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Integration of Root Assessment Method and Entropy Weighting in Determining Business Location Selection

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Abstract: Business location is one of the key factors in determining the success of a business. Choosing the right location can affect customer accessibility, operational costs, and a company's competitiveness in the market. Determining the location of a business is often faced with various problems that can affect the success and continuity of the business. One of the main challenges is the accessibility and reach of the market, and un-strategic or hard-to-reach locations can limit customer potential and reduce business appeal. Another problem is that it often arises from the diversity of criteria that must be taken into account and the importance of each criterion varies depending on the type of business. The purpose of this study is to apply a more objective approach in determining business locations by integrating the root assessment method and entropy weighting methods in systematically evaluating various business location criteria and giving fair weight based on their level of importance. By applying this combination of methods, the decision-making process becomes more accurate and in accordance with business needs, and provides solutions that can be adapted by various types of businesses in determining strategic locations that support long-term success. Business location ranking shows the highest rated location is Location 6, with a score of 4.4254. Furthermore, Location 10 is ranked second with a score of 4.3993, followed by Location 2 in third place with a score of 4.3916. These results show that Location 6 is the most superior location in this assessment.
Keywords: Combination; Determining; Entropy Weighting; Location; Root Assessment Method;

1. INTRODUCING

Business location is one of the key factors in determining the success of a business. Choosing the right location can affect customer accessibility, operational costs, and a company's competitiveness in the market[1]. A strategic location allows businesses to reach consumers easily, increase brand visibility, and facilitate the distribution of products or services. In addition, a location close to suppliers or business partners can also reduce transportation and logistics costs. Determining the location of a business is often faced with various problems that can affect the success and continuity of the business. One of

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the main challenges is the accessibility and reach of the market, and un-strategic or hard-to-reach locations can limit customer potential and reduce business appeal. To overcome these challenges, the selection of a new business location requires a more structured and data-driven approach, such as the use of objective evaluation methods that combine various assessment criteria with appropriate weighting.

A decision support system (DSS) is an information system designed to assist decision-makers in analyzing complex problems and making more informed decisions decision support system[2]–[4]. DSS utilizes a variety of analysis techniques to present relevant information and alternative decisions that can be selected based on predetermined criteria. This system is particularly useful in situations involving many variables and uncertainties, as well as in decision-making that requires an in-depth analysis of the various options available. DSS can integrate many interrelated factors, give weight to each criterion, and provide recommendations based on more objective and measurable data analysis. Another advantage is that DSS can quickly manage and analyze large amounts of data, saving time and resources needed for decision-making. DSS is not only a tool, but also an integral part of a smarter, data-driven decision-making process[5]–[7]. One of the methods in DSS is the root assessment method.

The root assessment method is an approach used to assess and evaluate alternatives based on a number of relevant criteria in an objective and structured manner[8]–[10]. This method aims to provide a clear picture of how well an alternative meets the criteria that have been determined, by assessing the main factors that affect the decision. The root assessment method works by identifying the root cause of the problem or the most basic factors, and assigning weight or assessment to each criterion based on its relevance. This approach is often used in a variety of fields, with the aim of obtaining more accurate and measurable decisions. The weakness of the root assessment method in determining the weight of the criteria lies in its dependence on the subjective assessment process[11]. Although the root assessment method aims to assess alternatives in a structured manner, the selection process and weighting of criteria are often still influenced by the personal opinions or preferences of the decision-makers, which can lead to bias in the evaluation results. This is especially the case if the selected criteria have a high level of complexity or if there is not enough data to provide accurate weights. Additionally, difficulties in determining the exact weight of criteria can be problematic, especially in cases where the criteria are interrelated or have different influences on the final decision. If the weight of the criteria is not set appropriately, then the evaluation results of root assessment method can become unbalanced, leading to less than optimal decisions. In highly dynamic situations, the Root assessment method requires periodic adjustments or updates to maintain the accuracy and objectivity of the weights given. The solution to overcome the weight in the root assessment method is to use the entropy weighting method.

