Journal of International Conference Proceedings (JICP) Vol. 1 No. 1, pp. 43-54, May, 2024
P-ISSN: 2622-0989/E-ISSN: 2621-993X
https://www.ejournal.aibpmjournals.com/index.php/JICP

Strategies to Enhance the Productivity of an Automotive Company Throughout the Supplier Selection Process Method

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ARTICLE INFORMATION

Publication information

Research article

HOW TO CITE
Muhamar, H., Ananda, I. G., Yurika, N., & Purwanto, P. (2024). Strategies to enhance the productivity of an automotive company throughout the Supplier Selection Process method. *Journal of International Conference Proceedings*, *7*(1), 43-54.

DOI:
https://doi.org/10.32535/jicp.v7i1.3001

Received: 13 March 2024
Accepted: 14 April 2024
Published: 16 May 2024

ABSTRACT

The study aims to determine strategies for selecting suppliers to improve productivity at the automotive company. Supplier selection methods are vital for purchasing and procurement departments, as they directly influence organizational success. By carefully assessing suppliers, these departments can ensure cost efficiency by negotiating favorable terms and prices and guaranteeing high-quality products or services that meet established standards. By employing qualitative research methods, the research scrutinizes the criteria, decision-making processes, and challenges in selecting suppliers through analysis of the methods. The result indicates that the Fuzzy AHP emerges as the most prominent method. The findings of this research contribute to the existing body of knowledge by offering valuable insights and practical implications for improving supplier selection processes within automotive companies. This research identifies and ranks criteria for supplier selection and monitoring, as well as explains where supplier selection strategies could be improved, with the ultimate goal of improving supply chain management and overall organizational performance in the automotive sector.

Keywords: Automotive Industry; Procurement; Purchasing; Selection Method; Suppliers

INTRODUCTION

The business market is becoming increasingly competitive as advancements in technology provide opportunities for innovation and the creation of more distinctive and current products (Andiana & Kusmantini, 2024). One of how the supply chain contributes to the enhancement of productivity is through the selection of raw materials that are both affordable and of high quality. Product flow is one of the systems that make up the supply chain (Emhar, 2013). Using this approach, items are transported from suppliers to customers, and it is necessary to have a strong network of raw material providers to guarantee that product capacity coverage is maintained (Leng & Zailani, 2012). In light of this, serious consideration ought to be given to it. One of the things that might increase the performance of the product flow is the selection of the supplier (Rohmanna et al., 2022).The growth and long-term viability of an organization is achieved by the strategic utilization of available resources, the consolidation of production sources, and the coordination and integration of these elements to create unique outcomes (Sandroto et al., 2024).

Strategic planning is the first step in supply chain management (SCM). During this step, businesses make projections about demand, create production plans, and design strategies for sourcing and procurement. This foresight guarantees that supply and demand are aligned, so reducing the expenses associated with carrying inventory and preventing stockouts while simultaneously ensuring that products are available when they are required. In our globally interconnected and globalized world, technology plays an essential part in SCM. As a result of the visibility, agility, and reactivity that are provided by supply chain planning software, inventory management systems, and real-time analytics tools, businesses are able to quickly adjust their operations in response to shifting market conditions and fluctuating client requirements. In its most basic form, efficient management of the supply chain is a multi-faceted activity that calls for teamwork, creativity, and ongoing development. Building resilient and competitive supply chains that are capable of driving success in a market that is constantly shifting can be accomplished by organizations through the optimization of processes, the utilization of technology, and the prioritization of customer needs.

Effective collaboration between a manufacturer and suppliers is essential since the lack of coordination leads to significant delays, inferior product quality, and ultimately, unsatisfactory customer service (Anaraki et al., 2021). As organizations increasingly rely on external suppliers and manufacturers and outsource their operations, the negative impacts of making poor decisions become more significant. Consequently, an outsourced-type producer must evaluate, control, and choose its suppliers.

