CHAIN: Journal of Computer Technology, Computer Engineering and Informatics
Website : https://ejournal.techcart-press.com/index.php/chain
E-ISSN 2964-2485
P-ISSN 2964-2450
Volume 1, Number 3, July 2023
DOI : **https://doi.org/10.58602/chain.v1i3.47**
Page 106-112

Decision Support System for Best Supplier Selection Using Simple Additive Weighting and Rank Sum Weighting

A Ferico Octaviansyah Pasaribu
Information Technology, Universitas Teknokrat Indonesia, Indonesian
fericopasaribu@teknokrat.ac.id

Abstract: Decision Support System or DSS is a computer system designed to help make complex and problem-oriented decisions. SAW method is one of the methods used in multi-criteria decision making to sort and select alternatives based on an assessment of several criteria. The SAW method uses a simple summation approach of weighted weights assigned to each criterion. Rank sum weighting is one method used in decision support systems to sort alternatives based on assessments on specific criteria. The results of this study are the selection of the best suppliers using the simple additive weighting method and applying the rank sum weighting model in determining the weight of the criteria used, namely price, product quality, delivery time, packaging form, and the number of shipments. Ranking results for rank 1 were obtained by Supplier B with a value of 0.846, for rank 2 were obtained by Supplier E with a value of 0.837, for rank 3 were obtained by Supplier C with a value of 0.787, for rank 4 were obtained by Supplier A with a value of 0.723, for rank 5 were obtained by Supplier B with a value of 0.698.
Keywords: Alternative; Decision; DSS; Rank Sum; SAW

1. INTRODUCING

Information technology plays an important role in running business and industry. Companies use software and IT systems to manage their daily operations, such as finance, supply chain, inventory management, customer management, and marketing. Information technology also facilitates electronic commerce (e-commerce), allowing businesses to sell products and services online[1]–[3]. Information technology has brought significant social changes in various aspects of life. Information technology has also influenced industries such as education, health, entertainment, and more.

Suppliers are parties or companies that provide products or services to other companies or organizations. They are an integral part of the supply chain of an enterprise, which supplies raw materials, components, parts, or services necessary for the production or operation of the company. Suppliers play a role in various industries and sectors, such as manufacturing, retail, construction, food and beverage, information technology, and more. They may provide physical goods, such as raw materials or finished products, or provide services, such as shipping services, machine maintenance, or financial services. Companies that choose the right supplier have benefits such as good product quality, delivery reliability, competitive prices, and adequate inventory availability. Good supplier selection

A Ferico Octaviansyah Pasaribu: *Coresponding Author

CHAIN: Journal of Computer Technology, Computer Engineering and Informatics
Website : https://ejournal.techcart-press.com/index.php/chain
E-ISSN 2964-2485
P-ISSN 2964-2450
Volume 1, Number 3, July 2023
DOI : **https://doi.org/10.58602/chain.v1i3.47**
Page 106-112

plays an important role in achieving operational efficiency, meeting customer needs, and maintaining competitive advantage. In relationships with suppliers, companies usually enter into contracts or agreements that include quality requirements, prices, delivery schedules, payments, and other terms. Open communication, collaboration, and regular monitoring of supplier performance are important in ensuring successful and sustainable cooperation.

The utilization of technology in industry has become a key factor in improving efficiency, productivity, innovation, and competitiveness. Selecting the right supplier is a critical factor in the industry to ensure an efficient supply chain, good product quality, and business continuity. Some factors to consider in the selection of suppliers in the industrial field include price, product quality, delivery time, packaging form, number of shipments.

Decision Support System or DSS is a computer system designed to help make complex and problem-oriented decisions[4]–[7]. The main purpose of DSS is to provide decision makers with relevant, accurate, and timely information so that they can make better decisions. Decision Support Systems combine a variety of techniques and tools, including data processing, statistical analysis, mathematical models, simulation, artificial intelligence, and data visualization. It allows decision makers to analyze existing information, understand the consequences of various choices, and predict the outcome of decisions made. The advantages of using a decision support system include DSS assisting decision makers in analyzing relevant information and making better decisions based on accurate data, DSS can automate complex decision-making processes, saving time and effort in analyzing data, DSS enables collaboration between different decision makers, allowing them to work together in producing the best decisions, DSS provides visualization of data and information that helps decision makers. One method in decision support systems is simple additive weighting (SAW)[7]–[9].

