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Analysis of the Selection of Building Raw Material Suppliers Using the Analytical Hierarchy Process Method at CV. Saonek Raya

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Abstract. *The selection of suppliers is crucial in an effort to increase the competitiveness of the business. Companies that have high competitiveness can survive by focusing on improved quality, improved productivity, increased efficiency. Choosing the right supplier can help the company deal with the production cost problem so that the company can increase profits. The research is aimed at selecting the best suppliers in the CV. Saonek Raya in the activities of supplying building raw materials. There are five vendors that will be analyzed in this study: UD. Sri Rezeki, Hendra Building Store, Safira Building Shop, Sayosa Building Store and Banjar Building Store. In determining suppliers, researchers use the Analytical Hierarchy Process Method (AHP) as the primary method of selection of suppliers. To determine the right supplier, the researchers used six criteria: price, quality, delivery, service, payment system and quantity accuracy. Of the 6 criteria the matching results are in the building stores of hendra, the construction store of sayosa and the building store of banjar. Analysis using the method of AHP Buildings of Hendra Builder scored 2,90, Builtings of Sayosa Builder Scored 2,10 and Builtins of Banjar Scored 7,00. Based on this, Banjar Building Store is the best Supplier for companies in supplying building raw materials needs based on 6 criteria*

Keywords: *AHP, Saonek Raya, supplier selection*

I. INTRODUCTION

Technology and the pressure of competition have made small and large industries, both private and state, compete to produce high-quality products. Only companies with high competitiveness can survive by focusing on improved quality, improved productivity, increased efficiency and engaging employees in solving problems within the company. (Casella, 2019). The selection of suppliers is crucial in improving the competitiveness of the company. Choosing the right supplier can help the company deal with the production cost problem so that the company can increase profits.

CV. Saonek Raya is a contractor company that offers services in the field of construction and leveraging. CV. Saonek Raya is located at Jl. Menur, RT.01/RW.03, Kel. Klaru, SP2, Kab. Sorong. CV. Saonek Raya has competence to work on structural and architectural construction projects of commercial buildings in the city and district of Sorong. In an effort to compete to capture consumers in the world of business, CV. Saonek Raya always strives to provide the best possible service and end result in order to attract customers. One of the services provided by the CV. Saonek Raya is the maximum duration of construction time at the minimum price, for it requires the help of the appropriate supplier. The first problem faced CV. Saonek Raya has not had a fixed Supplier so in completing the construction process often does not conform to the scheduled, in order to get the right supplier, then it is necessary to make the selection of supplier. Suppliers who can provide a quality product or service, with a cheaper price, delivery in time, and good service is the supplier expected by the company (Talangkas & Pulansari, 2021).

At present CV. Saonek Raya has more than five suppliers and the most frequently used only 5 suppliers are UD. Sri Rezeki, Hendra Building Store, Safira Building Shop, Sayosa Building Store and Banjar Building Store. The second problem of these five suppliers is that the choice is still determined by the subjective relationship between the company's leadership and the suppliers that often results in long lead times, or

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poor quality of the goods. Saonek Raya has a weakness in selecting suppliers, that is, choosing by judging only based on the price offered and the quality that the goods possess subjectively. (Wulandari, 2017). According to Rani Irma Handayani & Yuni Darmianti (2017) buy at the price of the cheapest goods persupplier so the quality of the raw materials purchased poorly will result in complaints from customers. Based on this problem, it is necessary to carry out analysis in determining the ideal supplier for the company.

From the above problems, this research aims to determine the main supplier that will be used by the CV. Saonek Raya in the selection of building raw materials using the AHP method. AHP Method is one of the tools used to make a decision which supplier is best in accordance with the established criteria. According to Maria Felicia Limansantoso (2013) as quoted from Saaty (1998) Analytical Hierarchy Process (AHP) is a method or a widely known system support tool for solving multicriteria decision problems. This method is used to obtain a ratio scale of pairs of comparisons in a layered hierarchical structure, by setting a relative priority weight on each decision element, where the weight is to represent the intensity of a preference or a decision element.

