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OPTIMIZING SUPPLIER SELECTION IN MULTI JAYA ABAD BUILDING STORE USING AHP

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ABSTRACT

This study explores the application of the Analytical Hierarchy Process (AHP) method within a Decision Support System (DSS) for supplier selection in Multi Jaya Abad Building Store. Efficient supplier selection is a crucial factor in ensuring the smooth operation and profitability of a building store. The AHP method is employed to assist the store in addressing these challenges by identifying key criteria relevant to supplier selection, such as price, product quality, product range, delivery reliability, and customer service. The research involves the development of a decision matrix incorporating these criteria, the establishment of pairwise comparisons to determine their relative importance, and the utilization of AHP to calculate the overall priority weights for each supplier. The results demonstrate that AHP significantly enhances the store's decision-making process, providing a structured approach to selecting suppliers based on a comprehensive evaluation of multiple criteria. The study contributes valuable insights into the practical application of AHP as an effective tool in supplier selection processes for building supply stores, promoting informed decision-making and ultimately improving operational efficiency and customer satisfaction.

Keywords *: Analytical Hierarchy Process (AHP), supplier selection, decision support system (DSS), customer satisfaction*

1. INTRODUCTION

In the dynamic landscape of modern business, supplier selection stands as a pivotal facet of organizational success, especially for retail enterprises such as building supply stores. The ability to make informed and optimal choices when it comes to suppliers directly influences a company's operational efficiency and, ultimately, its profitability. For Multi Jaya Abad Building Store and similar enterprises, the task of identifying the right suppliers is compounded by the multifaceted nature of criteria involved in the decision-making process.

Factors such as product quality, pricing, delivery reliability, product range, and customer service are just a few of the critical considerations that need to be weighed carefully.

With these challenges in mind, the present study delves into the integration of the Analytical Hierarchy Process into a Decision Support System to streamline and enhance the supplier selection process.

Multi Jaya Abadi is a Building Store that operates in the building materials trading sector and has played an important role in this industry in its region. So far, Multi Jaya Abadi Building Shop has collaborated with more than 50 suppliers who operate in various building materials, such as paint, zinc and a number of other materials. Selection of raw material suppliers is one of the strategic activities at the Multi Jaya Abadi Store because the supplier's role will play a role in determining the company's success.

So far, supplier selection has only been based on the price offered and the promised delivery speed. Because there are many suppliers who offer cooperation to companies, it is necessary to carry out a supplier selection process. The most common thing that happens is that after a supplier is selected, problems often occur, namely quality, quantity and delivery time that do not match what was promised when ordering, thus disrupting the production process. Even though it has collaborated well with several suppliers, Multi Jaya Abadi does not yet have an appropriate supplier selection method that can be implemented with a good planning process. Therefore, companies need to select suppliers using the right method so that raw material orders are fulfilled optimally and get the best suppliers who can work together in the long term.

This research aims to demonstrate how AHP, a multi-criteria decision-making method, can be effectively employed to prioritize and select suppliers by systematically evaluating the significance of each criterion.

By doing so, this paper seeks to contribute to the growing body of literature on the practical implementation of AHP in supplier selection, ultimately benefiting businesses like Multi Jaya Abad Building Store by offering a structured approach to optimizing supplier choices and, consequently, improving operational efficiency and customer satisfaction. The subsequent sections of this paper will expound upon the research methods, results, and discussion, followed by conclusions drawn from the findings and pertinent references.

2. RESEARCH METHOD

In this research AHP is a method used to make multi-criteria decisions by comparing various alternatives based on several given criteria. In the context of this journal, AHP is used to select the most optimal supplier in the Multi Jaya Abad building shop by considering various factors or criteria such as price, product quality, product range, and so on.

The AHP method involves steps such as creating a hierarchy of criteria, relative assessment of criteria, relative assessment of alternatives to each criterion, and calculation of relative weights to determine the best choice. This method helps in making more informed and optimal decisions in the context of supplier selection.

The first step is to identify the relevant criteria for decision making. The criteria used to evaluate the performance or quality of a supplier consist of quality, price, delivery time, distance, service and availability of stock.

