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PT XYZ Supplier Selection Criteria Using Analytic Network Process

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Abstract. Supplier selection is a critical decision in manufacturing industries, as choosing suppliers based solely on the lowest price is no longer efficient. Inaccurate supplier selection can harm a company, especially in the automotive sector, where suppliers provide essential raw and supporting materials for production. PT XYZ, an automotive component manufacturer in Indonesia, faces challenges in selecting suppliers that meet diverse customer requirements while maintaining production efficiency and competitiveness. This research applies the Analytic Network Process (ANP) method to model supplier selection criteria, considering interdependencies and feedback relationships among criteria. The ANP approach allows for pairwise comparisons within and between clusters, generating priority weights for each criterion. Data were collected through questionnaires distributed to authorized decision-makers in production and management divisions. The results show that, from the production perspective, the top three criteria are consistent quality (0.30), price (0.25), and material specification (0.10). From the management perspective, the key criteria are price (0.30), consistent quality (0.15), and supplier professionalism (0.10). These findings highlight differing priorities between operational and strategic viewpoints. The study concludes that ANP provides a structured framework for evaluating supplier selection criteria, supporting long-term supplier partnerships and enhancing supply chain performance. The derived weights can inform PT XYZ's supplier evaluation system and contribute to more aligned and effective procurement strategies.

Keywords: *analytic network process, criteria, weight, supply chain*

INTRODUCTION

Rapid and competitive market conditions, along with a difficult economic climate, have compelled many large and small companies to prioritize time savings, cost efficiency, and productivity gains. Companies must therefore streamline their business processes, including by treating supplier selection as a critical decision-making issue to secure suppliers that enhance competitiveness (Adebayo et al., 2024; Sahoo et al., 2024; Sharma & Joshi, 2023; Vaka, 2024; Wu et al., 2017).

PT XYZ is an automotive manufacturing company engaged in the production of components for motorcycles and cars. As part of an integrated automotive supply chain, PT XYZ provides innovative and high-quality parts and components. However, its supplier selection process has historically been intuitive and focused primarily on price. In an era of increasingly fierce competition, companies must also consider quality, quantity, service, and other factors (Cusumano et al., 2015; Gunasekaran et al., 2019; Ngo & Nguyen, 2016; Porter, 2023; Sun & Pang, 2017). Thus, PT XYZ requires a supplier evaluation system with criteria tailored to its needs, objectives, and resources.

This situation presents companies with the challenge of selecting alternative suppliers, as they often rely on multiple raw material providers. No supplier is perfect (Gencer and Gürpinar, 2007); for example, some offer lower prices and good flexibility but fall short in quality and delivery accuracy. The supplier providing the best efficiency across the company's requested criteria emerges as the optimal choice. Supplier selection thus constitutes a multi-criteria problem, requiring analysis that incorporates both strategic and operational factors, including tangible and intangible elements (Alastal et al., 2025; Bruno et al., 2016; Govindan et al., 2015; Ngo & Nguyen, 2016; Yildiz & Yayla, 2015). Relying solely on low price quotes is no longer efficient; to maximize supply chain performance, other criteria aligned with company goals must be integrated.

Observations indicate that PT XYZ needs to overhaul its supplier selection evaluation system. The criteria employed by PT XYZ are interdependent, making the Analytic Network Process (ANP) the most suitable method. ANP accounts for the interests of various stakeholders by modeling interdependencies among criteria and sub-criteria. It yields priority weights for all criteria used in supplier selection (Yoserizal and Singgih, 2012), which can inform long-term supply chain strategies, particularly for supplier partnerships.

Several studies have explored supplier selection using multi-criteria decision-making (MCDM) methods. For instance, Gencer and Gürpinar (2007) applied ANP in the electronics industry, emphasizing interdependencies among criteria. Similarly, Cebi and Bayraktar (2003) proposed an integrated approach blending qualitative and quantitative factors. In the Indonesian context, Dewayana and Budi (2009) identified criteria such as price, quality, delivery, and service via ANP, while Yoserizal and Singgih (2012) incorporated green product and process considerations. These studies underscore that supplier selection is a complex, multi-dimensional problem unsuited to price-only evaluation.

Despite these advancements, many companies—including PT XYZ—continue to rely on intuitive, price-focused methods. Such approaches overlook critical interdependencies among criteria like quality, delivery accuracy, service, and supplier relationships. Moreover, prior studies often neglect differing perspectives between production and management divisions, risking misalignment in evaluations (Franke et al., 2021; Sawiris et al., 2015). This study addresses these gaps by applying ANP to model interdependent supplier selection criteria at PT XYZ and comparing priority weights from production and management viewpoints.

