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Strategies for automotive filter component manufacturers towards electric vehicles era in Indonesia

Rahmat Nurcahyo*, Hikari Nurhadi, Muhammad Habiburrahman

Department of Industrial Engineering, Faculty of Engineering, University of Indonesia, Depok 16424, Indonesia

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Abstract

In conventional cars, a filter is one of the automotive components directly associated to the internal combustion engine (ICE) and will be disappeared if electric vehicles dominate. By carrying out a case study approach to filter manufacturers and formulating problems with a strategic management approach and SWOT analysis, the results show that filter manufacturers can still take advantage of opportunities by using their existing internal strengths; therefore, an alternative strategy is to implement aggressive or diversification strategies in the future.

Keywords: Filter; electric vehicle; SWOT; strategy

1. Introduction

Current environmental problems cannot be separated from automotive vehicles that use an internal combustion engine (ICE) which causes greenhouse gas emissions in the environment. Fuel-based internal combustion engines have high emission levels because they operate on fossil fuels that provide about 25% of the world's power (about 3000 of the oil equivalent of 13,000 million tonnes per year), which causes about 10% of greenhouse gas emissions. (GHG) world (Reitz et al., 2020).

Historical data shows that the discovery of new oil reserves occurs slowly; on the contrary, oil consumption shows a high growth rate. If oil discovery and consumption follow current trends, the use of world oil resources around 2038 will become increasingly difficult (Ehsani, Gao, Longo, & Ebrahimi, 2018).

One of the solutions to these two issues is to develop an electric vehicle (EV). Many countries have supported the development of sustainable technology in the automotive sector by making innovations regarding this EV (International Energy Agency, 2020). In general, electric vehicles are classified as Plug-in Electric Vehicle (PEV), Hybrid Electric Vehicle (HEV), and Fuel Electric Vehicle (FEV) based on their energy source and propulsion device (Chan & Chau, 2001; Chau, 2015). Many countries worldwide have also started to appeal and make policies regarding electric vehicles that encourage public interest in using these vehicles, which is evidenced by the sales of these environmentally-friendly vehicles, where sales of electric vehicles always increase every year (International Energy Agency, 2020).

There are several studies about predicting the existence of electric vehicles in many countries with various research methods. Even in Indonesia, which has carried out this research, it is estimated that the dominance of electric vehicles will begin to appear in 2030 to 20 years later. This depends on various aspects, especially subsidies and government policies related to electric vehicles (Maghfiroh, Pandyaswargo, & Onoda, 2021). Vehicles with internal combustion engine-based are supported by more automotive components than electric vehicles. About 30% of automotive components in vehicles with internal combustion engines based will disappear along with the shift in the use of electric vehicles in the public where it is estimated that electric vehicles will dominate more than vehicles with internal combustion engine based in the next 10 to 30 years around the world.

Almost every manufacturing element in the house, automobile, or office uses a filtering process at some point throughout the manufacturing process. There will be numerous changes if particles cannot be separated from the fluid. The filter is primarily used to remove pollutants (typically solids) from usable fluids (water and gas), such as drinking water, cabin air, fuel (gas or liquid), lubricating fluids, compressed air, or processed air, as well as to extend the service life or avoid fouling of other equipment. For example, the engine will be compressed in the car due to particulate contamination in the fuel, intake air, and lubricating fluids. These emissions are far more harmful to the environment (Sparks & Chase, 2013).

A filter is one of the automotive components that is directly related to an internal combustion engine. With the existence of electric vehicles, a vehicle (passenger car) no longer needs a fuel filter, air filter and oil filter, and only one filter is used by electric vehicles, namely the cabin air filter. Thus, it is necessary to take advantage of new opportunities for automotive filter manufacturers in Indonesia by developing alternative strategies based on a review of external aspects as

* Corresponding author.
Email: rahmat@eng.ui.ac.id.
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well as internal factors owned by the company that will have an impact on the company's business performance in the future. The novelty of this paper lies in the strategies formulated for automotive filter manufacturers.

