# PREDICTING THE POSITION OF MILITARY PERSONNEL IN A CAREER PATTERN WITH TOPSIS ALGORITHM AND RECOMMENDATION SYSTEM

**LELI SETYANINGRUM[1,2], EDI ABDURACHMAN[3,] HARCO LESLIE HENDRICS SPITS WARNARS[4], JUNEMAN ABRAHAM[5]**

[1]Computer Science Doctoral Study Program, BINUS Graduate Program, Bina Nusantara University, Jakarta 11530, Indonesia
[2]Indonesian Navy Education Office, Center of the Indonesian Navy, Jakarta 12230, Indonesia
[3]Computer Science Doctoral Study Program, BINUS Graduate Program, Bina Nusantara University, Jakarta 11530, Indonesia
[4]Computer Science Doctoral Study Program, BINUS Graduate Program, Bina Nusantara University, Jakarta 11530, Indonesia
[5]Psychology Department, Faculty of Humanities-Bina Nusantara University, Jakarta 11480, Indonesia
E-mail: [1,2]leli.setyaningrum@gmail.com, [3]edia@binus.ac.id, [4]spits.hendric@binus.ac.id, [5]juneman@binus.ac.id

## ABSTRACT

A career pattern is required in the context of a long-term career in a military organization. A decisive stage runs from hiring to termination for the accomplishment success of organizational tasks. To place positions in military organizations, the TOPSIS algorithm and recommendation system are beneficial in identifying career trends. TOPSIS ranks each employee's job proposals. The system employing collaborative filtering generates suggestions based on the rank data given the criteria of position placement. Determining military personnel's careers following their professions and areas of competence will be considerably aided by calculating the TOPSIS algorithm and recommendation system. It will make it easier for decision-makers to place the right man in the right places.

**Keywords:** *Military Personnel, Career Pattern, Recommendation System, TOPSIS, Personnel Positioning*

## 1. INTRODUCTION

Information resources are increasingly needed in various systems in the military field so an evaluation framework is urgent for system developments to expand system integration and extend the cycle of a system.[1] The career pattern of military personnel is closely related to completion and success in various tasks so it becomes one of the main assets in the organization.[2] The need to determine the method of personnel placement is pivotal to can assist the field of human resources and leadership in making decisions about personnel positions and, therefore, support the completion of tasks by position linked to personnel competencies. Efforts to develop systems are an improvement of processes that still have limitations in supporting decision-making.[2] An appropriate method is urgently needed to assist military organizations in placing their personnel. However, we need not only an accurate placement of personnel but also a system that can provide information based on existing data on the predictions of available positions for personnel. This will be very helpful in getting personnel positions in the correct positions earlier so that they can provide consideration to the leaders in making decisions regarding personnel career patterns.

The right personnel is people with the knowledge and skills that can use the information and technology required by their jobs, and are in harmony with the organization, work, and environment. Failure to select the right personnel is a material and immaterial loss to the organization.

## 2. LITERATURE REVIEW

Position placement is an inseparable part of the personnel career pattern. Various models and methods have been developed to find the right pattern according to the needs of an organization. In its development, the military career pattern model can be said to be a model in which there are active activities of military personnel, structured within the formal hierarchy of military organizations.[3][4][5] The development of military organizations must be supported by personnel with the fields and expertise according to their position.[6] In addition, with the ability to take control of technology and information so that it can be in line with developments and not harm the organization, especially in material and immaterial aspects.[7]

2.1. Military personnel career patterns

In its development, the military field has changed, including increasing strength, being easy to implement, and integrating technology. This ultimately affects the demand for personnel capabilities in each existing position, so it requires efforts to improve personnel capabilities, which include providing various education and training.[8] Military personnel is subject to a command system, comply with the principle of subordination, and carry out various training.[9]

A career can be interpreted as a position held by a person sequentially during his life, covering various ongoing work activities and related aspects of life.[10] The components of a career are education and capabilities. A career pattern can also be called a career path which includes a person's position starting from the most junior to the most senior or before retirement.[11]

So that the career pattern of military personnel can be said to be a personnel position starting from the lowest to the highest before retirement, which requires various education and training to achieve it, and following the command line.

2.2. Recommendation System

The recommendation system provides predictions based on various of relevant information through a model that includes behavior, attributes, or content of an accessible resource.[12] In building the model, there are several phases, as shown in Figure 1.

