Decision Support System Perspective Using Entropy and Multi-Attribute Utility Theory in the Selection of the Best Division Head

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Abstract—The Division Head is a figure responsible for the management, coordination, and supervision of a division in an organization. Its main tasks include the development of strategy, planning, and implementation of operational activities of the division in accordance with organizational objectives. Problems in choosing the best Division Head often arise due to various complex factors. One of the main problems is the lack of clear and objective criteria in determining the suitability of candidates to the duties and responsibilities of the division's leadership. The combination of entropy weighting with the MAUT (Multi-Attribute Utility Theory) method is an approach that combines two decision-making analysis techniques. First, entropy weighting is used to determine the relative weight of each attribute used in the analysis. This technique helps measure the degree of uncertainty or randomness in the data, so attributes that have higher variation will be given a lower weight. Once attribute weights are determined, the MAUT method is used to evaluate and compare decision alternatives based on the subjective preferences of the decision maker. MAUT allows decision makers to assess and assign the relative utility value of each decision alternative to each attribute taken into account. By combining these two techniques, decision makers can obtain more accurate and structured results in complex decision making, taking into account both data variation and subjective preferences. The results of the alternative ranking of the best division head selection showed results for the Head of Information Technology (IT) Division with a value of 0.6918 ranked 1, Head of Quality Division with a value of 0.5242 got rank 2, and Head of Human Resources (HR) Division with a value of 0.4221 got rank 3.

Keywords: Combination; Decision-Making; Division Head; Entropy Weighting; MAUT Method;

1. INTRODUCTION

The Division Head is a figure responsible for the management, coordination, and supervision of a division in an organization. Its main tasks include the development of strategy, planning, and implementation of operational activities of the division in accordance with organizational objectives. In addition, the Head of Division also has an important role in leading the work team, managing human resources, and ensuring work efficiency and effectiveness. With strong leadership skills, the Division Head is able to direct and motivate team members to achieve predetermined targets, maintain the operational continuity of the division, and contribute to achieving overall organizational success. In addition, the Head of Division is also responsible for establishing good relations with internal and external parties of the organization, including with other divisions, partners, and related stakeholders. This aims to ensure the achievement of synergy between departments and support the creation of effective collaboration in achieving the vision and mission of the organization. As a leader, the Division Head must also have good analytical skills in monitoring the development of the division and identifying opportunities and challenges that may be faced, so as to take appropriate strategic steps to optimize the performance of the division. With integrity, wisdom, and high dedication, the Division Head is able to become the backbone of the organization in achieving long-term success. Problems in choosing the best Division Head often arise due to various complex factors. One of the main problems is the lack of clear and objective criteria in determining the suitability of candidates to the duties and responsibilities of the division's leadership. Sometimes, the selection process tends to be influenced by personal preferences or internal political interests, which can obscure the objective evaluation of the abilities and experience of the candidate for Head of Division. In addition, a lack of transparency in the selection process can also create dissatisfaction among employees and affect the motivation and overall performance of the team. Other problems include mismatches between the abilities and experience possessed by the elected Division Head and the demands and complexity of the tasks at hand, which can hinder the progress and achievement of organizational goals. Therefore, it is important to address these issues by implementing a transparent, objective, and criterion-based selection process that is clear, and ensuring the alignment of leadership competencies and vision with the needs of the division and the organization as a whole. This research is urgent because the selection of division heads is a strategic decision that has a major impact on the company's performance and direction. In an increasingly complex business environment, organizations need a structured and efficient approach to selecting leaders that best fit their needs. Using a decision support system that integrates entropy theory and multi-attribute utility allows organizations to better handle this complexity, by providing a deeper understanding of the preferences and uncertainties involved in decision making. This research is not only relevant for the benefit of organizations in optimizing the use of their human resources, but also has the potential to make an important contribution in the development of management decision-making theory and practice.
Research related to the selection of division heads was conducted by Aisyah (2021), the AHP algorithm method was applied to the selection of the best manager selection with the results, namely Bambang JB with a total score of 440 with an A rating with good decisions[1]. Further research conducted by Situmorang (2023) the application of the ROC and MABAC methods produced candidate information that had the highest value with a value of 0.41 in the selection process[2]. Research from Hamidah (2021) The SAW (Simple Additive Weighting) method was used in the selection of bureau heads with the results of the study obtained a score of 0.975 by V4 candidates, so that those selected to become bureau heads were candidates who obtained the highest score, namely V4[3]. The last research was conducted by Sumarno (2021) the selection of the head of Kanit PPA using the Weight Product method obtained the highest value of 0.341 in the name of Mr. B[4]. Results from previous research in the selection of division heads using decision support systems show that this approach has the potential to increase objectivity and efficiency in the selection process.