Table 2.1 Criteria Comparison Matrix

Criteria	*Quality*	*Price*	*Delivery Time*	*Geographical Location*	*Service*	*Availability of Stock*
Quality	1	0,5	0,25	0,333	0,2	0,333
Price	2	1	0,25	0,333	0,25	0,25
Delivery Time	4	4	1	0,333	0,50	0,25
Geographical Location	3	3	3	1	0,333	0,5
Service	5	4	2	3	1	0,333
Availability of Goods	3	4	4	2	3	1
Total	18	16,5	10,5	7	5,283	2,667

After getting the results from the criteria comparison, the next step is to normalize the results of the criteria comparison values, normalization is carried out with the formula of the comparison value

divided by the total value, the following are the data normalization results:

Table 2.2 Criteria Normalization Matrix

Criteria	*Quality*	*Price*	*Delivery Time*	*Geographical Location*	*Service*	*Availability of Stock*
Quality	0,056	0,03	0,02	0,048	0,04	0,125
Price	0,111	0,061	0,02	0,048	0,05	0,094
Delivery Time	0,222	0,242	0,1	0,05	0,09	0,094
Geographical Location	0,167	0,182	0,29	0,14	0,063	0,188
Service	0,278	0,242	0,19	0,429	0,189	0,125
Availability of Goods	0,167	0,242	0,38	0,286	0,568	0,375
Total	1	1	1	1	1	1

After normalizing and getting priority values and eigen values, to determine the type of data, whether the data has coefficients using the value rules, if the CI/RI value is below 10%, then hierarchical consistency can be accepted, if it is above 10% the judgment data assessment needs to be corrected. A hierarchical weighting value for each criterion is obtained according to the priority value as described in Table 2.3

Table 2.3 Criteria Priority Value

Criteria	*Value*
Quality	0,053
Price	0,064
Delivery Time	0,133
Geographical Location	0,171
Service	0,242
Availability of Goods	0,336

Next, the results of the priority values will be used to determine the results of the ranking of AHP values, by weighing each of the criteria that will be used. This weighting uses the same method (repetition for each criterion) as described before. After getting the weighting value for each criterion that will be used, the next step is to determine the supplier data that will be included in the AHP calculation. After obtaining data on the value of each product selection criteria based on what has been determined by the Multi Jaya Abadi Building Store, the next step is to recapitulate the calculations for the six products (standard PVC pipes, concrete nail packages, electrical installation equipment, light steel, wall paint, cement) becomes the total weighted value of all products from each alternative. The results of these calculations can be seen in Table 2.4.

Table 2.4 Total Calculation of All Products for Each Supplier

No	*Supplier*	*Quality (%)*	*Price (%)*	*Delivery Time (Day)*	*Distance (KM)*	*Service (Day)*	*Stock (1:1)*

1	Anugerah Damai Bersama, PT	15,0	73,2	6	53	8	19,3
2	Triputra Menara Jaya, PT	8,5	74,5	6	8	8	20,0
3	Kasih Abadi, CV	10,7	73,5	4	53	10	17,2
4	Nipsea Paint and Chemicals, PT	13,0	78,8	5	31	11	18,0
5	Sahabat Setia Makmur, CV	12,5	74,7	4	40	8	16,3
6	Tirtakencana Tatawarna, PT	11,0	78,8	4	36	8	19,5
7	Kurnia, CV	11,3	75,7	5	43	11	21,2
8	Citra Sejati Jakarta, CV	8,0	78,8	6	39	11	17,3
9	Adhi Cakra Utama Mulia, PT	11,8	74,2	5	35	8	19,0
10	Sukses Jaya Semesta	9,5	75,0	5	60	8	16,5
11	Catur Aditya Sentosa, PT	11,0	81,2	4	26	10	17,8
12	Mutiara Angkasa Biru	10,2	74,2	5	40	8	18,8
13	Anta Graha Makmur, PT	10,5	75,3	5	33	7	17,3
14	Bahan Jaya, CV	6,0	75,7	7	40	8	18,7
15	Bumen Hutama Jaya, PT	14,0	75,7	4	43	8	16,5
16	Fortuna Multi Trada, PT	8,7	75,7	4	8	11	18,5
17	Pasar Listrik Murah	11,2	74,8	5	77	5	19,2
18	Sinarmitra Fortuna Keramindo Jakarta, PT	9,5	74,7	5	41	7	18,7
19	Sukses Jaya Semesta	5,2	78,7	5	60	9	16,3
20	Trisesa Ozora Steelindo, PT	14,7	76,3	4	27	9	13,5

