

Application of Analytical Hierarchy Process (AHP) Method in Decision Support System for Selecting Automatic Motorcycle Engine Oil

Agatha Rinta Suhardi

Universitas Widyatama

Email: agatha.rinta@widyatama.ac.id

Abstract

The rapid development of Industry 4.0 has always been an interesting topic of discussion for the manufacturing or service industry. The automotive industry in Indonesia has experienced significant development, although it is currently facing quite significant challenges. In general, this industry is still one of the main contributors to national economic growth. This study aims to obtain decisions in choosing automatic motorcycle engine oil. The research method used is descriptive analysis using the Analysis Hierarchy Process (AHP) with the criteria of oil brand, oil price, oil resistance and oil size. The results of the study showed that the first criterion in having automatic motorcycle engine oil is the oil brand. Of the four oil brands studied, it was found that consumers, especially young people, were SPX 2.

Keywords: decision making, AHP, engine oil.

1. Introduction

The economic conditions in Indonesia after the Covid-19 pandemic are getting better. This has a positive impact on the progress of industry in various fields. Rapid market growth encourages every company to maintain performance to continue to improve in order to survive in global competition. This performance is attempted to optimize output according to consumer expectations. Problems related to supplier selection are important problems in the industry. Company productivity can decrease if there is a mistake in choosing a supplier. Suppliers are one of the supporting factors for smooth processes. One of the activities that plays a significant role in company performance is determining suppliers (Hadiwijaya & Sundari, 2020). The rapid development of Industry 4.0 has always been an interesting topic of discussion for the manufacturing or service industry. The competition that is happening now is not only between one manufacturer and another but has expanded into competition between one supply chain and another. The role of Supply Chain Management or supply chain management includes the relationship between company actors from within and outside the company (Febryanto et al, 2022).

The automotive industry in Indonesia has experienced significant development, although it is currently facing quite significant challenges. In general, this industry is still one of the main contributors to national economic growth. The automotive industry faces various challenges, including global economic uncertainty, rising prices of raw materials and components, and increasingly tight competition. The automotive industry is currently growing in line with technological advances. The automotive industry that is currently developing rapidly is the increasing number of people using automatic motorbikes. In maintaining automatic motorbike engines, motorbike users need engine oil so that the motorbike engine remains durable and works well. Currently, various brands of engine oil have emerged that can be used on automatic motorbikes with various criteria. These various brands make it difficult for consumers who use automatic motorbikes to have the best engine oil. One method of a decision-making system in determining problems involving multiple criteria is the Analytical Hierarchy Process (AHP) method. Analytical Hierarchy Process (AHP) is one method to help compile a priority from various choices using several criteria (Wulandari & Bulan, 2019). The Analytical Hierarchy Process (AHP) method is a framework for making effective decisions on complex problems by simplifying and accelerating the decision-making process by breaking down the problem into its parts. By looking at the criteria used to make decisions, it would be very suitable to use the AHP method with multiple criteria. (Syaif & Riandari, 2020).

2. Literature Review

Supply Chain Management is the integrated process or utilization of suppliers, manufacturers, warehouses, and retailers to produce and deliver good products at the right time and quantity, according to consumer needs at minimum cost. Supply chain management is an approach used to efficiently integrate various organizations from suppliers, manufacturers, distributors, retailers, and customers. That is, goods are produced in the right quantity, at the right time, and at the right place with the aim of achieving minimum overall system costs and also achieving the desired service level. (Suhardi, 2024).

A decision support system can be defined as an information system that helps in identifying decision-making opportunities or provides information to assist in decision-making (Wulandari & Bulan, 2019). Decision making to choose the best supplier based on certain criteria requires a certain method. Analytical Hierarchy Process (AHP) is one method that has both qualitative and quantitative measures in determining suppliers. The decision-making technique in AHP is used to determine the priority of existing supplier alternatives. Priority determination is done by considering certain criteria. (Hadiwijaya & Sundari, 2020).