SAW method is one of the methods used in multi-criteria decision making to sort and select alternatives based on an assessment of several criteria[10], [11]. The SAW method uses a simple summation approach of weighted weights assigned to each criterion[12]. The SAW method is a relatively simple and easy method to implement. However, it is important to pay attention to the validity and accuracy of the assigned weights, as well as take into account the presence of bias or lack of information in the decision-making process[4], [13]. Weighting criteria is an important stage in decision support systems, but it can often raise some issues that need attention. Some common problems in weighting in decision support systems include subjectivity, unavailable or limited information, misalignment or conflict between criteria, and changes in priorities. One criterion weighting model is rank sum weighting.

Rank sum weighting is one method used in decision support systems to sort alternatives based on assessments on specific criteria. This method involves ranking the relative of each alternative based on an assessment given by stakeholders, and then assigning weight to each of those ratings.

The purpose of this research is to select the best supplier using the simple additive weighting method and apply the rank sum weighting model in determining the weight of the criteria used.

2. METHOD

Research stages are a series of steps or processes that must be carried out in order to conduct scientific research systematically[14], [15]. These stages assist researchers in planning, implementing, analyzing, and presenting research results in a structured and objective manner. The stages of research carried out are shown in Figure 1.

A Ferico Octaviansyah Pasaribu: *Coresponding Author

CHAIN: Journal of Computer Technology, Computer Engineering and Informatics
Website : https://ejournal.techcart-press.com/index.php/chain
E-ISSN 2964-2485
P-ISSN 2964-2450
Volume 1, Number 3, July 2023
DOI : **https://doi.org/10.58602/chain.v1i3.47**
Page 106-112

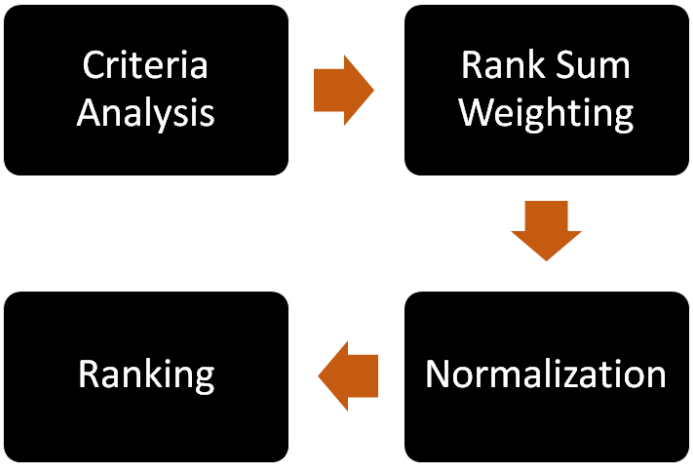

Figure 1. Research Stage

The explanation of the stages of research will be explained as follows.

2.1. Criteria Analysis

The first stage is collecting data by conducting interviews with companies to obtain criteria used in supplier selection. Based on data collection criteria, namely price, product quality, delivery time, packaging form, number of shipments.

2.2. Rank Sum Weighting

Rank Sum Weighting is a weighting based on the importance of the criteria which will then be normalized and divided by the number of criteria used. The rank sum formula can be seen in the following equation.

$$W_j(RS) = \frac{n-r_j+1}{\sum_{k=1}^{n} n-r_k+1} = \frac{2(n+1-r_j)}{n(n+1)} \quad (1)$$

Where r_j is a rank of criterion j, j=1,2,3,n

2.3. Normalization

The second stage of the SAW method is to normalize the decision table that has been made so that it will produce a normalization matrix, a formula for normalizing as in the following equation

$$r_{ij} \begin{cases} \frac{x_{ij}}{\max x_{ij}} ; if\ j\ is\ an\ attribute\ benefit \\ \frac{min\ x_{ij}}{x_{ij}} ; jika\ j\ is\ an\ attribute\ cost \end{cases} \quad (2)$$

2.4. Rangking

The third stage of the SAW method is to calculate the final result of multiplication between the normalized matrix and vector weights so that the final value for ranking will be obtained. The calculation formula looks like the following equation.