The primary objective of this study is to develop a structured framework for supplier selection at PT XYZ using the Analytic Network Process (ANP). Specifically, it identifies key criteria and sub-criteria in the automotive manufacturing context, models their interdependencies via ANP, and derives priority weights reflecting both operational and strategic perspectives. The study also compares evaluation priorities between production and management divisions to align procurement decisions, fostering long-term supplier partnerships and enhancing supply chain performance.

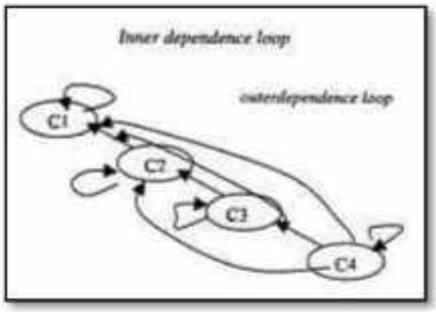
This study offers practical and theoretical benefits. Practically, it equips PT XYZ with a decision-support tool for supplier evaluation, shifting from price-centric to comprehensive assessments. The resulting criteria weights can integrate into procurement systems for greater consistency, transparency, and objectivity. Theoretically, it advances supply chain management knowledge by applying ANP in an industrial setting, capturing criterion interdependencies and reconciling organizational viewpoints. Additionally, it provides a replicable methodology for other manufacturers facing similar challenges, promoting strategic procurement and sustainable supply chain practices.

Basic Concepts of Analytic Network Process (ANP)

The Analytic Network Process (ANP) method is a development of the Analytic Hierarchy Process (AHP) method. The ANP method is able to improve the weakness of AHP in the form of the ability to accommodate the linkage between criteria or alternatives (Saaty, 2001). There are 2 types of relationships in the ANP method, namely the relationship in a set of elements (inner dependence) and the relationship between different elements (outer dependence). The existence of this relationship causes the ANP method to be more complex than the AHP method.

Weighting with ANP requires a model that represents the interconnectedness between the criteria and the subcriteria they have (Sorourkhah & Edalatpanah, 2021; Taherdoost & Madanchian, 2023; Zhao et al., 2017). There are 2 controls that need to be considered in modeling the system that you want to know the weight. The first control is a hierarchical control that shows the relationship of criteria and sub-criteria. This control does not require a hierarchical structure as in the AHP method. Another control is the linkage control which shows the interrelationship between criteria or clusters (Ros & Guillaume, 2019; Singh & Srivastava, 2020).

It is assumed that a system has N clusters where the elements in each cluster interact with each other or have an influence on some or all of the existing clusters. If the cluster is denoted with *Ch,* where *h = 1, 2, ..., N,* with elements as much *as nh* denoted with *eh1, eh2, ..., ehnh.* The influence of one set of elements in a cluster on other elements in a system can be represented by a ratio-scale priority vector taken from paired comparisons.



Gambar 1. *Feedback Network* (*Hiernet*)
Source: Saaty (2001)

After the model is created, the results of the pairwise comparison data are performed using a supermatrix table. Then a weighting process will be carried out for each cluster that has been determined based on the criteria of prospective suppliers. The weighting calculation algorithm is carried out starting from the data in the form of pairwise comparison until the weight of each performance indicator is produced. Criteria are made based on the needs and objectives of the selection.

To show the final result of the comparison calculation, the supermatrix will be raised continuously until the number of each column in a row is the same size.
The calculation formula can be seen in the following equation

$$\lim_{M \to \infty} \frac{1}{M} \sum_{k=1}^{M} \frac{\sum_{j=1}^{n} a_{ij}^{k}}{\sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij}^{k}}$$

The preference relationship imposed between the two elements does not have a problem of relationship consistency. If element A is twice element B, then element B is 1/2 times element A. However, this consistency does not apply if there are many elements to be compared. Because of the limitations of human numerical ability, the priority given to a set of elements is not always logically consistent. Suppose A is 7 times more important than D, B is 5 times more important than D, C is 3 times more important than B, then it would not be easy to find that numerically C is 15/7 times more important than A. This has to do with the nature of AHP itself, i.e. that judgment to deviate from logical consistency.