Managing operations and managing the procurement of raw materials in the business is one of the fundamental elements to being productive, and one of the primary keys to being successful is supplier selection (Bai & Sarkis, 2010; Parthiban et al., 2013). Supplier selection involves the evaluation of many factors and conflicting objectives in order to choose providers that meet the desired quality, price, timing, and quantity requirements (Mangka et al., 2021). Hence, choosing the appropriate supplier substantially decreases procurement expenses, promotes market competitiveness, and improves end-user contentment. The supplier selection process aims to find suppliers with considerable ability to satisfy a manufacturer's demands consistently and with satisfactory general performance (Anaraki et al., 2021).

Converting needs into effective criteria can be challenging since needs are typically represented as generic qualitative ideas, but criteria should be precise requirements that

can be statistically evaluated. As companies increasingly seek to establish strategic partnerships with their suppliers, there is a need for an effective tool to assist these organizations in evaluating the performance of potential suppliers, selecting the most suitable ones, and managing the resulting strategic partnerships (Anaraki et al., 2021). Several methods have been suggested to evaluate these criteria, including Multi-Criteria Decision Analysis (MCDA), Linear Programming (LP), Fuzzy, Neural Networks, Data Envelopment Analysis (DEA), Quality Function Deployment (QFD), and other techniques.

The automotive supply business, which operates in a highly competitive environment in today's global market, must prioritize supplier selection in order to ensure its continued success (Gergin et al., 2022). The automotive industry is a prominent sector in the economics of developed nations and needs efficient supply chain management. Within the context of the automotive industry, the term "supply chain" refers to the network of organizations, resources, activities, and technologies that are engaged in the process of designing, manufacturing, distributing, and maintaining automobiles and the components that include them. Numerous stakeholders are involved at each stage of the supply chain for automobiles, which is characterized by its high level of complexity and interconnectedness. It is necessary for these stakeholders to effectively coordinate and collaborate with one another in order to guarantee that operations will run smoothly and that vehicles and components will be delivered on schedule. Over the past few years, the dynamics of the automotive supply chain have been further impacted by a number of variables, including globalization, outsourcing, and just-in-time production techniques.

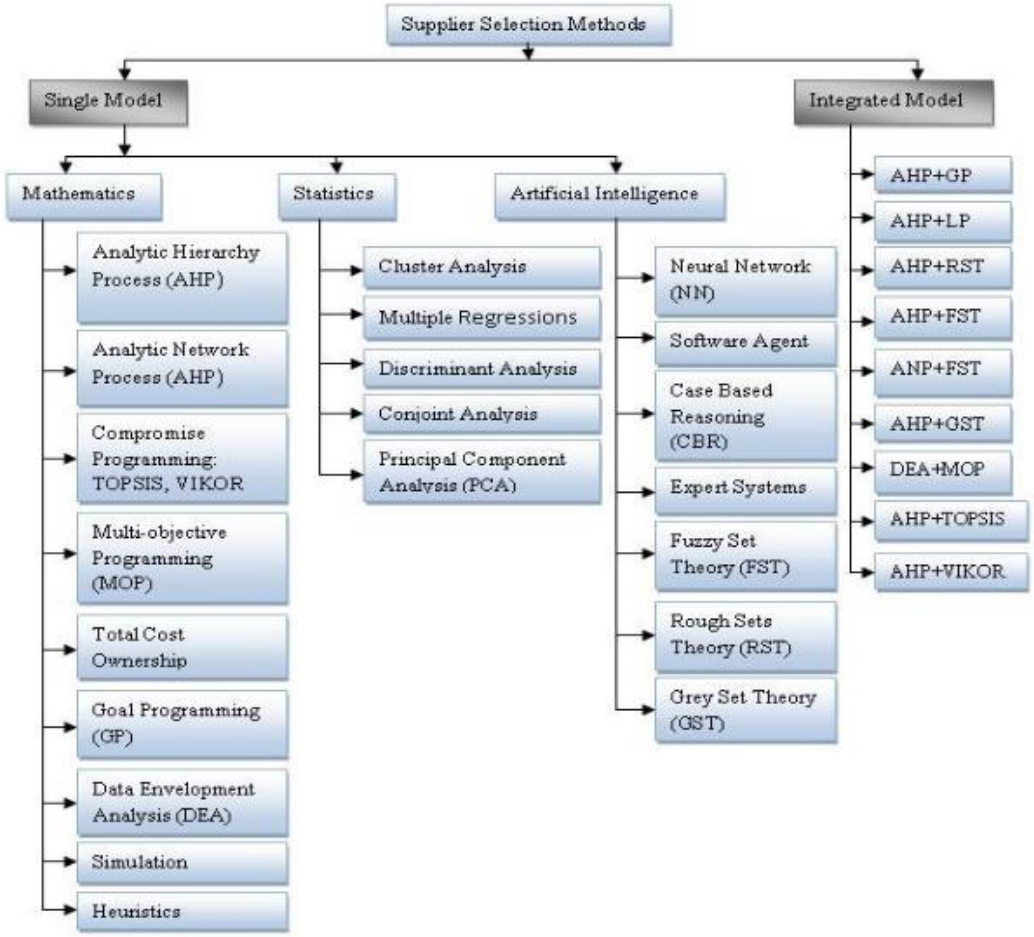
The article outlines a methodical structure for the selection of suppliers in the automotive company. Specifically, the research focuses on the process of supplier selection using a certain methodology. The paper is structured into six sections. Part 1 about the Introduction of supplier selection. Part 2 presents the literature review. Part 3 offers succinct descriptions of several approaches to selecting supplier analysis methodologies. Meanwhile, Part 4 explores the process of selecting suppliers for the automotive industry as a result. Part 5 about the discussion. Ultimately, Part 6 presents the conclusions.