The first phase is collecting information consisting of various relevant information forms. For example, the recommendation system model in e-learning requires information about student interests, learning methods, ability to do assignments, and interaction with the system to the final student grades. The second phase is feedback, consisting of three methods, namely explicit (depending on the information the user is involved in, for example, rating), implicit (through monitoring, for example, email content, and browsing history), and hybrid (using implicit and explicit). The third phase is learning, using a form of a learning algorithm to explore and filter the features obtained as information. The last is Recommendation or prediction, a phase for making recommendations or predictions based on model information, memory, or activity through the system.[12] [13] [14]
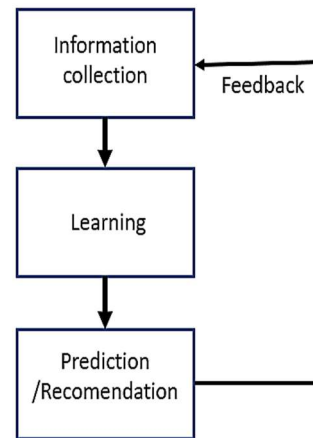


*Figure 1. The phase of the Recommendation* [12]

The common recommendation approach technique is content-based-filtering (CB), collaborative-filtering (CF), and hybrid filtering (HB). CB is based on content, an algorithm using domain and attribute analysis. CF is an independent technique with an unclear domain and works with a user-item matrix or database form, consisting of memory-based and model-based. Whereas HB combines different recommendation techniques to eliminate problems in one of the other approach techniques.[12][13]

This study uses collaborative filtering to complete the search for predictions of prospective personnel to occupy a position.

2.3. TOPSIS

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), developed by Yoon and Hwang in 1980, based on the shortest distance is an alternative to serve as a ideal geometric solution, while the farthest distance is a negative-ideal, which is also one of the MCDM methods (Multi - Criteria Decision - Making). [15][16]

Convenience, ease of understanding, and faster calculations is the reason this research uses TOPSIS. The steps in implementing TOPSIS are listed in Table 1. [7][17][18]

a.  Forming and normalizing the decision matrix.

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & . & . & a_{1j} \\ a_{21} & a_{22} & . & . & a_{2j} \\ . & . & . & . & . \\ . & . & . & . & . \\ a_{i1} & a_{i2} & . & . & a_{ij} \end{bmatrix} \rightarrow r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}} \quad \substack{i=1,..,m \\ j=1,..,n} \quad ---- 1)$$

m → number of decision points
n → number of evaluation factors
A → evaluation matrix
r → normalize of decision matrix
R → standard of decision matrix

$$\rightarrow \quad R_{ij} = \begin{bmatrix} a_{11} & a_{12} & . & . & a_{1n} \\ a_{21} & a_{22} & . & . & a_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ a_{m1} & a_{m2} & . & . & a_{mn} \end{bmatrix}$$

Normalization of the decision matrix is carried out by dividing all values in the matrix by the square root value of the sum of the squares of each value in the column.

b.  Normalized weighted for decision matrix.

Determine the weight value in the relationship with the evaluation factor ($W_i$), then each element in each matrix column R is multiplied by the value in $w_i$, and a matrix V is formed.

$$\sum_{i=1}^{n} w_i = 1 \rightarrow V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & . & . & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & . & . & w_n r_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ w_1 r_{m1} & w_2 r_{m2} & . & . & w_n r_{mn} \end{bmatrix} ---2)$$

W → evaluation factor
V → weighted standard of decision matrix

c.  Determine solutions from Positive-Ideal ($A^+$) and Negative-Ideal ($A^-$).

Based on the weighted normative value, the positive-ideal value ($A^+$) and the ideal-negative solution value ($A^-$) can be found.

$$A^+ = \{z_1^+, z_2^+, \ldots \ldots, z_n^+\} \text{ (maximum value) ---3)}$$

$$A^- = \{z_1^-, z_2^-, \ldots \ldots, z_n^-\} \text{ (minimum value) ---4)}$$

d.  Perform distance calculations between alternatives.

As a determination of the value of the distance between the maximum and minimum ideal points.

$$S_i^- = \sqrt{\sum_{j=1}^{n}(z_{ij} - z_j^+)^2} \qquad i = 1,2,3,\ldots,m \qquad ---5)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}(z_{ij} - z_j^-)^2} \qquad i = 1,2,3,\ldots,m \qquad ---6)$$

S → ideal point

e.  Perform calculations on relative proximity to the ideal solution.

The ideal-positive and ideal-negative criteria are the values used to calculate the relative closeness of the alternative to the value of the ideal solution ($C_i^*$).