The Entropy weighting method is a technique used in multi-criteria decision-making to determine the weight of each criterion based on the degree of uncertainty or variation of information contained in the data[12]–[14]. The main concept of this method is that the greater the variation or uncertainty in the data for a criterion, the greater the weight given to the criterion, since the more varied or informative criteria are considered more important in decision-making. Conversely, criteria with low variation or little information will have less weight. The advantage of the Entropy weighting method is its ability to reduce subjectivity in weighting and provide more objective results based on the distribution of existing data[13], [15]. This method is particularly useful when the available data varies greatly or when subjective assessments of criteria tend to be biased. However, the downside of this method is that the reliance on existing data makes it less effective if the data used is not representative enough or has errors, as well as does not take into account the specific context or preferences of the decision-maker. By combining this method with entropy weighting techniques, the root assessment method can provide more objective

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results and take into account the variability and uncertainty that exist in the decision-making process.

Research from Nawawi (2021) the application of the SAW method can be a recommendation for management to open a business place based on the highest alternative value[16]. Research from Sudarsono (2022) the selection of business locations used is the MOOSRA and MOORA methods, resulting in the first rank being Alternative A1 with a reference value of 0.564[17]. Research from Aritonang (2023) that a decision support system built using the Multi Objective Optimization method based on Ratio Analysis (MOORA) for the selection of a coffee shop business location can easily and quickly help in choosing the optimal location for the business[18]. Research from Tensen (2024) the simple additive weighting (SAW) method helps in choosing the right location is the main consideration for business actors before they start their business operations[19].

The purpose of this study is to apply a more objective approach in determining business locations by integrating the root assessment method and entropy weighting methods in systematically evaluating various business location criteria and giving fair weight based on their level of importance. By applying this combination of methods, the decision-making process becomes more accurate and in accordance with business needs, and provides solutions that can be adapted by various types of businesses in determining strategic locations that support long-term success.

2. RESEARCH METHODOLOGY

Research methodology is a series of approaches, methods, and procedures used to collect, analyze, and interpret data to answer research questions or achieve specific goals[20]–[22]. The research methodology also ensures that the research process is carried out systematically and scientifically by considering the validity, reliability, and ethics of research. The research stage is a series of systematic steps taken to achieve a goal or answer a research question. These stages are interrelated and provide a systematic structure for the research process. Figure 1 is the stage of the research carried out.

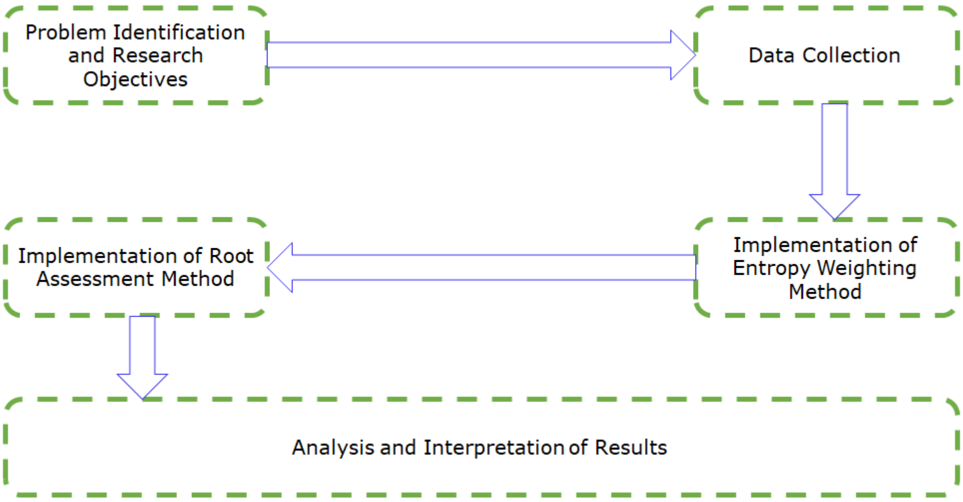

Figure 1. Research Stage

The stage of determining the criteria for choosing a business location begins with the identification of problems and research objectives, which is recognizing the importance of choosing a strategic business location as a key factor in business success. At this stage, the researcher sets the objectives of the research, such as determining the best location based on relevant criteria and ensuring that the methods used are able to produce

