Analysis of Ready Mix Raw Material Supplier Selection at PT. Remicon Widyaprima Using the Analytical Hierarchy Process (AHP)

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Abstract

This study aims to analyze the selection of raw material suppliers for ready-mix production, particularly cement, at PT. Remicon Widyaprima using the Analytical Hierarchy Process (AHP) method. Frequent delays in cement delivery have disrupted production activities, making a systematic evaluation essential to determine the most suitable supplier. Data were collected through pairwise comparison questionnaires distributed to seven internal experts and analyzed using AHP to calculate the priority weights for each criterion. The evaluation criteria include product quality, flexibility, cost, delivery punctuality, and responsiveness. The results indicate that product quality is the most dominant criterion, followed by flexibility and cost. PT. Semen Merah Putih was identified as the best supplier, having the highest priority weight. The Consistency Ratio (CR) value of 0.0650 confirms that the expert assessments are consistent. These findings demonstrate that the AHP method is effective in objectively evaluating and selecting suppliers based on predefined criteria. Keywords: Supplier, Ready Mix, Vendor Performance Indicator (VPI), Analytical Hierarchy Process (AHP).

Keywords: *Supplier, Ready Mix, Vendor Performance Indicator* (VPI), *Analytical Hierarchy Process* (AHP)

INTRODUCTION

Table 1. National Construction Data

Year	Annual Construction Percentage
2022	9.45%
2023	9.86%
2024	10.6%

Source: Statistics Indonesia (BPS), 2022–2024

The Indonesian construction industry has shown a consistent growth trend, as reflected in its contribution to the national Gross Domestic Product (GDP), which increased from 9.45% in 2022 to 10.06% in the third quarter of 2024 (BPS, 2022–2024). This growth indicates a rising demand for construction materials, particularly ready-mix concrete, which has become the preferred choice in infrastructure, industrial, and residential development projects. National ready-mix consumption increased from 62 million m^3 in 2022 to 68 million m^3 in 2023

(Indonesian Concrete Association, 2023), underscoring the sector's vital role in supporting national development.

Table 2. Impact of Delivery Delays

No	Type of Impact	Value	Description
1	Total delivery delays	19 days	Occurred throughout 2024 from three suppliers
2	Disrupted production time	152 hours	1 day = 8 working production hours
3	Number of delayed ready-mix batches	76 batches	1 batch requires 2 hours of production
4	Delayed mixer trucks	7 units/day	Caused by batching plant operational downtime
5	Overtime & operational cost losses	Confidential	Due to extended working hours for operators
6	Downtime cost of machines & electricity	Confidential	Machines remain on but not producing
7	Potential project penalty costs	Confidential	If concrete arrives late at the project site

Source: Processed by researchers, 2025

However, the increase in demand does not always correlate with smooth supply chain operations. Internal data from PT. Remicon Widyaprima indicate 19 days of cement delivery delays during 2024, resulting in 152 hours of production disruption, 76 delayed batches, and operational downtime for approximately seven mixer trucks per day. These delays reduce operational efficiency and create financial and reputational risks, particularly due to the potential for late concrete deliveries to strategic construction projects in Batam. This situation highlights that supplier selection should not be based solely on price or availability. Instead, it requires an evaluation based on measurable and structured criteria.

Previous research by Pinandito & Pulansari (2021) applied the Fuzzy AHP method to evaluate supplier performance in the manufacturing sector. However, its application in the ready-mix concrete industry remains limited, despite the industry's dynamic and time-sensitive supply chain characteristics. This research gap provides an opportunity to explore how multi-criteria decision-making methods, such as the Analytical Hierarchy Process (AHP), can be adapted to select cement suppliers in the ready-mix industry.

The contribution of this study lies in providing an objective and structured evaluation framework for selecting raw material suppliers for ready-mix concrete. This framework enables companies to minimize delivery delays, enhance batching plant operational efficiency, and support the smooth execution of construction projects in strategic areas. Therefore, this research adopts the Analytical Hierarchy Process (AHP) to compare various criteria and determine priorities systematically. The study focuses on developing a cement supplier selection model for PT. Remicon Widyaprima, considering cement as the primary raw material in ready-mix production.

KAJIAN TEORI

Vendor Performance Indicator (VPI)

Vendor Performance Indicator (VPI) is a supplier performance evaluation method that employs a multi-criteria approach, integrating both quantitative and qualitative data into a single comprehensive index (Li, Fun, & Hung, 1997). In its application, supplier performance is typically assessed based on five key dimensions, commonly referred to as QFCDR: Quality: Consistency of products with specifications, including maintaining a low defect rate. Flexibility: The ability to adapt to unexpected changes in order quantity or delivery schedules. Cost: Price, purchase discounts, and total cost of ownership. Delivery: Timeliness and accuracy of delivery performance. Responsiveness: The speed and accuracy in responding to company issues or requests..

Multi Criteria Decision Making (MCDM)

The Multi-Criteria Decision Making (MCDM) approach is particularly suitable for complex decision-making situations, as it enables the simultaneous analysis of multiple criteria (Mardani et al., 2015). Beyond serving as a mere technical tool, MCDM functions as a systematic framework that integrates objective data and subjective preferences through the weighting and evaluation of alternatives (Velasquez & Hester, 2013). Its primary strength lies in its ability to establish the prioritization of alternatives in a transparent and methodological manner, thereby reducing bias and enhancing decision accountability (Triantaphyllou, 2000).

Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) is a multi criteria decision making method that compares elements in pairs to determine their priorities. This method calculates eigenvalues and consistency ratios to ensure logical assessments, and it can be integrated with other techniques such as Fuzzy Logic or Quality Function Deployment (QFD) to produce more objective and structured decisions (Vaidya & Kumar, 2006).

1. According to Saaty (1994), the stages of the Analytic Hierarchy Process (AHP) are as follows: Define the Goal and Problem: Establish the decision focus and identify the problem to be solved.
2. Construct the Hierarchy: Develop a hierarchical structure consisting of the goal, criteria, sub-criteria, and alternatives. Develop Pairwise
3. Comparison Matrices: Evaluate each element against others within the same level using a 1–9 scale.
4. Calculate Local Priority Weights: Determine the relative weight of each element within its hierarchical level.
5. Compute the Consistency Index (CI): Measure the logical consistency of judgments based on the maximum eigenvalue.
6. Compute the Consistency Ratio (CR): Compare the CI with the Random Index (RI) to ensure that $CR \leq 0.1$.
7. Calculate Global Priority Weights: Multiply the local weights by the upper-level weights to obtain the overall weight of each alternative.
8. Select the Best Alternative: The alternative with the highest global weight is chosen as the final decision..

RESEARCH METHODOLOGY

This study employs a quantitative approach using the Analytical Hierarchy Process (AHP) method to evaluate and determine the priority of cement suppliers at PT Remicon Widyaprima Batam. Primary data were collected through pairwise comparison questionnaires distributed to seven respondents selected based on expert judgment, consisting of employees directly involved in procurement, logistics, and production activities. Secondary data include internal company reports related to cement delivery delays throughout 2024 and other relevant literature sources.

Table 3. Informans

Nama	Jabatan
Christatnto	Production Manager
Sandra	Head of Laboratory
Ayak	Supervisor
Erha	Procurement Staff
Agung	Inventory Staff
Jhon	Quality Control
Choirul	Logistics Staff

Source: Processed by the researcher, 2025

The research instrument consists of an AHP questionnaire employing the Saaty scale (1–9) to assess the relative importance among criteria. The supplier evaluation criteria are determined with reference to the Vendor Performance Indicator (VPI) framework, which comprises five main dimensions, namely:

Table 4. *Vendor perfomance indicator*

Criteria	Sub-Criteria
QUALITY	The products received from the supplier have a low defect rate, and the supplier meets the company's product specifications
FLEXIBILITY	The supplier can fulfill large orders and easily adjust delivery schedules
COST	The supplier is open to price negotiations, and the prices offered are more competitive compared to other suppliers
DELIVERY	The supplier consistently delivers goods on time, and the delivered quantities match the orders
RESPONSIVENESS	The supplier handles complaints quickly and professionally, and always provides effective problem solving solutions

Source: Processed by the researcher, 2025

The alternatives evaluated in this study consist of the three main cement suppliers of PT Remicon Widyaprima, namely PT Semen Padang, PT Semen Merah Putih, and PT Semen Tiga Roda. The data analysis was carried out using the Analytical Hierarchy Process (AHP) method through several stages. First, a hierarchical structure was constructed consisting of the goal, criteria, sub-criteria, and alternatives. Second, pairwise comparison matrices were developed based on the results of the distributed questionnaires. Third, the priority weights of each element were calculated using the eigenvector method. Fourth, the Consistency Ratio (CR) was computed to ensure that the judgments were logically consistent ($CR \leq 0.1$). Finally, the global weights were determined to obtain the ranking and identify the best-performing supplier.

