Analysis the Application of the Weighted Product Method in Decision Support Systems for Assistance Programmes for MSMEs

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Abstract— **Productive Micro Business Assistance (BPUM) is a government policy. This assistance has been carried out since the Covid-19 Pandemic in Indonesia. The Mojokerto city government conducts a selection of MSMEs which is expected to avoid errors in determining MSME assistance. Therefore, a decision support system is needed that is developed using the Weighted Product method to make it easier and faster to determine MSMEs that are eligible to receive assistance. The stages of system development start from problem analysis, data collection, analysis of method application, and system development. Based on the calculation of the resulting S vector, the largest value is 0.10568 and the smallest value is 0.05886 from 9382 MSME data. The last calculation is the V vector value which produces recommendations in the form of data ranking that can be used by the Mojokerto City Diskopukmperindag to determine which MSMEs are entitled to receive assistance. The results of the selected alternatives are in accordance with the ranking with the largest value of 0.10568 and the smallest value of 0.05886. Providing recommendations by the decision support system to policy makers can be based on the largest relative preference value owned by MSMEs.**

Keywords— *Productive Assistance for Micro Enterprises, Decision Support Systems, Micro Small and Medium Enterprises (MSME), Weighted Products*

I. INTRODUCTION

MSMEs are a requirement to support the development of a country due to the large contribution of MSMEs to the country, especially in the economic and social fields [1]. In addition, MSMEs also play a role in assisting in employment and community equity, therefore various supporting policies and programmes have been formulated and implemented by the central and regional governments to support the empowerment and sustainable growth of MSMEs. In 2018, there were 116.98 million workers (97% of the total workforce in the economic sector) and 60% of Indonesia's Gross Domestic Product came from MSMEs [2]. This states that MSMEs play an important role in maintaining the domestic economy. However, the COVID-19 pandemic has had a significant impact on industrial

life, especially in the economic field, from the International Monetary Fund Survey in 2020. Several research institutions estimate that the world economy is weak and global economic growth will be at minus 3% [3].

During the COVID-19 pandemic, 37,000 MSMEs reported significant losses. It is estimated that 56% of MSMEs experienced a decline in sales, 22% reported financial problems, 15% reported problems related to the allocation of goods and the remaining 4% had difficulty obtaining raw materials. [4]. According to Thaha (2020) there are several surveys showing that more than 50% of MSMEs show significant losses [5]. Losses due to the COVID-19 pandemic in the MSME sector have resulted in business actors feeling a direct impact in the form of declining sales levels.

In response to this, the government has made a policy of providing Micro Business Productive Assistance (BPUM) to MSMEs. This assistance aims to help MSMEs that lack capital [6]. Therefore, the government selects each MSME so that there are no errors in determining the recipients of assistance to MSMEs. So that the provision of assistance is right on target, the local government collects data for each MSME that needs assistance. This process requires a policy or method, namely decision making so that it can easily determine which MSMEs are eligible to receive assistance.

Some research related to MSMEs conducted by Sidabutar (2022) is related to the "Decision Support System for Providing MSME Assistance to the Cooperative Office Applying the OCRA Method", where the cooperative office experiences obstacles and takes a long time in choosing MSMEs that deserve this assistance. But this solution can be resolved because of the Operational Competitiveness Rating Analysis (OCRA) method used in providing MSME assistance. The study results show that this method requires a sample, where the sample is an alternative. In addition to alternatives, criteria are also needed which in the end will be used as reference

material in determining MSME assistance recipients [7]. Further research was conducted by Pantatu (2022) related to the "Decision Support System for MSME Assistance Recipients Using the Multi Attribute & Utility Theory (MAUT) Method" where the Perindag Office experienced problems in determining who was really entitled to receive MSME assistance. The solution is to use a decision support system that can be done to find out the results of the selection of MSME Assistance Recipients using the MAUT method so that it can be implemented. From the results of research conducted using PHP with a MySQL database, the MAUT method provides a final result assessment by ranking from the Highest to the Lowest Alternative Value [8]. The last research was conducted by Sugiana (2022) related to "Decision Making to Select MSMEs that deserve Assistance Using the Simple Additive Weighting (SAW) Method". In this study, decision support calculations were carried out using the simple weighted (SAW) method, using six criteria, namely land ownership, sales, assets, working capital, number of employees, and age of MSMEs [9].