Based on the calculation results of each supplier selection criteria for all products, the next step is to determine the data weighting based on the data that has been obtained from the Multi Jaya Abadi Building Store. After carrying out the weighting for each criterion, data recapitulation is carried out for all products as attached in the Table 2.5

Table 2.5 Weighting of All Products from Each Supplier

No	***Supplier***	***Quality***	***Price***	***Delivery Time***	***Geographical Location***	***Service***	***Availability of Stock***
1	Anugerah Damai Bersama, PT	3	3	2	3	2	5
2	Triputra Menara Jaya, PT	4	3	2	5	2	5
3	Kasih Abadi, CV	3	3	4	3	1	5
4	Nipsea Paint and Chemicals, PT	3	3	3	4	1	5
5	Sahabat Setia Makmur, CV	3	3	4	4	3	5

6	Tirtakencana Tatawarna, PT	3	3	4	4	3	5
7	Kurnia, CV	3	3	3	4	1	5
8	Citra Sejati Jakarta, CV	4	3	2	4	1	5
9	Adhi Cakra Utama Mulia, PT	3	3	3	4	3	5
10	Sukses Jaya Semesta	4	3	3	3	2	5
11	Catur Aditya Sentosa, PT	3	2	4	5	2	5
12	Mutiara Angkasa Biru	3	3	3	4	3	5
13	Anta Graha Makmur, PT	3	3	3	4	3	5
14	Bahan Jaya, CV	4	3	1	4	2	5
15	Bumen Hutama Jaya, PT	3	3	4	4	3	5
16	Fortuna Multi Trada, PT	4	3	3	5	1	5
17	Pasar Listrik Murah	3	3	3	1	4	5
18	Sinarmitra Fortuna Keramindo Jakarta, PT	4	3	3	4	3	5
19	Sukses Jaya Semesta	4	3	3	3	2	5
20	Trisesa Ozora Steelindo, PT	3	3	4	5	2	5

Then, the next step is to enter this data into the AHP calculation to get the value you want to get. After that, the value weight data is multiplied by the value of each criterion that has been obtained.

Table 2.6 Weighting of All Products from Each Supplier

No	***Supplier***	***Quality***	***Price***	***Delivery Time***	***Geographical Location***	***Service***	***Availability of Stock***
1	Anugerah Damai Bersama, PT	0,137	0,147	0,128	0,132	0,113	0,453
2	Triputra Menara Jaya, PT	0,239	0,147	0,128	0,456	0,113	0,453
3	Kasih Abadi, CV	0,137	0,147	0,247	0,132	0,053	0,453
4	Nipsea Paint and Chemicals, PT	0,137	0,147	0,157	0,247	0,053	0,453
5	Sahabat Setia Makmur, CV	0,137	0,147	0,247	0,247	0,157	0,453
6	Tirtakencana Tatawarna, PT	0,137	0,147	0,247	0,247	0,157	0,453
7	Kurnia, CV	0,137	0,147	0,157	0,247	0,053	0,453
8	Citra Sejati Jakarta, CV	0,239	0,147	0,128	0,247	0,053	0,453
9	Adhi Cakra Utama Mulia, PT	0,137	0,147	0,157	0,247	0,157	0,453
10	Sukses Jaya Semesta	0,239	0,147	0,157	0,132	0,113	0,453
11	Catur Aditya Sentosa, PT	0,137	0,111	0,247	0,456	0,113	0,453

12	Mutiara Angkasa Biru	0,137	0,147	0,157	0,247	0,157	0,453
13	Anta Graha Makmur, PT	0,137	0,147	0,157	0,247	0,157	0,453
14	Bahan Jaya, CV	0,239	0,147	0,075	0,247	0,113	0,453
15	Bumen Hutama Jaya, PT	0,137	0,147	0,247	0,247	0,157	0,453
16	Fortuna Multi Trada, PT	0,239	0,147	0,157	0,456	0,053	0,453
17	Pasar Listrik Murah	0,137	0,147	0,157	0,061	0,220	0,453
18	Sinarmitra Fortuna Keramindo Jakarta, PT	0,239	0,147	0,157	0,247	0,157	0,453
19	Sukses Jaya Semesta	0,239	0,147	0,157	0,132	0,113	0,453
20	Trisesa Ozora Steelindo, PT	0,137	0,147	0,247	0,456	0,113	0,453