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^+} \quad 0 \le C_i^* \le 1; \ i = 1,2,3,\ldots,m \qquad ---7)$$

$C_i^*$ → ideal solution

## 3.  PREDICTION OF POSITION MODEL

The models used in this study are TOPSIS and Collaborative Filtering (CF), which can provide better predictive results for predicting personnel career patterns. This can help determine the personnel, which is an essential part of the career

pattern.

*Figure 2. Models of career management* [11]

Determining the personnel career is closely related to the career management model, which consists of several aspects, as seen in Figure 2. Career exploration is closely related to various information possessed by personnel, such as talents, interests, experience, and others. Awareness is a manifestation of the characteristics and qualities of personnel towards themselves which influence their career development. The determination of personal career goals is related to motivation in achieving success. In achieving career success for personnel, a strategy is needed in career development that involves personnel and organizations resources to achieve success for a career. After that, the strategy was implemented to achieve personnel career goals. Feedback is also very much needed to provide an evaluation and assessment of the career that has been achieved so that it can be known if there are changes in career development. [11]

### 3.1. Previous Similar Research

#### a. TOPSIS Method

In previous research, models related to personnel careers using TOPSIS can be seen in Table 1. Development of the use of TOPSIS, carried out in the recruitment process to determine the right personnel to occupy positions according to their expertise and field. Meanwhile, there is no separate discussion about the processes at the following career stages, so further research on the sustainability of personnel career patterns can be more complete.

*Table 1. Position placement model in recruitment processes for career personnel with TOPSIS*

| NO. | REFF | RESULTS |
|---|---|---|
| 1. | [19] | Use of Fuzzy Laws in TOPSIS in the form of a mathematical model. |
| 2. | [20] | Use the fuzzy TOPSIS process with a new measurement of alternative ratings, taking the critical characteristics derived from the method on the main outranking and the basis of the veto concept. |
| 3. | [21] | Development of TOPSIS fuzzy variants using veto limits as ideal-positive and ideal-negative solutions, as well as in applications plus the use of votes for ranking. |
| 4. | [22] | Use the Fuzzy TOPSIS method on the decision criteria for applicant candidates, objective evaluation up to ranking. |
| 5. | [23] | - The weighted Scoring (WS) method was the first selection.<br>- Criteria weight using the Analytical Hierarchy Process (AHP) method.<br>- Sorting technique with the ideal solution using TOPSIS.<br>- PROMETHEE Evaluation Preference Method to determine the selection of the right candidate<br>- Use criteria on evaluation, methodology, and combination of methods. |
| 6. | [24] | TOPSIS method with intuitionistic fuzzy sets |

#### b. Recommendation System Method

Several studies have been conducted on using a recommendation system for position placement. The recommendation system provides access to filtering information that provides a unique attraction for its users. It has been widely used in various activities requiring assistance selecting the desired subject. It can be seen in Table 2 that the use of a recommendation system for placement of positions, especially in the recruitment process, has been developed and used in general to online.

*Table 2. Position placement model with Recommendation System*

| NO. | REFF | RESULTS |
|---|---|---|
| 1. | [25] | Comparison of several existing models through surveys regarding online job recommendation system portals for job seekers, namely Casper, Proactive, Prospect, Work4, eRecruiter, CareerBuilder, AIS, and LinkedIn job. Use KNN, MF, GPA, and others to address privacy, modeling, and security needs. There are still deficiencies in scalability and evaluation size. |
| 2. | [26] | Implementing layered architecture and a combination of hybrid filtering and KNN, in the education sector context. Using content-based filtering to process student data and collaborative filtering to process student feedback. |
| 3. | [27] | Job recommendations targeting prospective employees based on matching with the content base and preferences of prospective employees, which are obtained from them, including through curriculum vitae, using matching, content-based filtering, and collaborative-filtering methods. |

### 3.2. Model of Development of Military Career Patterns in Position Placement

The need for personnel in the military field is becoming increasingly complex, covering various fields of ability and expertise. Thus, the placement of personnel in one position must meet the criteria and be able to carry out the responsibilities of that position. The need for organizational development and adaptation to technology also influences the need for personnel with mastery in new areas within the military organization. Thus, it is urgently needed a form method that can assist in determining the career pattern of personnel, especially in the placement of positions in the organization. The method used is a method that should be easy to implement and easy to learn by its users, which also allows it to be used in the military with limited personnel and technological resources. The method

used in this study is a combination of TOPSIS and a recommendation system, namely collaborative filtering. This study uses item-based collaborative filtering because each person must complete several criteria in a position. Each position has several different criteria according to the demands of the field that must be owned by the personnel occupying it. While the data used is sample data found in military organizations in the Indonesian Navy, the process of calculating it can be seen in each method used. The results of this method are to be used as material for suggestions, considerations, and complete information in the process of personnel career patterns while serving as military members.