LITERATURE REVIEW

Supplier selection method is a crucial part of procurement, a variety of both quantitative and qualitative factors impacting the decision-making process make the supplier selection issue complicated and risky. The automotive industry, particularly the electric automobile sector, is experiencing rapid expansion, with revenues exceeding 10 million in 2022. The proportion of electric automobiles in overall sales has increased by over thrice in a span of three years, rising from approximately 4% in 2020 to 14% in 2022 (Shree et al., 2024). Consequently, the supplier must possess the appropriate supplier selection methodology to meet the significant demand. The selection process starts from information sharing where the procurement will find many suppliers before applying the selection process, this information sharing process is important because it will affect the performance of a company (Andiana & Kusmantini, 2024). The selection process aims to identify and collaborate with suppliers that best meet an organization's requirements in terms of quality, cost, delivery, and reliability. Before discussing supplier selection methods appropriate for the automotive sector, it would be beneficial to have a general understanding of all currently used methods. Tookey states that supplier selection is one of the most important aspects of supply chain management. This is a multiple-criteria decision-making (MCDM) problem that incorporates both qualitative and quantitative criteria (Thiruchelvam & Tookey, 2011). To get more understanding of supplier methods,

let's examine the following Figure on supplier selection methods for classification put forth by Mukherjee (2016).

Figure 1. Classification Supplier Selection Methods



Source: Mukherjee (2016)

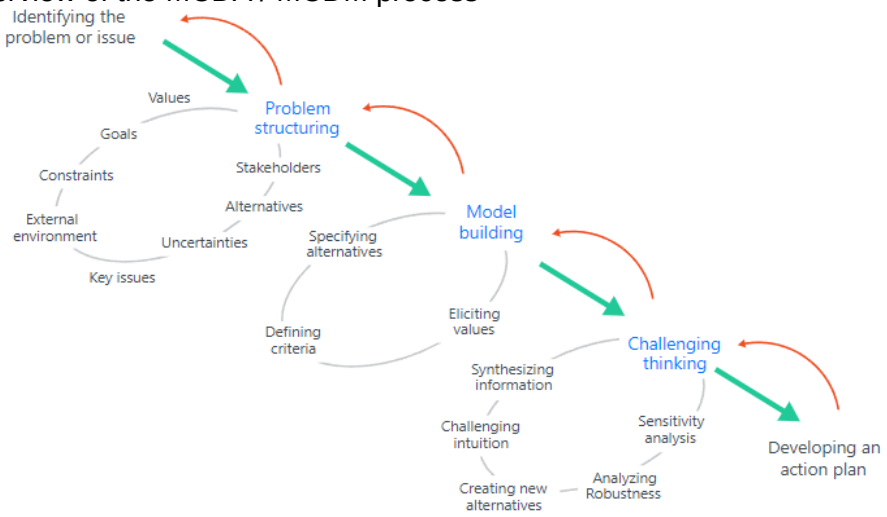
There are two models of supplier selection method: Single model and Integrated model. Single-model supplier selection methods can be advantageous in terms of simplicity, efficiency, and ease of use, but they may lack flexibility, provide an incomplete analysis, and risk overlooking important factors. Integrated models, on the other hand, can address these limitations by considering multiple criteria and objectives simultaneously, providing a more comprehensive analysis of the supplier selection process. Integrated models for supplier selection are designed to address the complexity and uncertainty inherent in the supplier selection process, providing a more comprehensive and effective approach to selecting the right set of suppliers. Various methods and approaches from these two models have been studied in the literature to optimize the selection process, of the many existing methods there are some prominent methods.