RESULT AND DISCUSSION

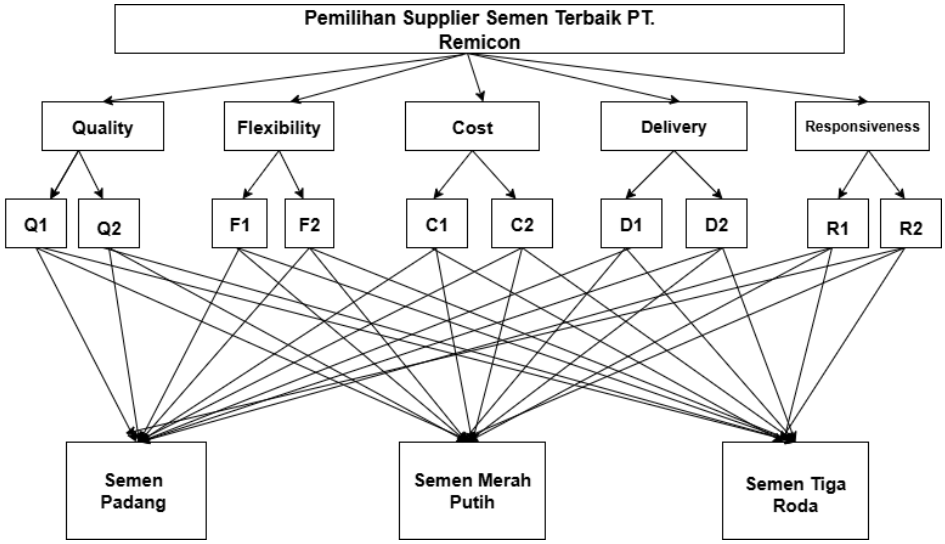
1. Defining the Goal and Problem

Cement, as the primary raw material, plays a crucial role in determining the quality and continuity of concrete production in the ready-mix industry. The selection of suppliers must consider several key aspects, including product quality, supply consistency, delivery punctuality, pricing, and reliability of cooperation, as any errors in supplier selection can disrupt production and increase costs. This study applies the Analytical Hierarchy Process (AHP) method to determine the most suitable cement supplier based on PT Remicon Widyaprima's operational criteria, ensuring that the resulting decision is objective, measurable, and supports production efficiency.

2. Developing the Hierarchical Structure

The second stage of AHP involves constructing a hierarchical structure to facilitate the decision-making process. The main goal of this study is to identify the best cement supplier for PT Remicon Widyaprima. After defining the goal, the criteria and sub-criteria were identified to evaluate the supplier alternatives in detail. These components provide a comprehensive framework for assessing each aspect of supplier performance. The hierarchical structure of this research is illustrated in Figure 1.

Figure 1. Hierarchical Structure



Source: Processed by the researcher, 2025

3. Pairwise Comparison Matrix

The data obtained from the questionnaires distributed to seven respondents at PT Remicon Widyaprima were processed into a pairwise comparison matrix using the AHP 1-9 scale. This scale represents the degree of importance of one element relative to another, as described in Table 4.

Table 4. AHP Pairwise Comparison Scale

Level of Importance	Definition	Description
1	Equal importance	Both elements have the same level of influence
3	Slightly more important	Experience and judgment slightly favor one element over another
5	More important	One element is strongly preferred and shows clear dominance over its counterpart
7	Very important	One element is proven to be highly preferred and demonstrates strong dominance in practice
9	Absolutely more important	One element is absolutely preferred over the other, with the highest level of confidence
2, 4, 6, 8	Intermediate values between adjacent judgments	These values represent compromise levels between the two adjacent judgments
Reciprocal	If element *i* has a certain value when compared with element *j*, then *j* has the reciprocal value when compared with *i*	

Source: (saaty, 2008)

4. Geometric Mean

Table 5. Geometric Mean of Criteria

Criteria	Quality	Flexibility	Cost	Delivery	Responsiveness
Quality	1.000	5.776	6.060	8.081	8.376
Flexibility	0.173	1.000	3.471	5.117	6.060
Cost	0.165	0.288	1.000	3.000	4.017
Delivery	0.124	0.195	0.333	1.000	3.000
Responsiveness	0.119	0.165	0.249	0.333	1.000
TOTAL	**1.581**	**7.424**	**11.114**	**17.532**	**22.453**

Source: Processed by the researcher, 2025

This step aims to calculate the geometric mean of pairwise comparisons among criteria, enabling a proportional representation of their relative importance. Based on Table 6, the Quality criterion ranks as the most dominant factor (22.453), reaffirming that product quality is the primary priority in cement supplier selection. This finding aligns with the study by Zhang & Li (2022). Flexibility follows as the second most important criterion (17.532), which contrasts with Rahman (2019), who emphasized Cost as the key determinant. This indicates that PT Remicon places higher value on suppliers' ability to adjust order quantities, schedules, and specifications. Meanwhile, Cost (11.114) and Delivery (7.424) occupy subsequent positions, suggesting acceptable tolerance toward these factors as long as quality and flexibility requirements are fulfilled. Responsiveness (1.581) holds the lowest weight, although it remains a supplementary factor under certain conditions.

Table 6. Normalized Geometric Mean of Criteria

Criteria	Quality	Flexibility	Cost	Delivery	Responsiveness
Quality	0.632	0.778	0.545	0.461	0.373
Flexibility	0.109	0.135	0.312	0.292	0.270
Cost	0.104	0.039	0.090	0.171	0.179
Delivery	0.078	0.026	0.030	0.057	0.134
Responsiveness	0.075	0.022	0.022	0.019	0.045

Source: Processed by the researcher, 2025

The normalization process presented in Table 6 indicates that Quality receives the highest weight, followed by Flexibility, Cost, Delivery, and Responsiveness. This result confirms that, after standardization, product quality remains the company's primary focus in supplier selection. Flexibility ranks second, emphasizing the importance of a supplier's ability to adapt to quantity, schedule, and product specification requirements to ensure continuity of supply.

Meanwhile, Cost, Delivery punctuality, and Responsiveness are relatively less dominant, although they are still considered supporting factors in the decision-making process.

Table 7. Geometric Mean Matrix of Sub-Criteria

Sub-Criteria	**Q1**	**Q2**
Q1	1,000	3,918
Q2	0,255	1,000
Sub-Kriteria	**F1**	**F2**
F1	1,000	0,146
F2	6,832	1,000
Sub-Kriteria	**C1**	**C2**
C1	1,000	5,987
C2	0,167	1,000
Sub-Kriteria	**D1**	**D2**
D1	1,000	0,249
D2	4,017	1,000
Sub-Kriteria	**R1**	**R2**
R1	1,000	0,173
R2	5,776	1,000

Source: Processed by the researcher, 2025

The geometric mean matrix presented in Table 7 demonstrates varying dominance levels across sub-criteria within each main criterion group. The results highlight the following dominant sub-criteria: Q1 for Quality, F2 for Flexibility, C1 for Cost, D2 for Delivery, and R2 for Responsiveness. These values indicate preliminary preferences prior to the normalization process.