The Analytical Hierarchy Process (AHP) method was developed by Saaty, a mathematician. This method is a framework for making effective decisions on complex problems by simplifying and accelerating the decision-making process by breaking the problem into its components, arranging the components or variables in a hierarchical order, assigning numerical values to subjective judgments about the importance of each variable and synthesizing various considerations to determine the same variables that have the highest priority and act to influence the outcome in the situation (Wulandari & Bulan, 2019). Analytical Hierarchy Process (AHP) is a method for breaking down a complex unstructured situation into several components in a hierarchical arrangement, by giving subjective values about the relative importance of each variable and determining which variables have the highest priority in influencing the outcome of the situation. The decision-making process is basically choosing the best alternative. Such as structuring the problem, determining alternatives, determining the probability value for the instrumental variables, determining the value, time preference requirements, and specifying the risk. No matter how wide the alternatives that can be determined or how detailed the exploration of the probability value, the limitation that remains is the basis for comparison in the form of a single criterion. The main tool of the Analytical Hierarchy Process (AHP) is to have a functional hierarchy with the main input being human perception. With a hierarchy, a complex and unstructured problem is broken down into its groups and arranged into a hierarchical form (Parhusip, 2019).

The advantages of AHP compared to others are 1) a hierarchical structure, as a consequence of the criteria selected down to the deepest sub-criteria, 2) taking into account validity up to the tolerance limit of inconsistency of various criteria and alternatives selected by decision makers, 3) taking into account the durability or resilience of the output of the sensitivity analysis of decision making. (Parhusip, 2019). Selection criteria are an important element in the activity of determining suppliers. Determination of supplier selection can be done based on price, quality, process capability and delivery timeliness. Cost, quality and delivery parameters are the three main criteria in supplier selection. Furthermore, according to Dickson, the quality aspect is the main criterion in supplier assessment (Hadiwijaya & Sundari, 2020).

3. Research Method

The research method used is descriptive analysis. This study uses a questionnaire that functions as an instrument to obtain data in determining automatic motorcycle engine oil. The object of this study is located at the Honda Workshop (PT Daya Anugrah Mandiri), Soekarno Hatta 518, Bandung, West Java. The criteria for selecting oil are oil brand, oil price, oil durability, and oil size. The stages of the Analysis Hierarchy Process (AHP) method are determining the main criteria, determining alternatives, determining the hierarchy structure, the scale of determining

weights, determining work priorities, determining the consistency matrix, determining alternative criteria. Formula for calculating consistency ratio:

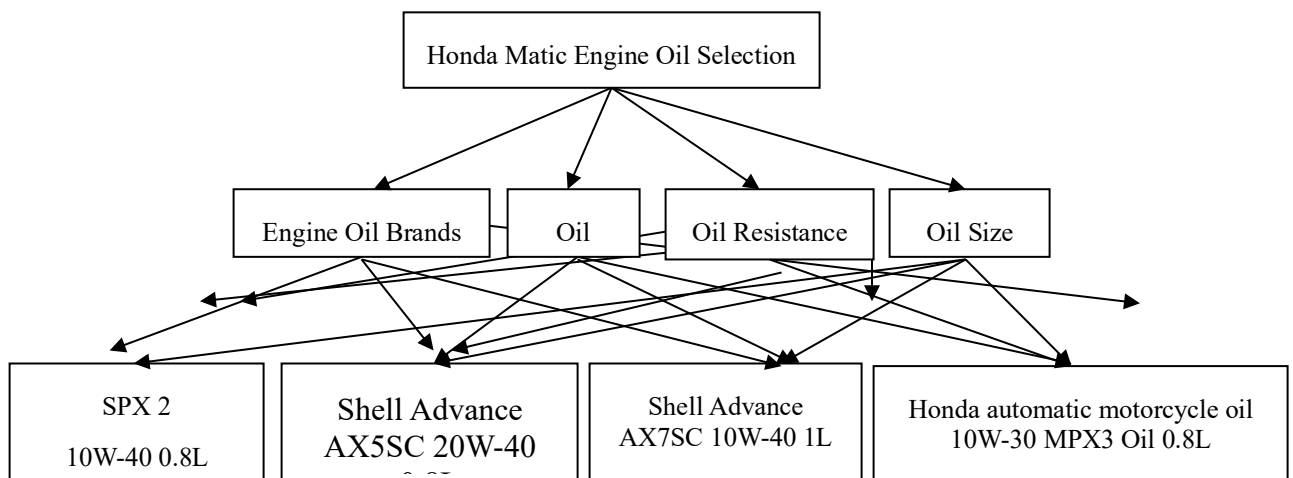
$$CI = \frac{\lambda_{maks} - n}{n - 1} \dots\dots (1)$$

