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IMPLEMENTATION MULTI-CRITERIA DECISION MAKING FOR SUPPLIER SELECTION ALUMINUM INGOT IN CV. SL

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A R T I C L E I N F O

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Analytical Hierarchy Process (AHP), Expert Choice, Supplier Selection.

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Abstract. *The purpose of this study is to determine the priority order of the criteria, sub- criteria, then determine which suppliers CV SL company can choose. The population in this study is the decision maker and management of CV SL.The sampling technique used was purposive sampling in order to obtain 7 people. The data analysis technique in this study used the Analytical Hierarchy Process (AHP), while the analytical tool used was expert choice 11. The results of the analysis of this study obtained the importance weight of the criteria with the first priority is quality (0.34), price (0.26) , availability (0.15), delivery (0.12), performance history (0.07), warranty & complaint service (0.06). Meanwhile, the results of the assessment of the importance of alternatives in supplier selection show that the LN supplier (0.0786) has the highest weight, the two IS suppliers (0.0760), the three MJ suppliers (0.0733), the four TL suppliers (0.0711), the fifth supplier FI (0.0703), the sixth supplier LM (0.0684). The results of this calculation can be used by the company as a consideration in determining the next supplier selection policy.*

Abstrak. Tujuan dari penelitian ini adalah untuk mengetahui urutan prioritas kriteria, subkriteria, kemudian menentukan supplier yang dapat dipilih perusahaan CV SL. Populasi pada penelitian ini yaitu pengambil keputusan dan manajemen CV SL. Teknik pengambilan sampel yaitu menggunakan purposive sampling sehingga diperoleh 7 orang. Teknik analisis data pada penelitian ini menggunakan Analytical Hierarchy Process(AHP), sedangkan alat analisis yang digunakan adalah expert choice 11. Hasil analisis dari penelitian ini diperoleh bobot kepentingan kriteria dengan urutan prioritas pertama kualitas (0,34), harga (0,26), ketersediaan (0,15), delivery (0,12), performance history (0,07), garansi & layanan pengaduan (0,06). Sedangkan hasil dari penilaian tingkat kepentingan alternatif dalam pemilihan supplier menunjukkan bahwa supplier LN (0,0786) memiliki bobot yang paling tinggi, kedua supplier IS (0,0760), ketiga supplier MJ (0,0733), keempat supplier TL (0,0711), kelima supplier FI (0,0703), keenam supplier LM (0,0684). Hasil perhitungan ini dapat digunakan perusahaan sebagai pertimbangan dalam menetapkan kebijakan pemilihan supplier berikutnya.

INTRODUCTION

The automotive industry is currently one of the seven sectors that are prioritized for industrial development. The development of the automotive industry is supported by Indonesia's potential to become the largest vehicle market in ASEAN countries. The Ministry of Industry States (2021) that the development and growth of the domestic automotive industry is currently experiencing very rapid progress because Indonesia is a country that has very high mobility activities and cannot be separated from automotive vehicles. The number of automotive vehicles in various regions in Indonesia continues to grow every day, this is evidenced by data on the number of vehicle ownership in Indonesia in the last 5 years.

The increase in vehicle ownership in Indonesia and globally has also had a positive impact on the vehicle components and parts industry. The demand for the production of components and spare parts has increased in line with the increase in motorized vehicle production (Ministry of Industry States, 2022) . The basic material for making these spare parts and spare parts is aluminum. According to data from the United States (US) geological survey agency, total aluminum production worldwide in 2022 will be 68 million metric tons. The country of China, namely China, is listed as the largest aluminum producer in the world in 2022 because the country has a high need for aluminum to meet production needs in the motor vehicle industry. The Indonesian state itself, through PT Indonesia Asahan Alumunium (INALUM), is targeting aluminum production to reach around 300,000 tons in 2024.

Beside from that, there is the CV.SL company, this company is an aluminum smelting company. The CV.SL company runs a B2B business, namely producing aluminum bars as a basic material for making motor vehicle spare parts. From data on sales of Aluminum Ingots in 2021 and 2022, every month the CV SL company experiences an increase. As demand increases, problems arise, namely not being able to meet the total demand target each month. According to interviews with the company, the reason for the non-fulfillment of demand is because the workforce has a small number and lacks expertise in the production process. The second cause is the limited availability of raw materials. The limited availability of raw materials is influenced by the price of raw materials in the market which tends to be unstable, the third cause is limited capital to purchase raw materials. This capital limitation is related to SL companies implementing budgeting for purchasing raw materials but there is price instability for raw materials and full payment systems at the beginning but raw material products can be less than the amount agreed upon delivery, goods are also not sent immediately after making payment, quality of goods something is not appropriate that causes losses during the production process. This causes the funds to purchase raw materials for the production process to stop and cannot be allocated properly.