Following normalization, as shown in Table 9, the dominant sub-criteria weights are obtained for Q1 (0.797), F1 (0.872), C2 (0.857), D1 (0.801), and R2 (0.852). This outcome demonstrates a shift in emphasis for certain criteria after standardizing the weight values, suggesting that proportional weighting influences the prioritization structure. Table 9 below presents the normalized geometric mean values of the sub-criteria.

Table 8. Normalized Geometric Mean of Sub-Criteria

Sub-Criteria	**Q1**	**Q2**
Q1	0,797	0,797
Q2	0,203	0,203
Sub-Kriteria	**F1**	**F2**
F1	0,872	0,872
F2	0,128	0,128
Sub-Kriteria	**C1**	**C2**
C1	0,143	0,143
C2	0,857	0,857
Sub-Kriteria	**D1**	**D2**

D1	0,801	0,801
D2	0,199	0,199
Sub-Criteria	**R1**	**R2**
R1	0,148	0,148
R2	0,852	0,852

Source: Processed by the researcher, 2025

The managerial interpretation of these findings indicates that PT Remicon should give primary attention to maintaining consistent product quality (Q1), ensuring supplier capability to adjust to significant changes in demand volume (F1), achieving efficiency in procurement costs (C2), securing on-time delivery performance (D1), and ensuring rapid response to operational complaints (R2). These sub-criteria represent critical factors for sustaining production stability and strengthening supplier performance in the long term.

The following matrix presents the results of pairwise comparisons obtained after calculating the geometric mean values for each alternative.

Table 9. Geometric Mean Matrix of Alternatives

CRITERIA	SUB-CRITERIA	ALTERNATIF	PT. SEMEN PADANG	PT. SEMEN MERAH PUTIH	PT. SEMEN TIGA RODA
QUALITY	Q1	PT. SEMEN PADANG	1,000	0,205	3,227
		PT SEMEN MERAH PUTIH	4,877	1,000	7,168
		PT SEMEN TIGA RODA	0,310	0,140	1,000
	Q2	PT. SEMEN PADANG	1,000	0,215	3,227
		PT SEMEN MERAH PUTIH	4,648	1,000	6,060
		PT SEMEN TIGA RODA	0,310	0,165	1,000
FLEXIBILITY	F1	PT. SEMEN PADANG	1,000	0,205	3,227
		PT SEMEN MERAH PUTIH	4,877	1,000	6,915
		PT SEMEN TIGA RODA	0,310	0,145	1,000
	F2	PT. SEMEN PADANG	1,000	3,227	6,060
		PT SEMEN MERAH PUTIH	0,310	1,000	4,321
		PT SEMEN TIGA RODA	0,165	0,231	1,000
COST	C1	PT. SEMEN PADANG	1,000	3,734	0,182
		PT SEMEN MERAH PUTIH	0,268	1,000	0,124
		PT SEMEN TIGA RODA	5,505	8,081	1,000
	C2	PT. SEMEN PADANG	1,000	0,288	3,471
		PT SEMEN MERAH PUTIH	3,471	1,000	5,505

		PT SEMEN TIGA RODA	0,288	0,182	1,000
DELIVERY	D1	PT. SEMEN PADANG	1,000	4,017	5,565
		PT SEMEN MERAH PUTIH	0,249	1,000	3,471
		PT SEMEN TIGA RODA	0,180	0,288	1,000
	D2	PT. SEMEN PADANG	1,000	0,221	3,471
		PT SEMEN MERAH PUTIH	4,534	1,000	6,591
		PT SEMEN TIGA RODA	0,288	0,152	1,000
RESPONSIVE NESS	R1	PT. SEMEN PADANG	1,000	3,227	0,215
		PT SEMEN MERAH PUTIH	0,310	1,000	0,143
		PT SEMEN TIGA RODA	4,648	7,000	1,000
	R2	PT. SEMEN PADANG	1,000	3,000	0,200
		PT SEMEN MERAH PUTIH	0,333	1,000	0,157
		PT SEMEN TIGA RODA	5,000	6,358	1,000

Source: Processed by the researcher, 2025

Table 10 below presents the normalized values of each alternative. The normalization process was conducted to ensure comparability across all criteria, allowing for an objective evaluation of supplier performance.