In practice, such consistency is impossible to obtain. On the matrix is practically consistent λ max □ n , whereas in the matrix not every variation from A_{IJ} will bring a change in the value of λ max. Deviation λ max from n is a Consistency Index (CI) parameter as follows:

$$CI = (\lambda_{max} - n)/(n - 1)$$

Description:
CI = Consistency Index
λ max = greatest eigenvalue
n = number of elements compared

A CI value will not be meaningful if there is a standard for stating whether CI shows a consistent matrix. Saaty provides a benchmark by conducting a random comparison of 500 samples .

Saaty argues that a matrix resulting from a random comparison is an absolutely inconsistent matrix. From the random matrix, the Consistency Index value is also obtained, which is called the Random Index (RI). By comparing CI with RI, a benchmark is obtained to determine the consistency level of a matrix, which is called the Consistency Ratio:
(CR), with the formula:

$$CR = CI / RI$$

Description :
CR = Consistency Ratio CI = Consistency Index RI = Random Inde.

From 500 random matrix samples with a comparison scale of 1 – 9, for several order of matrices, the average value of RI was obtained as follows:

Table 1. Random Index Value

Order Matrix	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Source: Saaty (2001)

A comparison matrix is consistent when the CR value is no more than 10%. If the consistency ratio is closer to zero, it means that the better the value and shows the consistency of the comparison matrix.

RESEARCH METHOD

The first step is to determine the criteria and sub-criteria for supplier selection. The selection is based on a literature study, observations of the procurement system currently used by the company, and the results of the questionnaire, which are then distributed to the respondents who are authorized in decision-making, namely the Production Process Section which includes the Head of Production, Production Manager and Quality Control Section.

The second step is to determine the relationship of dependency between criteria which is assisted by the distribution of questionnaires. The relationship affecting between the criteria is illustrated with an arrow. The interdependence between the two criteria is called outer dependence which is depicted by a line with two arrows while inner dependence is depicted by a loop (Chung et al, 2005). From this relationship it can be used to create a network model for the analysis of criteria in supplier selection.

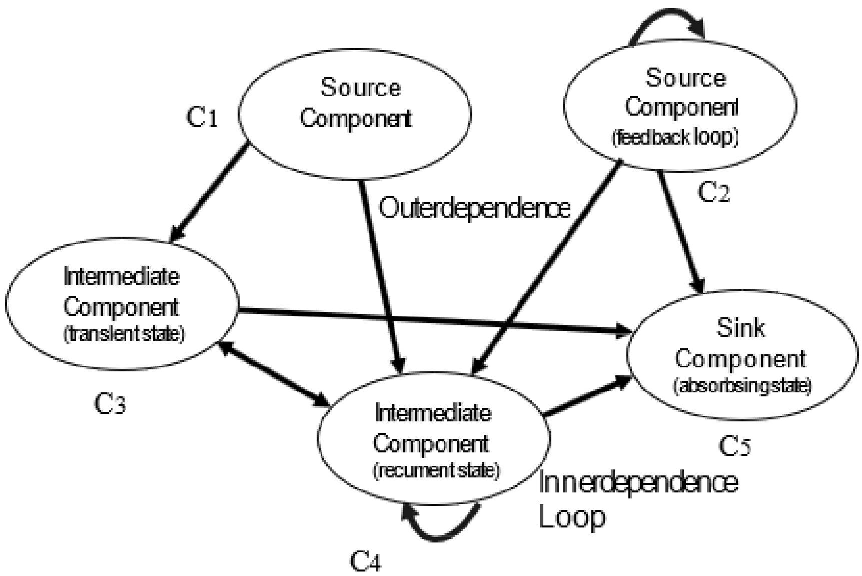


Figure 2. Interdependent relationships
Source: Developed based on Chung et al. (2005)

The third step is for respondents to conduct a paired comparison of elements that have a dependency relationship based on their control criteria, using a 1-9 rating scale. A score of 1 means that both criteria are equally important while a score of 9 means that it dominates all criteria (Jharkharia and Shankar, 2005). Inverse comparison is indicated by the value reciprocal, if aij 1/ aij . The most important thing in the Analytical Network method

Process (ANP) is calculating the priority weight. Priority weight is a decimal number under one with the total priority for the criteria in a group equal to 1. The most accurate way to calculate priority weights for comparison matrices is by mathematical operations based on matrix and vector operations known as eigen vectors.

A.w λmax .in

where A is the paired comparison matrix, w is the eigenvector, is the largest eigenvalue of A (Chung et al, 2005) λmaks

The fourth step is to process the data of the paired comparison questionnaire. To help the calculation process, super decisions software is used. This stage will generate both local weights and global weights to see how much influence the criteria used have on supplier selection.