Decision support systems (DSS) show that they are very useful tools in aiding complex decision making[5], [6]. DSS uses data, models, and analytical techniques to provide relevant and accurate information to decision makers. Various advantages of DSS, including its ability to improve decision-making efficiency, reduce uncertainty, and support more comprehensive analysis. In addition, DSS can also assist users in evaluating decision alternatives and identifying the best solution based on predetermined criteria. The importance of DSS development that can be tailored to the specific needs and context of the organization or environment in which DSS will be used. This includes selecting the right analysis model, collecting and processing accurate data, and integration with existing systems in the organization. DSS development for the selection of division heads requires a holistic and sustainable approach, involving various stakeholders and relevant experts to ensure the success and reliability of the system[7], [8]. By overcoming these challenges and utilizing the potential of DSS optimally, it is hoped that the process of selecting division heads can become more structured, transparent, and oriented towards achieving organizational goals effectively. One method in decision support systems is Multi-Attribute Utility Theory.

Multi-Attribute Utility Theory (MAUT) is one approach in decision making used to solve complex alternative selection problems[9], [10]. This theory allows decision makers to integrate various relevant criteria or attributes in the decision-making process by taking into account their subjective preferences towards each of those criteria. In MAUT, decision makers rate each alternative based on the utility value assigned to each attribute, which is then summed up to get the total utility value for each alternative. This process allows decision makers to simultaneously consider various factors that are important in complex decision-making contexts, such as cost, quality, time, risk, and personal preferences Multi-Attribute Utility Theory[11], [12]. MAUT can be applied in a variety of contexts, including in the selection of division heads, where a number of criteria such as experience, leadership skills, and organizational culture fit can be systematically evaluated and integrated to aid more informed and objective decision making. The use of the MAUT method in the selection of division heads requires a systematic stage in determining criteria, collecting data, assessing preferences, and using mathematical models to calculate utility values. In addition, it is important for decision makers to ensure that the process is transparent, open to multi-stakeholder participation, and results in decisions that are acceptable to all parties concerned. Thus, MAUT can be a powerful and effective tool in helping organizations conduct optimal division head selection, taking into account various aspects that are relevant and important to the overall success of the organization[9], [13]. One of the main drawbacks of the Multi-Attribute Utility Theory (MAUT) method in the determination of criterion weights is the subjectivity involved in this process. The weighting of criteria often depends on the subjective preferences of the decision maker, which can produce inconsistent or unstable results. In addition, the difficulty in measuring the importance of criteria objectively and the difficulty in grouping criteria that are often interrelated, are also challenges. Deadly dependence on the subjective preferences of decision makers can also lead to personal biases or irrelevant interests affecting the decision-making process, reducing the objectivity and reliability of the results produced. Therefore, MAUT users need to be careful in dealing with this subjectivity and ensure that the weighting process is carried out transparently and based on careful and balanced analysis. One method to cover the weaknesses of the MAUT method is to use the Entropy method.

The method of weighting criteria using entropy is one approach used in decision making to determine the relative weight of each criterion[14]–[16]. This method utilizes the entropy concept of information theory to measure the degree of uncertainty or diversity in the data associated with each criterion. Using the value of entropy, this method makes it possible to identify the most informative or most relevant criteria in decision making. The relative weight of each criterion is determined based on the resulting entropy value, where the criterion with the higher entropy value will have a lower weight and vice versa. The advantage of this method is its ability to account for complexity and uncertainty in criteria data, thereby giving it more objective weight[17]–[19]. In addition, the method of weighting criteria using entropy also requires complete and accurate data to provide reliable results. Uncertainty in the data or lack of information can affect the entropy value and consequently, result in inaccurate weighting of criteria. In addition, the use of this method can also be complex especially when there are many criteria to be assessed. Decision makers need to understand well the concept of entropy and how to apply it in the specific context of their decision-making. By carefully considering the advantages and disadvantages of this method, users can use this approach effectively to support a better and more informed decision-making process.

The combination of entropy weighting with the MAUT (Multi-Attribute Utility Theory) method is an approach that combines two decision-making analysis techniques. First, entropy weighting is used to determine
the relative weight of each attribute used in the analysis. This technique helps measure the degree of uncertainty or randomness in the data, so attributes that have higher variation will be given a lower weight. Once attribute weights are determined, the MAUT method is used to evaluate and compare decision alternatives based on the subjective preferences of the decision maker. MAUT allows decision makers to assess and assign the relative utility value of each decision alternative to each attribute taken into account. By combining these two techniques, decision makers can obtain more accurate and structured results in complex decision making, taking into account both data variation and subjective preferences.

2. RESEARCH METHODOLOGY

2.1 Research Stages Framework

The research stage framework is a series of steps designed to guide the research process from start to finish. These stages include problem formulation, literature study, research design, data collection, data analysis, and interpretation of research results[20], [21]. Each stage has an important role in directing to understand in depth the topic under study, collect relevant data, carefully analyze findings, and present results clearly and systematically. This framework helps ensure that research is conducted with appropriate methodologies and produces findings that are valid and beneficial to the development of knowledge and problem solving in various fields. The framework of the research stages as shown in Figure 1.