In addition to these methods, there is also the Weighted Product (WP) method that can be used in decision support. The Weighted Product (WP) method is one of the decision support system methods included in the Fuzzy Multiple Attribute Decision Making (FMADM) category. The WP method has been widely applied in decision making because this method is considered very simple by including all factors and computations [10]. This weighted product method uses multiplication calculations to connect attribute ratings, where each attribute rating must be lifted by the attribute weight. The WP method is a decision-making method based on the magnitude of preference values. The WP method has been successfully applied to several previous researchers such as employee selection [11] dan untuk menentukan lokasi perumahan [12].

In this research case, the Mojokerto City Diskopukmperindag in determining decision making regarding the provision of assistance still uses manual methods. The data used has not been centralised so that the umkm data owned by each unit is different. This data that has not been centralised does not have historical data so that this can cause one of the obstacles in making decisions.

The purpose of this research is to apply the Weighted Product Method in a decision support system to help the Mojokerto City Cooperative, Small and Medium Enterprises and Trade Industry Office select recipients of the MSME Support Programme.

II. LITERATURE REVIEW

A. Decision Support System

A decision support system is a system that is used as a problem-solving tool to assist decision makers (managers) in making decisions. The decision support system itself aims to solve decisions that require judgement or that cannot be supported by algorithms at all. [13].

The benefit of implementing a decision support system is to improve the ability of decision makers by providing better alternative decisions so that it can help to make a decision. This decision support system can save time, energy and costs so that it can be said that the decision support system increases efficiency and effectiveness for decision making. [14].

Decision support systems function as management aids. So this system is not intended to replace the function of decision makers in making decisions. This system is designed only to assist decision makers in carrying out their duties.

B. Weighted Product Method

Weighted Product is a popular multi-criteria decision analysis and multi-criteria decision making method. Like all FMADM methods, it is used to solve cases where the data consists of many attributes of interest consisting of Simple Additive Weighting (SAW), Weighted Product (WP), Elimination and Choice Translation Reality (ELECTRE), Technique for Others Reference by Similarity to Ideal Solution (TOPSIS), and Analytic Hierarchy Process (AHP) methods [15]. *Weighted Product is a finite set of decision alternatives described in terms of multiple decision criteria.*

The selection of the Weighted Product method is also based on its ability to provide optimal solutions in the ranking system. The selection of this method is also based on the computational complexity that is not too difficult so that the time required to produce calculations is relatively short [16]. The Weighted Product method has also been widely used as a reference in ranking systems and decision support systems.

The following are the characteristics of the weighted product method calculation, namely:

1. The weighted product method uses multiplication to relate attribute ratings, where the rating of each attribute must first be multiplied by the weight of the attribute concerned.

2. This process is similar to the normalisation process.

C. MSMEs

MSME is a business or business conducted by individuals, groups, small business entities, or households [17]. Indonesia as a developing country makes MSMEs the main foundation of the community's economic sector, this is done to encourage the ability of independence in developing in the community, especially in the economic sector.

D. Productive Micro Business Assistance (BPUM)

Since Covid 19, MSMEs in Indonesia, the economy in Indonesia has decreased, especially in MSMEs, therefore the government provides support to MSMEs by providing assistance, one of which is BPUM. Productive Micro Business Assistance is one type of Direct Cash Assistance (BLT) provided by the government to the people of Indonesia, especially MSME players. During a pandemic like this, the

government hopes that people will still be able to run their businesses well and have the capital to carry out promotions [18].