II. RESEARCH METHOD

The research was carried out at CV. Saonek Raya, which is located in JL. Menur, RT.03/RW.04, Kel.Klaru, Mariat District, SP2, Sorong District, Southwest Papua Province. The object investigated is a building raw material supplier. There are five suppliers that are thoroughly investigated in this study, namely, UD. Sri Rezeki, Hendra Building Store, Safira Building Shop, Sayosa Building Store and Banjar Building Store. The data collection techniques in this study comprise two stages:

1. Interview with the authorities related to the purchase of raw materials in the CV. Saonek Raya. The authorities here are, Company Director, Purchasing Administrator, and Head of the Company.
2. The questionnaire is given a total of 15 questionnaires for 5 suppliers. Each supplier consists of 3 respondents for each supplier consisting of, Corporate Director (Respondent 1), Administrator Purchesing (Responent 2), and Corporate Field Chief (Responent 3). There are 2 kinds of questionnaries namely questionnars for the Importance Performance

Table 1. Criteria and Sub-Criteria

Criteria	Sub-Criteria
Price	Appropriateness of prices with the quality of goods owned (H1) Ability to provide discounts on orders in certain quantities (H2)
Quality	Material strength (Q1) Product defect rate (Q2)
Delivery	Ability to deliver goods according to the agreed date (D1) Ability to handle transportation systems (D2)
Quantity Service	Ease of contact (S1) Ability to provide information clearly (S2) Ability to respond to customer requests in any situation (S3)
Payment System	Ease of making payments in various ways (PS1) Flexibility in terms of payment if there is a sudden need (PS2)

Table 2. Random Index

Value IR	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59
Matrix Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Analysis method (IPA) to determine the level of gaps and suitability and the Analytical Hierarchy Process (AHP) method to determine alternative elements in the AHP method which aims to make the selected alternative the best alternative that can meet the expectations of the company, and the last method is the Geometric Mean that is useful for obtaining a single decision 1.

The Table 1 shows the criteria and sub-criteria used in this study. There are 6 criteria and 11 sub-criteria which will become parameters in supplier selection using the AHP and geometric mean methods.

The data processing steps using the AHP and Geometric Mean methods in this study are (Hasiani et al., 2021) :

1. Develop a hierarchical structure
2. Create a comparison matrix
3. Calculation of normalization
4. Calculating the consistency index (CI) with the formula: CI = (λ max-n)/n-1
5. Calculating the consistency ratio (CR) with the formula: CR = CI/RI

Where, CR = Consistency Ratio, CI = Consistency Index, and RI = Random Index.

There are 6 criteria and 11 sub criteria that will be the parameters in the selection of suppliers using the AHP method and mean geometry. As for the measures of data processing using AHP and Mean Geometry methods in this study are (Hasiani et al., 2021):

1. Structure of the hierarchy
2. Create a comparison matrix
3. Calculate index consistency (CI) with formula: CI = (λ maks-n)/n-1
4. Calculate consistency ratio (CR) with formula: CR = CI/RI
5. Checking the consistency of the hierarchy. If the value is more than 10% then the data must be corrected. However, if the consistency ratio is less or equal to 10% then the calculation results can be declared correct.
6. Calculate the geometric mean with the following formula:
   G = $\sqrt{x1 \cdot x2 \cdot \ldots xn}$

Where, G = Geometric mean, X_n = 1st, 2nd, 3rd, nth assessment, and n = number of assessments.

III. Result and Discussion

The Importance Performance Analysis (IPA) method is used to determine to what extent the performance provided by the suppliers to the company and which suppliers are unable to meet the company's expectations. Suppliers who are unable to meet the expectations of the company will be selected and are unqualified to be potential suppliers for the company.

There are two types of analysis in the IPA method, the gap analysis (GAP) and the level of conformity analysis to find out which suppliers are able to meet the company's expectations and the suppliers who are unable to satisfy the expectations of the company that will then be selected. Based on the gap analysis of the respondents' answers, the results were obtained shown in Table 3.

Table 3. Spacing Analysis Results (GAP)

Supplier	GAP
UD. Sri Rezeki	-0,78
Store Hendra	0,08
Store Safira	-0,14
Store Sayosa	0,08
Store Banjar	0,31

A good performance quality level is indicated by a positive GAP value or >0. On the other hand, if the GAP analysis results are negative or <0 then it can be said that the supplier has poor performance quality. Based on the above table, out of the initial 5 suppliers, UD. Sri Rezeki (-0,78) and Safira Building Store (-0.14) have a negative GAP or <0. Based on that, it can be stated that UD. Sri Rezeki and Safira Building Store have poor performance quality and are unable to meet the company's expectations.