RESULTS AND DISCUSSION

Data Collection

The supporting research that was used as the basis for determining the criteria was Dewayana and Budi (2009) using the criteria of price, discount, punctuality, reliability of goods, quality of goods, quality of delivery of goods, payment methods, payment grace periods, communication, documentation, responsiveness. Hapsari and Suparno (2010) used the criteria of quality, delivery time, number of shipments, *packaging*, warranty and complaint service, complaint procedure, responsiveness, communication system, price, delivery frequency, production capacity, payment, organizational structure, financial and *history*. Yoserizal and Moses (2012) used the criteria of quality, delivery time, number of shipments, *packaging*, payment time relief, communication system, complaint procedures, responsiveness, warranty and complaint services, technical information, prices, discounts, *green products*, and *green processes*. The criteria of the three studies were modified according to the objectives and conditions through discussions with the company. The criteria for selecting suppliers at PT XYZ are presented in Table 2.

Table 2. Clusters and criteria for selecting PT XYZ suppliers

Cluster	Criteria
Cost (B)	Price (H)
Quality (Ku)	Conformity of raw materials to specification (SB)
	Ability to provide consistent quality (K)
Accuracy (To)	Delivery time (WP)
	Shipping Amount (JP)
Service (S)	Warranty and complaint service (GL)
	Responsive (R)
Supplier Relations (HP)	Financial Ability (KK)
	Supplier Professionalism (KP)
	Supplier Reference (RP)

Source: Adapted from Dewayana & Budi (2009), Hapsari & Suparno (2010), and Yoserizal & Singgih (2012)

In the ANP process, questionnaires were distributed to determine the relationship of dependency between the criteria assessed by the respondents who were authorized to conduct the assessment. The results of the questionnaire were used to describe the relationship between the criteria.

Data Processing

The relationship of dependency between criteria is used to create a network model between criteria as the basis for supplier selection presented in Figure 3. The figure shows the relationship of criteria within clusters (inner dependence) and between clusters (outer dependence). The relationship between these criteria was used to compile a paired comparison questionnaire between criteria and clusters. The results of pair-based comparisons that have been tested with geometric averages are used as input to the Super Decisions software.

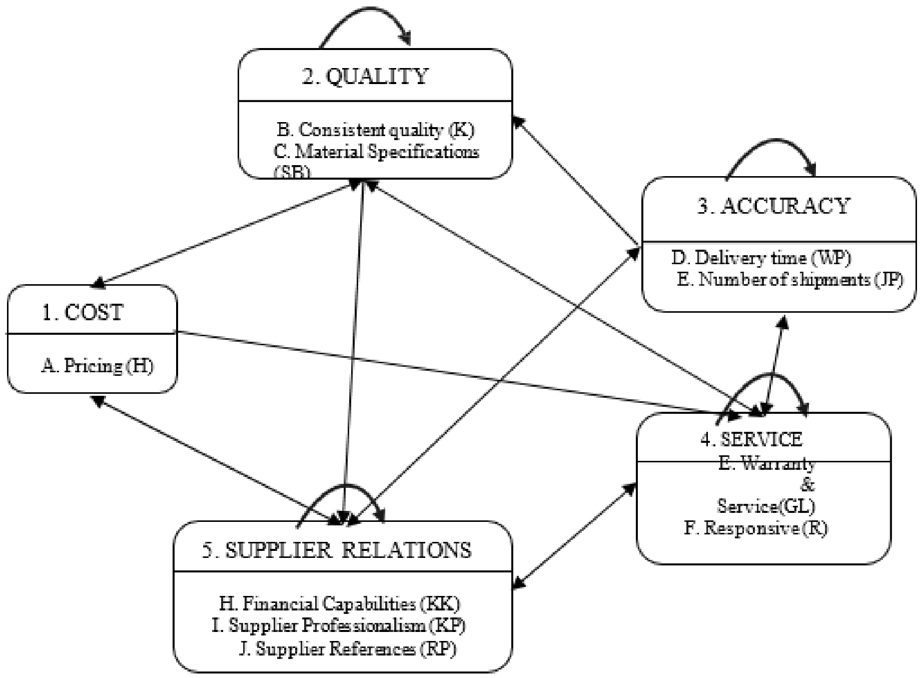


Figure 3. An influential criteria model in supplier selection using *the Analytical Network Process* (ANP)

Source: Analysis results using Super Decisions software

The output of the Super Decisions software in the form of a limiting column is used to show the global weight. The local weight of the criteria is obtained from the final priority results in the normalized by cluster column. From this global weight, the local weight of the cluster can be calculated by dividing the global weight value by the local weight of the criteria. The results of the calculation of local weight and global weight can be seen in Table 3 for the assessment of the production part and Table 5 for the assessment of the management side.