3. $V_i = \sum_{j=1}^{n} w_j . r_{ij}$ (3)

A Ferico Octaviansyah Pasaribu: *Coresponding Author

CHAIN: Journal of Computer Technology, Computer Engineering and Informatics
Website : https://ejournal.techcart-press.com/index.php/chain
E-ISSN 2964-2485
P-ISSN 2964-2450
Volume 1, Number 3, July 2023
DOI : **https://doi.org/10.58602/chain.v1i3.47**
Page 106-112

3. RESULT AND DISCUSSIONS

The first stage will determine the criteria that will be used as assessment parameters in this SAW method. The criteria used are as in table 1 below.

Table 1. Criteria Data

Criteria Name	Types of Criteria
Price	Cost
Product Quality	Benefit
Delivery Time	Cost
Packaging Form	Benefit
Number of Shipments	Benefit

After the criteria are obtained, then determine each criterion weight using rank sum weighting. The calculation results of each criterion weight using rank sum as follows.

$$W_1 = \frac{2(5+1-1)}{5(5+1)} = \frac{10}{30} = 0.33$$
$$W_2 = \frac{2(5+1-2)}{5(5+1)} = \frac{8}{30} = 0.27$$
$$W_3 = \frac{2(5+1-3)}{5(5+1)} = \frac{6}{30} = 0.2$$
$$W_4 = \frac{2(5+1-4)}{5(5+1)} = \frac{4}{30} = 0.13$$
$$W_5 = \frac{2(5+1-5)}{5(5+1)} = \frac{2}{30} = 0.07$$

Based on the results of weighting criteria using rank sum weighting, weights are obtained for each criterion as in table 2.

Table 2. Criteria Weighting Using Rank Sum Weighting

Criteria Name	Types of Criteria	Weights Criteria
Price	Cost	0.33
Product Quality	Benefit	0.27
Delivery Time	Cost	0.2
Packaging Form	Benefit	0.13
Number of Shipments	Benefit	0.07

The assessment data obtained from the companies used for the value of each supplier is shown in table 3.

Table 3. Supplier Assessment Data

Supplier Name	Criteria				
	Price	Product Quality	Delivery Time	Packaging Form	Number of Shipments
Supplier A	8	7	8	6	9
Supplier B	7	9	7	9	5
Supplier C	6	7	9	9	5
Supplier D	9	6	7	7	8
Supplier E	5	6	6	5	7

The next process we will normalize based on the assessment of each existing supplier using the following formula (2). The price criteria because it is a cost attribute will use the following formula.

A Ferico Octaviansyah Pasaribu: *Coresponding Author

CHAIN: Journal of Computer Technology, Computer Engineering and Informatics
Website : https://ejournal.techcart-press.com/index.php/chain
E-ISSN 2964-2485
P-ISSN 2964-2450
Volume 1, Number 3, July 2023
DOI : **https://doi.org/10.58602/chain.v1i3.47**
Page 106-112

$r_{1,1} = \frac{\min x}{x_{1,1}} = \frac{5}{8} = 0.625$ $r_{1,2} = \frac{\min x}{x_{1,2}} = \frac{5}{7} = 0.714$ $r_{1,3} = \frac{\min x}{x_{1,3}} = \frac{5}{6} = 0.833$

$r_{1,4} = \frac{\min x}{x_{1,4}} = \frac{5}{9} = 0.556$ $r_{1,5} = \frac{\min x}{x_{1,5}} = \frac{5}{5} = 1$

Product quality criteria because it is a benefit attribute will use the following formula.