2. Methodology

The research was conducted at a filter manufacturer in Indonesia which produces various types of automotive filters. Then the analysis is carried out based on external and internal factors of the company, and assessment variables can be identified to the 30 respondents of research objects who are experts in their fields those are related to internal factors of the company, namely Representative Management, Marketing, Finance & Finance, Research and Development, and Information Systems. Identifying external and internal aspects must involve all levels, from managers to employees (David, 2015).

The research was conducted using an analysis of the company's external and internal conditions based on the identified variables from the company's external and internal factors through the data obtained during the last 3-10 years. This research refers to the methodology of (David, 1986) regarding EFE and IFE, then performs a correlation test using product moment Pearson's analysis and validation test, then the last one formulates the matching stage with the SWOT Matrix, IE Matrix, and Grand Strategy Matrix.

Authors identified external and internal factors based on books and journals to provide a questionnaire which shared to a team of experts and for all levels of employees in filter companies to obtain data and information about the strengths and weaknesses of the company, as well as evaluate external aspects as opportunities and threats for the company.

Politics, Economics, Sociocultural, and Technological (PEST) variables may all be used to identify points that can be used to evaluate external factors within the organization (Macmillan & Tampoe, 2012). The summary of those factors are:

(1) Changes in politics are likely to affect a wide range of issues, including general political climate, government changes, shifts in global powers, and particular laws and regulations. Automotive is one of five primary industries that Indonesia is encouraging as a focus area, which might provide an opportunity for filter producers to participate in electric vehicles era in Indonesia. However, the new regulation of electric vehicles, including government incentives (reduced pricing) for utilizing electric vehicles, might challenge filter producers. The application of taxes will depend on the vehicle's exhaust emissions under the policy of Sales Tax on Luxury Goods (PPnBM or *Pajak Penjualan Atas Barang Mewah*). Green technology cars, particularly pure electric vehicles (PEV), will profit from this.

(2) The potential attractiveness of alternative strategies is directly influenced by economic factors. For example, when interest rates rise, capital expansion funds become more expensive or unavailable. In terms of economics, Indonesia performed admirably. Although Indonesia's Gross Domestic Product (GDP) is considered very good, at 5 percent, compared to the world average of only 2.7 percent, a stronger dollar and rising inflation reduce consumer interest in purchasing goods and services.

(3) Sociocultural changes include social, cultural, demographic, and environmental shifts that affect all goods, services, markets, and customers. With a population growth rate of 1.01 percent each year, market potential and superior resources will expand. The average consumption activity of Indonesians, on the other hand, falls by 1.3 percent per year.

(4) Technology has the potential to affect product innovation, knowledge, distribution channels, and work processes in ways that may be both opportunities or threats. Even if there will be some challenges to electric vehicle regulations, the government will continue to promote technological development. From 2015 to 2035, biofuel and gas vehicles will require a filter to filter contaminants from biofuel and gas engines, and as information technology advances, it will be easier to find various sources of information about electric vehicles, and the global development of filters could be a big opportunity for filter manufacturers. The key issue with electric vehicle technology is that battery prices have dropped by 34 percent on average over the previous 10 years, implying that by 2040, there will be a price parity between electric and conventional vehicles, posing a danger to vehicles powered by internal combustion engines.

Furthermore, all companies have strengths and weaknesses in the functional areas of business when it comes to internal factors. In every sector, no company is equally strong or weak. Setting objectives and plans is based on internal strengths and weaknesses, external opportunities/threats, and a clear mission statement. Five key factors are evaluating the company's internal factors, namely company management, marketing, finance/accounting, production/operations, research and development (R&D), and information system operations management that described by David (2015) as:

(1) Planning, organizing, motivating, staffing, and regulating are the five main operations that make up the management function. Although management at this company has a formal corporate reporting structure as well as a formal planning, control, and coordination system and is assessed on a regular basis, the distribution of awards, positions, bonuses, and wages among employees has not been equitable.