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objective and accurate decisions. Furthermore, Data collection is carried out, where quantitative information is collected for each alternative location based on predetermined criteria, such as accessibility, rental costs, and market potential. This data can come from surveys, statistical documents, or related reports. The next stage is the Implementation of the entropy weighting method, which is used to calculate the weight of the criteria objectively based on the degree of data variation on each criterion. This weight then becomes the basis for evaluating alternative locations. After that, the implementation of the root assessment method is carried out, where the performance of each alternative location is assessed by utilizing the weight of the criteria from the entropy method. This process includes data normalization and alternative location ranking based on the Root Assessment approach. Finally, in result analysis and interpretation, researchers analyze the results of the rankings to determine the best location, interpret the implications of the results, and provide recommendations for decision-makers. This stage ensures that the results of the research can be applied practically in the selection of business locations.

Entropy Weighting Method

The entropy weighting method is an objective technique in multi-criteria decision-making that is used to determine the level of importance (weight) of each criterion based on the degree of variation or uncertainty of the data associated with that criterion. This method is based on the concept of information entropy, which measures the degree of irregularity or uncertainty in a dataset. The higher the variation in the value of a criterion, the greater the weight given, because the criterion is considered more informative in distinguishing alternatives. Using this approach, the Entropy method generates weights that are free from the subjectivity of decision-makers, making them suitable for applications that require accurate and objective data-driven judgments.

Performance data from each alternative based on predetermined criteria is collected. This data is presented in the form of a decision matrix, where the rows represent the alternatives, and the columns represent the criteria by using the following formula.

$$X = \begin{bmatrix} x_{11} & x_{21} & x_{n1} \\ x_{12} & x_{22} & x_{n2} \\ \vdots & \vdots & \vdots \\ x_{1m} & x_{2m} & x_{nm} \end{bmatrix} \quad (1)$$

The decision matrix is normalized to eliminate the influence of different scales on the criteria. Normalization is carried out using the following formula.

$$k_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \quad (2)$$

The calculation of the entropy value for each existing criterion is calculated using a formula.

$$E_j = \left[\frac{-1}{\ln m}\right] \sum_{i=1}^{m} r_{ij} \ln r_{ij} \quad (3)$$

The calculation of the degree of dispersion is calculated to reflect the significant degree of a criterion calculated using a formula.

$$D_j = 1 - E_j \quad (4)$$

The final weight calculation for each criterion is calculated by normalizing the value of the degree of dispersion calculated using the formula.

$$w_j = \frac{D_j}{\sum_{j=1}^{m} D_j} \quad (5)$$

The resulting weights represent the relative importance of each criterion based on the available data. This weight can then be used in other decision-making methods to evaluate alternatives as a whole.

Root Assessment Method

The root assessment method is a multi-criteria decision-making method that uses a root-based mathematical approach to evaluate and rank alternatives based on

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predetermined criteria. This method involves normalizing the data and calculating the evaluation value by considering the weight of the criteria, where the root-based approach aims to reduce the extreme impact or outlier value in the data. In this way, the Root Assessment Method provides a more balanced and fair assessment of alternatives, making it suitable for use in complex decision-making that involves many criteria.

Performance data from each alternative based on predetermined criteria is collected. This data is presented in the form of a decision matrix, where the rows represent the alternatives, and the columns represent the criteria by using the following equation (1).

The normalization of the decision matrix is obtained from the original data of the normalized decision matrix to ensure that all values are on a comparable scale by using formulas.

$$n_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \quad (6)$$

The multiplication of the weights of each value in the normalized decision matrix is multiplied by the weights of the relevant criteria to reflect its importance with the formula.

$$k_{ij} = n_{ij} * w_i \quad (7)$$

Calculating the total normalization score for each alternative is calculated by summing the values of the multiplication results on all criteria using a formula.

$$S_{+i} = \sum_{i=1}^{n} k_{+ij} \quad (8)$$

$$S_{-i} = \sum_{i=1}^{n} k_{-ij} \quad (9)$$

Equation (8) is calculated for the benefit criterion, and equation (9) is calculated for the cost criterion.

Determining the final value of the alternative is calculated to provide a ranking based on the total normalized score by using the formula.

$$RI_i = \sqrt[2+S_{-i}]{2 + S_{+i}} \quad (10)$$

This stage provides a systematic framework for objectively evaluating alternatives, taking into account the weight of the criteria and the variation in values present in the decision matrix.