$$CR = \frac{CI}{RI} \dots\dots\dots (2)$$

4. Finding and Discussion

Based on the results of observations conducted at the Honda Workshop, there are quite a lot of automatic motorcycle users, especially in the Bandung city area. Most of these motorcycle users are young people. In this condition, young people are generally not careful in choosing motorcycle oil, but this will actually have a great effect on the automatic motorcycle engine. The research steps used are: (1) Determine the main criteria. The criteria used are oil brand (MO), oil price (HO), oil resistance (KO), oil size (UO). (2) Determine alternatives. The alternative oils used in the study were SPX 210W40 0.8 L, Shell Advance AX5SC 20W40 0.8 L, Shell Advance AX 7 SC 10W-40 1L, Honda Matic Motor Oil 10W-30 MPX 2 Oil 0.8L. (3) Determine the hierarchy structure. The hierarchy structure can be seen in Figure 1.

Figure 1. Hierarchy of automatic motorcycle engine oil selection.



Weighting scale. The weighting scale consists of numbers 1-9 which can be seen in the following table.

Table 1. Scale for Determining Weight Values

Level of Interest	Description
1	Equally Important
3	A Little More Important
5	More Important
7	Very important
9	Absolutely More Important
2, 4, 6, 8	Middle Value

Determining work priorities.

Table 2. Criteria Comparison Scale

Criteria	MO	HO	KO	UO
MO	1	5	3	2
HO	1/5	1	1/3	1/2
KO	1/3	3	1	1/2
UO	1/2	2	2	1

Table 2 is then converted into a pairwise matrix in decimal form.

Table 3. Pairwise Matrix

Criteria	MO	HO	KO	UO
MO	1.00	5.00	3.00	2.00
HO	0.20	1.00	0.33	0.50
KO	0.33	3.00	1.00	0.50
UO	0.50	2.00	2.00	1.00

In considering the criteria, the pairwise matrix will perform calculations using a synthetic method to obtain the overall priority.

Table 4. Pairwise Matrix Addition Results

Criteria	MO	HO	KO	UO
MO	0.49	0.45	0.47	0.50
HO	0.10	0.09	0.05	0.13
KO	0.16	0.27	0.16	0.13
UO	0.25	0.18	0.32	0.25

Table 5. Eigenvalues per criterion

Criteria	Eigenvalues
Oil Brands (MO)	0.48
Oil Price (HO)	0.25
Oil Resistance (KO)	0.18
Oil Size (UO)	0.09

Calculating matrix consistency

Table 6. λ_{max} values and CI criteria

Criteria	MO	HO	KO	UO	Eigenvalues
MO	1.00	5.00	3.00	2.00	0.48
HO	0.20	1.00	0.33	0.50	0.09
KO	0.33	3.00	1.00	0.50	0.18
UO	0.50	2.00	2.00	1.00	0.25
Total	2.03	11.00	6.33	4.00	

$$\lambda_{maks} = (2.03 \times 0.48) + (11.00 \times 0.09) + (6.33 \times 0.18) + (4.00 \times 0.25)$$

$$= 0.97 + 0.99 + 1.14 + 1 = 4.10$$

$$CI = \frac{\lambda_{maks} - n}{n - 1} = \frac{4.10 - 4}{4 - 1} = 0.03$$

Then determine the CR (Consistency Ratio) value for $n = 4$ and $RI = 0.9$

$$CR = CI/RI = 0.03/0.9 = 0.03$$

The CR obtained has a value of $0.03 < 0.10$, so it is considered consistent.

Determine alternative criteria. Alternative oil brand criteria.

The alternative criteria for oil brands used are SPX 210W40 0.8 L, Shell Advance AX5SC 20W40 0.8 L, Shell Advance AX 7 SC 10W-40 1L, and Honda Matic Motor Oil 10W-30 MPX 2 Oil 0.8L.