Regarding external and internal constraints, the company currently wants to work with aluminum ingot suppliers to meet production needs, but the conditions in the company, namely CV SL, have difficulty selecting aluminum ingot suppliers because the company determines supplier selection based on relational factors only. . The selection of these relational factors is not enough to determine supplier criteria because there are still quality, price and delivery factors that need to be considered. The absence of objective evaluation of suppliers and not paying attention to criteria can affect company performance. It has been proven that when working with suppliers, they are often faced with many problems, such as the criteria owned by suppliers conflict with each other. For example, supplier A offers substandard quality and has a lower price, while supplier B offers above standard quality but the delivery is not on

schedule. In terms of supplier prices, they are also inconsistent in providing prices, which are easy to change without providing information, delivery schedules also cannot match, suppliers sometimes cannot fulfill delivery requests within the agreed deadline. From the company's problems, there is uncertainty in its operations, therefore CV.SL needs the most optimal supplier (aluminum bar). The following is a list of suppliers at the CV.SL company:

Table 1 Supplier Data CV.SL

Supplier Name	Supply Composition
Supplier LN	10%
Supplier IS	5%
Supplier MJ	12%
Supplier TL	8%
Supplier FI	10%
Supplier LM	10%
Supplier KA	2%
Supplier MI	10%
Supplier SLI	2%
Supplier CM	3%
Supplier LG	2%
Supplier BA	10%
Supplier AU	2%
Supplier AG	10%
Supplier DA	2%

(Source: Company Data)

Making decisions in supplier selection requires tools to be able to analyze very complex problems so that when making decisions the results are of higher quality. CV SL will select six potential suppliers of new potential finished products and the supplier selection criteria will be adjusted to the company's conditions and product standards to be produced.

There is a method that can be used for supplier selection, namely MCDM. Multi Criteria Decision Making is a decision making method for determining the best alternative out of a number of alternatives based on certain criteria (Jaya, 2020). One of the methods available in this MCDM which includes quantitative and qualitative measurements, is the Analytical Hierarchy Process (AHP). The AHP method is a framework for effective decision-making in complex problems by simplifying and accelerating the decision-making process by compiling a hierarchy of criteria, interested parties and results to determine weights or priorities. AHP can provide alternative rankings when there are several criteria, sub-criteria that play a role in the decision-making process, because the calculations carried out determine the order in which alternative suppliers are selected (Fitriana & Santosa, 2020). Implementation of the Analytical Hierarchy Process (AHP) method has been applied to determining raw material suppliers materials for construction (Ahadian, 2020), selection of materials for road construction (Yuliani, 2020), selection of spare parts suppliers (Naufal et al., 2021), selection of syrup filler machines (Willyandi & Septiani, 2022). Kurnaz (2022) applies AHP to select e-commerce that is suitable for conducting commercial transactions during the pandemic era, while Ibrahim & Mohammed (2022) uses it to evaluate two types of home financing.

METHODS

This research was conducted at an aluminum smelting company, namely CV SL. The research was conducted during January-May 2023. This type of research is descriptive quantitative. The population and sample used were 7 management people from the CV.SL company consisting of directors, deputy

directors, managers, heads of finance, heads of production, production supervisors, and heads of warehousing. Data collection methods include interviews, questionnaires and documentation. The data needed are primary data and secondary data. The primary data used is from interviews and questionnaires while the secondary data used is journals, company documents such as supplier data, company profiles, price data and total demand data. The variables used in the criteria are six indicators, namely price, quality, warranty and service, delivery, performance history, availability. There are fourteen sub-criteria used, namely price compatibility with the market, ability to provide shipping costs, conformity of goods with the desired specifications, ability to provide consistent quality, ease of claim processing, guarantee of goods on time, speed in responding to complaints and resolving complaints, ability to deliver goods according to the agreed date, the ability to choose the means of transportation, the accuracy of the number of shipments, the ability to fulfill the set schedule, the ability to maintain contractual agreements, the ability to fulfill ordering needs, the ease of sending goods for inventory. These criteria and sub-criteria are used by companies in supplier selection. The object of this research is decision making to determine the best supplier of aluminum ingots. The analysis technique used in this study is the AHP method. Calculations are done manually or with the help of Microsoft Excel and expert choice 11 software. AHP steps:

1. Weighting each criterion and sub-criteria
2. Find the geometric mean of the questionnaire results using the formula:
   $G = \sqrt[n]{X_1, X_2, X_3, \dots\dots, X_n}$
   G = Geometric Mean
   Xn = Assessment from respondents
   N = Number of assessments
3. Each criteria weight in the initial matrix is divided by the sum of the weights of each matrix column and looks for the row average as the normalized criteria weight (EigenVector)
4. The consistency matrix is obtained by multiplying the normalized criteria weights by each criteria weight of the initial matrix, then looking for the average row of the consistency matrix
5. Divide the average row value of the consistency matrix by the weight of the normalization criteria and then average it to obtain λ max
6. Calculate the consistency index.
   CI = (λmax – n) / (n – 1)
   CI = consistency index
   λmax = maximum eigenvalue
   n = Number of elements
7. Calculating the Consistency Ratio.
   CR = CI / RI
   CR = Consistency Ratio
   CI = Consistency Index
   RI = Random Consistency Index
8. If the CR value is > 0.1 then the assessment criteria must be improved, otherwise CR < 0.1 then the assessment process is considered consistent.
9. Weighting suppliers
10. Selection of suppliers. Selecting the best supplier for the company

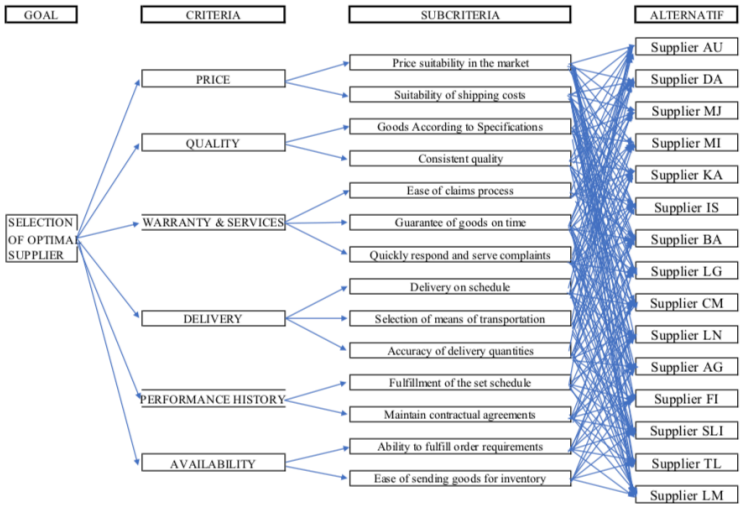

Figure 1. Research Analysis Model

RESULTS

Data collection

The respondents used in this study consisted of respondents who knew well the supplier selection activities at CV SL. There were seven respondents involved in this study. The questionnaire distributed to research respondents consisted of three parts, namely statements for criteria, sub-criteria and sub-criteria for each supplier. The questionnaire configuration for statements representing the criteria contains 15 comparison items, sub-criteria there are 10 comparison items, while for selecting alternative suppliers there are 210 comparison items in each sub-criterion.

AHP Analysis Results

There are three levels to be analyzed using the AHP method with the aim of knowing the weight or priority order of importance of each variable considered, namely at level 1 (criteria) namely price, quality, warranty and complaint service, delivery, performance history and availability, then level 2 (subcriteria), and level 3 alternative suppliers. These three levels have the same calculation order. The following is a recapitulation of criteria data at level 1 from processing data of questionnaire results.