(2) The process of identifying, predicting, developing, and fulfilling client wants and desires for products and services is known as marketing. The company's popularity with consumers, brand names, and excellent quality stems from having a large number of customers with various types of filters and good brand names, making it Indonesia's top filter producer. However, due to backorders and claims, its capacity to have many different filters causes a lack of positive connections and relationships that are efficient, effective, supportive, and mutually beneficial.

(3) Finance is frequently seen as the most accurate indicator of a company's competitive position and overall investor appeal. It is critical to determine the organization's financial strengths and weaknesses in order to formulate effective plans. Investment decisions, funding decisions, and dividend decisions are all part of the financial/accounting function (Fredrikson, 1969). According to the company's annual report, the financial capacity of its loans and its ability to create internal money are both excellent.

(4) The production/business operation function's inputs,

processes, and outputs differ between industries and markets. Production/operations management, according to Roger Schroeder, consists of five functions or decision areas: process, capacity, inventory, labor, and quality. The company's weaknesses include semi-automated production/manufacturing technology, the utilization of a large workforce, and poor access to raw materials (imports), which creates delays in the manufacturing process.

(5) Supporting current companies, assisting in the launch of new businesses, producing new goods, enhancing product quality, boosting manufacturing efficiency, and deepening or extending the company's technological capabilities are all examples of research and development. A well-equipped and globally recognized filter testing laboratory delivers expanded ideas and scientific skills to meet customer demands.

(6) All business functions are linked through information, which serves as the foundation for all managerial initiatives. Conducting an internal audit requires assessing the company's internal strengths and weaknesses in information systems. End-to-end ERP (Enterprise Resource Planning) may increase corporate performance by providing accurate real - time data.

3. Results and Discussion

To ensure the validity of the factors that have been developed in the External Factor Evaluation (EFE) Matrix and the Internal Factor Evaluation (IFE) Matrix, a survey is carried out to determine the weight and rating of all of these factors. From the weight and rating of all the factors that have been carried out, a correlation test and validity test can be carried out to determine whether the statement items are valid or not. Correlation testing was conducted by using the Pearson Product Moment correlation formula. Then the validity test was carried out. Table 1 and Table 2 explain the initial results regarding the EFE and IFE matrix statement items.

Table 1 shows the calculation of the EFE Matrix, which is used to eliminate factors that are not valid based on r count less than 0.361. Factor O1 "Automotive is one of the five main sectors that have been chosen by Indonesia as a priority industry to promote" and T4 "The average consumer activity of Indonesians falls by 1.3 percent per year" are eliminated since both r-count are less than 0.361.

Table 2 shows the calculation of the IFE Matrix, which is used to eliminate factors that are not valid based on r count less than 0.361. Factor S5 "Use of end to end ERP (Enterprise Resource Planning) can improve company performance to get correct and accurate information" and W3 "The company has semi-automated production/manufacturing technology with the use of a lot of manpower" are eliminated since both r-count are less than 0.361