3. RESULT AND DISCUSSIONS

The integration of root assessment method and entropy weighting in determining business location selection criteria is an approach that combines two objective methods to produce more accurate and fair decisions. The entropy weighting method also ensures that the weight given to each criterion truly reflects the importance of that criterion based on available data, rather than based on subjective preference. The root assessment method is applied to evaluate alternative business locations by combining the values of each normalized criterion and multiplying it by the weights generated from the entropy method. The root assessment method uses a root-based approach to calculate the total score of each alternative business location, so that it can reduce the impact of extreme values and provide a more balanced assessment. By integrating these two methods, the process of selecting a business location becomes more objective and accurate, as they complement each other in handling various aspects of decision-making involving complex criteria and varied data.

Data Collection

Collecting business location selection data is an important stage in the decision-making process that involves gathering relevant and accurate information to evaluate various location alternatives. The data collected must include various criteria that affect the success of the business, such as: Accessibility (L1) benefit criterion type: Data on how easily a location is accessible to customers and suppliers, including information on road infrastructure, public transportation, and proximity to business centers or industrial

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estates. Rental Cost (L2) cost criterion type: Information about the rental price or purchase price of land in various locations considered. This includes monthly, long-term costs, and potential increases in rental prices or property values. Market Potential (L3) benefit criterion type: Data on demographics, population, and purchasing power in the area around the business location. This includes data on population density, age, income level, and consumer preferences relevant to the type of business being run.

Safety and Environment (L4) benefit criterion type: Data on the level of security in the area, including crime rates, as well as environmental factors that can affect the comfort and sustainability of the business, such as pollution, cleanliness, and environmental health levels. Competition and Presence of Competitors (L5) cost criterion type: Information on the number of competitors already in the area, as well as the presence of similar or complementary industries that can support or hinder the business to be built. Supporting Facilities (L6) benefit criterion type: Data about public facilities available around the location, such as the existence of shopping centers, hospitals, schools, or other facilities that support business survival and employee comfort.

The data on alternative assessment of business locations includes information obtained based on various relevant criteria to determine the optimal location. In the scoring table, each location is graded based on six main criteria. Each criterion is assigned a value on a scale of 1 to 10, where a higher number reflects better performance in that criterion. This data is used to evaluate and rank business locations, with the aim of choosing the location that best suits the needs and desired business goals. Table 1 is the data on the assessment of alternative business locations.

Table 1. Business Location Alternative Assessment Data

Location Name	Criteria Code					
	L1	**L2**	**L3**	**L4**	**L5**	**L6**
Location 1	9	7	8	6	5	9
Location 2	8	8	7	9	6	8
Location 3	6	6	9	8	4	7
Location 4	7	5	6	7	7	6
Location 5	8	6	7	9	6	8
Location 6	9	8	8	7	8	9
Location 7	7	7	7	8	5	7
Location 8	6	5	8	6	6	6
Location 9	8	7	6	9	5	8
Location 10	7	8	9	8	6	9

The collected data is then used in the evaluation process, both qualitatively and quantitatively, to assess and rank alternative locations based on existing criteria. Data sources in the selection of business locations cover various aspects that support comprehensive evaluation and appropriate decision-making. By integrating all of that data using an analytical approach, entrepreneurs can objectively evaluate locations and choose the one that best suits their business needs and goals.

Implementation of Entropy Weighting Method

The entropy weighting method is a technique used in multi-criteria decision-making (MCDM) to determine the relative importance or weight of various criteria based on the content of the information it provides. This method uses entropy, a concept of information theory, to measure uncertainty or randomness in the data of each criterion.

Performance data from each alternative based on predetermined criteria is collected. This data is presented in the form of a decision matrix, where the rows represent the alternatives, and the columns represent the criteria by using equation (1).