Table 10. Normalized Geometric Mean of Alternatives

CRITERIA	SUB CRITERIA	ALTERNATIF	PT. SEMEN PADANG	PT SEMEN MERAH PUTIH	PT SEMEN TIGA RODA
QUALITY	Q1	PT. SEMEN PADANG	0,162	0,153	0,283
		PT SEMEN MERAH PUTIH	0,788	0,744	0,629
		PT SEMEN TIGA RODA	0,050	0,104	0,088
	Q2	PT. SEMEN PADANG	0,168	0,156	0,314
		PT SEMEN MERAH PUTIH	0,780	0,725	0,589
		PT SEMEN TIGA RODA	0,052	0,120	0,097
FLEXIBILITY	F1	PT. SEMEN PADANG	0,162	0,152	0,290
		PT SEMEN MERAH PUTIH	0,788	0,741	0,621
		PT SEMEN TIGA RODA	0,050	0,107	0,090
	F2	PT. SEMEN PADANG	0,678	0,724	0,532

		PT SEMEN MERAH PUTIH	0,210	0,224	0,380
		PT SEMEN TIGA RODA	0,112	0,052	0,088
COST	C1	PT. SEMEN PADANG	0,148	0,291	0,139
		PT SEMEN MERAH PUTIH	0,040	0,078	0,095
		PT SEMEN TIGA RODA	0,813	0,631	0,766
	C2	PT. SEMEN PADANG	0,210	0,196	0,348
		PT SEMEN MERAH PUTIH	0,729	0,680	0,552
		PT SEMEN TIGA RODA	0,061	0,124	0,100
DELIVERY	D1	PT. SEMEN PADANG	0,700	0,757	0,554
		PT SEMEN MERAH PUTIH	0,174	0,189	0,346
		PT SEMEN TIGA RODA	0,126	0,054	0,100
	D2	PT. SEMEN PADANG	0,172	0,161	0,314
		PT SEMEN MERAH PUTIH	0,779	0,729	0,596
		PT SEMEN TIGA RODA	0,049	0,111	0,090
RESPONSIVENESS	R1	PT. SEMEN PADANG	0,168	0,287	0,158
		PT SEMEN MERAH PUTIH	0,052	0,089	0,105
		PT SEMEN TIGA RODA	0,780	0,623	0,736
	R2	PT. SEMEN PADANG	0,158	0,290	0,147
		PT SEMEN MERAH PUTIH	0,053	0,097	0,116
		PT SEMEN TIGA RODA	0,789	0,614	0,737

Source: Processed by the researcher, 2025

5. Menentukan Bobot Prioritas

The objective of determining priority weights is to identify the relative importance of each criterion within the decision-making process.

Tabel 11. Bobot prioritas kriteria

CRITERIA	WEIGHT	EIGEN VALUE	PRIORITY
QUALITY	0,558	3,390	I
FLEXIBILITY	0,224	1,281	II
COST	0,117	0,616	III
DELIVERY	0,065	0,327	IV
RESPONSIVENESS	0,037	0,191	V

Source: Processed by the researcher, 2025

Based on the AHP calculation results, the Quality criterion obtained the highest weight (0.558), indicating that it is the most dominant factor in the decision-making process. This finding demonstrates that the company places strong emphasis on quality as the key determinant for successful supplier selection. Prioritizing quality aligns with the need to maintain consistent product standards and remain competitive in the market.

The Flexibility criterion ranks second (0.224), suggesting that a supplier's ability to adapt to changes in demand or market conditions is also viewed as highly important. In a dynamic competitive environment, flexibility becomes an essential capability to respond to demand fluctuations and operational challenges. Meanwhile, Cost (0.117) ranks third. Although cost remains a consideration, the results indicate that the company is not solely focused on obtaining the lowest price; rather, it prioritizes quality and flexibility. In other words, the procurement strategy emphasizes value for money over cost efficiency alone.

The Delivery (0.065) and Responsiveness (0.037) criteria occupy the fourth and fifth priority levels, respectively. Their relatively low weights suggest that delivery speed and supplier responsiveness are not primary determinants compared to quality and flexibility. Nevertheless, these factors remain relevant in supporting a smooth supply chain, even though they are not the main priority. From a managerial perspective, these findings imply that in supplier selection, the company should prioritize quality as the main benchmark, ensure that suppliers possess high flexibility, and continue to consider cost efficiency without compromising quality.

Table 12. Results of Sub-Criteria Priority Weights

SUB CRITERIA	WEIGHT	EIGEN VALUE	PRIORITY
Q1	0,797	1,593	I
Q2	0,203	0,407	II
F1	0,872	1,745	I
F2	0,128	0,255	II
C1	0,143	0,286	II
C2	0,857	1,714	I
D1	0,801	1,601	I
D2	0,199	0,399	II
R1	0,148	0,295	II
R2	0,852	1,705	I

Source: Processed by the researcher, 2025

Based on the AHP calculation results, the priority weights for each sub-criterion are presented in Table 12. The sub-criteria with the highest weights and ranked as first priority within their respective main criteria are Q1 (0.797) under Quality, F1 (0.872) under Flexibility, C2 (0.857) under Cost, D1 (0.801) under Delivery, and R2 (0.852) under Responsiveness. Meanwhile, the other sub-criteria Q2, F2, C1, D2, and R1 are placed in second priority, indicating relatively lower levels of influence.

These findings reveal that supplier selection is influenced not by a single determining factor, but rather by a combination of multiple key aspects. The company does not solely emphasize cost or delivery speed; instead, it prioritizes a balanced evaluation across quality, flexibility, cost efficiency, timeliness, and responsiveness. Emphasizing these dominant sub-

criteria is expected to enhance the company's competitiveness, reduce the risk of supply chain disruptions, and secure supply continuity amid dynamic market conditions.