Criteria	Director	Deputy Director	Manager	Head Of Finance	Head Of Production	SPV Production	Head of Warehouse	Geomean	Criteria
Price	0,25	0,33	1,00	1,00	0,33	0,33	1,00	**0,51**	Quality
Price	4,00	3,00	3,00	3,00	5,00	3,00	4,00	**3,50**	Warranty & Service
Price	4,00	2,00	3,00	4,00	4,00	5,00	5,00	**3,71**	Delivery
Price	5,00	3,00	3,00	3,00	1,00	3,00	3,00	**2,76**	Performance History
Price	3,00	2,00	3,00	3,00	2,00	3,00	3,00	**2,67**	Availability
Quality	5,00	3,00	3,00	5,00	5,00	5,00	5,00	**4,32**	Warranty & Service
Quality	5,00	2,00	3,00	4,00	5,00	5,00	4,00	**3,83**	Delivery
Quality	5,00	5,00	3,00	5,00	3,00	3,00	5,00	**4,02**	Performance History
Quality	2,00	2,00	2,00	2,00	2,00	2,00	3,00	**2,12**	Availability
Warranty & Service	0,33	0,50	0,33	0,50	0,50	0,33	0,50	**0,42**	Delivery
Warranty & Service	0,50	0,50	0,50	0,50	1,00	1,00	0,50	**0,61**	Performance History
Warranty & Service	0,33	0,33	0,33	0,33	0,33	0,33	0,25	**0,32**	Availability
Delivery	2,00	2,00	0,50	2,00	2,00	3,00	4,00	**1,92**	Performance History
Delivery	1,00	3,00	1,00	1,00	1,00	1,00	1,00	**1,17**	Availability
Performance History	0,33	0,50	0,25	0,30	0,33	0,25	0,33	**0,32**	Availability

Figure 2. Table Recapitulation of Criteria Data

There are six criteria used, while there are 15 pairwise comparisons that can be made. The average calculation is obtained from The geometric average formula is as follows:

$$G = \sqrt[7]{0{,}25 \times 0{,}33 \times 1{,}00 \times 1{,}00 \times 0{,}33 \times 0{,}33 \times 1{,}00}$$

$$G = \sqrt[7]{0{,}0092}$$

$$G = 0{,}51$$

This geomean calculation is carried out because AHP only requires one single value to represent a number of respondents.

Table 2 Criterion Pairwise Comparison Matrix

Indicator	Price	Quality	Warranty & Service	Delivery	Performance History	Avaibility
Price	**1**	**0,51**	**3,5**	**3,71**	**2,76**	**2,67**
Quality	1,96	**1**	**4,32**	**3,83**	**4,02**	**2,12**
Warranty & Service	0,29	0,23	**1**	**0,42**	**0,61**	**0,32**
Delivery	0,27	0,26	2,38	**1**	**1,92**	**1,17**
Performance History	0,36	0,25	1,64	0,52	**1**	**0,32**
Avaibility	0,37	0,47	3,13	0,85	3,13	**1**
TOTAL	**4,25**	**2,72**	**15,97**	**10,34**	**13,44**	**7,60**

(Source: Data processing results)

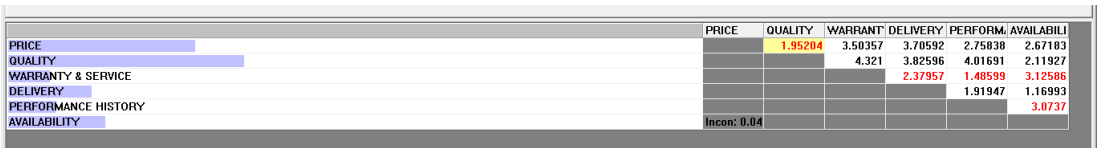

Figure 2. Criteria Comparison Matrix Expert Choice

Table 3 Criteria Weights

Indicator	Price	Quality	Warranty & Service	Delivery	Performance History	Avaibility	Average weight
Price	0,24	0,19	0,22	0,36	0,21	0,35	**0,26**
Quality	0,46	0,37	0,27	0,37	0,30	0,28	**0,34**
Warranty & Service	0,07	0,09	0,06	0,04	0,05	0,04	**0,06**
Delivery	0,06	0,10	0,15	0,10	0,14	0,15	**0,12**
Performance History	0,09	0,09	0,10	0,05	0,07	0,04	**0,07**
Avaibility	0,09	0,17	0,20	0,08	0,23	0,13	**0,15**
Total	1,00	1,00	1,00	1,00	1,00	1,00	1

(Source: Data processing results)

The average weighted value of the criteria is obtained from the sum of the values in each row divided by the total number of criteria. In this study there were 6 criteria, For example criteria price line indicator calculation: 0.24+0.19+0.22+0.36+0.21+ 0.35 : 6 = 0.26