III. RESEARCH METHODS

The decision-making method used in this research uses the Weighted Product method. This method is used because it can perform weighting on each desired criterion, and the calculation results of this method can produce alternatives that are considered the best choice.

Steps to use the Weighted Product method [19] :

1. Determination of weight value "W"

$$W_j = \frac{w_j}{\sum w_j}$$

Wj is a positive-valued power for the profit attribute, and a negative-valued power for the cost attribute.

2. Determination of weight value "S"

$$Si = \prod_{j=1}^{n} X_{ij}^{wj}$$

Where Si is the result of decision normalisation on alternatives to-i, X_{ij} is the Alternative Rating per item, i is an alternative, j is the attribute, and $\prod_{j}^{n} =_1 X_{ij}$ is the multiplication of alternative ratings per attribute of j = 1 – n, In this alternative where $\sum Wj = 1$.

3. Determination of weight value "V"

$$Vi = \frac{Si}{\prod_{j=1}^{n}(W_j)^{wj}}$$

Where, Vi is the preference result of the alternative to-i and $\prod_{j}^{n} =_1 x_{ij *Wj}$ is the sum of the multiplication results of alternative ratings per attribute.

Table 1. Criteria for Assistance for Micro Businesses

Criteria	Description	
	Weight	**Cost/Benefit**
Indonesian citizens living in Mojoketo City	2	Benefit
Have E-KTP	3	Benefit
Have a Business Identification Number (NIB)	5	Benefit
Not as ASN, TNI/POLRI, Employee BUMN/BUMD	4	Benefit
Receiving KUR	3	Benefit
Has never received assistance in the previous year	5	Benefit

From Table 1 above there is information in the form of weights for each criterion starting from numbers 1 to 5, where the weight value indicates the level of importance as described below:

Weight 1 = Not important,
Weight 2 = Less Important,
Weight 3 = Quite Important,
Weight 4 = Important,
Weight 5 = Very Important.

While *Cost/Benefit* from Table 1 above explains from each criterion whether it requires costs or not, because the criteria above are not related to costs, then all criteria are declared *benefit*.

There are five stages carried out in the research as described in Figure 1.

1. Literature Study

   At this stage, researchers are looking for various reference sources that can be used as supporting literature studies, including studies conducted by previous researchers. Literature study activities explore sources from journal articles, books, and various other sources related to the methods used in decision support systems, including the Weighted Product (WP) method.

2. Problem Analysis

   The problems faced by the Mojokerto City Diskopukmperindag in the process of providing assistance to MSMEs are traced and analysed to get the right solution in decision making. Analysis of the problems is carried out in research related to providing assistance to MSMEs. The results of the analysis show the need for a Decision Support System (DSS), in this case using the Weighted Product method to quickly find out which MSMEs are eligible to receive assistance.
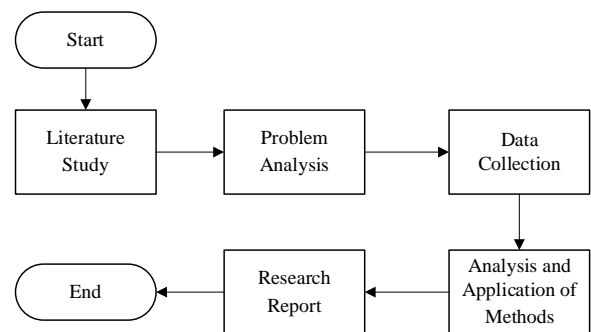

Figure 1. Research Stages

3. Data Collection

   The data in this study are secondary data in the form of MSME data obtained from Diskopukmperindag since 2021 and MSME managers who registered in 2022 in Mojokerto City.

In addition, interviews were also conducted with the Head and Staff of Diskopukmperindag as an initial study to obtain criteria and weights for each criterion. The data can be used to calculate scores and rankings that can make it easier for Diskopukmperindag to select MSMEs that are eligible to receive assistance.

