the General Staff of the various military organizations of the Force. The Course of Improvement of Aeronautical Officers (CIO) taught by SIAO is one of the legal prerequisites for the promotion to the first post of Senior Officer. The instructors who make up your faculty are selected from your own training classes in this postgraduate school.

It is observed that, in isolation, the very high student academic performance does not disqualify the last place in the class for the function of instructors of the School. Moreover, the way the selection process is conducted reduces the relative relevance of the other criteria, as they end up being little explored in advising the Commander.

This work aims to improve this decision-making process, proposing an ordering that considers the relative importance of all criteria used, giving more clarity in the selection of new instructors. Considering this context, the objective of this work is to order sixty-seven students of CIO 1/2021, candidates for the nomination of instructor. The students were submitted to the evaluation of the six criteria currently adopted by SIAO.

2. Literature Review

Nabeeh et al. (2019) analyzed a better way to select personnel for a company. The traditional selection method looks only at curriculum and is not always accurate. This study found that, using a combination of the methods Analytic Hyerarchy Process (AHP) and Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS), it was possible to find more accurately the best person for the job. It was also found that this combined method was more efficient than the traditional method.

The AHP method consists in reflecting on the functioning of the human mind when evaluating alternatives to a complex decision-making problem. This method allows dealing with tangible and intangible values of decision-making problems, because it allows the creation of measures for qualitative variables, based on subjective judgments of decision makers (SAATY, 1980). This method allows you to compare the criteria evenly to calculate their weights.

The TOPSIS is a compensatory multicriteria decision method, i.e. the poor performance of an alternative in a given criterion can be compensated for its good performance in another. This ordering technique uses the Euclidean distances between each alternative and the positive ideal solution (PIS) and the negative ideal solution (NIS), and recommends the best ranking of alternatives for decision makers (HWANG; YOON, 1981). Thus, the best alternative is that it keeps the minimum distance from the PIS and the maximum distance from the NIS.

3. Hypotheses/Objectives

The motivation for this research questions whether the Multicriteria Decision Analysis (MCDA) can be used in the decision-making process in personnel selection problems. The aim of this article is to demonstrate that the combined application of AHP and TOPSIS methods, in a ranking problem, improves the decision-making process of nodding new instructors in a postgraduate school of the Brazilian Air Force, generating a more reliable response, and reducing the cognitive effort of the decision-maker (DM).

4. Research Design/Methodology

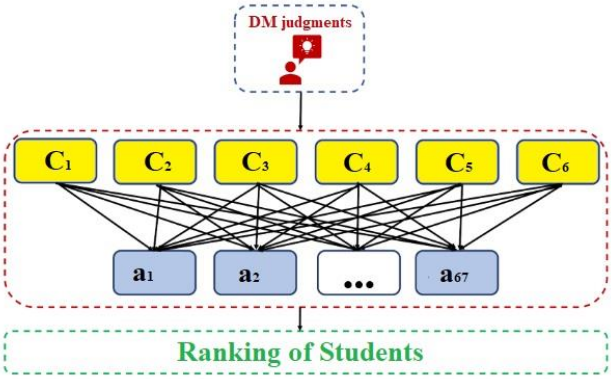
The action space of this deterministic decision problem was characterized by the discrete set of alternatives $A = \{a_1;\ a_2;\ a_3; \ldots;\ a_{67}\}$, representing the sixty-seven students of CIO 1/2021, who are candidates for the nomination. This set is stable and did not change during the decision-making process. In this proposed methodology, the AHP method was applied to define the weights of the criteria of the decision-making process. The same criteria used by SIAO for the indication of new instructors were considered in this study, according to Table 1. The Figure 1 illustrates the hierarchical structure of this problem.

Table 1 - Criteria for indication of instructors.

Criteria	Description	Goal
C_1	Final average of the disciplines attended, ranging from 0,000 to 10,000.	Maximize
C_2	Grade for the oral presentation of the course conclusion work, ranging from 0,000 to 10,000.	
C_3	Subjective evaluation of the instructor guiding the group work, expressed on a verbal scale, in which: 1 - I do not strongly indicate; 2 - I do not indicate; 3 - Neutral; 4 - I indicate; and 5 - Strongly indicate.	
C_4	Subjective evaluation of the Course Completion Work Advisor, expressed in a verbal scale, in which: in which: 1 - I do not strongly indicate; 2 - I do not indicate; 3 - Neutral; 4 - I indicate; and 5 - Strongly indicate.	