Multi-Criteria Decision Making

Benjamin Franklin presented an outline of the first formal method for multi-criteria decision-making in 1772 (Franklin & Bigelow, 1904). Franklin addressed a well-known letter to his friend Joseph Priestley, who is famous for a number of things, including the discovery of oxygen. In the letter, Franklin detailed his technique, which he referred to as "moral or prudential algebra." The ranking or selection of alternatives (including individuals) based on the joint consideration of numerous criteria is a characteristic that

is shared by all MCDA applications, including the ones that are being discussed in these instances. To provide the most possible "value for money," several applications also entail the distribution of budgets or other limited resources among a number of different choices. The Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are two techniques that are frequently utilized for the purpose of selecting suppliers. The MCDA method incorporates both of these techniques. The AHP method breaks down complicated decisions into a hierarchy of criteria and alternatives, which enables decision-makers to rank the criteria in order of importance and evaluate suppliers based on those criteria. On the other hand, TOPSIS assigns a ranking to suppliers based on the distance between them and the ideal and negative-ideal solutions.

Figure 2. Overview of the MCDA / MCDM process



Source: 1000minds (n.d.)

Linear Programming (LP)

In 1827, Fourier presented a method for solving linear inequalities that is today known as LP. This method is also the name of the Fourier–Motzkin elimination method. Fourier is at least partially attributed with the challenge of solving systems of linear inequalities, according to Sierksma and Zwols (2015). LP is a somewhat well-known topic of optimization for a number of different reasons. The formulation of practical challenges in operations research is frequently accomplished through the use of LP problems (Dantzig, 1982). In a mathematical model with linear requirements and a linear objective function, the goal of linear programming is to discover the best possible outcome for the set of parameters. The purpose of LP is to maximize or minimize a linear function while adhering to linear equality and inequality constraints when solving the problem. A convex polytope is defined by the constraints, and the objective function is a linear function that is specified on this polytope. In order to tackle problems that involve optimization, planning, scheduling, and resource allocation, partial differential equations LP are utilized in a variety of domains, including engineering, business, economics, and mathematics.

Fuzzy Set Theory and Neural Network

Fuzzy sets, also known as uncertain sets, are sets in mathematics where the elements have varying degrees of membership. Zadeh (1965) independently developed fuzzy sets in 1965 as an expansion of the traditional idea of a set. An expansion of classical set theory that permits elements to have different membership levels is called fuzzy set theory. Fuzzy sets, in contrast to classical sets, have ambiguous boundaries and

elements with degrees of membership ranging from 0 (not included) to 1 (fully included). Classical sets have elements that either belong or do not belong. A neural network is a type of computer model that draws inspiration from the architecture and functionality of real neurons found in the brain. It is composed of networked neurons, which are interconnected units that process and transmit information. Artificial neural networks are utilized in machine learning applications, while biological neural networks are present in the nervous systems of living things. Neural networks are used in machine learning to approximate nonlinear functions and thus solve complex problems like pattern recognition. It uses the weighted sum of all the inputs, adjusted for the weights of the connections between the inputs and the neuron, to determine the output of the neuron. We increase this sum by a bias term (Dawson & Wilby, 1998). The fuzzy set theory allows for the representation of vague and subjective information, while neural networks can learn from historical data to predict supplier performance and make recommendations.