International Conference of Organizational Innovation 2025

Proceedings

ICOI

2025

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Table 7. Comparison Scale of Alternative Oil Brands

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil
SPX 2	1.00	3.00	2.00	7.00
SA/AX5SC	0.33	1.00	0.50	4.00
SA/AX 7	0.50	2.00	1.00	0.50
MPX 2 Oil	0.14	0.25	2.00	1.00

Table 8. Results of Summation and Eigenvalues of Alternative Oil Brands

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil	Nilai Eigen
SPX 2	0.51	0.48	0.36	0.56	0.48
SA/AX5SC	0.17	0.16	0.09	0.32	0.18
SA/AX 7	0.25	0.32	0.18	0.04	0.20
MPX 2 Oil	0.07	0.04	0.36	0.08	0.14

Based on Table 8, the priority order of criteria and alternative oil brands can be seen as follows:
SPX 2, Shell Advance AX 7 SC, Shell Advance AX5SC, MPX 2 Oil.

Alternative criteria for oil prices.

Table 9. Alternative Comparison Scales of Oil Prices

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil
SPX 2	1.00	0.20	3.00	0.20
SA/AX5SC	5.00	1.00	2.00	0.33
SA/AX 7	0.33	0.50	1.00	3.00
MPX 2 Oil	5.00	3.00	0.33	1.00

International Conference of Organizational Innovation 2025

Proceedings

ICOI

2025

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Table 10. Summation Results and Alternative Eigenvalues of Oil Prices

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil	Nilai Eigen
SPX 2	0.09	0.04	0.47	0.04	0.16
SA/AX5SC	0.44	0.21	0.32	0.07	0.26
SA/AX 7	0.03	0.11	0.16	0.66	0.24
MPX 2 Oil	0.44	0.64	0.05	0.22	0.34

Based on Table 10, the priority order of criteria and alternative oil prices can be seen as follows: MPX 2 Oil, Shell Advance AX5SC, Shell Advance AX 7, SPX 2.

Alternative criteria for oil resistance.

Table 11. Alternative Comparison Scales of Oil Resistance

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil
SPX 2	1.00	4.00	2.00	0.33
SA/AX5SC	0.25	1.00	3.00	0.50
SA/AX 7	0.50	0.33	1.00	3.00
MPX 2 Oil	3.00	2.00	0.50	1.00

Table 12. Summation Results and Alternative Eigen Values of Oil Resistance

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil	Nilai Eigen
SPX 2	0.21	0.55	0.31	0.09	0.29
SA/AX5SC	0.05	0.14	0.46	0.13	0.20
SA/AX 7	0.11	0.05	0.15	0.52	0.21
MPX 2 Oil	0.63	0.27	0.08	0.26	0.31

Based on Table 12, the priority order of criteria and alternative oil resistance can be seen as follows: MPX 2 Oil, SPX 2, Shell Advance AX 7, Shell Advance AX5SC.

Alternative criteria for oil size

Table 13. Alternative Comparison Scales of Oil Sizes

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil
SPX 2	1.00	0.20	3.00	0.50
SA/AX5SC	0.50	1.00	0.50	0.33
SA/AX 7	0.33	2.00	1.00	0.17
MPX 2 Oil	0.20	3.00	6.00	1.00

Table 14. Summation Results and Eigenvalues of Alternative Oil Sizes

Criteria	SPX 2	SA/AX5SC	SA/AX 7	MPX 2 Oil	Nilai Eigen
SPX 2	0.49	0.25	0.29	0.77	0.45
SA/AX5SC	0.25	0.13	0.05	0.05	0.12
SA/AX 7	0.16	0.25	0.10	0.03	0.13
MPX 2 Oil	0.10	0.38	0.57	0.15	0.30

Based on Table 14, the priority order of criteria and alternative oil sizes can be seen as follows: SPX 2, MPX 2 Oil, Shell Advance AX 7, Shell Advance AX5SC

Determining global priorities. This stage is to find the priority of each engine oil based on existing criteria, namely Oil Brand, Oil Price, Oil Durability, and Oil Size. Furthermore, combining the weight of each criterion with the alternative criteria for automatic motorcycle oil. This step is done by compiling a relationship table that describes the weight between each alternative engine oil and the criteria, then the weight of each oil is multiplied by its weight in each criterion and the results are added up.