Next, look for the AHP algorithm calculation value using the criteria priority value data previously obtained in Table 2.3

Table 2.7 AHP Algorithm Results

No	***Supplier***	***Quality***	***Price***	***Delivery Time***	***Geographical Location***	***Service***	***Availability of Stock***
1	Anugerah Damai Bersama, PT	0,007	0,009	0,017	0,023	0,027	0,152
2	Triputra Menara Jaya, PT	0,013	0,009	0,017	0,078	0,027	0,152
3	Kasih Abadi, CV	0,007	0,009	0,033	0,023	0,013	0,152
4	Nipsea Paint and Chemicals, PT	0,007	0,009	0,021	0,042	0,013	0,152
5	Sahabat Setia Makmur, CV	0,007	0,009	0,033	0,042	0,038	0,152
6	Tirtakencana Tatawarna, PT	0,007	0,009	0,033	0,042	0,038	0,152
7	Kurnia, CV	0,007	0,009	0,021	0,042	0,013	0,152
8	Citra Sejati Jakarta, CV	0,013	0,009	0,017	0,042	0,013	0,152
9	Adhi Cakra Utama Mulia, PT	0,007	0,009	0,021	0,042	0,038	0,152
10	Sukses Jaya Semesta	0,013	0,009	0,021	0,023	0,027	0,152
11	Catur Aditya Sentosa, PT	0,007	0,007	0,033	0,078	0,027	0,152
12	Mutiara Angkasa Biru	0,007	0,009	0,021	0,042	0,038	0,152
13	Anta Graha Makmur, PT	0,007	0,009	0,021	0,042	0,038	0,152
14	Bahan Jaya, CV	0,013	0,009	0,010	0,042	0,027	0,152
15	Bumen Hutama Jaya, PT	0,007	0,009	0,033	0,042	0,038	0,152
16	Fortuna Multi Trada, PT	0,013	0,009	0,021	0,078	0,013	0,152
17	Pasar Listrik Murah	0,007	0,009	0,021	0,011	0,053	0,152
18	Sinarmitra Fortuna Keramindo Jakarta, PT	0,013	0,009	0,021	0,042	0,038	0,152

19	Sukses Jaya Semesta	0,013	0,009	0,021	0,023	0,027	0,152
20	Trisesa Ozora Steelindo, PT	0,007	0,009	0,033	0,078	0,027	0,152

Based on the total AHP calculation value data in Table 2.7, the next step is to sort the supplier data based on the highest total value as the first rank to the lowest total value as the last rank in Table 2.8.

Table 2.8 Final Results of AHP Algorithm Ranking

No	***Supplier***	***Total Value***	***Rank***
1	Trisesa Ozora Steelindo, PT	0,308	1
2	Catur Aditya Sentosa, PT	0,305	2
3	Triputra Menara Jaya, PT	0,297	3
4	Fortuna Multi Trada, PT	0,286	4
5	Sahabat Setia Makmur, CV	0,282	6
6	Tirtakencana Tatawarna, PT	0,282	6
7	Bumen Hutama Jaya, PT	0,282	6
8	Sinarmitra Fortuna Keramindo Jakarta, PT	0,276	8
9	Adhi Cakra Utama Mulia, PT	0,27	10
10	Mutiara Angkasa Biru	0,27	10
11	Anta Graha Makmur, PT	0,27	10
12	Bahan Jaya, CV	0,254	12
13	Pasar Listrik Murah	0,254	13
14	Citra Sejati Jakarta, CV	0,247	14
15	Sukses Jaya Semesta	0,245	16
16	Sukses Jaya Semesta	0,245	16
17	Nipsea Paint and Chemicals, PT	0,245	18
18	Kurnia, CV	0,245	18
19	Kasih Abadi, CV	0,237	19
20	Anugerah Damai Bersama, PT	0,236	20

The calculation results above were obtained from combining the priority value of the criteria with the priority value of the supplier's weight. From the calculation results obtained, the best supplier was PT Trisesa Ozora Steelindo with the highest total AHP calculation value, with total value 0.308.

