Determination of Priorities for the Development of Small and Medium Enterprises in the Province of South Sulawesi Using the Weighted Product Model

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ABSTRACT

Small and Medium Enterprises (SMEs) are a sector that plays a vital role in running the national economy. The South Sulawesi Provincial Office of Industry as a regional government organization is tasked with administering affairs in the industrial sector of the South Sulawesi Province. In terms of developing SMEs, the South Sulawesi Provincial Industry Service has the right to determine priority industries that have the potential to be developed. The decision-making process at the South Sulawesi Industry Office is still experiencing several obstacles. This is due to the decision making does not use an objective method. In order to help solve this problem, we need a system that can be used to determine industrial development priorities. This research builds a web-based decision support system software regarding priority setting for SMEs development in South Sulawesi Province using the weighted product model. A method that will find a concluding solution by considering industry weights and criteria. This study uses the implementation of the data management subsystem using MySQL. Meanwhile, the implementation of the model management subsystem uses the weighted product model and the dialog management subsystem uses a website interface that can assist the South Sulawesi Provincial Office of Industry in determining priorities for the development of SMEs.

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1. INTRODUCTION

Economic development that leads to industrialization can encourage economic growth and create jobs for the community. In the history of the development of economic development, the process of the industrial revolution began in the 18th century in England. With the first discovery, namely cotton weaving, after that new innovations in the form of processing engines, trains, steam engines, and steam power ships. These developments led to the spread of industrialization to other countries, increased international trade and led to the industrial revolution.

According to the Regulation of the Minister of Industry of the Republic of Indonesia [1], Industry is all forms of economic activity that process raw materials and/or utilize industrial resources to produce goods that have added value or higher benefits, including industrial services.

The industrial classification for each region or country is different. The more advanced the level of industrial development in an area, the more industrial classifications and the more complex the nature of its activities. Based on the business scale, industry can be divided into small, medium and large industries.

Small and Medium Enterprises (SMEs) are a sector that plays a vital role in running the national economy. South Sulawesi as one of the main corridors of economic development, especially in the eastern part of Indonesia. According to the Head of the South Sulawesi Industry Service, Ahmad Akil, SMEs are one of the contributors to economic growth in South Sulawesi that needs to be developed, with the presence of SMEs in

South Sulawesi it is very helpful in creating jobs, although there are still various problems that need to be fixed, such as access to capital, promotion and sales [2].

The South Sulawesi Provincial Office of Industry as a local government organization is tasked with administering affairs in the industrial sector of the South Sulawesi Province. In terms of developing SMEs, the South Sulawesi Provincial Industry Office has the right to determine priority industries that have the potential to be developed. However, in determining priorities the South Sulawesi Provincial Industry Service must be objective so that the decision is truly appropriate and accountable so that it does not harm anyone.

The decision-making process at the South Sulawesi Industry Office is still experiencing several obstacles. This is due to the decision making does not use an objective method. In order to help solve these problems, we need a system that can be used for prioritization. The use of decision support systems in industry is nothing new. Research has been carried out on decision support systems in determining priority for SMEs development in Karo District using the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method [3]. While research using the Weighted Product model method has been carried out research on the decision-making system for granting credit to BMT Muamalah Sejahtera Kendari. This study produced a decision support system for granting credit, where the implementation of this system showed that Weighted Product model in the process of rating new customer credit has the same results, if the method is calculated manually [4].

Qualified technological developments and with reference to the problems above, it is very appropriate to apply a method to assist the South Sulawesi Industrial Service in making decisions in providing support to SMEs. Several methods are often preferred to be applied because they are more suitable and able to handle certain data well [5].

In this study, the method applied is the Weighted Product model to help set a priority for various SMEs in South Sulawesi Province.

2. RESEARCH METHOD

This study uses a design and creation approach. The design and creation method is a combination of system development and research. We chose this type of research because in addition to conducting research on this title, we also developed a decision support system for setting priorities for the development of SMEs in South Sulawesi Province. The system development approach used is Rapid Application Development (RAD) which is a system development method that can reduce software development time. RAD is divided into 3 stages [6], namely:

1) Requirement Planning is the stage of determining system features, objectives and constraints through consultation with the South Sulawesi Provincial Office of Industry.