![Figure 1. Research Stage Framework](image)

The research stage framework in figure 1 is a research process that is carried out starting with determining alternatives, determining criteria, collecting data on alternative assessment results. The next process uses the entropy weighting method to determine the weight of the criteria, then applies the MAUT method for the Selection of the Best Division Head, and finally provides recommendations for the ranking results of the Selection of the Best Division Head.

2.2 Alternative Determination

Alternative determination is an important process in decision making in various fields, be it in the context of business, education, or everyday life. When faced with a complex problem or situation, it is important to structure and evaluate the various options or alternatives available. This makes it possible to consider the various possible outcomes and possible impacts of each alternative. The process of determining alternatives involves a thorough analysis of the advantages and disadvantages of each option, as well as considering its values, goals, and limitations. By making careful determination of alternatives, a person or an organization can make more informed and effective decisions, which in turn can lead to the achievement of desired goals. In the selection of the best division head the alternative used is the leader of each division, there are 7 divisions that will become 7 alternatives in this study. Alternative data is obtained based on the results of collection of needs with the company where the data is always used every year in the selection of the best division heads.

2.3 Determination of Criteria

Criteria determination is a crucial stage in the decision-making process where parameters or standards are identified to evaluate available alternatives. These criteria serve as a guide to choose the option that best suits the goal to be achieved or the problem to be solved. In determining the criteria, it is necessary to consider the needs, priorities, and values relevant to the situation. Criteria can be quantitative factors, such as cost or time, or
qualitative factors, such as quality, sustainability, or social impact. In addition, clarity, relevance, and consistency of criteria are also important to ensure that alternative evaluations are carried out objectively and comprehensively. By determining the criteria well, decision makers can facilitate a more efficient and accurate evaluation process, making it possible to choose the most appropriate alternative according to the desired needs and goals. The results of the collection of criteria used in the selection of the best division heads are leadership, knowledge, effective communication, professional integrity and ethics, and responsibility. This criterion will be used in selecting the best division head using a decision support system model.

2.4 Alternative Assessment Data

Alternative assessment data in the context of selecting the best division head, you need predefined assessment criteria. The assessment data is obtained from the results of the assessment conducted from each division member on the performance of the division head. This assessment data is carried out by the company using questionnaires from each division member.

2.5 Stages of Weighting Using Entropy

The weighting method using entropy is an approach used in multi-criteria decision making to measure the degree of uncertainty or variation in criterion data. Entropy is used to evaluate how random or uncertain the information contained in each criterion is, assuming that the higher the level of entropy, the more uncertain the information possessed. This process involves calculating the entropy for each criterion and then assigning a relative weight based on the associated entropy level. Criteria with lower levels of entropy, meaning they have more definitive or structured information, will be given higher weight, while criteria with higher levels of entropy will be given lower weight. By using the entropy-weighting method, decision makers can reduce uncertainty in the evaluation of criteria and give more weight to the level of importance of each criterion in multi-criteria decision making. This method helps to produce more informed and consistent decisions in situations where there are many criteria to consider. The first step in the entropy method is to create a decision matrix from alternative assessment data using the following equation.

\[
X = \begin{bmatrix}
    x_{11} & \cdots & x_{1n} \\
    \vdots & \ddots & \vdots \\
    x_{m1} & \cdots & x_{mn}
\end{bmatrix}
\]

(1)

Where the \( x \) value for each column and row is an alternative value based on existing criteria. The next process calculates the normalized value of the matrix based on the decision matrix by using the following equation.

\[
k_{ij} = \frac{x_{ij}}{\max_{x_{ij}}}
\]

(2)

Where the value of \( x_{ij} \) is the value of each alternative \( i \) based on an existing \( j \) criterion, while \( k_{ij} \) is the value of the normalization matrix of alternative \( i \). The next process calculates the value of the criterion matrix based on the results of matrix normalization using the following equation.

\[
a_{ij} = \frac{k_{ij}}{\sum_{i=1}^{n} k_{ij}}
\]

(3)

Where the \( k_{ij} \) value is the value of the normalized result of each alternative \( i \) based on an existing \( j \) criterion, while \( a_{ij} \) is the value of the criteria matrix. The next process calculates the entropy value using the following equation.

\[
E_j = \left[ -lnm \right] \sum_{i=1}^{n} [a_{ij} \cdot ln(a_{ij})]
\]

(4)

where \( m \) is the number of alternatives for each criterion, while \( E_j \) is the entropy value. The process then calculates the value of the dispersion using the following equation.

\[
D_j = 1 - E_j
\]

(5)

where \( D_j \) is the dispersion value, while \( E_j \) is the entropy value. The final process calculates the criterion dispersion value or criterion weight by using the following equation.

\[
W_j = \frac{D_j}{\sum D_j}
\]

(6)

All of the above stages from (1) to (6) are stages in determining the weight of criteria using the entropy method.