Table 4 Eigen Vector Values for the Criteria Pairwise Comparison Matrix

Indicator	Price	Quality	Warranty & Service	Delivery	Performance History	Avaibility	***Vector Eigen***

Price	0,24	0,19	0,22	0,36	0,21	0,35	**1,56**
Quality	0,46	0,37	0,27	0,37	0,30	0,28	**2,05**
Warranty & Service	0,07	0,09	0,06	0,04	0,05	0,04	**0,34**
Delivery	0,06	0,10	0,15	0,10	0,14	0,15	**0,70**
Performance History	0,09	0,09	0,10	0,05	0,07	0,04	**0,45**
Avaibility	0,09	0,17	0,20	0,08	0,23	0,13	**0,90**
Total	1,00	1,00	1,00	1,00	1,00	1,00	6,00

(Source: Data processing results)

Table 5 Calculation of Eigen Values (λ)

Indicator	Total	Average	Eigen Values
Price	4,25	0,26	1,10
Quality	2,72	0,34	0,93
Warranty & Service	15,97	0,06	0,91
Delivery	10,34	0,12	1,21
Performance History	13,44	0,07	1,00
Avaibility	7,60	0,15	1,14
Number of Eigen Lamda Max			**6,30**

(Source: Data processing results)

Consistency Index (CI):

CI = (λ max –n)/n-1 = (6.30 - 6)/6 - 1

= 0.059

After obtaining the CI value, then the CR calculation is carried out. For the number of criteria 6, the IR value = 1.24.

Consistency Ratio (CR):

CR = CI/IR

= 0.059/1.24= 0.048

The value is consistent because CR ≤ 0.1. If the CR value is > 0.1 then it is inconsistent or does not meet the requirements. From the calculation above, the CR value is 0.048, it can be said that the CR value meets the consistent requirements. Here is the priority ranking for each criterion:

Figure 3. Criteria Ranking Weight Expert Choice

Table 6 Criteria Weights

Indicator	Weight	Ranking
Quality	0,34	**1**
Price	0,26	**2**
Avaibility	0,15	**3**
Delivery	0,12	**4**
Performance History	0,07	**5**
Warranty & Service	0,06	**6**

(Source: Data processing results)

Based on table 7, quality is ranked first with the highest weight, namely 0.34, the second criterion is price with a weight of 0.26, the third criterion is availability with a weight of 0.15, the fourth criterion is delivery with a weight of 0.12, the fifth criterion is performance history with a weight of 0.07 and the last criteria, namely the six guarantees and service with a weight of 0.06. The high quality weight value in supplier selection also shows that CV.SL prioritizes high quality for the products it sends. This is because aluminum ingots are raw material for spare parts. If the quality of the aluminum ingot is good it will affect the finished product and vice versa if the aluminum ingot is of poor quality it will reduce the quality of the finished product. The price criterion which ranks second in supplier selection with a weight of 0.26 has quite an important role because the purchase of aluminum ingots represents a fairly large portion of the sales value of the finished product.

The stages for analyzing sub-criteria and alternative suppliers are the same as criteria analysis. The following are the analysis results and weights in the table:

Supplier	Price		Quality		Warranty & Services			Delivery			Performance History		Availability	
	0,26		0,34		0,06			0,12			0,07		0,15	
	Price suitability in the market	Suitability of shipping costs	Goods According to Specifications	Consistent quality	Ease of claims process	Guarantee of goods on time	Quickly respond and serve complaints	Delivery on schedule	Selection of means of transportation	Accuracy of delivery quantities	Fulfillment of the set schedule	Maintain contractual agreements	Ability to fulfill order requirements	Ease of sending goods for inventory
	0,8	0,2	0,34	0,66	0,12	0,55	0,33	0,39	0,12	0,49	0,81	0,19	0,82	0,18
Supplier AU	0,047	0,060	0,069	0,071	0,067	0,061	0,057	0,072	0,070	0,070	0,062	0,059	0,058	0,056
Supplier DA	0,054	0,059	0,057	0,061	0,052	0,058	0,055	0,057	0,057	0,055	0,061	0,061	0,057	0,054
Supplier MJ	0,074	0,068	0,072	0,070	0,056	0,094	0,079	0,072	0,073	0,080	0,074	0,072	0,073	0,077
Supplier MI	0,066	0,067	0,062	0,065	0,051	0,071	0,072	0,064	0,061	0,069	0,061	0,059	0,063	0,064
Supplier KA	0,072	0,066	0,061	0,063	0,079	0,064	0,066	0,063	0,070	0,067	0,062	0,061	0,068	0,068
Supplier IS	0,079	0,066	0,075	0,077	0,076	0,060	0,075	0,084	0,080	0,071	0,081	0,074	0,076	0,076
Supplier BA	0,063	0,067	0,060	0,060	0,061	0,080	0,066	0,064	0,063	0,060	0,067	0,067	0,065	0,063
Supplier LG	0,064	0,066	0,063	0,062	0,036	0,051	0,065	0,068	0,062	0,061	0,064	0,061	0,067	0,064
Supplier CM	0,074	0,072	0,067	0,063	0,060	0,044	0,052	0,061	0,056	0,057	0,060	0,059	0,054	0,052
Supplier LN	0,076	0,073	0,084	0,085	0,058	0,068	0,075	0,080	0,079	0,089	0,071	0,078	0,073	0,076
Supplier AG	0,059	0,062	0,058	0,057	0,071	0,061	0,069	0,054	0,059	0,059	0,060	0,060	0,056	0,057
Supplier FI	0,066	0,067	0,069	0,072	0,106	0,082	0,064	0,075	0,073	0,064	0,072	0,075	0,071	0,071
Supplier SLI	0,067	0,064	0,058	0,056	0,085	0,063	0,065	0,058	0,064	0,062	0,064	0,068	0,077	0,075
Supplier TL	0,072	0,073	0,071	0,070	0,065	0,068	0,072	0,065	0,068	0,069	0,075	0,080	0,073	0,081
Supplier LM	0,065	0,070	0,074	0,069	0,075	0,076	0,070	0,063	0,063	0,065	0,066	0,066	0,069	0,067
TOTAL	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0

Figure 4 . Calculation of Weight Values for Criteria, Subcriteria and Alternative Suppliers

Supplier	Price		Quality		Warranty & Services			Delivery			Performance History		Availability		Final Weight
	0,26		0,34		0,06			0,12			0,07		0,15		
	Price suitability in the market	Suitability of shipping costs	Goods According to Specifications	Consistent quality	Ease of claims process	Guarantee of goods on time	Quickly respond and serve complaints	Delivery on schedule	Selection of means of transportation	Accuracy of delivery quantities	Fulfillment of the set schedule	Maintain contractual agreements	Ability to fulfill order requirements	Ease of sending goods for inventory	
	0,80	0,20	0,34	0,66	0,12	0,55	0,33	0,39	0,12	0,49	0,81	0,19	0,82	0,18	
Supplier AU	0,0098	0,0031	0,0080	0,0159	0,0005	0,0020	0,0011	0,0034	0,0010	0,0041	0,0035	0,0008	0,0071	0,0015	0,0619
Supplier DA	0,0113	0,0031	0,0066	0,0137	0,0004	0,0019	0,0011	0,0027	0,0008	0,0032	0,0035	0,0008	0,0071	0,0014	0,0575
Supplier MJ	0,0154	0,0035	0,0083	0,0157	0,0004	0,0031	0,0016	0,0034	0,0011	0,0047	0,0042	0,0010	0,0090	0,0021	0,0733
Supplier MI	0,0138	0,0035	0,0072	0,0145	0,0004	0,0024	0,0014	0,0030	0,0009	0,0040	0,0035	0,0008	0,0078	0,0017	0,0648
Supplier KA	0,0150	0,0034	0,0071	0,0141	0,0006	0,0021	0,0013	0,0030	0,0010	0,0040	0,0035	0,0008	0,0084	0,0018	0,0660
Supplier IS	0,0165	0,0034	0,0086	0,0172	0,0005	0,0020	0,0015	0,0039	0,0012	0,0042	0,0046	0,0010	0,0093	0,0020	0,0760
Supplier BA	0,0131	0,0035	0,0070	0,0135	0,0004	0,0026	0,0013	0,0030	0,0009	0,0036	0,0038	0,0009	0,0080	0,0017	0,0632
Supplier LG	0,0134	0,0035	0,0073	0,0139	0,0003	0,0017	0,0013	0,0032	0,0009	0,0036	0,0036	0,0008	0,0082	0,0017	0,0633
Supplier CM	0,0154	0,0038	0,0078	0,0142	0,0004	0,0015	0,0010	0,0029	0,0008	0,0034	0,0034	0,0008	0,0067	0,0014	0,0633
Supplier LN	0,0158	0,0038	0,0097	0,0191	0,0004	0,0023	0,0015	0,0037	0,0011	0,0052	0,0040	0,0010	0,0089	0,0021	0,0786
Supplier AG	0,0124	0,0032	0,0067	0,0127	0,0005	0,0020	0,0014	0,0025	0,0008	0,0035	0,0034	0,0008	0,0068	0,0015	0,0583
Supplier FI	0,0137	0,0035	0,0080	0,0162	0,0008	0,0027	0,0013	0,0035	0,0011	0,0038	0,0041	0,0010	0,0088	0,0019	0,0703
Supplier SLI	0,0140	0,0033	0,0067	0,0125	0,0006	0,0021	0,0013	0,0027	0,0009	0,0037	0,0037	0,0009	0,0094	0,0020	0,0639
Supplier TL	0,0149	0,0038	0,0082	0,0156	0,0005	0,0022	0,0014	0,0030	0,0010	0,0041	0,0042	0,0011	0,0089	0,0022	0,0711
Supplier LM	0,0136	0,0036	0,0086	0,0155	0,0005	0,0025	0,0014	0,0029	0,0009	0,0038	0,0037	0,0009	0,0085	0,0018	0,0684
TOTAL	0,21	0,05	0,12	0,22	0,01	0,03	0,02	0,05	0,01	0,06	0,06	0,01	0,12	0,03	1,0