2) System Design. In this stage, the system architecture is formed based on specific requirements and describes the basic abstraction of the system and its relationships.

3) Implementation. At this stage PHP will be used as a programming language. The program code is prepared according to the Weighted Product model procedure. The activity carried out is to build a system that can determine the development priorities of SMEs in South Sulawesi Province according to the needs and design of the system that has been made.

In general, the steps taken in this study were processing the data including attributes and alternatives by using the Weighted Product model to rank them so as to obtain priority results for the development of SMEs.

2.1. Weighted Product

Weighted Product model is one of the Multi Criteria Decision Making (MCDM) methods which is a decision making technique from several existing alternatives according to the desired criteria. Basically the application of the Weighted Product model is more efficient because the time needed in the calculation is shorter [7].

The use of the Weighted Product model in a decision support system is nothing new, in previous research a scholarship recipient system at SMKN 4 Jeneponto was designed [8]. In this study, evaluating several alternatives based on the following four criteria: parents' income, grades, number of siblings and distance traveled between home and school. The Weighted Product model multiplies the criteria values to get a score.

In the Weighted Product model, the values of the criteria are taken into account to determine alternative preference scores. By using multiplication to connect attribute ratings so that the rating of each attribute is raised to the first power of the attribute weight [9]. The stages of the Weighted Product model are as follows [10]:

1) Determine the criteria and alternatives, thus the criteria will be used as a reference in making decisions and alternatives.
2) Give weight to each criterion according to the level of importance.
3) Normalize the weights, where $\sum w_j = 1$. w_j is a rank with a positive value for cost criteria and a negative value for benefit criteria. The equation for normalizing weights is as follows:

$$w_j = \frac{w_j}{\sum w_j} \qquad (1)$$

4) Determine the value of the vector *S*, after normalizing the weights, then calculate the value of the vector *S* with the second equation below:

$$S_i = \prod_{j=1}^{n} a_{ij}^{w_j} \qquad (2)$$

Information:
S_i = Alternative preferences (Vector *S*)
n = Number of criteria
j = Criteria Value
a_{ij} = Variable value of the alternative on each criterion
i = Alternate value

5) Determine the value of vector *V* using the equation below::

$$V_i = \frac{\prod_{j=1}^{n} a_{ij}^{w_j}}{\prod_{j=1}^{n} (x_j^*)^{w_j}} \qquad (3)$$

6) Do a ranking based on the largest value based on the calculation of the Weighted Product model, the best value is the largest of all alternatives.

3. RESULTS AND DISCUSSION

The research used a dataset of 1,117 SMEs from South Sulawesi Province in 2021. The SMEs data is also referred to as an alternative which will later be processed using the Weighted Product model to determine priority for SMEs development. The calculation steps for determining priority for SMEs development using the Weighted Product model are as follows:

1) Determining alternatives and criteria as the basis for determining development priorities. This criterion becomes a reference for calculating the Weighted Product model. The criteria used are labor, investment, production capacity, production value and raw material value.
2) Giving weight to each criterion, there are five criteria with each value and weight in the following table according to the level of importance. The Weight of Each Criterion can be seen in **Table 1.**

Table 1. Weight of Each Criterion

Criteria code	Information	Weight
C1	Labor	2
C2	Investment	3
C3	Production capacity	5
C4	Production value	5
C5	Raw material value	4

3) Normalize the weights using equation (1) with the proviso that the exponential value is positive for the cost and a negative value for the benefit criterion. The following is the result of weight normalization:

$$w_1 = \frac{2}{19} = 0.1$$
$$w_2 = \frac{3}{19} = 0.2$$
$$w_3 = \frac{5}{19} = 0.3$$
$$w_4 = \frac{5}{19} = 0.3$$
$$w_5 = \frac{4}{19} = 0.2$$

The normalization calculation results are obtained as **Table 2.** below.