2.6 Stages of the MAUT Method

The MAUT (Multi-Attribute Utility Theory) method is an approach in decision making used to handle situations where decisions must be made based on several interrelated attributes or criteria. This method allows decision makers to combine their subjective preferences against various criteria by taking into account the relative weight of those criteria and the utility value associated with each alternative. MAUT provides a strong framework for
more rational and informed decision making in situations where there are many factors to consider. The first stage in the MAUT method is to make a decision matrix using the following equation.

\[
X = \begin{bmatrix}
    x_{11} & \cdots & x_{n1} \\
    \vdots & \ddots & \vdots \\
    x_{1m} & \cdots & x_{nm}
\end{bmatrix}
\]

Where the \(x\) value for each column and row is an alternative value based on existing criteria. The next process calculates the normalized value of the matrix based on the decision matrix by using the following equation.

\[
r_{ij}^* = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}}
\]

\[
r_{ij} = 1 + \frac{\min x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}}
\]

Where the value of \(x_{ij}\) is the value of each alternative \(i\) based on an existing \(j\) criterion, while \(r_{ij}\) is the value of the normalization matrix of alternative \(i\). In calculating the normalization matrix for (8) calculated for criteria with type of benefit and for (9) calculated for criteria with type of cost. The next process calculates the utility value using the following equation.

\[
 u_{ij} = \frac{e((r_{ij})^2) - 1}{1.71}
\]

Where \(u_{ij}\) is the utility value, while \(r_{ij}\) is the value of the matrix normalization result. The last process in the MAUT method is to calculate the final value of the utility using the following equation.

\[
u_i = \sum_{j=1}^{n} u_{ij} * w_j
\]

Where \(u_i\) is the final value of utility for each alternative, while \(r_{ij}\) is the value of the result of matrix normalization, and \(w_j\) is the weight of criteria that have been calculated using the entropy weighting method.

2.7 Ranking Recommendation Selection of the Best Division Head

Recommend ranking the selection of the best division heads, it is important to integrate criteria relevant to the goals of the organization and the specific needs of the division. Carefully consider aspects of leadership, managerial ability, industry experience, and interpersonal qualities in evaluating candidates, the results of ranking recommendations obtained from the final results of the MAUT method.

3. RESULT AND DISCUSSION

The Decision Support System (DSS) that uses the Entropy and Multi-Attribute Utility Theory (MAUT) weighting method is an effective approach in selecting the best Division Head. The Entropy weighting method is used to measure the degree of certainty and diversity in the data, ensuring that significant factors are considered proportionally. With the measurement of the level of certainty and diversity through the Entropy method, the resulting decisions become more measurable and accountable. Meanwhile, MAUT is used to evaluate subjective preferences and take into account various criteria such as leadership skills, experience, and previous performance. In addition, the integration of Multi-Attribute Utility makes it possible to consider various factors in a balanced manner, which can reduce subjective biases that may arise in the selection of Division Heads. By combining these two methods, DSS can provide holistic and structured information to stakeholders, making it easier for them to choose the best Division Head who best suits the company's needs and supports the achievement of long-term strategic goals. The combination of these methods not only helps to increase efficiency in decision making, but also ensures that the decisions taken are based on in-depth and objective analysis, resulting in optimal results for the company.

3.1 Determination of Criteria

Determining the right criteria in selecting the best Division Head through a decision support system (SPK) is a crucial first step. The criteria chosen should reflect the needs and objectives of the company as a whole. By paying close attention to these criteria, DSS can provide a solid foundation for selecting Division Heads who not only have the necessary technical capabilities, but also fit into the company's overall culture and vision. The criteria used in selecting the best Head of Division are shown in table 1.

<table>
<thead>
<tr>
<th>Criteria ID</th>
<th>Criteria Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDB-1</td>
<td>Leadership</td>
</tr>
<tr>
<td>HDB-2</td>
<td>Knowledge</td>
</tr>
<tr>
<td>HDB-3</td>
<td>Effective Communication</td>
</tr>
</tbody>
</table>
The criteria data in Table 1 are obtained based on the results of needs collection in the form of interviews with the company in determining the best division head. This criterion is used to assess the performance of division heads within the company.

### 3.2 Alternative Assessment Data

The assessment data is obtained from the results of the assessment conducted from each division member. The data will be used in the performance appraisal of the division head. This assessment data is carried out by the company using questionnaires from each division member. The data on the assessment of the performance of the Head of Division are shown in Table 2.