$r_{2,1} = \frac{x_{2,1}}{\max x} = \frac{7}{9} = 0.777$ $r_{2,2} = \frac{x_{2,2}}{\max x} = \frac{9}{9} = 1$ $r_{2,3} = \frac{x_{2,3}}{\max x} = \frac{7}{9} = 0.778$

$r_{2,4} = \frac{x_{2,4}}{\max x} = \frac{6}{9} = 0.667$ $r_{2,5} = \frac{x_{2,5}}{\max x} = \frac{6}{9} = 0.625$

Delivery time criteria because it is a cost attribute will use the following formula.

$r_{3,1} = \frac{\min x}{x_{3,1}} = \frac{6}{8} = 0.75$ $r_{3,2} = \frac{\min x}{x_{3,2}} = \frac{6}{7} = 0.857$ $r_{3,3} = \frac{\min x}{x_{3,3}} = \frac{6}{9} = 0.667$

$r_{3,4} = \frac{\min x}{x_{3,4}} = \frac{6}{7} = 0.857$ $r_{3,5} = \frac{\min x}{x_{3,5}} = \frac{6}{6} = 1$

Product quality criteria because it is a benefit attribute will use the following formula.

$r_{4,1} = \frac{x_{4,1}}{\max x} = \frac{6}{9} = 0.667$ $r_{4,2} = \frac{x_{4,2}}{\max x} = \frac{9}{9} = 1$ $r_{4,3} = \frac{x_{4,3}}{\max x} = \frac{6}{9} = 1$

$r_{4,4} = \frac{x_{4,4}}{\max x} = \frac{7}{9} = 0.778$ $r_{4,5} = \frac{x_{4,5}}{\max x} = \frac{5}{9} = 0.556$

Number of shipments criteria because it is a benefit attribute will use the following formula.

$r_{5,1} = \frac{x_{5,1}}{\max x} = \frac{9}{9} = 1$ $r_{5,2} = \frac{x_{5,2}}{\max x} = \frac{5}{9} = 0.556$ $r_{5,3} = \frac{x_{5,3}}{\max x} = \frac{5}{9} = 0.556$

$r_{5,4} = \frac{x_{5,4}}{\max x} = \frac{8}{9} = 0.889$ $r_{5,5} = \frac{x_{5,5}}{\max x} = \frac{7}{9} = 0.778$

The next step we will calculate the final result of multiplication between the normalized matrix and the vector weight so that the final value for ranking will be obtained. The calculation formula looks like equation (2) below.

The result of calculating the final value of alternative 1, namely Supplier A.

$$V_1 = (w_1.r_{1,1}) + (w_2.r_{2,1}) + (w_3.r_{3,1}) + (w_4.r_{4,1}) + (w_5.r_{5,1})$$
$$V_1 = (0.33 \times 0.625) + (0.27 \times 0.778) + (0.2 \times 0.75) + (0.13 \times 0.667) + (0.07 \times 1)$$
$$V_1 = 0.206 + 0.21 + 0.15 + 0.087 + 0.07 = 0.723$$

The result of calculating the final value of alternative 2, namely Supplier B.

$$V_2 = (w_1.r_{1,2}) + (w_2.r_{2,2}) + (w_3.r_{3,2}) + (w_4.r_{4,2}) + (w_5.r_{5,2})$$
$$V_2 = (0.33 \times 0.714) + (0.27 \times 1) + (0.2 \times 0.857) + (0.13 \times 1) + (0.07 \times 0.556)$$
$$V_2 = 0.263 + 0.27 + 0.171 + 0.13 + 0.039 = 0.846$$

The result of calculating the final value of alternative 3, namely Supplier C.

$$V_3 = (w_1.r_{1,3}) + (w_2.r_{2,3}) + (w_3.r_{3,3}) + (w_4.r_{4,3}) + (w_5.r_{5,3})$$
$$V_3 = (0.33 \times 0.833) + (0.27 \times 0.778) + (0.2 \times 0.667) + (0.13 \times 1) + (0.07 \times 0.556)$$
$$V_3 = 0.275 + 0.21 + 0.133 + 0.13 + 0.039 = 0.787$$

The result of calculating the final value of alternative 4, namely Supplier D.