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$$X = \begin{bmatrix} 9 & 7 & 8 & 6 & 5 & 9 \\ 8 & 8 & 7 & 9 & 6 & 8 \\ 6 & 6 & 9 & 8 & 4 & 7 \\ 7 & 5 & 6 & 7 & 7 & 6 \\ 8 & 6 & 7 & 9 & 6 & 8 \\ 9 & 8 & 8 & 7 & 8 & 9 \\ 7 & 7 & 7 & 8 & 5 & 7 \\ 6 & 5 & 8 & 6 & 6 & 6 \\ 8 & 7 & 6 & 9 & 5 & 8 \\ 7 & 8 & 9 & 8 & 6 & 9 \end{bmatrix}$$

The decision matrix is normalized to eliminate the influence of different scales on the criteria, normalization is done using equation (2).

$$k_{11} = \frac{r_{11}}{\sum_{i=1}^{m} r_{11,110}} = \frac{9}{9+8+6+7+8+9+7+6+8+7} = \frac{9}{75} = 0{,}1200$$

The calculation results of the decision matrix normalization are shown in table 2.

Table 2. Normalization Matrix Entropy Method

Location Name	**Criteria Code**					
	L1	**L2**	**L3**	**L4**	**L5**	**L6**
Location 1	0,1200	0,1045	0,1067	0,0779	0,0862	0,1169
Location 2	0,1067	0,1194	0,0933	0,1169	0,1034	0,1039
Location 3	0,0800	0,0896	0,1200	0,1039	0,0690	0,0909
Location 4	0,0933	0,0746	0,0800	0,0909	0,1207	0,0779
Location 5	0,1067	0,0896	0,0933	0,1169	0,1034	0,1039
Location 6	0,1200	0,1194	0,1067	0,0909	0,1379	0,1169
Location 7	0,0933	0,1045	0,0933	0,1039	0,0862	0,0909
Location 8	0,0800	0,0746	0,1067	0,0779	0,1034	0,0779
Location 9	0,1067	0,1045	0,0800	0,1169	0,0862	0,1039
Location 10	0,0933	0,1194	0,1200	0,1039	0,1034	0,1169

The calculation of the entropy value for each existing criterion is calculated using equation (3).

$$E_1 = \left[\frac{-1}{\ln 10}\right] \sum_{i=1}^{m} r_{11,110} \ln r_{11,110}$$

$$E_1 = (-0{,}4343) * (-2{,}2932) = 0{,}9959$$

$$E_2 = \left[\frac{-1}{\ln 10}\right] \sum_{i=1}^{m} r_{21,210} \ln r_{21,210}$$

$$E_2 = (-0{,}4343) * (-2{,}2888) = 0{,}9940$$

$$E_3 = \left[\frac{-1}{\ln 10}\right] \sum_{i=1}^{m} r_{31,310} \ln r_{31,310}$$

$$E_3 = (-0{,}4343) * (-2{,}2932) = 0{,}9959$$

$$E_4 = \left[\frac{-1}{\ln 10}\right] \sum_{i=1}^{m} r_{41,410} \ln r_{41,410}$$

$$E_4 = (-0{,}4343) * (-2{,}2922) = 0{,}9955$$

$$E_5 = \left[\frac{-1}{\ln 10}\right] \sum_{i=1}^{m} r_{51,510} \ln r_{51,510}$$

$$E_5 = (-0{,}4343) * (-2{,}2855) = 0{,}9926$$

$$E_6 = \left[\frac{-1}{\ln 10}\right] \sum_{i=1}^{m} r_{61,610} \ln r_{61,610}$$

$$E_6 = (-0{,}4343) * (-2{,}2922) = 0{,}9955$$

The calculation of the degree of dispersion is calculated to reflect the significant degree of a criterion calculated using a formula.

$$D_1 = 1 - E_1 = 1 - 0{,}9959 = 0{,}0041$$

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$$D_2 = 1 - E_2 = 1 - 0{,}9940 = 0{,}0060$$
$$D_3 = 1 - E_3 = 1 - 0{,}9959 = 0{,}0041$$
$$D_4 = 1 - E_4 = 1 - 0{,}9955 = 0{,}0045$$
$$D_5 = 1 - E_5 = 1 - 0{,}9926 = 0{,}0074$$
$$D_6 = 1 - E_6 = 1 - 0{,}9955 = 0{,}0045$$

The final weight calculation for each criterion is calculated by normalizing the value of the degree of dispersion calculated using equation (5).