**Table 2.** Data on the Assessment of the Performance of the Head of Division

<table>
<thead>
<tr>
<th>Alternative</th>
<th>HDB-1</th>
<th>HDB-2</th>
<th>HDB-3</th>
<th>HDB-4</th>
<th>HDB-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Marketing Division</td>
<td>4.3</td>
<td>4.7</td>
<td>4.4</td>
<td>4.6</td>
<td>4.8</td>
</tr>
<tr>
<td>Head of Finance Division</td>
<td>4.2</td>
<td>4.5</td>
<td>4.6</td>
<td>4.5</td>
<td>4.7</td>
</tr>
<tr>
<td>Head of Human Resources (HR) Division</td>
<td>4.4</td>
<td>4.6</td>
<td>4.5</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Head of Operations Division</td>
<td>4.6</td>
<td>4.5</td>
<td>4.3</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Head of Information Technology (IT) Division</td>
<td>4.7</td>
<td>4.7</td>
<td>4.4</td>
<td>4.7</td>
<td>4.6</td>
</tr>
<tr>
<td>Head of Production Division</td>
<td>4.5</td>
<td>4.5</td>
<td>4.3</td>
<td>4.5</td>
<td>4.7</td>
</tr>
<tr>
<td>Head of Sales Division</td>
<td>4.3</td>
<td>4.6</td>
<td>4.2</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Head of Customer Service Division</td>
<td>4.4</td>
<td>4.4</td>
<td>4.3</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Head of Quality Division</td>
<td>4.6</td>
<td>4.3</td>
<td>4.6</td>
<td>4.7</td>
<td>4.6</td>
</tr>
</tbody>
</table>

The performance appraisal data of the division head in Table 1 is obtained based on the assessment questionnaire given from each existing division member. The data will be used in the performance appraisal of the best division heads by the company.

### 3.3 Criteria Weighting Method Using Entropy

The criterion weighting method using entropy is an approach used in decision support systems (DSS) to assign relative weights to each criterion based on the degree of uncertainty or diversity of information contained in the data set. In this context, entropy is used as a measure of uncertainty or randomness in data. The steps in this method involve calculating the entropy for each criterion and then normalizing that entropy value to get the relative weight. Criteria with higher entropy values will be given lower weight, while criteria with lower entropy values will be given higher weights because they provide more definite or structured information. The criterion weighting method using entropy allows DSS to account for uncertainty or diversity in data when assigning weights to each criterion, thereby increasing accuracy and objectivity in the decision-making process. The stages in weighting criteria using entropy first create a decision matrix based on alternative assessments using equation (1).

$$X = \begin{bmatrix} x_{11} & x_{21} & x_{31} & x_{41} & x_{51} \\ x_{12} & x_{22} & x_{32} & x_{42} & x_{52} \\ x_{13} & x_{23} & x_{33} & x_{43} & x_{53} \\ x_{14} & x_{24} & x_{34} & x_{44} & x_{54} \\ x_{15} & x_{25} & x_{35} & x_{45} & x_{55} \\ x_{16} & x_{26} & x_{36} & x_{46} & x_{56} \\ x_{17} & x_{27} & x_{37} & x_{47} & x_{57} \\ x_{18} & x_{28} & x_{38} & x_{48} & x_{58} \\ x_{19} & x_{29} & x_{39} & x_{49} & x_{59} \end{bmatrix}$$

The results of the decision matrix of alternative assessment data are as follows.

$$X = \begin{bmatrix} 4.3 & 4.7 & 4.4 & 4.6 & 4.8 \\ 4.2 & 4.5 & 4.6 & 4.5 & 4.7 \\ 4.4 & 4.6 & 4.5 & 4.7 & 4.8 \\ 4.6 & 4.5 & 4.3 & 4.6 & 4.6 \\ 4.7 & 4.7 & 4.4 & 4.7 & 4.6 \\ 4.5 & 4.5 & 4.3 & 4.5 & 4.7 \\ 4.3 & 4.6 & 4.2 & 4.7 & 4.8 \\ 4.4 & 4.4 & 4.3 & 4.6 & 4.6 \\ 4.6 & 4.3 & 4.6 & 4.7 & 4.6 \end{bmatrix}$$

The next process in the entropy method is to calculate matrix normalization using (2), the result of matrix normalization is as follows.
The results of the overall normalization calculation are shown in table 3.

### Table 3. Matrix Normalization Calculation Results

<table>
<thead>
<tr>
<th>Alternative</th>
<th>HDB-1</th>
<th>HDB-2</th>
<th>HDB-3</th>
<th>HDB-4</th>
<th>HDB-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Marketing Division</td>
<td>0.9149</td>
<td>1.0000</td>
<td>0.9565</td>
<td>0.9787</td>
<td>1.0000</td>
</tr>
<tr>
<td>Head of Finance Division</td>
<td>0.8936</td>
<td>0.9574</td>
<td>1.0000</td>
<td>0.9574</td>
<td>0.9792</td>
</tr>
<tr>
<td>Head of Human Resources (HR) Division</td>
<td>0.9362</td>
<td>0.9787</td>
<td>0.9783</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Head of Operations Division</td>
<td>0.9787</td>
<td>0.9574</td>
<td>0.9348</td>
<td>0.9787</td>
<td>0.9583</td>
</tr>
<tr>
<td>Head of Information Technology (IT) Division</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.9565</td>
<td>1.0000</td>
<td>0.9583</td>
</tr>
<tr>
<td>Head of Production Division</td>
<td>0.9574</td>
<td>0.9574</td>
<td>0.9348</td>
<td>0.9574</td>
<td>0.9792</td>
</tr>
<tr>
<td>Head of Sales Division</td>
<td>0.9149</td>
<td>0.9787</td>
<td>0.9130</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Head of Customer Service Division</td>
<td>0.9362</td>
<td>0.9362</td>
<td>0.9348</td>
<td>0.9787</td>
<td>0.9583</td>
</tr>
<tr>
<td>Head of Quality Division</td>
<td>0.9787</td>
<td>0.9149</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.9583</td>
</tr>
</tbody>
</table>