$$V_4 = (w_1.r_{1,4}) + (w_2.r_{2,4}) + (w_3.r_{3,4}) + (w_4.r_{4,4}) + (w_5.r_{5,4})$$

A Ferico Octaviansyah Pasaribu: *Coresponding Author

CHAIN: Journal of Computer Technology, Computer Engineering and Informatics
Website : https://ejournal.techcart-press.com/index.php/chain
E-ISSN 2964-2485
P-ISSN 2964-2450
Volume 1, Number 3, July 2023
DOI : **https://doi.org/10.58602/chain.v1i3.47**
Page 106-112

$$V_4 = (0.33 \times 0.556) + (0.27 \times 0.667) + (0.2 \times 0.875) + (0.13 \times 0.778) + (0.07 \times 0.889)$$
$$V_4 = 0.183 + 0.18 + 0.171 + 0.101 + 0.062 = 0.698$$

The result of calculating the final value of alternative 5, namely Supplier E.

$$V_5 = (w_1.r_{1,5}) + (w_2.r_{2,5}) + (w_3.r_{3,5}) + (w_4.r_{4,5}) + (w_5.r_{5,5})$$
$$V_5 = (0.33 \times 1) + (0.27 \times 0.667) + (0.2 \times 1) + (0.13 \times 0.556) + (0.07 \times 0.778)$$
$$V_5 = 0.33 + 0.18 + 0.2 + 0.072 + 0.056 = 0.837$$

The results of supplier selection ranking using the SAW method with rank sum weighting are presented in table 4.

Table 4. Rangking Result

Supplier Name		Rank
Supplier B	0.846	1
Supplier E	0.837	2
Supplier C	0.787	3
Supplier A	0.723	4
Supplier D	0.698	5

Based on the table above, the ranking results for rank 1 were obtained by Supplier B with a value of 0.846, for rank 2 were obtained by Supplier E with a value of 0.837, for rank 3 were obtained by Supplier C with a value of 0.787, for rank 4 were obtained by Supplier A with a value of 0.723, for rank 5 were obtained by Supplier B with a value of 0.698.

4. CONCLUSION

The results of this study are the selection of the best suppliers using the simple additive weighting method and applying the rank sum weighting model in determining the weight of the criteria used, namely price, product quality, delivery time, packaging form, and the number of shipments with the criteria used, namely price, product quality, delivery time, packaging form, and the number of shipments.

5. REFERENCES

[1] J. S. Putri, A. T. Priandika, and Y. Rahmanto, "Sistem Informasi Administrasi Surat Menyurat Pada Kantor Balai Desa Jatimulyo," *Chain J. Comput. Technol. Comput. Eng. Informatics*, vol. 1, no. 1 SE-Articles, pp. 1–6, Jan. 2023, doi: 10.58602/chain.v1i1.1.

[2] T. Ardiansah, Y. Rahmanto, and Z. Amir, "Penerapan Extreme Programming Dalam Sistem Informasi Akademik SDN Kuala Teladas," *J. Inf. Technol. Softw. Eng. Comput. Sci.*, vol. 1, no. 2, pp. 44–51, 2023.

[3] D. Alita and R. B. A. Shodiqin, "Sentimen Analisis Vaksin Covid-19 Menggunakan Naive Bayes Dan Support Vector Machine," *J. Artif. Intell. Technol. Inf.*, vol. 1, no. 1, pp. 1–12, 2023.

[4] A. F. O. Pasaribu and N. Nuroji, "Sistem Pendukung Keputusan Penentuan Pelanggan Terbaik Menggunakan Profile Matching," *J. Data Sci. Inf. Syst.*, vol. 1, no. 1, pp. 24–31, 2023.

[5] A. F. Pasaribu, A. Surahman, A. T. Priandika, S. Sintaro, and Y. T. Utami, "Sistem

A Ferico Octaviansyah Pasaribu: *Coresponding Author

CHAIN: Journal of Computer Technology, Computer Engineering and Informatics
Website : https://ejournal.techcart-press.com/index.php/chain
E-ISSN 2964-2485
P-ISSN 2964-2450
Volume 1, Number 3, July 2023
DOI : **https://doi.org/10.58602/chain.v1i3.47**
Page 106-112

Pendukung Keputusan Seleksi Penerimaan Guru Menggunakan SAW," *J. Artif. Intell. Technol. Inf.*, vol. 1, no. 1, pp. 13–19, 2023.