Table 13. Results of Alternative Priority Weights

CRITERIA	SUB-CRITERIA	ALTERNATIVE	WIGHT	EIGEN VALUE	PRIORITY
QUALITY	Q1	PT. SEMEN PADANG	0,199	0,607	II
		PT SEMEN MERAH PUTIH	0,720	2,269	I
		PT SEMEN TIGA RODA	0,081	0,243	III
	Q2	PT. SEMEN PADANG	0,212	0,652	II
		PT SEMEN MERAH PUTIH	0,698	2,228	I
		PT SEMEN TIGA RODA	0,090	0,271	III
FLEXIBILITY	F1	PT. SEMEN PADANG	0,201	0,614	II
		PT SEMEN MERAH PUTIH	0,717	2,266	I
		PT SEMEN TIGA RODA	0,082	0,248	III
	F2	PT. SEMEN PADANG	0,645	2,029	I
		PT SEMEN MERAH PUTIH	0,271	0,834	II
		PT SEMEN TIGA RODA	0,084	0,253	III
COST	C1	PT. SEMEN PADANG	0,193	0,591	II
		PT SEMEN MERAH PUTIH	0,071	0,214	I
		PT SEMEN TIGA RODA	0,736	2,369	III
	C2	PT. SEMEN PADANG	0,251	0,769	II
		PT SEMEN MERAH PUTIH	0,654	2,048	I
		PT SEMEN TIGA RODA	0,095	0,286	III
DELIVERY	D1	PT. SEMEN PADANG	0,671	2,138	II
		PT SEMEN MERAH PUTIH	0,236	0,727	III
		PT SEMEN TIGA RODA	0,093	0,282	I
	D2	PT. SEMEN PADANG	0,215	0,660	II
		PT SEMEN MERAH PUTIH	0,701	2,228	I
		PT SEMEN TIGA RODA	0,083	0,252	III
RESPONSIVENESS	R1	PT. SEMEN PADANG	0,205	0,623	II
		PT SEMEN MERAH PUTIH	0,082	0,247	III
		PT SEMEN TIGA RODA	0,713	2,239	I
	R2	PT. SEMEN PADANG	0,198	0,606	II
		PT SEMEN MERAH PUTIH	0,088	0,267	III
		PT SEMEN TIGA RODA	0,713	2,267	I

Source: Processed by the researcher, 2025

Based on the AHP calculation results, the priority weights for each alternative across all sub-criteria are presented in Table 13. For the Quality criteria (Q1 and Q2), PT Semen Merah

Putih ranks first, while PT Semen Padang and PT Semen Tiga Roda occupy the second and third positions, respectively. In the Flexibility criteria, PT Semen Merah Putih leads in F1 (first priority), while PT Semen Padang holds the highest priority in F2. For the Cost criterion, PT Semen Merah Putih dominates in C2, whereas PT Semen Tiga Roda ranks first in C1. Within the Delivery criterion, PT Semen Merah Putih excels in D2, PT Semen Tiga Roda leads in D1, and PT Semen Padang occupies the intermediate position across several sub-criteria. Meanwhile, for Responsiveness, PT Semen Tiga Roda consistently holds the highest priority, indicating superior responsiveness compared to the other alternatives.

6. Consistency Test of Main Criteria

The next stage in the AHP method is to test the consistency of the pairwise comparison matrix. This test is carried out by calculating the maximum eigenvalue (λ_max), which is obtained by summing the products of each column total with the priority vector and dividing the result by the number of criteria. This value is used to ensure logical consistency in the pairwise comparison judgments:

$$\lambda \text{ maks} = \frac{(6{,}08 + 5{,}73 + 5{,}28 + 5{,}03 + 5{,}20)}{5}$$

$$= \mathbf{5{,}292}$$

After obtaining the λ_max value, the next step is to calculate the Consistency Index (CI) using the formula:

$$CI = \frac{(\lambda_{maks} - n)}{(n-1)}$$

CI = (5,292 – 5) / (5-1)
= 0,292 / 4
= 0,073

The final step is to compute the Consistency Ratio (CR) by comparing the CI value to the Random Index (RI), which is determined based on the matrix size. For a 5×5 matrix, the RI value is 1.12. Thus, the CR is calculated as follows :

CR = CI / CR
CI = Consistency Index (CI)
RI = Random Index (RI)
CR = CI / CR
= 0,073 / 1,12
= 0,065178

Since the CR value is less than < 0,1, the pairwise comparison matrix can be considered logically consistent. Therefore, the resulting priority weights are valid and can be used for further analysis..

7. Supplier Evaluation

After the priority weights for the criteria and alternatives have been determined, the next step is to synthesize these results to obtain the overall weight of each supplier relative to the criteria. This process begins with calculating the local priority values. Subsequently, each local priority value is multiplied by the corresponding criterion weight to produce the global priority. The

supplier with the highest global priority is then selected as the most suitable alternative based on the evaluation.