Compliance level analysis to determine which supplier is to be selected based on its suitability score.

Table 4. Compliance Level Analysis Results

Supplier	Tki
UD. Sri Rezeki	80%
Store Hendra	106%
Store Safira	98%
Store Sayosa	104%
Store Banjar	112%

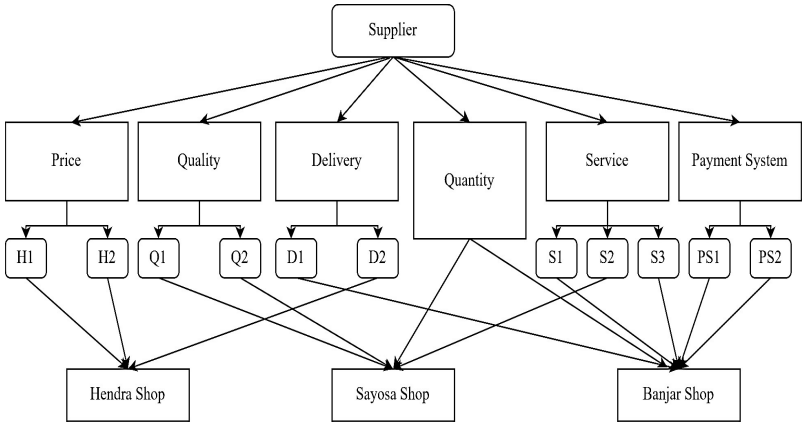

Figure 1. Hierarchical structure of building raw material supplier selection

Table 5. Pair Comparison of Criteria of Respondent

Criteria	Prince	Quality	Delivery	Quantity	Service	Payment System
Prince	1	1	3	0,333	5	3
Quality	1	1	3	0,333	3	5
Delivery	0,333	0,333	1	0,2	3	1
Quantity	3	3	5	1	7	5
Service	0,2	0,333	0,333	0,143	1	0,333
Payment System	0,333	0,2	1	0,200	3	1

(Source: data processing)

Table 6. Normalization of Comparison Pairs between Criteria

Criteria	Prince	Quality	Delivery	Quantity	Service	Payment System	Amount	Priority	eigen value
Prince	0,201	0,204	0,229	0,192	0,270	0,163	1,260	0,210	1,045
Quality	0,139	0,142	0,229	0,133	0,110	0,163	0,916	0,153	1,078
Delivery	0,067	0,047	0,076	0,095	0,076	0,109	0,471	0,078	1,027
Quantity	0,419	0,426	0,322	0,400	0,359	0,403	2,328	0,388	0,970
Service	0,056	0,098	0,076	0,085	0,076	0,066	0,458	0,076	1,005
Payment System	0,118	0,083	0,067	0,095	0,110	0,095	0,567	0,095	0,990
total	1,000	1,000	1,000	1,000	1,000	1,000	6,000	1,000	6,114

(Source: data processing)

Based on the above table it is concluded that UD. Sri Rezeki and the Safira Building Store are unable to meet the expectations of the company or the company is very dissatisfied with the performance given so that the two suppliers will be selected and considered unqualified to be the candidate potential supplier for the company.

In this study, there are 3 prospective suppliers who are eligible to become suppliers for the company. After knowing the suppliers who will become alternatives, the next step is to compile the hierarchical structure. The hierarchical structure in this study is Figure 1.

Couple Comparison Analytical Hierarchy Process (AHP)

The alternatives in this research consist of Hendra Building Shop, Sayosa Building Shop, and Banjar Building Shop. After determining the criteria, sub-criteria and alternatives, the next step is to conduct pairwise comparisons. Pairwise comparisons are used to determine the level of importance of each element (Naptalena &

Pulansari, 2020). Pairwise comparisons are carried out by comparing each element with other elements.

Pairwise comparisons were made to 3 respondents' answers for each element of criteria, sub-criteria, and alternatives. After obtaining the results of pairwise comparisons from 3 respondents for each element, the next stage is to calculate the geometric mean of respondents' answers to get a single decision. The results of pairwise comparisons after the geometric mean are as seen in Table 5.