Table 15. Global Priorities in Selecting Automatic Motorcycle Engine Oil

	Oil Brands(0.48)	Oil Price (0.09)	Oil Resistance (0.18)	Oil Size (0.25)	Total	Ranking
SPX 2	0.48	0.18	0.20	0.14	0.3164	1
SA/AX5SC	0.16	0.26	0.24	0.34	0.2201	4
SA/AX7	0.29	0.20	0.21	0.31	0.2519	3
MPX 2 Oil	0.45	0.12	0.13	0.30	0.2728	2

Based on the results of the table above, it can be seen that the priority of selecting automatic motorcycle engine oil based on the main criteria and alternative criteria obtained the results that the first rank in the priority of selecting automatic motorcycle engine oil is SPX 210W40 0.8 L, Honda Matic Motor Oil 10W-30 MPX 2 Oil 0.8L, Shell Advance AX 7 SC 10W-40 1L, Shell Advance AX5SC 20W40 0.8 L

5. Conclusion

The results of the analysis and data processing can be concluded that in conducting research for the selection of automatic motorcycle engine oil with the first criteria of oil brand, second oil price, third oil resistance and fourth oil size. It can be seen that the highest priority of the main criteria in the selection of automatic motorcycle engine oil, especially among young people, prioritizes oil brands as their main choice. The alternative engine oil criteria studied were SPX 210W40 0.8 L, Shell Advance AX5SC 20W40 0.8 L, Shell Advance AX 7 SC 10W-40 1L, and Honda Matic Motor

International Conference of Organizational Innovation 2025

Proceedings

ICOI

2025

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Oil 10W-30 MPX 2 Oil 0.8L. The community, especially young people, prioritize alternative criteria for oil brands in sequence SPX 2 10W40 0.8 L, Honda Matic Motor Oil 10W-30 MPX 2 Oil 0.8L, Shell Advance AX 7 SC 10W-40 1L, and finally Shell Advance AX5SC 20W40 0.8 L as decision support in selecting engine oil. This decision support system using the Analysis Hierarchy Process (APH) method can help the community, especially young people who like to use automatic motorbikes, in choosing engine oil according to their needs.

Acknowledment. Thank you to all parties, especially Widyatama University and the Bachelor of Management Study Program who have helped so that this research activity can be carried out and run well and according to plan.

References

- Febryanto, I.D., Berlianto, R., Prihono. (2022). Application of the Analytical Hierarchy Process (AHP) Method in Selecting Warehouse Locations for Onlineshop Goods Storage (Case Study: Expedited Shipment of Finished Goods). *Prozima*, 6(2), 120-129.
- Hadiwijaya, N. & Sundari, J. (2020). Penggunaan Analytical Hierarchy Process (AHP) pada Penentuan Prioritas Supplier Food Chemical di PT. Garuda HidroTive Internasional. *Elinvo (Electronics, Informatics, and Vocational Education)*, 5(2), 129-140.
- Parhusip, J. (2019). Penerapan Metode Analytical Hierarchy Process (AHP) Pada Desain Sistem Pendukung keputusan Pemilihan Calon Penerima Bantuan Pangan Non Tunai (BPNT) Di Kota Palangka Raya. *Jurnal Teknologi Informasi*, 13(2), 18-29.
- Suhardi, A.R. (2024). Implementation of Supply Chain Management and Strategic Process in Total Quality Management to Improve Operational Performance. *Quality Innovation Prosperity*, 28(3), 139-160.
- Syaif, M. & Riandari, F. (2020). Analysis Method Analytical Hierarchy Process (AHP) in Taking Decisions on Giving Rewards (Bonuses) Based on Employee Performance. *Jurnal Teknologi Komputer*, 14(2), 391-398.
- Wulandari, R.E., & Bulan, S.J. (2019). Penerapan Analytical Hierarchy Process (AHP) Dalam Perangkingan Bengkel Mobil Terbaik Di Kota Kupang. *Jurnal Teknologi Terpadu*, 5(1), 13-17.

International Conference of Organizational Innovation 2025

Proceedings

ICOI

2025

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>)