4. Analysis and Application of Methods

The results of the study of problem analysis and data collection of MSMEs obtained from Diskopukmperindag Kota Mojokerto were further analysed and used as material for developing a decision support system. Determination of decisions from the system developed with the Weighted Product method can assist policy makers in determining which MSMEs are eligible to receive assistance. The system evaluation in this method offers a holistic and structured approach in multi-criteria decision making.

5. Research Report

The results of the entire decision-making process and the methods used in this study are compiled in the form of a report. The report generated from the output of the decision support system can be used by the Head of the Mojokerto city Diskopukmperindag in making policies on providing assistance to MSMEs.

IV. RESULTS AND DISCUSSION

Based on the data of Mojokerto city MSMEs registering in 2022, there are several MSMEs that have received assistance in 2021 but they register again in 2022. Therefore, it is necessary to compare the 2021 data with the 2022 data so that it is easier to find out which MSMEs have received assistance in 2021. MSMEs that only registered in 2022 received a weight of 5 (very important). Other weights used in this study include having to live in Mojokerto City as evidenced by e-KTP documents, having a business licence, the owner not being a State Civil Apparatus, and not receiving KUR assistance from the government.

The data obtained from the Mojokerto City Diskopukmperindag in 2022 was 9382 MSMEs. This data is then weighted according to the completeness of the data and the provisions in Table 1. The matrix of alternative criteria entered into the decision support system can be seen in Figure 2.

Figure 2. Alternative Criteria Matrix

After comparing MSME data in 2021 and 2022 along with the weights obtained from each criterion, then calculate the relative value of the initial weight (wj) using Equation 1, where Σ wj = 1.

$$W_j = \frac{w_j}{\sum w_j} \quad \ldots\ldots\ldots (1)$$

The results of the calculation obtained the relative value of the initial weight on each criterion as shown in Table 2, where the importance weight comes from the weight divided by the number of weights and the total of all importance weights is one.

Table 2. Initial Weight Relative Value

No	Criteria	Initial Weight Relative Value
1	C1: Indonesian citizen Mojoketo City	0,090909091
2	C2: Have E-KTP	0,136363636
3	C3: Have a Business Identification Number (NIB)	0,227273000
4	C4: Not as ASN, TNI / POLRI, BUMN / BUMD Employees	0,181818000
5	C5: Receiving KUR	0,136364000
6	C6: Has never received assistance in the previous year	0,227273000
	Jumlah ($\sum$ Wj)	**1,000000000**

The process results of the decision support system for calculating the relative value of importance weights are shown in Figure 3.

Figure 3. Calculation Result of Importance Weight

Next, make a comparison matrix of alternatives and criteria, namely by determining the alternative values of all criteria ranging from C1 to C6. After making the decision matrix, the next step is to make the rank value using Equation 2.

Rank = Weight of Importance * Weighting Type ……(2)

Notes: There are two types of weighting, Benefit (weight 1) or Cost (weight -1) as shown in Table 1.

The calculation results are obtained as in Table 3, where the importance weight is multiplied by 1 because all criteria are included in the benefit weighting type.

Table 3. Rank Value

No	Criteria	Rank
1	C1: Indonesian citizen Mojoketo City	0,090909091
2	C2: Have E-KTP	0,136363636
3	C3: Have a Business Identification Number (NIB)	0,227273000
4	C4: Not as ASN, TNI / POLRI, BUMN / BUMD Employees	0,181818000
5	C5: Receiving KUR	0,136364000

6	C6: Has never received assistance in the previous year	0,227273000
	Jumlah ($\sum W_j$)	**1,000000000**

The results of the process of the decision support system for calculating the rank of each weight as shown in Figure 4.

Figure 4. Rank Calculation Results

After obtaining the rank value of each weight, the next step is to determine the calculation of the vector value *Si*, by using Equation 3.

$$Si = \prod_{j=1}^{n} X_{ij}^{Wj} \qquad \ldots \ldots \ldots (3)$$

The results of the calculation of the Si value carried out in the decision support system can be seen in Figure 5.