The calculation results of table 3 are the results of the calculation of matrix normalization for each alternative based on existing criteria. The next process in the entropy method is to calculate the value of the criteria matrix using (3), the results of calculating the value of the criteria matrix are as follows.

\[
a_{11} = \frac{k_{11}}{\sum_{i=1}^{5}k_{1i,19}} = \frac{0.9149}{0.85106} = 0.1075
\]

The results of the overall the value of the criteria matrix are shown in table 4.

### Table 4. Value of the Criteria Matrix

<table>
<thead>
<tr>
<th>Alternative</th>
<th>HDB-1</th>
<th>HDB-2</th>
<th>HDB-3</th>
<th>HDB-4</th>
<th>HDB-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Marketing Division</td>
<td>0.1075</td>
<td>0.1152</td>
<td>0.1111</td>
<td>0.1106</td>
<td>0.1137</td>
</tr>
<tr>
<td>Head of Finance Division</td>
<td>0.1050</td>
<td>0.1103</td>
<td>0.1162</td>
<td>0.1082</td>
<td>0.1114</td>
</tr>
<tr>
<td>Head of Human Resources (HR) Division</td>
<td>0.1100</td>
<td>0.1127</td>
<td>0.1136</td>
<td>0.1130</td>
<td>0.1137</td>
</tr>
<tr>
<td>Head of Operations Division</td>
<td>0.1150</td>
<td>0.1103</td>
<td>0.1086</td>
<td>0.1106</td>
<td>0.1090</td>
</tr>
<tr>
<td>Head of Information Technology (IT) Division</td>
<td>0.1175</td>
<td>0.1152</td>
<td>0.1111</td>
<td>0.1130</td>
<td>0.1090</td>
</tr>
<tr>
<td>Head of Production Division</td>
<td>0.1125</td>
<td>0.1103</td>
<td>0.1086</td>
<td>0.1082</td>
<td>0.1114</td>
</tr>
<tr>
<td>Head of Sales Division</td>
<td>0.1075</td>
<td>0.1127</td>
<td>0.1061</td>
<td>0.1130</td>
<td>0.1137</td>
</tr>
<tr>
<td>Head of Customer Service Division</td>
<td>0.1100</td>
<td>0.1078</td>
<td>0.1086</td>
<td>0.1106</td>
<td>0.1090</td>
</tr>
<tr>
<td>Head of Quality Division</td>
<td>0.1150</td>
<td>0.1054</td>
<td>0.1162</td>
<td>0.1130</td>
<td>0.1090</td>
</tr>
</tbody>
</table>

The calculation results of table 4 are the results of the calculation of value of the criteria matrix for each alternative based on existing criteria. The next process in the entropy method is to calculate the entropy value using equation (4), the result of the entropy value is as follows.

\[
E_1 = \left(\prod_{n=1}^{29}a_{11;19} \cdot \ln(a_{11;19})\right) = (-0.45521) \cdot (-2.1966) = 0.999716
\]
\[
E_2 = \left(\prod_{n=1}^{29}a_{21;29} \cdot \ln(a_{21;29})\right) = (-0.45521) \cdot (-2.19684) = 0.999827
\]
\[
E_3 = \left(\prod_{n=1}^{29}a_{31;39} \cdot \ln(a_{31;39})\right) = (-0.45521) \cdot (-2.19677) = 0.999972
\]
\[
E_4 = \left(\prod_{n=1}^{29}a_{41;49} \cdot \ln(a_{41;49})\right) = (-0.45521) \cdot (-2.19708) = 0.999934
\]
\[
E_5 = \left(\prod_{n=1}^{29}a_{51;59} \cdot \ln(a_{51;59})\right) = (-0.45521) \cdot (-2.196705) = 0.999921
\]

The next process in the entropy method is to calculate the dispersion value using equation (5), the result of the dispersion value is as follows.

\[
D_1 = 1 - E_1 = 1 - 0.999716 = 0.000284
\]
\[
D_2 = 1 - E_2 = 1 - 0.999827 = 0.000173
\]
\[
D_3 = 1 - E_3 = 1 - 0.999972 = 0.000028
\]
\[
D_4 = 1 - E_4 = 1 - 0.999934 = 0.000066
\]
\[
D_5 = 1 - E_5 = 1 - 0.999921 = 0.000079
\]

The next process in the entropy method is to calculate the dispersion weight value or criterion weight value using equation (6), the result of the dispersion weight value or criterion weight valueis as follows.

\[
W_1 = \frac{D_1}{\sum_{i=1}^{5}D_{11,19}} = 0.352
\]
\[
W_2 = \frac{D_2}{\sum_{i=1}^{5}D_{12,19}} = 0.213
\]
\[
W_3 = \frac{D_3}{\sum_{i=1}^{5}D_{13,19}} = 0.257
\]
The result of visualization of the criterion weights using the entropy weighting method as shown in Figure 2.