$$w_1 = \frac{D_1}{\sum_{j=1}^{m} D_{1,6}} = \frac{0{,}0041}{0{,}0041 + 0{,}0060 + 0{,}0041 + 0{,}0045 + 0{,}0074 + 0{,}0045} = \frac{0{,}0041}{0{,}0306} = 0{,}1332$$
$$w_2 = \frac{D_2}{\sum_{j=1}^{m} D_{1,6}} = \frac{0{,}0060}{0{,}0041 + 0{,}0060 + 0{,}0041 + 0{,}0045 + 0{,}0074 + 0{,}0045} = \frac{0{,}0060}{0{,}0306} = 0{,}1959$$
$$w_3 = \frac{D_3}{\sum_{j=1}^{m} D_{1,6}} = \frac{0{,}0041}{0{,}0041 + 0{,}0060 + 0{,}0041 + 0{,}0045 + 0{,}0074 + 0{,}0045} = \frac{0{,}0041}{0{,}0306} = 0{,}1332$$
$$w_4 = \frac{D_4}{\sum_{j=1}^{m} D_{1,6}} = \frac{0{,}0045}{0{,}0041 + 0{,}0060 + 0{,}0041 + 0{,}0045 + 0{,}0074 + 0{,}0045} = \frac{0{,}0045}{0{,}0306} = 0{,}1477$$
$$w_5 = \frac{D_5}{\sum_{j=1}^{m} D_{1,6}} = \frac{0{,}0074}{0{,}0041 + 0{,}0060 + 0{,}0041 + 0{,}0045 + 0{,}0074 + 0{,}0045} = \frac{0{,}0074}{0{,}0306} = 0{,}2422$$
$$w_6 = \frac{D_6}{\sum_{j=1}^{m} D_{1,6}} = \frac{0{,}0045}{0{,}0041 + 0{,}0060 + 0{,}0041 + 0{,}0045 + 0{,}0074 + 0{,}0045} = \frac{0{,}0045}{0{,}0306} = 0{,}1477$$

The results of the criteria weighting with this entropy weighting method will be used in the root assessment method in selecting business locations.

Implementation of Root Assessment Method

The application of the root assessment method in the selection of business locations involves a systematic approach to evaluate and rank various alternative locations based on predetermined criteria. The first step is to compile a decision matrix where each location alternative is evaluated based on predetermined criteria. The root assessment method ensures that the decision-making process is carried out objectively and transparently, taking into account the specific needs of the business and the characteristics of the location being considered.

Performance data from each alternative based on predetermined criteria is collected. This data is presented in the form of a decision matrix, where the rows represent the alternatives, and the columns represent the criteria by using the following equation (1).

$$X = \begin{bmatrix} 9 & 7 & 8 & 6 & 5 & 9 \\ 8 & 8 & 7 & 9 & 6 & 8 \\ 6 & 6 & 9 & 8 & 4 & 7 \\ 7 & 5 & 6 & 7 & 7 & 6 \\ 8 & 6 & 7 & 9 & 6 & 8 \\ 9 & 8 & 8 & 7 & 8 & 9 \\ 7 & 7 & 7 & 8 & 5 & 7 \\ 6 & 5 & 8 & 6 & 6 & 6 \\ 8 & 7 & 6 & 9 & 5 & 8 \\ 7 & 8 & 9 & 8 & 6 & 9 \end{bmatrix}$$

The normalization of the decision matrix is obtained from the original data of the normalized decision matrix to ensure that all values are on a comparable scale by using equation (6).

$$n_{11} = \frac{x_{11}}{\sum_{i=1}^{m} x_{11,110}} = \frac{9}{9+8+6+7+8+9+7+6+8+7} = \frac{9}{75} = 0{,}1200$$

The calculation results of the decision matrix normalization are shown in table 3.