Note: column S is the result of calculating the vector Si

Figure 5. Vetor S Value Calculation Results

The final stage of the decision support process is to calculate the relative preference value (vector Vi) using Equation 4.

$$Vi = \frac{Si}{\prod_{j=1}^{n}(W_j)^{wj}} \qquad \ldots \ldots \ldots (4)$$

From the above formula, the largest value is 0.10568 and the smallest value is 0.05886 from 9382 MSME data in the Mojokerto City area. This value is obtained from the value of the Si vector divided by the total sum of all Si values in the S vector. The results of the calculation of the Si value carried out in the decision support system can be seen in Figure 6.

Note: column V is the calculation result of the relative preference value

Figure 6. Calculation Result of Vetor V Value

The result of the calculation of the V vector value is the last stage of the decision support system. The results in Figure 6 are some of the recommended MSMEs in the form of data ranking that can be used by Diskopukmperindag Kota Mojokerto to determine which MSMEs are entitled to receive assistance. Alternative MSMEs are selected according to the ranking with the largest value of 0.10568 and the smallest value of 0.05886.

V. CONCLUSIONS

The results of the research that has been carried out can be concluded that the Weighted Product method can be used in providing MSME assistance at the Mojokerto City Diskopukmperindag. By using this method, the decision support system developed can provide output in the form of a list of names of MSMEs that are recommended as beneficiaries. Factors that greatly influence the results in providing MSME assistance using the Weighted Product method are the criteria and weights of each criterion given to all candidates for beneficiaries from the Mojokerto City Diskopukmperindag. The results obtained a relative preference value with the highest number 0.10568 and the lowest value 0.05886. Providing recommendations by the decision support system to policy makers can be based on the largest relative preference value owned by MSMEs. Based on the case in this study, further research can be developed for system development to support decision making in providing the training needed for each fostered MSME.

REFERENCES

[1] Z. Sufiani, "Definisi,Kriteria dan Konsep UMKM," *Osfpreprints*, no. 90500120021, pp. 1–13, 2022.

[2] D. Chaerani, M. N. Talytha, T. Perdana, E. Rusyaman, and N. Gusriani, "Pemetaan Usaha Mikro Kecil Menengah (Umkm) Pada Masa Pandemi Covid-19 Menggunakan Analisis Media Sosial Dalam Upaya Peningkatan Pendapatan," *Dharmakarya*, vol. 9, no. 4, p. 275, 2020, doi: 10.24198/dharmakarya.v9i4.30941.

[3] N. Fernandes, "Economic effects of coronavirus outbreak (COVID-

19) on the world economy Nuno Fernandes Full Professor of Finance IESE Business School Spain," *SSRN Electron. Journal, ISSN 1556-5068, Elsevier BV,* pp. 0–29, 2020.

[4] R. T. Wijayanti, M. Najib, and M. Aminah, "The Effect of Entrepreneurial Marketing Perceptions on MSMEs Business Performance During Covid-19 Pandemic in Bogor City," *Indones. J. Bus. Entrep.*, vol. 8, no. 1, pp. 24–37, 2022, doi: 10.17358/ijbe.8.1.24.

[5] A. F. Thaha, "DAMPAK COVID-19 TERHADAP UMKM DI INDONESIA," *J. Brand*, vol. 2, no. 1, p. 1, 2020, [Online]. Available: https://ejournals.umma.ac.id/index.php/brand

[6] M. Rozzaq and A. Widiyarta, "Implementasi Program Bantuan Bagi Pelaku Usaha Mikro Di Kecamatan Gubeng Kota Surabaya," *J. Publicuho*, vol. 4, no. 2, pp. 315–325, 2021, doi: 10.35817/jpu.v4i2.17858.

[7] A. Sidabutar, R. K. Purba, and M. Mesran, "Sistem Pendukung Keputusan Pemberian Bantuan Umkm Pada Dinas Koperasi Menerapkan Metode Ocra," *Escaf*, pp. 1241–1251, 2022.