![Figure 2. Criteria Weighting Using Entropy Method](image)

The results of the weight of the criteria using the entropy method in figure 2 show that the Leadership criteria have a weight of 0.352, for the Knowledge criteria have a weight of 0.213, for the Effective Communication criteria have a weight of 0.257, for the Professional Integrity and Ethics criteria have a weight of 0.081, and for the Responsibility criteria have a weight of 0.097.

3.4 MAUT (Multi-Attribute Utility Theory) Method in the Selection of the Best Division Head

The MAUT (Multi-Attribute Utility Theory) method is an effective approach in the selection of the best division heads. This method allows decision makers to evaluate candidates based on a variety of relevant attributes, such as experience, leadership skills, industry knowledge, and communication skills. With MAUT, each attribute is weighted based on its importance relative to organizational goals, and then candidates are judged based on those attributes. This approach allows systematic and objective calculations, thus minimizing bias in the selection process. The MAUT method provides a solid framework for companies in selecting division heads that best suit the company's needs and vision. The stages in MAUT method first create a decision matrix based on alternative assessments using equation (7).

\[
X = \begin{bmatrix}
    x_{11} & x_{21} & x_{31} & x_{41} & x_{51} \\
    x_{12} & x_{22} & x_{32} & x_{42} & x_{52} \\
    x_{13} & x_{23} & x_{33} & x_{43} & x_{53} \\
    x_{14} & x_{24} & x_{34} & x_{44} & x_{54} \\
    x_{15} & x_{25} & x_{35} & x_{45} & x_{55} \\
    x_{16} & x_{26} & x_{36} & x_{46} & x_{56} \\
    x_{17} & x_{27} & x_{37} & x_{47} & x_{57} \\
    x_{18} & x_{28} & x_{38} & x_{48} & x_{58} \\
    x_{19} & x_{29} & x_{39} & x_{49} & x_{59} 
\end{bmatrix}
\]

The results of the decision matrix of alternative assessment data are as follows.

\[
X = \begin{bmatrix}
    4.3 & 4.7 & 4.4 & 4.6 & 4.8 \\
    4.2 & 4.5 & 4.6 & 4.5 & 4.7 \\
    4.4 & 4.6 & 4.5 & 4.7 & 4.8 \\
    4.6 & 4.5 & 4.3 & 4.6 & 4.6 \\
    4.7 & 4.4 & 4.7 & 4.6 & 4.7 \\
    4.5 & 4.5 & 4.3 & 4.5 & 4.7 \\
    4.3 & 4.6 & 4.2 & 4.7 & 4.8 \\
    4.4 & 4.4 & 4.3 & 4.6 & 4.6 \\
    4.6 & 4.3 & 4.6 & 4.7 & 4.6
\end{bmatrix}
\]
The next process in the MAUT method is to calculate matrix normalization using (8) because all criteria are of benefit type, the result of matrix normalization is as follows. 
\[ r_{11}^* = \frac{x_{11} - \min x_{11:9}}{\max x_{11:9} - \min x_{11:9}} = \frac{4.3 - 4.2}{4.7 - 4.2} = 0.1 = 0.2 \]

The results of the overall normalization calculation in the MAUT method are shown in table 5.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>HDB-1</th>
<th>HDB-2</th>
<th>HDB-3</th>
<th>HDB-4</th>
<th>HDB-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Marketing Division</td>
<td>0.2</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>Head of Finance Division</td>
<td>0</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Head of Human Resources (HR) Division</td>
<td>0.4</td>
<td>0.75</td>
<td>0.75</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Head of Operations Division</td>
<td>0.8</td>
<td>0.5</td>
<td>0.25</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Head of Information Technology (IT) Division</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Head of Production Division</td>
<td>0.6</td>
<td>0.5</td>
<td>0.25</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Head of Sales Division</td>
<td>0.2</td>
<td>0.75</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Head of Customer Service Division</td>
<td>0.4</td>
<td>0.25</td>
<td>0.25</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Head of Quality Division</td>
<td>0.8</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

The calculation results in table 5 are the results of the calculation of value of the criteria matrix for each alternative based on existing criteria in the MAUT method. The next process in the MAUT method is to calculate the utility value using (10), the result of the utility value is as follows.

\[ u_{11} = \frac{e((r_{11})^2 - 1)}{1.71} = \frac{e((0.2)^2 - 1)}{1.71} = \frac{0.0408}{1.71} = 0.0239 \]