2.1 Unified Modelling Language (UML)

UML (Unified Modeling Language) is one of the tools used in the development of object- oriented systems, and has become an industry standard for describing and documenting software systems [3]. UML to describe the functional requirements expected from a system which illustrates the interaction between the system and actors. This model is the first step in creatingan application program that can describe the types of interactions between system users and the system itself. The following are the design results for the website

design for selecting supplier for the Multi Jaya Abadi building shop :

1. Use Case Diagram

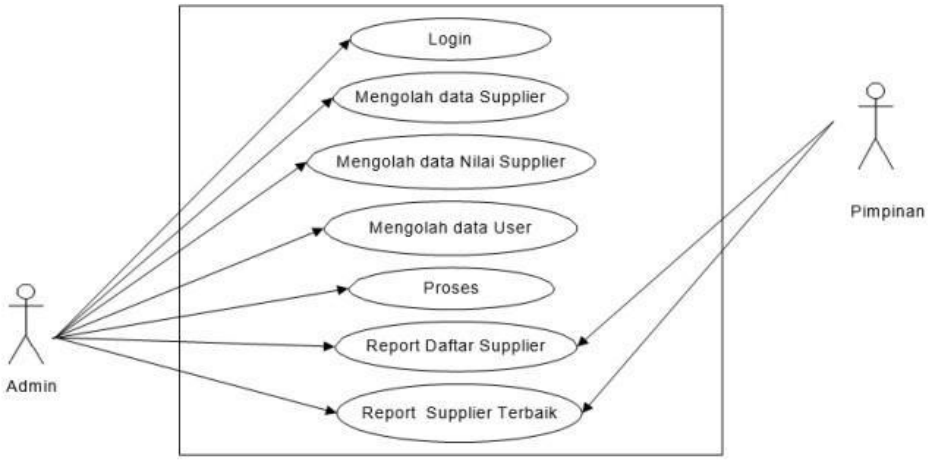

Figure 1. Use Case Diagram
Source: Personal Documentation

Use Case Diagrams describe the functionality provided by the system as units thatinteract between units or actors. For each use case that has been identified, a system behavior analysis is required. The following is a use case diagram shown in Figure 1.

2. Activity Diagram

Activity Diagrams are used to model the workflow of a business process and the sequence of activities in that process from the use case being executed, starting from the starting point to reaching the end point. The following is an activity diagram shown in Figure 2.

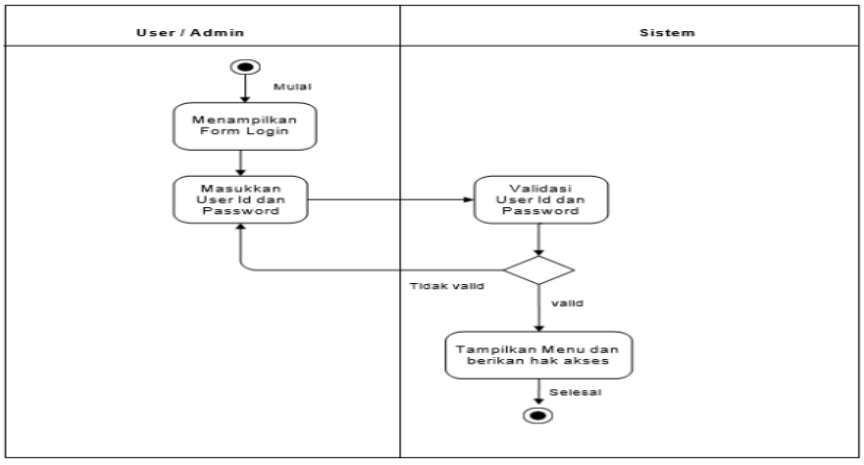

Figure 2. Activity Diagram Source: Personal Documentation

3. Sequence Diagram

Dequence Diagram is a diagram that describes how objects interact with the system, including users, displays, and others in the form of a massage that highlights timing [4]. The following is a usecase diagram shown in Figure 3.