Table 2. Weight Normalization Calculation Results

Criteria	Labor	Investment	Production capacity	Production value	Raw material value	Total
Weight	2	3	5	5	4	19
Normalization	0.1	0.2	0.3	0.3	0.2	1
Weightage	-0.1	0.2	0.3	0.3	-0.2	

4) After normalizing the weights, then calculating the value of vector *S* with equation (2), the following is the calculation:

$$S_i = 10^{-0.1} \times 1{,}000{,}000{,}000^{0.2} \times 1{,}000{,}000{,}000^{0.3} \times 3{,}000{,}000{,}000^{0.3} \times 117{,}000{,}000^{-0.2}$$
$$S_i = 0.7943 \times 63.0957 \times 251.1886 \times 696.8453 \times 0.0243$$
$$S_i = 213{,}550$$

So from the example of 6 cases of SMEs, the results of calculating the *S* vector for each alternative are as shown in **Table 3**.

Table 3. Vector *S* Calculation Results

Alternative	Enterprise names	C1	C2	C3	C4	C5	Vector *S*
A1	Barata Sejahtera	0.7248	49.5934	386.3445	465.1879	0.0219	141,263
A2	CV. Tirta Rumaju	0.9330	43.1736	344.9989	559.1248	0.0154	119,716
A3	UD. Anugrah Alam Nusantara	0.6849	90.2880	283.6791	566.0143	0.0149	148,208
A4	Ujung Loe Bangunan	0.7943	63.0957	251.1886	696.8453	0.0243	213,550
A5	PT. Bawakaraeng Lestari	0.8232	78.5872	51.2497	587.6716	0.0599	116,648
A6	PT. Lumpue Indah	0.8513	39.6906	261.5338	575.3426	0.0223	113,551

Determine the value of vector V using equation (3) as follows.

$$V_i = \frac{10^{-0.1} \times 1{,}000{,}000{,}000^{0.2} \times 1{,}000{,}000{,}000^{0.3} \times 3{,}000{,}000{,}000^{0.3} \times 117{,}000{,}000^{-0.2}}{213{,}550 + 141{,}263 + 116{,}648 + 148{,}208 + 113{,}551 + 119{,}716 + 123{,}682 + 151{,}333 + 136{,}964 + 175{,}497}$$

$$V_i = \frac{213{,}550}{1{,}440{,}412}$$

$$V_i = 0.1483$$

So that from the case examples of 6 SMEs, the results of calculating the vector V for each alternative are as shown in table 4.

Table 4. Vector V Calculation Results

Alternative	Vector S	Vector V
A1	141,263	0.0981
A2	119,716	0.0831
A3	148,208	0.1029
A4	213,550	0.1483
A5	116,648	0.0810
A6	113,551	0.0788

5) Perform ranking based on the greatest value. From the results of the calculations above, it results that the alternative A4 or Ujung Loe Bangunan is the first priority for SMEs development.

3.1. Use Case

Use case diagram is an illustration that describes the interaction relationship between the user and the activities running on the system. The use case of this research is shown in **Fig. 1** as follows.

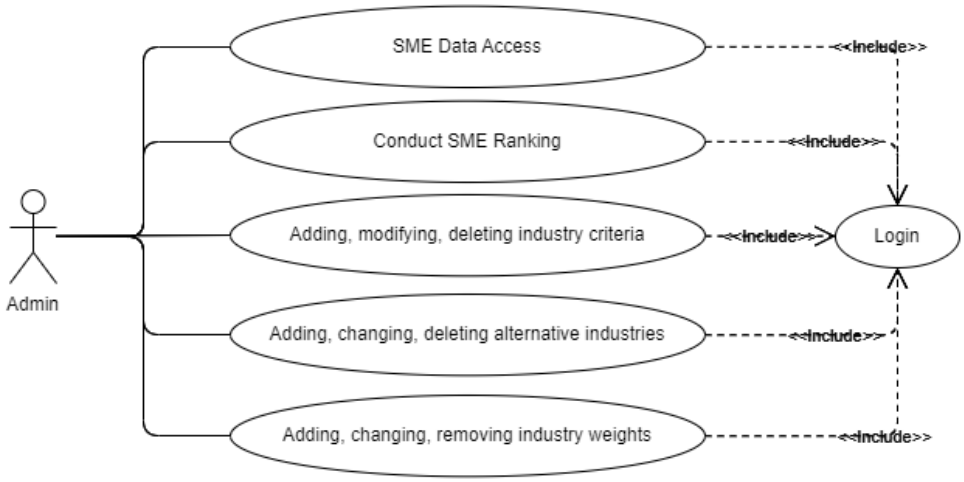

Fig. 1. Use Case Diagram.