Figure 3 is the model used, with several stages, first doing calculations with TOPSIS to determine the personnel ranking for the proposed positions to be filled. In the second stage, after the ranking of personnel is known, a search is carried out with collaborative filtering to find out whether other personnel can be proposed for a position along with the rank they have for that position. Then the third stage, based on the content-based filtering method, can be seen in more detail the positions personnel can take according to the specifications and criteria that must be met. This is done so that the person who gets a title follows their abilities, education, official experience, and position criteria. In previous research, a method that uses collaborative filtering based on TOPSIS has been used, for selecting video/movie camera lenses, by providing solutions to several alternatives based on several specified criteria to provide more accurate results.[28]

By combining these methods, we get personnel who master the assignment field. Nevertheless, in the end, it will require a lot of personnel who must have professional mastery of a field. Military organizations will be based on professionalism, following the demands of organizational development that follow technology according to the era.

The initial stage is to collect data contained in the personnel database, which includes personnel master data, position criteria data, and other data related to personnel, such as education, health, violations, psychology, skills, and competence/profession. Then do the calculations with TOPSIS, as seen in Figure 4, as you can see an example of a calculation for one position, which includes several steps.

a. Determine the general criteria needed for a particular position. In the military, this is related to rank and several things related to the basic abilities of the position.

b. Create a decision matrix based on the criteria for one predetermined position.
c. Determine the weight of each criterion in that one position.
d. Develop a normalized decision matrix (R) and make a weighted normalized decision matrix (Y) for that one position.
e. Determine the form of ideal-positive and ideal-negative solutions for one position.
f. Calculate the ideal-positive (D+) and ideal-negative (D-) solution distances in that one position.
g. Calculating the preference value of each alternative (V) for that one position.
h. Determine the rank that each personnel has for that position
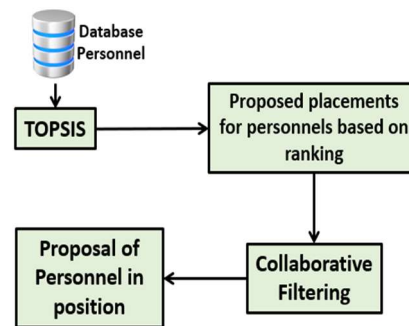


*Figure 3. Model of position placement with TOPSIS and Recommendation System*

After the ranking has been determined, a search is carried out again for the possibility that there is personnel who are not yet in the TOPSIS calculation results but have the same opportunity to occupy the position. By using collaborative filtering, personnel with the opportunity can be identified because it can help to find all possible opportunities for personnel to occupy positions according to their skill areas.

There are several steps in performing calculations with item-based collaborative filtering, namely : Provides personnel ratings for positions that have been obtained through TOPSIS, calculate the similarity between items using the cosine similarity method based on the rating determined through TOPSIS, and Perform calculations on personnel rating predictions for a position using the weighted sum method.

Using these two calculation methods provides a variety of possibilities and equal opportunities for every person who has a position according to the criteria in the system of career pattern military personnel. Figure 5 shows each step that gives results to the calculations carried out,

*Figure 4. Calculating ranking by TOPSIS*

which in the end, get a rating from all personnel who can obtain a position with equal opportunities. From these results, it can also be known that personnel



does not meet the desired qualifications.

*Figure 5. Collaborative filtering process for prediction based on TOPSIS*

This method is used to find predictions from all existing personnel without exception, considering various general and specific criteria, according to the required position. Thus, this can provide information and career paths following military personnel's abilities, experience, competence, and even professionalism. This is because each person will

have the burden of duties and responsibilities in the field under their control.

## 4. CONCLUSION

The need for military personnel who have professionalism in their fields is to support the success of various tasks and operations carried out. Using the TOPSIS method and collaborative filtering in calculating predictions for position placement as a form of career pattern is very helpful in exploring the possibilities of all existing military personnel based on ability, expertise, experience, and education for the positions to be filled. So that all personnel gets the same opportunity to occupy a position.

However, in the operational concept of the military field, there is a basic knowledge of the same field for all personnel at the first stage of entry into the organization. Determining competencies and fields that must be mastered for further service requires an appropriate and accurate method because, in the end, it will affect the fulfillment of positions with several different criteria. There must be a method developed in determining specific fields in future research that must be mastered by each personnel based on their talents, interests, and competencies so that in the course of their career, they can fill all projected positions in the military organization at various levels and types of ranks.

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