Table 14. Global Priority Results

Main Objective	Criteria	Sub Criteria	Weight	Alternative	Weight
Selecting the Best Cement Supplier at PT. Remicon	Quality (0,558)	Q1	0,444	PT. SP	0.089
				PT. SMP	0,320
				PT. STR	0,036
		Q2	0,113	PT. SP	0,024
				PT. SMP	0,079
				PT. STR	0,010
	Flexibility (0,024)	F1	0,195	PT. SP	0,039
				PT. SMP	0,140
				PT. STR	0,016
		F2	0,029	PT. SP	0,018
				PT. SMP	0,008
				PT. STR	0,002
	Cost (0,117)	C1	0,017	PT. SP	0,003
				PT. SMP	0,001
				PT. STR	0,012
		C2	0,100	PT. SP	0,025
				PT. SMP	0,065
				PT. STR	0,009
	Delivery (0,065)	D1	0,052	PT. SP	0,035
				PT. SMP	0,012
				PT. STR	0,005
		D2	0,013	PT. SP	0,003
				PT. SMP	0,009
				PT. STR	0,001
	Responsiveness (0,037)	R1	0,005	PT. SP	0,001
				PT. SMP	0,000
				PT. STR	0,004
		R2	0,031	PT. SP	0,006
				PT. SMP	0,003
				PT. STR	0,022

Source: Processed by the researcher, 2025

After establishing the global priorities, the final score for each alternative supplier was calculated by aggregating the respective global weights. The results of this calculation are presented in Table 15 :

Table 15. Final Alternative Weights

Alternative	Weight	Priority
PT. SEMEN PADANG	0,244	II

PT SEMEN MERAH PUTIH	0,638	I
PT SEMEN TIGA RODA	0,118	III

Source: Processed by the researcher, 2025

The results of the study indicate that quality emerged as the dominant criterion (0.558) in the selection of cement suppliers for PT. Remicon Widyaprima. This finding aligns with Latif and Wahyuning (2024), who emphasized the importance of product quality in procurement processes. However, in contrast to Rahman (2019), who identified cost as the primary consideration, the present results demonstrate a shift in focus toward prioritizing product quality consistency over price efficiency. This difference suggests that in the ready-mix industry, cement quality reliability has a direct impact on concrete production continuity and project customer satisfaction, thereby making it more critical than cost efficiency. Thus, the ready-mix sector exhibits unique characteristics and tends to be more sensitive to quality related aspects.

In terms of the flexibility criterion (0.224), PT. Semen Merah Putih excelled in sub-criterion F1, while PT. Semen Padang showed superiority in F2. This supports the findings of Wang et al. (2017), who stated that supplier flexibility is a key indicator in strengthening supply chain performance. In the ready-mix context, the need for dynamic scheduling adjustments highly dependent on construction project progress requires suppliers to adapt quickly. The fact that flexibility obtained a higher weight than cost reinforces that the company values supplier adaptability more highly than merely low price offerings.

Meanwhile, regarding cost, PT. Semen Tiga Roda ranked highest in C1, while PT. Semen Merah Putih dominated in C2. This demonstrates that cost considerations are not homogeneous and cannot be simplified solely to purchase price, but instead reflect overall cost efficiency. This pattern differs from the study by Manik (2023), which placed greater emphasis on price affordability.

Table 16. Comparison of Alternative Weights Based on Criteria

CRITERIA	PT. SEMEN PADANG	PT SEMEN MERAH PUTIH	PT SEMEN TIGA RODA
QUALITY	0,056	0,109	0,023
FLEXIBILITY	0,029	0,074	0,009
COST	0,014	0,033	0,011
DELIVERY	0,019	0,011	0,003
RESPONSIVENESS	0,004	0,002	0,013

Source: Processed by the researcher, 2025

Based on the data presented in Table 16, PT. Semen Merah Putih demonstrates the strongest performance in the criteria of quality (0.109) and flexibility (0.074), indicating its ability to maintain superior product quality while adapting to production needs. PT. Semen Padang excels in delivery (0.019), reflecting the company's strength in ensuring timely shipment and supply continuity. Meanwhile, PT. Semen Tiga Roda performs best in responsiveness (0.013), highlighting its capability to respond promptly to customer requirements and operational changes.

8. Recapitulation of Consistency Ratio (CR) Values

The purpose of recapitulating the Consistency Ratio (CR) values is to ensure that the pairwise comparison results generated through the AHP method are consistent and reliable. The CR value serves as an indicator to determine whether the judgments provided by respondents or decision-makers are logically consistent and free from contradictory evaluations.

Table 17. Recapitulation of Consistency Ratio Values

Pairwise Comparison	λ maks	CI	CR	Explanation
Among Criteria	5,29	0,0728	0,0650	Consistent
Among Sub-Criteria (Quality)	2	0	0	Consistent
Among Sub-Criteria (Flexibility)	2	0	0	Consistent
Among Sub-Criteria (Cost)	2	0	0	Consistent
Among Sub-Criteria Delivery	2	0	0	Consistent
Among Sub-Criteria Responsiveness	2	0	0	Consistent
Among Alternatives for Sub-Criteria Q1	30,702	0,0351	0,0605	Consistent
Among Alternatives for Sub-Criteria Q2	30,936	0,0468	0,0807	Consistent
Among Alternatives for Sub-Criteria F1	30,768	0,0384	0,0662	Consistent
Among Alternatives for Sub-Criteria F2	30,785	0,0393	0,0677	Consistent
Among Alternatives for Sub-Criteria C1	30,998	0,0499	0,0861	Consistent
Among Alternatives for Sub-Criteria C2	30,693	0,0347	0,0598	Consistent
Among Alternatives for Sub-Criteria D1	30,959	0,0480	0,0827	Consistent
Among Alternatives for Sub-Criteria D2	30,862	0,0431	0,0743	Consistent
Among Alternatives for Sub-Criteria R1	30,658	0,0329	0,0567	Consistent
Among Alternatives for Sub-Criteria R2	30,838	0,0419	0,0723	Consistent