C_5	Horizontal evaluation, in which each student evaluates his peers in the class, expressed on a verbal scale, in which: in which: 1 - I do not strongly indicate; 2 - I do not indicate; 3 - Neutral; 4 - I indicate; and 5 - Strongly indicate.	
C_6	Evaluation of Psychopedagogical Advisory, expressed on a verbal scale, in which: in which: 1 - I do not strongly indicate; 2 - I do not indicate; 3 - Neutral; 4 - I indicate; and 5 - Strongly indicate.	

Figure 1 - Hierarchical structure of the problem.



5. Data/Model Analysis

Based on the pairwise comparison of the criteria, their weights were calculated, according to Table 2. The calculated consistency ratio was below 0.10, or 10%.

Table 2 - Criteria weights.

Criteria	Weights
C_1	0.0328
C_2	0.1581
C_3	0.2540
C_4	0.0813
C_5	0.1239
C_6	0.3499

The consequences matrix can be seen in Table 3, where v_{ij} represents the performance of alternative $i = 1, 2, 3, \dots, 67$ in a criteria $j = 1, 2, 3, \dots, 6$. The data set in this table were provided anonymously by SIAO.

Table 3 - The consequences matrix.

Alternatives	Criteria					
	C_1	C_2	C_3	C_4	C_5	C_6
a_1	v_{11}	v_{12}	v_{13}	v_{14}	v_{15}	v_{16}
⋮	⋮	⋮	⋮	⋮	⋮	⋮
a_{67}	v_{671}	v_{672}	v_{673}	v_{674}	v_{675}	v_{676}

After ranking the alternatives using the TOPSIS method, the result was compared with the real choices made by the decision-maker. The Table 4 shows the results of this ranking, in which ε represents the proximity index of an alternative $i = 1, 2, 3, \dots, 67$, compared to PIS and NIS. In this case, 88.24% of candidates appointed to the role of instructor were in the first two quartiles.

Table 4 - Ranking by the TOPSIS method.

Quartile	ε	Rank	Chosen	Quartile	ε	Rank	Chosen
1th	0.948	1º	Yes	2th	0.543	18º	Yes
	0.801	2º	Yes		0.539	19º	No
	0.715	3º	Yes		0.522	20º	Yes
	0.659	4º	Yes		0.520	21º	No
	0.639	5º	Yes		0.509	22º	Yes

Quartile	ε	Rank	Chosen	Quartile	ε	Rank	Chosen
1th	0.628	6º	Yes	2th	0.505	23º	Yes
	0.623	7º	Yes		0.505	24º	Yes
	0.613	8º	Yes		0.502	25º	Yes
	0.603	9º	Yes		0.501	26º	Yes
	0.586	10º	No		0.491	27º	Yes
	0.582	11º	Yes		0.480	28º	No
	0.582	12º	Yes		0.469	29º	Yes
	0.576	13º	Yes		0.469	30º	Yes
	0.566	14º	Yes		0.463	31º	Yes
	0.560	15º	Yes		0.453	32º	Yes
	0.559	16º	Yes		0.451	33º	Yes
	0.558	17º	Yes		0.445	34º	Yes
3th	0.441	35º	Yes	4th	0.421	52º	No
	0.438	36º	Yes		0.421	53º	Yes
	0.437	37º	Yes		0.418	54º	Yes
	0.437	38º	Yes		0.414	55º	Yes
	0.436	39º	Yes		0.414	56º	Yes
	0.435	40º	Yes		0.410	57º	No
	0.434	41º	Yes		0.405	58º	No
	0.434	42º	Yes		0.375	59º	Yes
	0.431	43º	Yes		0.367	60º	Yes
	0.430	44º	No		0.332	61º	Yes
	0.429	45º	Yes		0.309	62º	No
	0.429	46º	Yes		0.307	63º	No
	0.429	47º	No		0.293	64º	No
	0.427	48º	Yes		0.292	65º	No
	0.426	49º	Yes		0.286	66º	No
	0.425	50º	Yes		0.112	67º	No
	0.424	51º	Yes				

6. Limitations

Although the results of this work improve the decision-making process, limitations were identified in the research. The first one refers to the emergence of new data after the final ranking calculations, during the advisory meeting for the choice of new instructors, which contributed to the divergences between the proposal and the actual choices. Another limitation concerns the use of Euclidean distances, applied in an R^6 space. The application of the Mahalanobis distance is recommended.

7. Conclusions

This application describes a real case of combined application of AHP and TOPSIS methods to improve the process of selecting instructors in a military school. This proposal can be incorporated into similar decision-making processes of the Brazilian Air Force, as well as in other Armed Forces and civilian institutions. It was observed that candidates closer to PIS received more nominations, and those closer to NIS received more rejections. In other words, the TOPSIS method was effective in ordering the alternatives, allowing the decision-maker to carry out a more comprehensive and fair assessment of the candidates, in addition to speeding up the process.

8. Key References

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