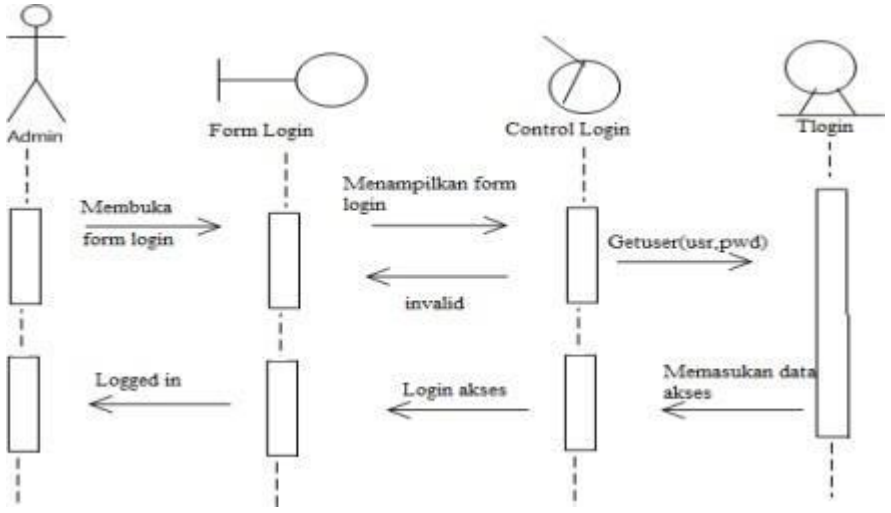

Figure 3. Sequence Diagram
Source: Personal Documentation

Class Diagram

Class Diagram is a specification that if instantiated will produces an object and is the core of development and design object oriented. Class describes the state (attributes/properties) of a system, as well as offering services to manipulate that state [5]. The Class Diagram on the Multi Jaya Abadi building shop website can be seen in Figure 4.

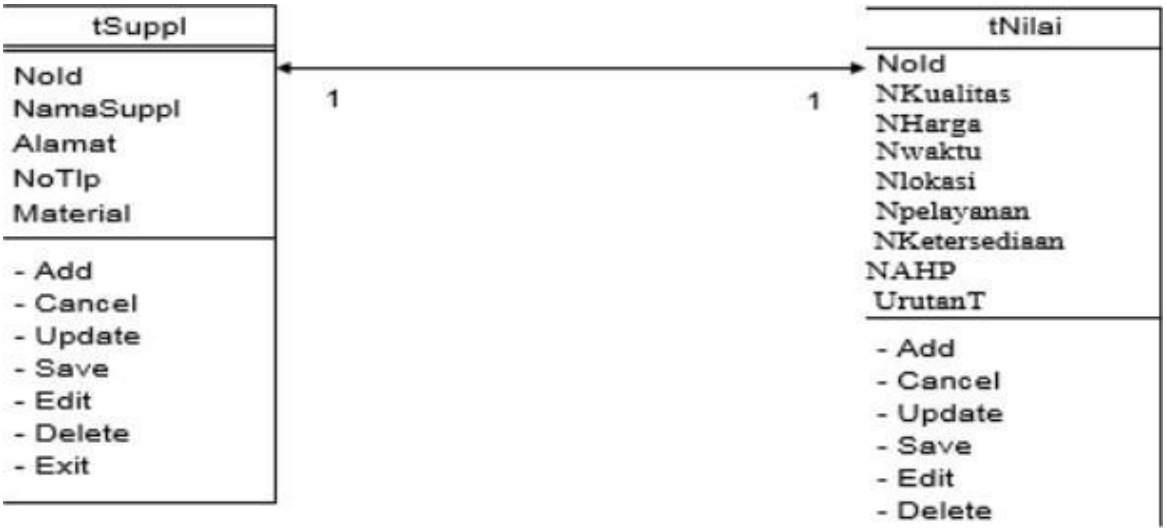

Figure 4. Class Diagram
Source: Personal Documentation

3. IMPLEMENTATION

3.1 Personnel

Users who can operate this application include several parties. The first is the purchasing and sales admin, they can use this application to monitor and choose which supplier they will choose to put their goods into the shop. the second is the supplier. the Supplier is users who can provide information related to the goods they supply to building stores.

3.2 Database Implementation

At this point, the implemented database functions by combining data personal assessment and judgment in a logical and contingent manner from experience and knowledge to construct a hierarchy modeling. AHP has been applied in planning, development, and cost benefit analysis, and less in treatment and for purposes predictions

3.3 Program Implementation

In the program implementation stage, the sales and purchasing admin has the obligation to always check up the supplier database for every import of goods

3.4 System Maintenance and Schedule

Application operational system maintenance is used to handle and prevent system errors. This maintenance can be carried out periodically with the aim of improving or adding features that can be used by both users.