The results of the overall utility value calculation in the MAUT method are shown in table 6.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>HDB-1</th>
<th>HDB-2</th>
<th>HDB-3</th>
<th>HDB-4</th>
<th>HDB-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Marketing Division</td>
<td>0.0239</td>
<td>1.0048</td>
<td>0.1661</td>
<td>0.1661</td>
<td>1.0048</td>
</tr>
<tr>
<td>Head of Finance Division</td>
<td>0.0000</td>
<td>0.1661</td>
<td>1.0048</td>
<td>0.0000</td>
<td>0.1661</td>
</tr>
<tr>
<td>Head of Human Resources (HR) Division</td>
<td>0.1015</td>
<td>0.4416</td>
<td>0.4416</td>
<td>1.0048</td>
<td>1.0048</td>
</tr>
<tr>
<td>Head of Operations Division</td>
<td>0.5243</td>
<td>0.1661</td>
<td>0.0377</td>
<td>0.1661</td>
<td>0.0000</td>
</tr>
<tr>
<td>Head of Information Technology (IT) Division</td>
<td>1.0048</td>
<td>1.0048</td>
<td>0.1661</td>
<td>1.0048</td>
<td>0.0000</td>
</tr>
<tr>
<td>Head of Production Division</td>
<td>0.2534</td>
<td>0.1661</td>
<td>0.0377</td>
<td>0.0000</td>
<td>0.1661</td>
</tr>
<tr>
<td>Head of Sales Division</td>
<td>0.0239</td>
<td>0.4416</td>
<td>0.0000</td>
<td>1.0048</td>
<td>1.0048</td>
</tr>
<tr>
<td>Head of Customer Service Division</td>
<td>0.1015</td>
<td>0.0377</td>
<td>0.0377</td>
<td>0.1661</td>
<td>0.0000</td>
</tr>
<tr>
<td>Head of Quality Division</td>
<td>0.5243</td>
<td>0.0000</td>
<td>1.0048</td>
<td>1.0048</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The calculation results in table 6 are the results of calculating the utility value of each alternative based on the criteria in the MAUT method. The last process in the MAUT method is to calculate the final value of the utility using (10), the final value of the utility results as follows.

\[ u_1 = \Sigma_{j=1}^n u_{1j} * w_{1j} \]
\[ u_1 = (u_{21} * w_1) + (u_{22} * w_2) + (u_{31} * w_3) + (u_{41} * w_4) + (u_{51} * w_5) \]
\[ u_1 = (0.0239 * 0.352) + (1.004 * 0.213) + (0.1661 * 0.257) + (0.1661 * 0.081) + (1.0048 * 0.097) \]
\[ u_1 = 0.3760 \]

The results of the overall final utility value calculation in the MAUT method are shown in table 7.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Final Utility Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Marketing Division</td>
<td>0.3760</td>
</tr>
<tr>
<td>Head of Finance Division</td>
<td>0.3097</td>
</tr>
<tr>
<td>Head of Human Resources (HR) Division</td>
<td>0.4221</td>
</tr>
<tr>
<td>Head of Operations Division</td>
<td>0.2431</td>
</tr>
<tr>
<td>Head of Information Technology (IT) Division</td>
<td>0.6918</td>
</tr>
<tr>
<td>Head of Production Division</td>
<td>0.1504</td>
</tr>
<tr>
<td>Head of Sales Division</td>
<td>0.2813</td>
</tr>
<tr>
<td>Head of Customer Service Division</td>
<td>0.0669</td>
</tr>
<tr>
<td>Head of Quality Division</td>
<td>0.5242</td>
</tr>
</tbody>
</table>

The calculation results in table 7 are the results of calculating the final utility value of each alternative based on the application of the MAUT method in determining the best division head.
3.5 Ranking Recommendation Selection of the Best Division Head

In the selection of the best division head, the combination of entropy weighting and the MAUT method provides a recommendation for alternative ranking results. The results of this process provide an objective and structured ranking, allowing the selection of division heads that better correspond to the needs and goals of the organization. Alternative ranking results as shown in Figure 3.

![Graph](image-url)

**Figure 3. Ranking Selection of the Best Division Head**

The results of the alternative ranking of the best division head selection Figure 3 shows the results for the Head of Information Technology (IT) Division with a value of 0.6918 getting rank 1, Head of Quality Division with a value of 0.5242 getting rank 2, and Head of Human Resources (HR) Division with a value of 0.4221 getting rank 3.

4. CONCLUSION

The combination of entropy weighting with the MAUT (Multi-Attribute Utility Theory) method is an approach that combines two decision-making analysis techniques. First, entropy weighting is used to determine the relative weight of each attribute used in the analysis. This technique helps measure the degree of uncertainty or randomness in the data, so attributes that have higher variation will be given a lower weight. Once attribute weights are determined, the MAUT method is used to evaluate and compare decision alternatives based on the subjective preferences of the decision maker. MAUT allows decision makers to assess and assign the relative utility value of each decision alternative to each attribute taken into account. By combining these two techniques, decision makers can obtain more accurate and structured results in complex decision making, taking into account both data variation and subjective preferences. The results of the alternative ranking of the best division head selection showed results for the Head of Information Technology (IT) Division with a value of 0.6918 ranked 1, Head of Quality Division with a value of 0.5242 got rank 2, and Head of Human Resources (HR) Division with a value of 0.4221 got rank 3.

REFERENCES