Table 1. External factors evaluation matrix for filter manufacturers

Factor	Code	Statement Item	Weight	Rating	Score	Correlation of Weight	Correlation of Rating	rcount > 0.361
Opportunities	**O1**	Automotive is one of the five main sectors that have been chosen by Indonesia as a priority industry to promote.	0.099	3.000	0.296	0.335	0.394	Not Valid
	O2	Indonesia's Gross Domestic Product (GDP) is rated as extremely good, with a growth rate of 5 percent compared to the global average of only 2.7 percent.	0.097	2.233	0.216	0.600	0.415	Valid
	O3	The company's market potential and superior resources will be enhanced by a population growth rate of 1.01 percent every year.	0.093	2.567	0.238	0.404	0.490	Valid
	O4	Technology development is aided by the government. From 2015 until 2035, biofuel and gas cars will require a filter to remove contaminants from their engines.	0.107	3.300	0.353	0.491	0.631	Valid
	O5	With the advancement of information technology, finding numerous sources of information on electric vehicles and the growth of filters throughout the world is becoming easier.	0.115	3.667	0.422	0.386	0.498	Valid
Threats	**T1**	When utilizing electric vehicles, the government provides incentives (reduced pricing).	0.101	3.167	0.319	0.777	0.595	Valid
	T2	The application of taxes will be dependent on the exhaust emissions produced by the vehicle under the policy of Sales Tax on Luxury Goods (PPnBM). Green technology cars, particularly pure electric vehicles, will profit from this	0.100	3.067	0.306	0.722	0.431	Valid
	T3	Consumer enthusiasm in purchasing goods and services is declining as the currency strengthens and inflation rises.	0.100	3.067	0.306	0.528	0.475	Valid
	T4	The average consumer activity of Indonesians falls by 1.3 percent per year.	0.088	2.400	0.210	0.306	0.403	Not Valid
	T5	In the last ten years, technology has reduced battery prices by 34 percent on average, resulting in a price parity between electric and conventional vehicles in 2040.	0.102	2.700	0.275	0.408	0.400	Valid
		Total Score	**1**		**2.941**			

Table 2. Internal factors evaluation matrix for filter manufacturers

Factor	Code	Statement Item	Weight	Rating	Score	Correlation of Weight	Correlation of Rating	rcount > 0.361
Strengths								
	S1	Management is assessed on a regular basis and adopts a formal corporate reporting structure as well as a formal planning, control, and coordination system.	0.101	3.333	0.338	0.461	0.566	Valid
	S2	By having a large number of customers, the company has a solid reputation with customers, brand names, and excellent quality.	0.110	3.533	0.390	0.373	0.391	Valid
	S3	The company's loan financial capacity and ability to generate internal funds are both excellent.	0.101	3.267	0.331	0.684	0.519	Valid
	S4	To fulfill client requests, a well-equipped and globally recognized filter testing laboratory delivers enhanced ideas and scientific skills.	0.106	3.400	0.362	0.375	0.469	Valid
	S5	End-to-end ERP (Enterprise Resource Planning) can help the company acquire more accurate and real time information.	0.097	2.933	0.286	0.340	0.376	Not Valid
Weaknesses								
	W1	Each employee's awards, positions, incentives, and salary were not distributed properly.	0.096	2.733	0.264	0.593	0.669	Valid
	W2	Due to backorders and claims, there is a lack of efficient, productive, helpful, and mutually beneficial interactions and relationships.	0.095	2.933	0.280	0.508	0.464	Valid
	W3	With a lot of manpower, the company has semi-automated production/manufacturing technologies.	0.090	2.200	0.199	0.320	0.402	Not Valid
	W4	Delays in the manufacturing process are caused by a lack of availability of raw materials (imports).	0.096	2.600	0.251	0.456	0.566	Valid
	W5	Due to the lack of a dedicated Research and Development (RnD) division, the potential to develop is limited.	0.104	3.167	0.331	0.693	0.575	Valid
		Total Score	**1**		**3.030**			

After conducting a validation test on the evaluation of external and internal factors, the results show that O1, T4, S5, and W3 are invalid statements because, based on the conclusion, the test results are r count < r table. Thus the final results obtained on the statement both from the evaluation of external factors and internal factors are described in table 3 and table 4 as follows:

Table 3. Final external factors evaluation matrix

Factor	Code	Statement Item	Weight	Rating	Score
Opportunities					
	O2	Indonesia's Gross Domestic Product (GDP) is rated as extremely good, with a growth rate of 5 percent compared to the global average of only 2.7 percent.	0.118899	2.23333	0.266
	O3	The company's market potential and superior resources will be enhanced by a population growth rate of 1.01 percent every year.	0.113892	2.56667	0.292
	O4	Technology development is aided by the government. From 2015 until 2035, biofuel and gas cars will require a filter to remove contaminants from their engines.	0.131414	3.3	0.434
	O5	With the advancement of information technology, finding numerous sources of information on electric vehicles and the growth of filters throughout the world is becoming easier.	0.141427	3.66667	0.519
Threats					
	T1	When utilizing electric vehicles, the government provides incentives (reduced pricing).	0.123905	3.16667	0.392
	T2	The application of taxes will be dependent on the exhaust emissions produced by the vehicle under the policy of Sales Tax on Luxury Goods (PPnBM). Green technology cars, particularly pure electric vehicles, will profit from this	0.122653	3.06667	0.376
	T3	Consumer enthusiasm in purchasing goods and services is declining as the currency strengthens and inflation rises.	0.122653	3.06667	0.376
	T5	In the last ten years, technology has reduced battery prices by 34 percent on average, resulting in a price parity between electric and conventional vehicles in 2040.	0.125156	2.7	0.338
Total Scores			**1**	**2.993**	

Table 4. Final internal factors evaluation matrix

Factor	Code	Statement Item	Weight	Rating	Score
Strengths	**S1**	Management is assessed on a regular basis and adopts a formal corporate reporting structure as well as a formal planning, control, and coordination system.	0.124847	3.33333	0.4162
	S2	By having a large number of customers, the company has a solid reputation with customers, brand names, and excellent quality.	0.135863	3.53333	0.48
	S3	The company's loan financial capacity and ability to generate internal funds are both excellent.	0.124847	3.26667	0.4078
	S4	To fulfill client requests, a well-equipped and globally recognized filter testing laboratory delivers enhanced ideas and scientific skills.	0.130967	3.4	0.4453
Weaknesses	**W1**	Each employee's awards, positions, incentives, and salary were not distributed properly.	0.118727	2.73333	0.3245
	W2	Due to backorders and claims, there is a lack of efficient, productive, helpful, and mutually beneficial interactions and relationships.	0.117503	2.93333	0.3447
	W4	Delays in the manufacturing process are caused by a lack of availability of raw materials (imports).	0.118727	2.6	0.3087
	W5	Due to the lack of a dedicated Research and Development (RnD) division, the potential to develop is limited.	0.128519	3.16667	0.407
		Total Scores	**1**	**3.1342**	

Table 3 shows the valid factors in EFE Matrix. The highest factor in opportunities is O5 “With the advancement of information technology, finding numerous sources of information on electric vehicles and the growth of filters throughout the world is becoming easier” and the highest factor in threats is T1 “When utilizing electric vehicles, the government provides incentives (reduced pricing)”.

Table 4 shows the valid factors in IFE Matrix. The highest factor in strength is S2 “By having a large number of customers, the company has a solid reputation with customers, brand names, and excellent quality” and the highest factor in weakness is W5 “Due to the lack of a dedicated Research and Development (RnD) division, the potential to develop is limited”.

After calculating the evaluation of the final external and internal factors, it is obtained on the X and Y axes. It is known that the development of the SWOT matrix strategy for filter manufacturers in facing the use of electric vehicles in Indonesia is in quadrant 1 where this strategy supports an aggressive strategy for growth. with the following calculations:

Y axis = EFE matrix value =

$$\sum_{O0}^{On} weight\ (On) x\ rating\ (On) - \sum_{T0}^{Tn} weight\ (Tn) x\ rating\ (Tn) \qquad (1)$$

Based on the results of the assessment from table 1 and the formula, the results are obtained Y-axis = 1.510 – 1.482 = + 0.028

X axis = IFE matrix value =

$$\sum_{S0}^{Sn} weight\ (Sn) x\ rating\ (Sn) - \sum_{W0}^{Wn} weight\ (Wn) x\ rating\ (Wn) \qquad (2)$$