4. CONCLUSION

The conclusion that can be drawn from designing an application system using AHP at the Multi Jaya Abadi Building Store is to produce an application program that can be accessed by admins and suppliers to determine a good supplier detail database for product entry into the Multi Jaya Abadi Building Store. With this system, it is hoped that it will make it easier for Multi Jaya Abadi Stores to determine suitable suppliers to minimize delays or other problems that are often faced.

REFERENCES

[1] S. P. T. Talangkas dan F. Pulansari, "Pemilihan Supplier Semen Pada Cv. Rizki Jaya Abadi Di Kabupaten Mojokerto Menggunakan Metode Fuzzy Ahp (Analytical Hierarchy Process)," Tekmapro J. Ind. Eng. Manag., vol. 16, no. 2, hal. 72–83, 2021, doi: 10.33005/tekmapro.v16i2.202.

[2] Kelvin dan Z. Rusdi, "SPK Menentukan Supplier Bahan Baku Pembuatan Kerupuk Menggunakan Metode AHP," J. Ilmu Komput. dan Sist. Inf., vol. 11, no. 1, hal. 3–9, 2023, [Daring]. Tersedia pada: https://journal.untar.ac.id/index.php/jiksi/article/view/24108

[3] A. Suprayitno, "Implementasi Metode AHP (Analytical Hierarchy Process) dalam Sistem Pendukung Keputusan Pemilihan Supplier U-Ditch (Studi Kasus: PT. Sokra Sana Kayaku, Surabaya)," J. Teknol., vol. 8, no. 2, hal. 1–7, 2018.

[4] Agnes Mareta, Arie Yandi Saputra, "Sistem Pendukung Keputusan Pemilihan Supplier Bahan Bangunan Menggunakan Metode Weight Product Pada Pt. Cipta Arsigriya," J. Ilm. Bin. STMIK Bina Nusant. Jaya Lubuklinggau, vol. 2, no. 2, hal. 43–50, 2020, doi: 10.52303/jb.v2i2.28.

[5] N. Putra, D. R. Habibie, dan I. F. Handayani, "Sistem Pendukung Keputusan Pemilihan Supplier Pada Tb.Nameene Dengan Metode Simple Additive Weighting (Saw)," Jursima, vol. 8, no. 1, hal. 45, 2020, doi: 10.47024/js.v8i1.194.

[6] R. Tejasukmana Putra, S. Adi Wibowo, dan Y. Agus Pranoto, "Sistem Pendukung Keputusan Penerimaan Blt Di Kecamatan Sampang Menggunakan Metode Saw Dan Metode Ahp Berbasis Web," JATI (Jurnal Mhs. Tek. Inform., vol. 5, no. 1, hal. 321–327, 2021, doi: 10.36040/jati.v5i1.3236.

[7] Edward, D. Trisnawarman, dan Z. Rusdi, "Sistem Penunjang Keputusan Pemilihan Supplier Besi Menggunakan Metode Saw (Simple Additive Weighting)," J. Ilmu Komput. dan Sist. Inf. Sist., vol. 6, no. 2, hal. 64–70, 2018.

[8] A. W. Arta, V. Atina, dan N. A. Sudibyo, "Pemodelan Sistem Pendukung Keputusan Pemilihan Supplier Batu Alam Dengan Algoritma Moora," Infotek J. Inform. dan Teknol., vol. 6, no. 2, hal. 288–299, 2023.

[9] E. R. Ahadian, M. Rizal, dan E. Tuhuteru, "Kriteria Pemilihan Supplier Material Semen Oleh Kontraktor Dengan Menggunakan Metode Analytical Hierarchy Process (Ahp) Di Kota Ternate," J. Sci. Eng., vol. 3, no. 1, hal. 1–9, 2020, doi: 10.33387/josae.v3i1.2077.

[10] I. Purnomo, "Penerapan Metode Analytical Hierarchy Process (Ahp) Sebagai Pendukung Keputusan Dalam Pemilihan Supplier Bahan Baku 71 Restoran Di Pt Sips," Sci. J. Ind. Eng., vol. 2, no. 11161283, hal. 1–5, 2021.

[11] H. Fadlisyah, M. F. Fathoroni, D. Z. Azizah, dan M. Fauzi, "Pemilihan Supplier Pengadaan Perangkat Sistem Gempa Bumi Dengan Metode Analytical Hierarchy Process (Ahp) Pada Pt
. Xyz," Tek. Ind. Fak. Tek
. Univ. Widyatama, vol. 1, no. 1, hal. 84–90, 2021