Calculation of Pair Comparison and Normality Criteria

The above table shows that according to respondents 1, the price criteria are as important as the quality criteria; the price criteria are three times more important than the delivery criteria; the quantitative accuracy criteria are three times more important than the quantitative accuracy criteria; and the price criteria are five times more significant than the service criteria. Meanwhile, the quality criteria are three times more important than the delivery criteria, the quantitative accuracy criteria are three times as important as the qualitative criterion, and the quality criteria are three times more important than the service criteria and five times more significant than the payment system criteria. Quantity accuracy criteria are five times more important than delivery criteria; delivery criteria are three times greater than service criteria and are just as important as payment system criteria. The accuracy of the sum criteria is seven times more important than the service criteria and five times more than the payment system criteria. The payment system criteria are three times more important than the service criteria.

CI = (6,114-6) / (6-1) = = 0,023

IR = 1, 24

CR = 0, 02 < 0, 1 = Consisten

Because Velue CR = 0, 02 < 0, 1 then the data is considered consistent, and there is no need to reassess.

The next step is to normalize the pairwise comparison data with the formula:

$$\text{Normalization} = \frac{\text{Geometric Mean Result}}{\text{Total Results per line}}$$

After all pairwise comparison data is normalized, the next step is to find the weight or priority value with the formula:

$$\text{Priority} = \frac{\text{Total number of lines}}{(\text{Number of elements})}$$

The weight or priority value is used to determine the best supplier for the company. The supplier with the highest weight value is the most ideal supplier for the company. The last stage is to calculate the consistency index value and consistency ratio with the formula:

$$\text{CI} = \frac{(\lambda \max - \text{n})}{\text{n} - 1}$$

Here are the normalization calculation results of the pair comparisons between alternatives to criteria and subcriteria:

Table 7. Normalization of Pairwise Comparison Between Alternatives Against Price Sub-Criteria

H1	Hendra	Sayosa	Banjar	Amount
Hendra	0,289	0,347	0,277	0,913
Sayosa	0,11	0,133	0,147	0,381
Banjar	0,601	0,511	0,576	1,697

Table 8. Normalization of Pairwise Comparison Between Alternatives Against Price Sub-Criteria

H2	Hendra	Sayosa	Banjar	Amount
Hendra	0,134	0,167	0,125	0,425
Sayosa	0,194	0,24	0,252	0,686
Banjar	0,672	0,593	0,623	1,888

Table 9. Normalization of Pairwise Comparison Between Alternatives Against Quality Sub-Criteria

Q1	Hendra	Sayosa	Banjar	Amount
Hendra	0,122	0,097	0,138	0,357
Sayosa	0,365	0,293	0,28	0,937
Banjar	0,513	0,61	0,582	1,705

Table 10. Normalization of Pairwise Comparison Between Alternatives Against Quality Sub-Criteria

Q2	Hendra	Sayosa	Banjar	Amount
Hendra	0,342	0,342	0,342	1,026
Sayosa	0,164	0,164	0,164	0,493
Banjar	0,494	0,494	0,494	1,481

Table 11. Normalization of Pairwise Comparison Between Alternatives Against Delivery Sub-Criteria

D1	Hendra	Sayosa	Banjar	Amount
Hendra	0,297	0,384	0,284	0,964
Sayosa	0,084	0,108	0,125	0,317
Banjar	0,619	0,509	0,591	1,719

Table 12. Normalization of Pairwise Comparison Between Alternatives Against Delivery Sub-Criteria

D2	Hendra	Sayosa	Banjar	Amount
Hendra	0,104	0,068	0,123	0,295
Sayosa	0,313	0,204	0,192	0,71
Banjar	0,583	0,727	0,685	1,995

Table 13. Normalization of Pairwise Comparison Between Alternatives Against Quantity Criteria

Quantity	Hendra	Sayosa	Banjar	Amount
Hendra	0,19	0,216	0,185	0,592
Sayosa	0,132	0,15	0,156	0,438
Banjar	0,678	0,633	0,659	1,97

Table 14. Normalization of Pairwise Comparison Between Alternatives Against Service Sub-Criteria

S1	Hendra	Sayosa	Banjar	Amount
Hendra	0,24	0,24	0,24	0,721
Sayosa	0,167	0,167	0,167	0,5
Banjar	0,593	0,593	0,593	1,779

Table 15. Normalization of Pairwise Comparison Between Alternatives Against Service Sub-Criteria

S2	Hendra	Sayosa	Banjar	Amount
Hendra	0,484	0,461	0,51	1,455
Sayosa	0,283	0,27	0,245	0,798
Banjar	0,233	0,27	0,245	0,747