Based on the results of the assessment from table 1 and the formula, the results are obtained X-axis = 1.749 - 1.384 = + 0.365

Different calculation with SWOT analysis. After getting the numbers on the X-axis and Y axis, it is known that the IE Matrix develops strategy for filter manufacturers in facing the transition usage of electric vehicles in Indonesia is in quadrant IV, namely grow and build where the strategy that will be used is the integration strategy or intensive strategy by doing the following calculations:

Y axis = EFE matrix value =

$$\sum_{O0}^{On} weight\ (On) x\ rating\ (On) + \sum_{T0}^{Tn} weight\ (Tn) x\ rating\ (Tn) \qquad (3)$$

Based on the results of the assessment from table 1 and the formula, the results are obtained Y-axis = 1.510 + 1.482 = 2.993

X axis = IFE matrix value =

$$\sum_{S0}^{Sn} weight\ (Sn) x\ rating\ (Sn) + \sum_{W0}^{Wn} weight\ (Wn) x\ rating\ (Wn) \qquad (4)$$

Based on the results of the assessment from table 2 and the formula, the results are obtained X-axis = 1.749 + 1.384 = 3.13.

In the SWOT analysis, the results obtained from external factors based on opportunities and threats are valued at + 0.028, and internal factors based on strengths and weaknesses are valued at + 0.365, where both values are positive and support aggressive strategies for filter manufacturer in facing the transition usage of electric vehicles in the future. Based on the SWOT analysis calculation, the company's position is currently in quadrant 1, which supports an aggressive strategy where the company has opportunities and strengths to utilize existing opportunities.

It is known that this company is in quadrant 1 in the SWOT analysis, so the next step is to take advantage of the existing aspects of the opportunity factor as well as the strength aspects of the company. After identifying the aspects of SO strategy, it was found that there are two strategies that this filter company can implement, namely:

- Strengthen and focus on existing business (increase automotive filter sales) by (1) Increasing control over distributors, retailers, and suppliers, (2) Seeking increased market share through greater marketing efforts and (3) Introducing the current product or service into a new geographic area. (S1, S2, S3, O2, O3, O4)
- Looking for increased sales by conducting research on improving current products or developing new

products outside the automotive segment. (S2, S3, S4, O2, O4, O5).

The Grand Strategy Matrix is a tool for formulating alternative strategies by positioning all organizations or companies in one of the four strategic quadrants. The placement of an organization or company is seen from the real condition of the company based on data and facts obtained from various sources. If we refer to the factors previously discussed, it can be said that this company fits in the position in quadrant 1. which has been obtained based on the survey results that have been mentioned in processing using SWOT.

In the IE matrix calculation, the results obtained for the external factors are 2.993, which are in a moderate condition and the internal factors are 3.13, which have a good position of internal strength in the 4th quadrant. Then the results show that the IE matrix is positioned to grow and build for the filter manufacturer where the strategy used is an integration strategy and an intensive strategy.

Based on the analysis results, there is a second scenario if there is an assessment where the threats are higher than the opportunities. Looking at the results of external factors in the SWOT analysis, which are small, namely +0.028, nearly to the negative results and if the results show a shift to a negative value, there will be a second scenario where the strategy taken is to avoid threats by utilizing existing internal strengths. Based on the identification of external factors, starting from the future threats where currently Indonesia is more serious about supporting the electric vehicle acceleration program by starting to make several policies that support the development of electric cars, such as Providing incentives (lowering prices) from the government for using electric vehicles and providing disincentives for conventional vehicles based on internal combustion engine. Another threat is the Policy on Sales Tax on Luxury Goods (PPnBM) regarding the imposition of taxes based on exhaust emissions produced by vehicles, which means it will benefit green technology vehicles, especially for pure battery electric vehicles (BEV). Apart from a policy perspective, another thing that must be considered in the development of technology towards a decrease in battery prices, which, known in the last 10 years, has averaged 34% price reduction, which causes a balance in prices between electric vehicles and conventional vehicles for the further years. Therefore it will be more interested in the use of electric vehicles both in terms of policy and price for the customers, and it can be concluded that internal combustion engine-based vehicles can be replaced by electric vehicles in the future.