Data Envelopment Analysis (DEA)
In operations research and economics, DEA is a nonparametric technique used to estimate production frontiers (Charnes et al., 1978). DEA is a useful technique in economics and operations research for calculating the production frontier and evaluating the efficiency of decision-making units (DMUs). By analyzing the data at hand, the DEA evaluates the input and output combinations of DMUs to assess their level of efficiency. It is particularly useful for assessing the performance of manufacturing and service operations and establishing benchmarks in operations management. DEA has been utilized in various fields, including international banking, logistical applications, economic sustainability, and police department operations. DEA is a method that helps evaluate the efficiency of suppliers by comparing their input and output quantities. It is a non-parametric approach that provides insights into relative efficiency. Suppliers who operate on the efficiency frontier are highly regarded as the most efficient and desirable options.

Quality Function Deployment (QFD)
A technique called QFD was created in Japan in 1966 to assist in translating customer feedback into engineering specifications for a product (Akao & Mazur, 2003). The term QFD refers to a procedure that involves the compilation of customer needs and the translation of those requirements into thorough engineering specifications. It places a significant amount of importance on listening to the voice of the customer (VOC) and ensuring that their requirements are interpreted in order to develop features in products that are tailored to meet their expectations. When it comes to analyzing the relationships that exist between product design, technical specifications, and consumer preferences, QFD is an organized strategy that may be utilized. It finds widespread application in a variety of industries, including engineering, manufacturing, research and development, and information technology engineering. In QFD, the most important tool is the "house of quality" matrix, which provides a graphical representation of the connection between product characteristics and customer needs. Six Sigma and Total Quality Management (TQM) are two procedures that aid firms in creating items that have a greater possibility of fulfilling the expectations of their customers. QFD is an integral component of these processes. Customers are the primary focus of the QFD methodology, which converts client requirements into specific technical requirements and evaluates suppliers based on their capacity to fulfill these criteria. The alignment of the capabilities of the provider with the requirements of the client is emphasized.

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P-ISSN: 2622-0989/E-ISSN: 2621-993X
https://www.ejournal.aibpmjournals.com/index.php/JICP

Suitable Selection Method for the Automotive Industry

The term QFD refers to a procedure that involves the compilation of client requirements and the translation of those needs into thorough engineering specifications. It is recommended to conduct a review of previous studies in order to ascertain the selection strategy that is most suitable for the automotive sector. When dealing with issues pertaining to the selection of suppliers, it is usual practice to adopt multiple Criteria Decision Making (MCDM) approaches. These approaches are typically utilized for tackling challenges that involve multiple conflicting criteria. The existing body of research contains a great number of studies that employ MCDM approaches for the purpose of selecting an appropriate supplier.

Table 1. Review of Automotive Supplier Selection Studies

No.	Study	Method	Sensitivity Analysis	Illustrative or Case Study
1	Kokangul & Susuz (2009)	AHP-Mathematical Programming	-	Case study
2	Kasirian et al. (2010)	AHP and ANP	-	Case study
3	Zeydan et al. (2011)	Fuzzy AHP-Fuzzy TOPSIS	-	Case study
4	Huang & Hu (2013)	Fuzzy ANP-Goal Programming	-	Case study
5	Dargi et al. (2014)	Fuzzy ANP	-	Case study
6	Keramati et al. (2014)	QFD (Quality Function Deployment)-ANP	+	Case study
7	Ayag & Samanhoglu (2016)	Fuzzy ANP	-	Case study
8	Dweiri et al. (2016)	AHP	+	Case study
9	Galankashi et al. (2016)	Balanced scorecard- Fuzzy AHP	-	Illustrative
10	Khan et al. (2016)	AHP-QFD	-	Case study
11	Zimmer et al. (2017)	Fuzzy AHP	+	Case study
12	Jain et al. (2018)	Fuzzy AHP and TOPSIS	+	Case study
13	Jiang et al. (2018)	Grey DEMATEL based ANP	+	Case study
14	Vasiljevic et al. (2018)	Rough AHP, Fuzzy AHP	-	Case study
15	Gupta et al. (2019)	Fuzzy AHP with MABAC, WASPAS TOPSIS	+	Case study
16	Suraraksa & Shin (2019)	AHP	-	Illustrative
17	Hadian et al. (2020)	VIKOR-AHP-BOCR	-	Case study
18	Manupati et al. (2021)	Fuzzy AHP-Fuzzy TOPSIS-Fuzzy VIKOR	-	Case study