Table 16. Normalization of Pairwise Comparison Between Alternatives Against Service Sub-Criteria

S3	Hendra	Sayosa	Banjar	Amount
Hendra	0,231	0,313	0,22	0,764
Sayosa	0,077	0,104	0,118	0,3
Banjar	0,693	0,583	0,661	1,937

Table 17. Normalization of Pairwise Comparison Between Alternatives Against Payment System Sub-Criteria

PS1	Hendra	Sayosa	Banjar	Amount
Hendra	0,149	0,166	0,147	0,462
Sayosa	0,104	0,115	0,118	0,336
Banjar	0,747	0,719	0,735	2,201

Table 18. Normalization of Pairwise Comparison Between Alternatives Against Payment System Sub-Criteria

PS2	Hendra	Sayosa	Banjar	Amount
Hendra	0,223	0,285	0,212	0,72
Sayosa	0,107	0,137	0,151	0,395
Banjar	0,67	0,578	0,637	1,885

The table above is the result of the calculation of normalization of the comparison of pairs between alternatives to criteria and sub-criteria. From the data above, take the priority data and then count the CI and CR values.

After normalizing the geometric mean pairwise comparison, the next step is to calculate the consistency ratio value to determine whether the existing data is consistent or not. The following is a recap of the data from the calculation of index consistency and ratio consistency:

The table above is the result of the calculation of normalization of the comparison of pairs between alternatives to criteria and sub-criteria. From the data above, take the priority data and then count the CI and CR values.

After normalizing the geometric mean pairwise comparison, the next step is to calculate the consistency ratio value to determine whether the existing data is consistent or not. The following is a recap of the data from the calculation of index consistency and ratio consistency:

Table 19. Score Priority, Consistency Ratio, dan Consistency Index

Sub Kriteria	Toko Hendra	Toko Sayosa	Toko Banjar	CI	CR
	Priority	Priority	Priority		
H1	0,30	0,13	0,57	0,01	0,01
H2	0,14	0,23	0,63	0,01	0,02
Q1	0,12	0,31	0,57	0,01	0,02
Q2	0,34	0,16	0,49	0,00	0,00
D1	0,32	0,11	0,57	0,02	0,03
D2	0,10	0,24	0,66	0,04	0,06
Quantity	0,20	0,15	0,66	0,00	0,01
S1	0,24	0,17	0,59	0,00	0,00
S2	0,48	0,27	0,25	0,00	0,00
S3	0,25	0,10	0,65	0,02	0,03
PS1	0,15	0,11	0,73	0,00	0,00
PS2	0,24	0,13	0,63	0,01	0,02
Total	2,90	2,10	7,00		

Source: Data Processing

Based on the data tables above the total priority values of each alternative to the sub-criteria, the alternative with the highest priority value is the most ideal alternative for the company. A way to determine an alternative with

the highest priority value is to sum up the entire priority score of each alternative to the sub-criteria.

Based on the priority value of each alternative to the sub-criteria, the alternative with the highest priority value is the most ideal alternative for the company. The way to determine the alternative with the highest priority value is to add up all the priority value scores of each alternative.

Table 19 shows the priority value of each alternative to all sub-criteria. Hendra's Building Shop scored 2.90, Sayosa's Building Shop scored 2.10, and Banjar's Building Shop scored 7.00. Based on the results of the calculation of the AHP analysis then Banjar Buildings Shop is the ideal supplier for CV. Saonek Raya.

IV. CONCLUSION

In this research, supplier selection analysis was carried out using three methods, namely Importance Performance Analysis (IPA), Analytical Hierarchy Process (AHP), and Geometric Mean. Based on analysis using the IPA method, the results showed that Hendra Building Shop, Sayosa Building Shop, and Banjar Building Shop had good performance as potential suppliers. A conformity level score (Tki) that exceeds 100% indicates that these suppliers meet the quality standards expected by the company. Through analysis using the AHP and Geometric Mean methods, Banjar Building Store was selected as the most ideal supplier for the company. The total priority value of 7.002 confirms that Banjar Building Store is the most ideal supplier for the company compared to other potential suppliers. Apart from that, the quantity accuracy criterion is the most important criterion considered by companies in selecting suppliers, with a total priority value of 0.388. Based on this, it can be concluded that the company prioritizes the accuracy and reliability of suppliers in fulfilling the required number of orders.

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