Figure 5. Calculation of Final Weight Values for Criteria, Subcriteria and Alternative Suppliers

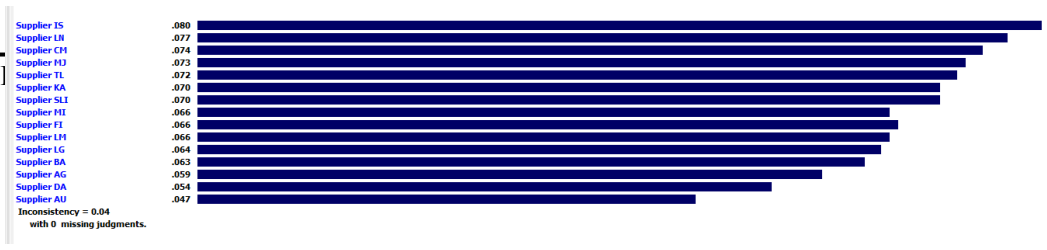

Figure 6. Alternative Ranking Weights Supplier Expert Choice

Table 7. AHP Calculation for Optimal Supplier Selection

Alternative	Weight	Ranking
Supplier LN	0,0786	1
Supplier IS	0,0760	2
Supplier MJ	0,0733	3
Supplier TL	0,0711	4
Supplier FI	0,0703	5
Supplier LM	0,0684	6

(Source: Data processing results)

The results obtained in table 10 are that there is an alternative ranking order. In this research, we only took 6 suppliers out of 15 existing suppliers, therefore in first place the LN supplier had the highest weight, namely 0.0786, the second rank was the IS supplier with a weight of 0.0760, the third rank was the MJ supplier with a weight of 0.0733 , fourth ranked TL supplier with a weight of 0.0711, fifth ranked FI supplier with a weight of 0.0703, sixth ranked LM supplier with a weight of 0.0684.

From the existing data in table 1, it also shows that the supply of aluminum ingot composition at the CV.SL company is some that is not appropriate because the highest composition supply is at supplier MJ at 12%, supplier LN at 10%, supplier FI at 10%, supplier LM at 10 %, MI suppliers by 10%, BA suppliers and AG suppliers by 10%. From table 5.46, the company should purchase aluminum ingots from LN suppliers as a top priority because these suppliers are able to provide weight scores for quality, price, availability, delivery, performance history, guarantee and good service. Suppliers BA and AG who have a low combined score of the six criteria actually provide a supply of aluminum ingots of 10% compared to supplier IS who should get that quantity of ingot supply. If there is an inappropriate composition supply, it is necessary to evaluate the purchase of aluminum ingots from suppliers, which has been done so far because the supplier with the highest weight value should be the company's main supplier.