Source: Gergin et al. (2022)

MCDM techniques are frequently utilized in the automotive business, as indicated by the table that incorporates the most recent research in the field. There are some studies that suggest a preference for employing a single MCDM strategy, while other studies

demonstrate a preference for utilizing integrated and fuzzy MCDM methods. It is possible to draw conclusions about the increasing popularity of the MCDM process as a selection method. On the other hand, the study that is going to follow will shed light on the method that is most suitable for the automobile sector within the framework of MCDM.

RESEARCH METHOD

The utilization of qualitative research methodology in a research publication that centers on supplier selection procedures in the automotive sector provides significant contributions by shedding light on the intricate and diverse aspects of supplier selection processes. A notable strategy is conducting a comprehensive search of secondary data sources, including procurement journals, supply chain journals, and publications focused on decision-making within the automotive industry. This study examines the experiences, obstacles, and decision-making factors associated with supplier selection, providing insights into the intricate nature of this process as explored in prior research. Furthermore, the utilization of case studies can be employed as a means to analyze certain occurrences of supplier selection inside automotive companies. Scholars have the opportunity to uncover ideal approaches, potential downsides, and the influence of various aspects such as quality, cost, reliability, and innovation on the process of selecting suppliers through the investigation of these practical circumstances. This is made possible by the examination of different practical situations. The usage of a qualitative approach makes it possible to gain a more comprehensive understanding of the subjective opinions, wishes, and apprehensions that have an effect on the process of selecting suppliers. The application of this method is a valuable supplement to quantitative methodologies, as it provides a full perspective on the landscape of supplier selection within the automotive industry.

RESULTS

The timely delivery of spare parts from the suitable supplier has a direct influence on the interests of businesses in the market as well as the strategic advantage they have over their competitors. According to this point of view, the process of selecting suppliers, which entails taking into consideration a number of different variables, is considered to be a vital decision-making process for companies. Furthermore, the necessity of proper collaboration and selection in supply chain management has increased during the current COVID-19 epidemic. This is true in terms of both the economic and social elements of the situation.

The purpose of this publication is to research and identify the most suitable option for adoption in the automotive supply business. In addition to this, a thorough investigation of a business that offers replacement parts for automobiles is carried out in an extremely effective manner. The first stage in the implementation of this idea is the formation of a group of knowledgeable individuals who will have the responsibility of managing the sector. Subsequently, a pool of criteria is developed by conducting an exhaustive examination of the current literature concerning the criteria that are utilized for the selection of suppliers.

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P-ISSN: 2622-0989/E-ISSN: 2621-993X
https://www.ejournal.aibpmjournals.com/index.php/JICP

Table 2. Review of Table 1

Method	Study No.																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
AHP	1	1						1		1						1	1		6
Mat Prog	1																		1
ANP		1				1							1						3
Fuzzy AHP			**1**						**1**		**1**	**1**		**1**	**1**			**1**	**7**
Fuzzy TOPSIS			1									1						1	3
Fuzzy ANP				1	1	1	1												4
Goal Programming				1															1
QFD						1				1									2
Balanced Scoredcard									1										1
Grey Demantel Base													1						1
Rough AHP														1					1
MABAC WASPAS															1				1
VIKOR																	1		1
BOCR																	1	1	2

Source: Author's Documentation

In Gergin et al. (2022), the Fuzzy AHP emerges as the most prominent method, as depicted in Figure 2.