[8] S. F. Pantatu and I. C. R. Drajana, "Sistem Pendukung Keputusan Penerima Bantuan UMKM Menggunakan Metode MAUT," *J. Nas. Komputasi dan Teknol. Inf.*, vol. 5, no. 2, pp. 317–325, 2022, doi: 10.32672/jnkti.v5i2.4207.

[9] I. Sugiana, A. I. Hadiana, and P. nurul Sabrina, "Pengambilan Keputusan untuk Memilih UMKM yang Layak Mendapatkan Bantuan Menggunakan Metode Simple Additive Weighting (SAW)," *Snestik*, pp. 351–356, 2022.

[10] C. P. S. Heru Supriyono, "Pemilihan Rumah Tinggal Menggunakan Metode Weighted Product," *Khazanah Inform. J. Ilmu Komput. dan Inform.*, vol. 1, no. 1, pp. 23–28, 2015.

[11] O. Fajarianto, M. Iqbal, and J. T. Cahya, "Sistem Penunjang Keputusan Seleksi Penerimaan Karyawan Dengan Metode Weighted Product," *J. Sisfotek Glob.*, vol. 7, no. 1, pp. 49–55, 2017.

[12] Oktafianto *et al.*, "Determining housing location using weighted product," *Int. J. Eng. Technol.*, vol. 7, no. 4, pp. 3563–3568, 2018, doi: 10.14419/ijet.v7i4.18838.

[13] H. Pratiwi, "Penjelasan sistem pendukung keputusan," *Spk*, no. May, p. 3, 2020, [Online]. Available: https://www.researchgate.net/publication/341767301%0APENJELASAN

[14] B. Patnandi, D. Mustikasari, and I. Puji Astuti, "Sistem Pendukung Keputusan Penerimaan Bantuan Pelaku Usaha Mikro Untuk Umkm Menggunakan Algoritma Electre (Elimination and Choice Translation Reality)," *JIKO (Jurnal Inform. dan Komputer)*, vol. 6, no. 1, p. 115, 2022, doi: 10.26798/jiko.v6i1.480.

[15] S. Hanief, "Penggunaan Algoritma FMADM pada Sistem Pendukung Keputusan untuk Seleksi Penerima Bantuan Dana Pendidikan Untuk Mahasiswa Tidak Mampu atau Kurang Mampu pada Yayasan Rumah Singgah XYZ," *Eksplora Inform.*, vol. 1, no. 1, pp. 6–16, 2011, [Online]. Available: https://eksplora.stikom-bali.ac.id/index.php/eksplora/article/view/171/119

[16] A. Ahmadi and D. T. Wiyanti, "Implementasi Weighted Product (WP) dalam Penentuan Penerima Bantuan Langsung Masyarakat PNPM Mandiri Perdesaan," *Semin. Nas. Apl. Teknol. Inf.*, pp. 19–22, 2014.

[17] A. I. Firmansyah, "Pengaruh Pertumbuhan Usaha Mikro, Kecil, Dan Menengah Terhadap Pertumbuhan Ekonomi Di Tulungagung," *Pengaruh Pertumbuhan Usaha Mikro, Kecil, Dan Menengah Terhadap Pertumbuhan Ekon. Di Tulungagung*, vol. 53, no. 9, pp. 1689–1699, 2019.

[18] Marihot Nasution, "BPUM: Program Baru Bagi UMKM di Tengah Pandemi Covid-19," *Bul. Apbn*, vol. V, pp. 11–15, 2020.

[19] Nurhayati, R. Hayami, and Y. Fatma, "Penerapan Metode Weighted Product (WP) Sebagai Pendukung Prioritas Penerima Bantuan Pinjaman Modal UMKM," *Pros. Semin. Nas. Comput. Technol. its Apl.*, vol. 1, no. 1, pp. 41–46, 2019.