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Table 3. Normalization Matrix Root Assessment Method

Location Name	Criteria Code					
	L1	L2	L3	L4	L5	L6
Location 1	0,1200	0,1045	0,1067	0,0779	0,0862	0,1169
Location 2	0,1067	0,1194	0,0933	0,1169	0,1034	0,1039
Location 3	0,0800	0,0896	0,1200	0,1039	0,0690	0,0909
Location 4	0,0933	0,0746	0,0800	0,0909	0,1207	0,0779
Location 5	0,1067	0,0896	0,0933	0,1169	0,1034	0,1039
Location 6	0,1200	0,1194	0,1067	0,0909	0,1379	0,1169
Location 7	0,0933	0,1045	0,0933	0,1039	0,0862	0,0909
Location 8	0,0800	0,0746	0,1067	0,0779	0,1034	0,0779
Location 9	0,1067	0,1045	0,0800	0,1169	0,0862	0,1039
Location 10	0,0933	0,1194	0,1200	0,1039	0,1034	0,1169

The multiplication of the weights of each value in the normalized decision matrix is multiplied by the weights of the relevant criteria to reflect its importance by using equation (7).

$$k_{11} = n_{11} * w_1 = 0{,}1200 * 0{,}1332 = 0{,}0160$$

The calculation results of the multiplication of the weights are shown in table 4.

Table 4. Multiplication of the Weights Root Assessment Method

Location Name	Criteria Code					
	L1	L2	L3	L4	L5	L6
Location 1	0,0160	0,0205	0,0142	0,0115	0,0209	0,0173
Location 2	0,0142	0,0234	0,0124	0,0173	0,0251	0,0153
Location 3	0,0107	0,0175	0,0160	0,0153	0,0167	0,0134
Location 4	0,0124	0,0146	0,0107	0,0134	0,0292	0,0115
Location 5	0,0142	0,0175	0,0124	0,0173	0,0251	0,0153
Location 6	0,0160	0,0234	0,0142	0,0134	0,0334	0,0173
Location 7	0,0124	0,0205	0,0124	0,0153	0,0209	0,0134
Location 8	0,0107	0,0146	0,0142	0,0115	0,0251	0,0115
Location 9	0,0142	0,0205	0,0107	0,0173	0,0209	0,0153
Location 10	0,0124	0,0234	0,0160	0,0153	0,0251	0,0173

Calculating the total normalization score for each alternative is calculated by summing the values of the multiplication results on all criteria using equation (8) and (9).

$$S_{+1} = \sum_{i=1}^{n} k_{11,31,41,61} = 0{,}0160 + 0{,}0142 + 0{,}0115 + 0{,}0173 = 0{,}0590$$

$$S_{-1} = \sum_{i=1}^{n} k_{21,51} = 0{,}0205 + 0{,}0209 = 0{,}0413$$

The calculation results of the total normalization score are shown in table 5.

Table 5. Total Normalization Score Root Assessment Method

Location Name	S_{+i}	S_{-i}
Location 1	0,0590	0,0413
Location 2	0,0593	0,0484
Location 3	0,0554	0,0342
Location 4	0,0480	0,0439
Location 5	0,0593	0,0426
Location 6	0,0609	0,0568

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Location 7	0,0536	0,0413
Location 8	0,0479	0,0397
Location 9	0,0575	0,0413
Location 10	0,0610	0,0484

Determining the final value of the alternative is calculated to provide a ranking based on the total normalized score by using equation (10).

$$RI_1 = \sqrt[2+S_{-1}]{2+S_{+1}} = \sqrt[2+0,0413]{2+0,0590} = \sqrt[2,0413]{2,0590} = 4,3679$$

The calculation results of the final value of the alternative are shown in table 6.

Table 6. The Calculation Results of the Final Value Root Assessment Method

Location Name	Final Value
Location 1	4,3679
Location 2	4,3916
Location 3	4,3303
Location 4	4,3284
Location 5	4,3731
Location 6	4,4254
Location 7	4,3448
Location 8	4,3148
Location 9	4,3614
Location 10	4,3993

The final score of the root assessment method provides an objective picture of the extent to which each location meets the needs and objectives of the business that have been set. The location with the highest total score is considered the best choice because it shows the optimal combination of all the criteria considered.