After identifying external factors regarding future threats in the second scenario, the company can use these strengths to anticipate future threats with its internal strengths. With the strength on the management side that carries out the company's formal reporting structure, planning system, control, and formal coordination to be evaluated regularly, the company can properly monitor its sales and production capabilities to be able to immediately take quick steps in analyzing and dealing with threats from the electric vehicle. Implementing international standards for management systems becomes a critical step and decision for the companies in order to survive in the competition (Alfredo & Nurcahyo, 2018), one of which is ISO 9001 quality management system that has a significant positive impact on the operational and business performance (Nurcahyo & Sumaedi, 2011; Nurcahyo, Zulfadlillah, & Habiburrahman, 2021). Then with the ability of a company that has a good customer reputation, brand name, and quality, it will make it easier for the company to make sales to many customers who can be identified by the company regarding regulations, segmentation, and sales trends in the region. One proven effective way is by implementing an integrated Six Sigma system to improve quality and customer satisfaction (Pranoto & Nurcahyo, 2014). Moreover, the three most important indicators for manufacturing reputation are sustainability award, certification of environmental and social standards and resource productivity. (Nurcahyo, Pustiwari, & Gabriel, 2018).

In addition, by utilizing financial capacity, corporate loan finance, and the company's ability to generate internal funds very well, it can be an important force in anticipating threats to electric vehicles. Then finally, based on the identification of the company's internal factors, having the internationally accredited filter testing laboratory can provide increased ideas and scientific capabilities in fulfilling all customer demands regarding testing of all types of filters with various standards owned by many countries and can develop products according to the filter specifications desired by customers. The testing laboratory also serves for quality assurance since the manufacturing strategy related to quality has a significant positive impact on manufacturing performance (Saptioratri Budiono, Nurcahyo, & Habiburrahman, 2021).

Thus, the diversification strategy can be an alternative strategy in this second scenario where the company can take advantage of internal strengths to avoid existing threats. There are two strategic supports for this type of diversification: related diversification and unrelated diversification.

By utilizing the company's strength in marketing capabilities, good finance, and product development capabilities by using good laboratory facilities, diversification related to similar products can be carried out. And, it can be analyzed based on the support of external factors, especially the government support factor in utilizing the country's natural resources for the manufacture of biofuels and gas for various types of industries. In contrast, it is known the current policy of using biofuels in the future for trucks, buses, heavy equipment, industrialization and machinery still requires four types of filters, namely oil, fuel, air, and cabin filters (for trucks and buses) can be an alternative scenario in facing the threat of filter manufacturers to the transition to using electric vehicles. In addition, unrelated diversification can be done by utilizing the ability of management to monitor and evaluate the level of sales and production of the company to be able to take steps in facing future threats and is supported by good financial capacity, controlling corporate loans, and the company's ability to eared funds, the diversification of unrelated products can also be a company choice in facing future threats if the related diversification is not a good choice.

4. Conclusion

Currently, automotive component manufacturers, especially those that support internal combustion engines, can consider carrying out a long-term strategy resulting from the advent of electric vehicles. Based on government policies that have now emerged due to the presence of electric vehicles, the economy

of a country in increasing production and service capabilities, consideration of inflation on the rupiah exchange rate, culture and social affairs of the Indonesian people based on the level of consumption and population growth, technological aspects, both in terms of technology for the development of electric vehicles that increasingly fast and information technology regarding filters, automotive components and electric vehicles.