3.2. Flowchart

The system in this study was carried out in several stages according to the flowchart in Fig. 2.

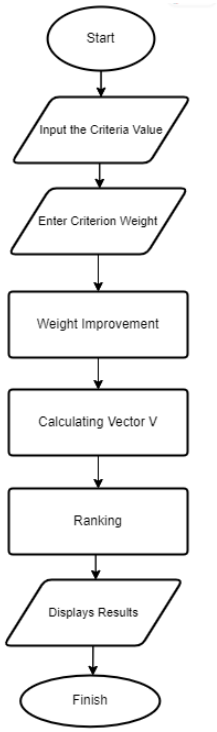

Fig. 2. Flowchart.

3.3. Implementation

The main display of the SMEs development determination system can be seen in Fig. 3. The homepage display will appear the first time when this system is run.

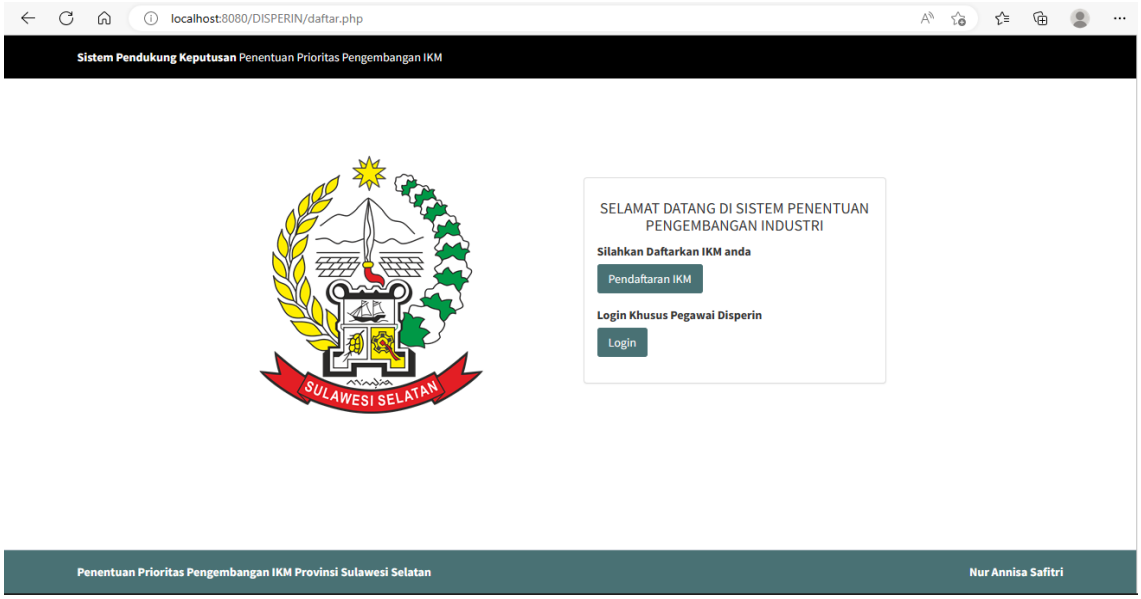

Fig. 3. Homepage Interface.

When logging in as an employee, the home menu will appear for the first time. On the home menu there is an information display in the form of criteria, weights, industry alternatives and a map display of featured SMEs. The home menu has two feature options: alternative changes and ranking features.

The alternative change feature will display alternative industry data along with vector values S and vector V. On this page there are services for editing, deleting tick, searching and adding value data. The alternative change feature is used to input alternative or SMEs data.