Source: Processed by the researcher, 2025

able 17 presents the recapitulation of the Consistency Ratio (CR) values for all pairwise comparison matrices, including those at the criteria level, sub-criteria level, and alternatives relative to each sub-criteria. The results indicate that all CR values are below the acceptable threshold of 0.1. This confirms that the judgments provided during the pairwise comparison process are logically consistent and reliable. Accordingly, the derived priority weights are valid and can be confidently used in the decision-making process for supplier selection at PT Remicon Widyaprima.

Table 18. Final Results

Main Recommendation	CRITERIA	Weight	SUB CRITERIA	Weight
The selected best supplier is PT Semen Merah Putih	QUALITY	0,558	Q1	0,797
			Q2	0,203
	FLEXIBILITY	0,224	F1	0,872
			F2	0,128
	COST	0,117	C1	0,143
			C2	0,857
	DELIVERY	0,065	D1	0,801
			D2	0,199
	RESPONSIVENESS	0,037	R1	0,148
			R2	0,852

Source: Processed by the researcher, 2025

Based on the Analytical Hierarchy Process (AHP) results (Table 18), the selected supplier with the highest final weight is PT Semen Merah Putih. The dominant criteria are quality (0.558), followed by flexibility (0.224), cost (0.117), delivery (0.065), and responsiveness (0.037). At the sub-criteria level, the highest values were assigned to Q1 (0.797), F1 (0.872), C2 (0.857), D1 (0.801), and R2 (0.852).

The dominance of the quality criterion (0.558) indicates that the quality of cement products is the primary factor in supplier selection. This is reasonable, as raw material quality directly affects production continuity and end-customer satisfaction. This finding is consistent with Latif and Wahyuning (2024), who also identified quality as the most important criterion with a weight of 0.565 in supplier evaluation. Therefore, the superior quality offered by PT Semen Merah Putih positions the company as a strategic partner capable of maintaining final product consistency.

In addition to quality, flexibility (0.224) is the second-most influential factor. The sub-criterion F1 (0.872) demonstrates PT Semen Merah Putih's capability to adapt to fluctuations in delivery volume and schedules. This is aligned with the findings of Wang et al. (2017), who emphasized that supplier flexibility is essential for establishing a resilient and responsive supply chain. For the company, selecting PT Semen Merah Putih ensures not only high product quality but also responsiveness to variable demand conditions.

Meanwhile, under the cost criterion (0.117), sub-criterion C2 (0.857) highlights the importance of price efficiency. Although cost carries a lower weight compared to quality, it remains a relevant consideration for optimizing expense structures without sacrificing product standards. This finding is consistent with Manik (2023), who showed that in the pharmaceutical industry, supplier evaluation is grounded in a combination of quality, cost, and delivery performance.

The delivery criterion (0.065) with sub-criterion D1 (0.801) also contributes to supplier evaluation, albeit with a smaller weight. Reliable and timely delivery remains essential to ensuring smooth production operations. Kamath, Naik, and Prasad (2016) similarly concluded in the steel pipe industry that delivery performance is a critical factor after product quality in maintaining supply chain continuity.

Lastly, responsiveness (0.037), though carrying the lowest weight, still contributes to long-term supplier relationships. Sub-criterion R2 (0.852) reflects PT Semen Merah Putih's ability to promptly respond to complaints or operational issues. This capability is crucial for building trust and long-term supplier loyalty.

Overall, the results highlight that PT Semen Merah Putih excels in two strategic dimensions—product quality and service flexibility. From a managerial perspective, these findings imply the need to strengthen long-term collaboration with PT Semen Merah Putih through strategic contract arrangements, continuous quality monitoring, and integrated communication systems to maintain supply chain resilience.

KESIMPULAN

Based on the Analytical Hierarchy Process (AHP) analysis, the most influential criterion in selecting raw material suppliers for ready-mix production at PT Remicon Widyaprima is Quality (0.558), followed by Flexibility (0.224), Cost (0.117), Delivery (0.065), and Responsiveness (0.037). The key sub-criteria include product conformity with required specifications, the supplier's ability to adjust demand, pricing and purchase discounts, on-time delivery performance, and responsiveness to operational issues. The results indicate that PT Semen Merah Putih ranks as the highest-priority supplier, with a satisfactory level of assessment consistency (CR = 0.0650). However, this study has several limitations, including a relatively small respondent sample of seven individuals and a focus limited to cement, which may reduce representativeness for other ready-mix raw materials. These limitations provide opportunities for future research to expand the scope of raw materials evaluated, involve a broader and more diverse set of respondents, and compare AHP with alternative decision-making methods to obtain more comprehensive and robust results.

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