DISCUSSION

AHP is a decision-making methodology that is widely used. It provides a methodical approach to complex problems that involve a number of criteria and several alternatives. A scientific framework for evaluating and ranking suppliers in accordance with a wide range of criteria, such as quality, cost, delivery, and reliability, is provided by the AHP within the automotive industry. The AHP is a framework that helps to facilitate the breakdown of the decision-making process into a hierarchical structure. This framework enables decision-makers to effectively dissect the problem into smaller, more manageable components and to construct linkages between criteria and possibilities. The AHP is a method that assigns weights to criteria and conducts pairwise comparisons in order to facilitate the quantification of subjective judgments and preferences in the process of selecting suppliers. The use of this strategy enables businesses to arrive at conclusions that are more sensible and well-informed.

Furthermore, the AHP facilitates the identification of the most appropriate supplier by taking into account the relative significance of each criterion and evaluating the extent to which each provider corresponds with these criteria. This approach promotes a clear and uniform assessment procedure, allowing firms to make strategic choices that maximize supplier effectiveness and improve overall supply chain effectiveness. In the automotive industry, the utilization of the AHP in supplier selection has been found to have a positive impact on decision-making processes, supplier relationships, and overall operational effectiveness. Through the utilization of the analytical capabilities of the AHP, firms can optimize their procurement procedures, minimize potential risks, and establish a lasting competitive edge within a constantly evolving market landscape.

CONCLUSION

In conclusion, this research highlights the significant significance of supplier selection within the automotive sector and the various approaches that may be employed to enhance this procedure. Through the effective evaluation and selection of suppliers,

organizations have the potential to optimize efficiency, guarantee product quality, and ultimately enhance customer happiness. There exist several supplier selection methods, including the AHP and MCDM techniques such as the Fuzzy AHP, which provide systematic methodologies for assessing suppliers according to numerous criteria and objectives. These approaches facilitate the ability of decision-makers to prioritize many aspects, including quality, pricing, delivery, and reliability. As a result, they help decision-makers to make educated and strategic supplier selections.

Successful operational outcomes rely on crucial collaboration between manufacturers and suppliers, as suboptimal supplier selection can lead to delays, subpar product quality, and disappointing customer service. Organizations can optimize their procurement processes, minimize expenses, and improve market competitiveness by utilizing methods such as AHP and MCDM. In general, the publication emphasizes the importance of supplier selection within the automotive sector and underscores the necessity for companies to embrace methodical and evidence-based strategies for assessing suppliers. Through the utilization of sophisticated methodology and optimal approaches in the process of supplier selection, organizations can cultivate robust supplier relationships, enhance operational effectiveness, and attain enduring expansion within the contemporary competitive market environment.

LIMITATION

This study's limitation is the number of informants or industries that supply the necessary data. To gather a more complete set of data, the number of key informants who contributed it should have exceeded five. This is also relevant to the time required for in-depth interviews and field observations. Using mixed techniques would have resulted in more robust results. This study we just researched based on the result of our interview to some experts in automotive industry.

ACKNOWLEDGEMENT

Firstly, we would like to say to thank you to our supervisor Mr. Purwanto, S.T, MM, PhD for his professional guidance and support, who has provided invaluable assistance and direction, enabling us to conduct research and write this paper smoothly.

Secondly, we wish to extend our thanks to everyone who has offered assistance and support, directly or indirectly, in the completion of this paper. Your contributions, no matter how small, have been indispensable. We would also like to thank all the participants and respondents involved in this study. Your participation and cooperation have enabled this research to proceed smoothly, providing vital data and information for the paper.

Lastly, we hope that our research could give you some advice to find the method for selecting supplier or some choice before you decide. So, this paper can contribute to research to find the best supplier for automotive industry.

DECLARATION OF CONFLICTING INTERESTS

We thus declare that no competing interests exist in relation to the study, endeavor, or activity detailed in the publication entitled “Strategies to Enhance the Productivity of an Automotive Company Throughout the Supplier Selection Process Method”. We can ensure any possible conflicts of interest have been truthfully and openly declared. We have taken steps to reduce the impact of any competing interests on the research, project, or activity, and we have done everything possible to ensure objectivity and accuracy in the material presented in this publication.

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