The Ranking feature consists of seven sub-features: graph, preference value, type of criteria, weight, rating, edit criteria and registration. The sub-chart feature displays a graph of priority industries as well as the percentage of workforce, investment value, production capacity and production value in South Sulawesi Province. Preference values display preference value data from each industry weight and there are services to edit, delete tick data, search, and add value data. The types of criteria display industry criteria data along with the types of criteria, which are worth the costs and benefits and there are also services for editing, searching, deleting tick data and adding criteria data. Weights display weight value data and weight results from each industry criteria and there is also edit, delete tick data, search and add value data. The ranking displays alternative data reports that have been ranked based on the value of vector v and the criteria for each industry. Edit criteria displays alternative industry data along with criteria and values and on this page there are services for editing, deleting tick data, searching and adding value data. Registration displays data on SMEs that have registered to apply for industrial assistance. Based on its characteristics, decision support systems can adapt at any time and are flexible so that this system provides services for adding, editing, deleting criteria and industry weights. This service is useful in order to assist users in the process of making industry priority decisions.

The use of the Weighted Product model in this system can help users make decisions in determining SMEs that have the potential to be developed based on predetermined criteria and weights. Based on data from 1,117 SMEs in South Sulawesi Province, the result was that Ujung Loe Bangunan had a vector value of V of 0.016, followed by Barata Sejahtera with a vector value of V of 0.01. The Weighted Product Result can be seen in **Fig. 5.**

Alternatif	Kriteria					P. Alternatif	P. Relatif
	Tenaga Kerja	Nilai Investasi	Kapasitas Produksi	Nilai Produksi	Bahan Baku		
UJUNG LOE BANGUNAN	0.7848	26	127	312	0.02	16461.39	0.0166
BARATA SEJAHTERA	0.7126	22	186	219	0.0179	11299.44	0.01139
PT. BAWAKARAENG LESTARI	0.8148	31	32	269	0.0516	11194.93	0.01129
UD. ANUGRAH ALAM NUSANTARA	0.6714	35	142	260	0.012	10354.09	0.01044
PT.LUMPUE INDAH	0.8442	18	132	264	0.0183	9822.46	0.00991

Fig. 4. Weighted Product Model Rating Results.

Apart from being in tabular form, this system is equipped with graphical visualization so that it can make it easier for users to analyze and understand the results of this model.

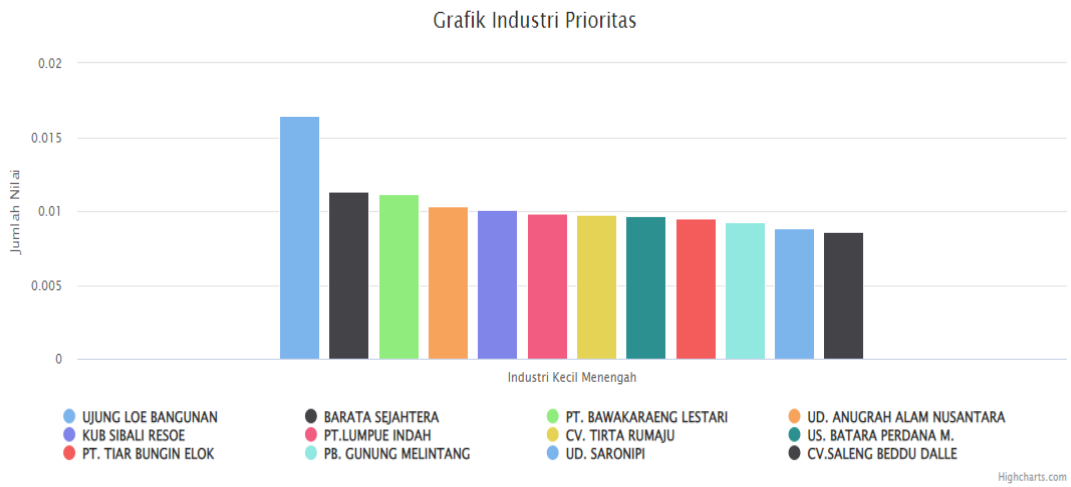

Fig. 5. Graph of Weighted Product Model Rating Results.

4. CONCLUSION

Based on the results of the research and system for determining the priority for the development of SMEs using the Weighted Product model above, the conclusions are as follows:

1) Use of the Weighted Product model to determine priorities and determine decisions by considering the weights and criteria.

2) This decision support system uses the PHP programming language with the implementation of the MySQL data processing subsystem which can assist the South Sulawesi Provincial Office of Industry in determining priority for SMEs development.

3) Alternative data, criteria and weights become dynamic assessment parameters, which can be added or subtracted according to user needs according to the characteristics of the decision support system.

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