CONCLUSION

This research aims to determine the selection criteria for selecting the best supplier for the CV.SL company. Criteria that can be considered for selecting a supplier are quality, price, availability, delivery, performance history, warranty, and service. Of the six criteria, the most important criteria are quality 0.34, price 0.26, availability of goods 0.15, delivery 0.12, performance history 0.07, lastly warranty and service 0.06. The ranking sub-criteria are consistent quality with a weight of 0.22, suitability of price in the market 0.21, ability to meet order requirements 0.12, goods according to specifications 0.12, accuracy of delivery quantity 0.06, fulfillment of specified schedule 0.06, conformity shipping costs with a weight of 0.05, delivery according to schedule 0.05, guarantee of goods on time 0.03, ease of delivery of goods according to inventory with a weight of 0.03, quick response and handling complaints 0.02, selection means of transportation 0.0, maintaining contract agreements 0.01, ease of claims process 0.01. The most optimal supplier for the CV.SL company is the supplier with the highest weight, the LN supplier with a weight of 0.0786, then the IS supplier with a weight of 0.0760, third is the MJ supplier

with a weight of 0.0733, fourth is the TL supplier with a weight of 0.0711 , the fifth FI supplier with a weight of 0.0703, the last is the LM supplier with a weight of 0.0684.

IMPLICATIONS

The managerial implications of this research for the CV.SL company include: i) To meet the need for aluminum ingots in SL companies, the company can make a larger proportion of orders from LN suppliers, IS suppliers, MJ suppliers, TL suppliers, LI suppliers, LM suppliers; ii) To minimize any constraints related to suppliers, the company can make efforts with the six partnering suppliers regarding the criteria and sub-criteria for aluminum ingots that the CV.SL company needs. Efforts that can be made include; a) On quality criteria, SL companies can create a quality control division to carry out tasks such as assessing products sent by suppliers. The quality control division can collect values about the shortcomings and advantages of products that have been sent by suppliers according to company standards. SL companies can also record quality by providing a rating scale for each product; b) Price criteria by creating procedures. If goods are not of good quality or take a long time to process returns, the SL company asks for return money. Create a pre-order letter when ordering. This PO letter consists of the quantity ordered and the price per kg. This PO letter also prevents suppliers from providing uncertain prices; c) Availability criteria by ensuring that the supplier is a direct/first hand producer and the supplier makes CV.SL one of the priorities of its customers. Conduct a survey of the supplier company to assess the supplier's ability to send products at any time and make a contract with the supplier; d) Delivery criteria, the supplier must make a delivery order first if he is going to deliver goods, so that the warehouse prepares space and does not pile up with products from other suppliers. If the quantity is accurate during delivery, the company should also weigh it twice to ensure the quantity of the product matches what is in the PO letter or not, because generally companies only weigh it once; e) Performance history criteria, the CV.SL company needs to look at the track record, background and reputation of the supplier company by looking at reviews from companies it has worked with; f) Guarantee and service criteria, by requesting sample items first if you want to send goods or if there is a return of goods, these sample specifications are adjusted to CV SL's requests. The SL company can also assess whether returned goods returned by the SL company can be processed quickly or not. This criterion is stated in the T&C in making the cooperation contract, namely that the return process must be completed within a mutually agreed time period.

SUGGESTION

Suggestions that can be given in this research are; i) The company needs to choose suppliers that have high value, namely LN suppliers because in the AHP analysis calculations, LN suppliers have superior value, the second supplier is IS, the third supplier is MJ, TL suppliers, FI suppliers, and LM suppliers. When choosing a supplier, companies also need to pay attention to the criteria in the first order, namely quality, second, price, third, availability, fourth, delivery, fifth, performance history, sixth, warranty and service. The order of these criteria was obtained based on the results of a questionnaire given to 7 respondents at the CV SL company; ii) For future researchers who will analyze suppliers, they can use AHP analysis calculations to make decisions and adjust them to criteria or sub-criteria that

are relevant to the company or in accordance with company policy. Apart from that, future researchers can use AHP to research in various industries, not only aluminum ingot companies and the use of AHP is not only about selecting suppliers in the operational management section but also marketing aspects such as choosing a market place for shopping or human resources. such as selecting the best employees

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