[6] R. Nuraini, Y. Daniarti, I. P. Irwansyah, A. A. J. Sinlae, and S. Setiawansyah, "Fuzzy Multiple Attribute Decision Making Menggunakan TOPSIS Pada Sistem Pendukung Keputusan Pemilihan Wireless Router," *JURIKOM (Jurnal Ris. Komputer)*, vol. 9, no. 2, pp. 411–419, 2022.

[7] S. Setiawansyah, A. Surahman, A. T. Priandika, and S. Sintaro, *Penerapan Sistem Pendukung Keputusan pada Sistem Informasi*. Bandar Lampung: CV Keranjang Teknologi Media, 2023. [Online]. Available: https://buku.techcartpress.com/detailebook?id=1/penerapan-sistem-pendukung-keputusan-pada-sistem-informasi/setiawansyah-ade-surahman-adhie-thyo-priandika-sanriomi-sintaro

[8] Refiza, "Penerapan Metode Simple Additive Weighting," *Indones. J. Comput. Inf. Technol.*, vol. 4, no. 2, pp. 96–103, 2019, [Online]. Available: https://ejournal.bsi.ac.id/ejurnal/index.php/ijcit/article/viewFile/426/324%0Ahttp://ejournal.bsi.ac.id/ejurnal/index.php/ijcit/article/download/426/324

[9] K. M. Sukiakhy, C. V. R. Jummi, and A. R. Utami, "Implementasi Metode SAW Dalam Sistem Pendukung Keputusan Pemilihan Karyawan Terbaik Pada PT. Cindyani Tiwi Lestari," *J. Sist. Inf. dan Sist. Komput.*, vol. 7, no. 1, pp. 13–22, 2022.

[10] R. D. Gunawan and F. Ariany, "Implementasi Metode SAW Dalam Sistem Pendukung Keputusan Pemilihan Plano Kertas," *J. Artif. Intell. Technol. Inf.*, vol. 1, no. 1, pp. 29–38, 2023.

[11] M. N. D. Satria, "Sistem Pendukung Keputusan Penerimaan Staff Administrasi Menggunakan Metode VIKOR," *J. Artif. Intell. Technol. Inf.*, vol. 1, no. 1, pp. 39–49, 2023.

[12] R. Aldisa, F. Nugroho, M. Mesran, S. A. Sinaga, and K. Sussolaikah, "Sistem Pendukung Keputusan Menentukan Sales Terbaik Menerapkan Metode Simple Additive Weighting (SAW)," *J. Inf. Syst. Res.*, vol. 3, no. 4 SE-Articles, Jul. 2022, doi: 10.47065/josh.v3i4.1955.

[13] Andris Silitonga and Dyah Ayu Megawaty, "Decision Support System Feasibility for Promotion using the Profile Matching Method," *J. Data Sci. Inf. Syst.*, vol. 1, no. 2 SE-Articles, pp. 50–56, May 2023, doi: 10.58602/dimis.v1i2.46.

[14] Ade Indah Permataasri and T. Ardiansah, "Aplikasi Pembelajaran Pengenalan Nama Dan Fungsi Anggota Tubuh Bagi Anak Usia Dini," *J. Data Sci. Inf. Syst.*, vol. 1, no. 2 SE-Articles, pp. 57–64, May 2023, doi: 10.58602/dimis.v1i2.45.

[15] Amik Herningsih, A. F. O. Pasaribu, and Y. Rahmanto, "Aplikasi Panduan Wisata dan Toko Oleh-Oleh di Provinsi Lampung Menggunakan Google Street View dan Game Engine," *J. Data Sci. Inf. Syst.*, vol. 1, no. 2 SE-Articles, pp. 65–76, May 2023, doi: 10.58602/dimis.v1i2.47.

A Ferico Octaviansyah Pasaribu: *Coresponding Author