Table 3. Results of the calculation of local weights and global weights of production party assessments

Cluster	Local Weights	Criteria	Local Weights	Global Weight
Cost	0.25	Pricing	1.00	0.25
Quality	0.40	Material Specifications standard	0.40	0.10
		Consistent quality	0.60	0.30
Accuracy	0.10	Delivery time	0.48	0.06
		Number of shipments	0.52	0.04
Service	0.15	Warranty & Service	0.55	0.08
		Responsive	0.45	0.07
Supplier relationships	0.10	Financial Capabilities	0.18	0.03
		Professionalism Suppliers	0.44	0.05
		Supplier references	0.38	0.02
		Total		1

Source: Calculation results using Super Decisions software

Table 4. Ranking criteria in supplier selection of production party assessment

Criteria	Weight	Peringkat
Consistent Quality	0.30	1
Pricing	0.25	2
Raw Material Specification	0.10	3
Warranty & Service	0.08	4
Responsive	0.07	5
Delivery Time	0.06	6
Supplier professionalism	0.05	7
Number of Shipments	0.04	8
Financial Capabilities	0.03	9
Supplier References	0.02	10

Source: Derived from Table 3

Table 5. Results of calculation of local weights and global weights of management assessments

Cluster	Local Weights	Criteria	Local Weights	Global Weight
Cost	0.30	Pricing	1.00	0.30
Quality	0.20	Material Specifications baku	0.45	0.05
		Consistent quality	0.55	0.15
Accuracy	0.10	Delivery time	0.58	0.05
		Number of shipments	0.42	0.05
Service	0.15	Warranty & Service	0.40	0.06
		Responsive	0.60	0.09
Supplier relationships	0.25	Financial Capabilities	0.20	0.07
		Professionalism Suppliers	0.50	0.10
		Supplier references	0.30	0.08
Total				1

Source: Calculation results using Super Decisions software

Table 6. Ranking criteria in the selection of suppliers assessment by management

Criteria	Weight	Rank
Pricing	0.30	1
Consistent Quality	0.15	2
Supplier Professionalism	0.10	3
Responsive	0.09	4
Supplier References	0.08	5
Financial Ability	0.07	6
Warranty & Service	0.06	7
Raw Material Specification	0.05	8
Delivery Time	0.05	9
Number of Shipments	0.05	10

Source: Derived from Table 5

Based on the results of observations, it is known that the selection of banana suppliers by PT XYZ still refers to the quality aspect in accordance with the specifications. Such decision-making can cause problems in terms of untimely completion, raw material specifications that are not in accordance with the agreement, and others. Therefore, this research aims to help companies minimize errors in supplier selection that can result in the company's production process.

According to the production side, the order of the top three criteria considered important in the selection of suppliers is consistent quality, price, and raw material specifications. These criteria account for the greatest weight (Table 4). Meanwhile, according to management, the order of criteria that are considered important is price, consistent quality, and supplier professionalism (Table 6). This condition shows that there is a difference of perspective in determining the weight of the criteria used for supplier selection. Therefore, the determination of the weight of the criteria for supplier selection also needs to be adjusted again.

In examining the two different perspectives, it is necessary to approach the company's interests in the short and long term. The two different perspectives require balanced treatment so that the importance of alignment of perceptions can be emphasized so that PT XYZ's supply chain planning can consider aspects of smooth production.

The results of prioritizing these criteria can be used as the basis for supplier selection. Selecting a supplier that matches the company's desired criteria will open up opportunities for long-term partnerships. A long-term partnership can maintain the commitment between the two parties so as to ensure the flow of materials with appropriate material specifications both in terms of quality, time and quantity of delivery. Risks can also be minimized so as to smooth production flows and reduce the company's production costs.

CONCLUSION

This study recommends that PT XYZ evaluate influential supplier selection criteria by incorporating viewpoints from production and management strata to align diverse interests, ensuring criteria match time-specific needs for cost reduction, productivity gains, and customer satisfaction. Institutionalizing an ANP-based framework in its procurement system would enable consistent, objective assessments through structured team discussions, a weighted scoring system blending perspectives, and periodic updates for evolving market conditions, sustainability, and goals—ultimately fostering resilient supply chains and long-term partnerships. For future research, scholars could extend this model by integrating fuzzy ANP to handle uncertainty in criteria weights or apply it comparatively across multiple automotive firms in Indonesia to validate generalizability.

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