Analysis and Interpretation of Results

Analysis and interpretation of results in the selection of business locations is a crucial stage to evaluate and understand the data that has been obtained through evaluation methods applied using the root assessment method or entropy weighting. At this stage, after calculating the final value of each location alternative, the results obtained should be analyzed to see how one location compares to another based on the total score that has been calculated. The score describes how well each location meets predetermined criteria, such as accessibility, rental costs, market potential, and others. After that, interpretation is carried out to identify the key factors that affect the ranking of these locations, for example whether lower rental costs or better accessibility have a significant influence on the final decision. This analysis is also important to identify the advantages and disadvantages of each location and to provide more targeted recommendations regarding the location that best suits the needs and goals of the business. Thus, this stage ensures that decisions taken are objective and based on relevant and measurable data. The results of the business location ranking are shown in Figure 2.

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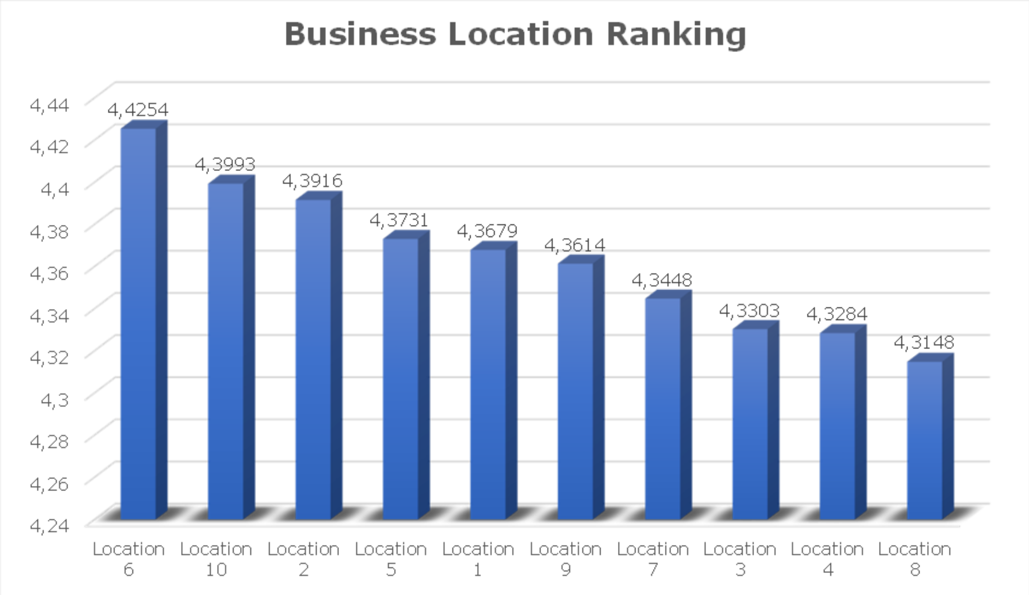

Figure 2. Business Location Ranking

Business location ranking shows the highest rated location is Location 6, with a score of 4.4254. Furthermore, Location 10 is ranked second with a score of 4.3993, followed by Location 2 in third place with a score of 4.3916. Location 5 is in fourth place with a score of 4.3731, while Location 1 ranks fifth with a score of 4.3679. The other locations have the following scores: Location 9 is ranked sixth with a score of 4.3614, followed by Location 7 in seventh place with a score of 4.3448. Location 3 and Location 4 ranked eighth and ninth with scores of 4.3303 and 4.3284 respectively. Lastly, Location 8 is in tenth place with a score of 4.3148. These results show that Location 6 is the most superior location in this assessment.

4. CONCLUSION

The purpose of this study is to apply a more objective approach in determining business locations by integrating the root assessment method and entropy weighting methods in systematically evaluating various business location criteria and giving fair weight based on their level of importance. By applying this combination of methods, the decision-making process becomes more accurate and in accordance with business needs, and provides solutions that can be adapted by various types of businesses in determining strategic locations that support long-term success. The integration of root assessment method and entropy weighting in determining business location selection criteria is an approach that combines two objective methods to produce more accurate and fair decisions. The entropy weighting method also ensures that the weight given to each criterion truly reflects the importance of that criterion based on available data, rather than based on subjective preference. The root assessment method is applied to evaluate alternative business locations by combining the values of each normalized criterion and multiplying it by the weights generated from the entropy method. Business location ranking shows the highest rated location is Location 6, with a score of 4.4254. Furthermore, Location 10 is ranked second with a score of 4.3993, followed by Location 2 in third place with a score of 4.3916. These results show that Location 6 is the most superior location in this assessment.

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