Of the three techniques, the matching stage strategies can have a consistent result, namely taking advantage of opportunities with the strengths of the company where the identification of the SWOT analysis and the big strategy matrix is positive, namely + 0.028 for the external factors evaluation and + 0.365 for the internal factors evaluation. Meanwhile, based on the IE matrix analysis, the results obtained are 2.993 for the external factors evaluation and 3.13 for the internal factors evaluation. Thus an alternative strategy that can be conducted is to implement an integration strategy for both suppliers and customers and also an intensive strategy in product development and market development that will depend on the filter sales trend going forward, so filter manufacturers can still carry out with aggressive strategies in the future.

However, there is a second scenario if the results show a regression to the negative value at the matching stage strategy, where after identifying in the SWOT analysis results, the positive value on the external factor matrix is very small and is almost close to a negative value, namely + 0.028 in the SWOT analysis. If the results show a negative value, then the alternative strategy is to diversify with the related or unrelated product because this analysis is strongly influenced by the evaluation of the company's internal factors that have strengths in terms of financial support, product development, and good marketing to avoid threats in the future based on the information that has presented, the highest sales that always increase of each for the other filter segment every year are truck, bus, heavy equipment, machinery, and industrialization segments, therefore even though the filter will disappear in the automotive business line, the filter manufacturer has a wide segmentation of filters and it can make the preparation if there is a shifting in the value of the trend for the opportunities and threats that will occur in the future.

There are still many gaps that can be completed in automotive component manufacturers that support internal combustion engine vehicles is facing the emergence of electric vehicles in the future. Because so far, the research has been looking for ways to increase the effectiveness and efficiency of electric vehicle production and automotive component companies related to internal combustion engines must have a way of facing threats in the future. The author gives the following suggestions for further research.

Further research can be developed with other methods and can achieve the best choice of strategy by using the QSPM method. Research is needed on automotive components that support internal combustion engines other than filters because the cases for utilizing opportunities and threats will differ. To increase the novelty that exists, mid-level companies or small companies that produce automotive components based on internal combustion engines can be the new object of further research because the challenges that will be faced in the future will be more difficult than larger companies.

References

Alfredo, E. I., & Nurcahyo, R. (2018). *The impact of ISO 9001, ISO 14001, and OHSAS 18001 certification on manufacturing industry operational performance.* Paper presented at the Proceedings of the International Conference on Industrial Engineering and Operations Management Bandung.

Chan, C. C., & Chau, K. T. (2001). *Modern Electric Vehicle Technology*: Oxford University Press.

Chau, K. T. (2015). *Electric Vehicle Machines and Drives: Design, Analysis and Application*: Wiley-IEEE Press.

David, F. R. (1986). The strategic planning matrix—a quantitative approach. *Long Range Planning, 19*(5), 102-107. doi:https://doi.org/10.1016/0024-6301(86)90015-4

David, F. R. (2015). *Strategic management concepts and cases: a competitive advantage approach.* (15 ed.).

Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M. (2018). *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles* (3rd ed.): CRC Press.

Fredrikson, E. B. (1969). [Financial Management and Policy, James C. Van Horne; Basic Financial Management: Text, Problems and Cases, Edward J. Mock, Robert E. Schultz, Raymond G. Schultz, Donald Hart Shuckett]. *The Journal of Finance, 24*(3), 565-568. doi:10.2307/2325369

International Energy Agency. (2020). *Policies to promote electric vehicle deployment*. Retrieved from https://www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment

Macmillan, H., & Tampoe, M. (2012). *Strategic Management process, content and implementation*. UK: Oxford University Press.

Maghfiroh, M. F. N., Pandyaswargo, A. H., & Onoda, H. (2021). Current Readiness Status of Electric Vehicles in Indonesia: Multistakeholder Perceptions. *Sustainability, 13*(23), 13177.

Nurcahyo, R., Pustiwari, S., & Gabriel, D. S. (2018). Developing a strategy map based on sustainability balanced scorecard framework for manufacturing industry in Indonesia. *International Journal of Engineering & Technology, 7*(2.34), 48-51.

Nurcahyo, R., & Sumaedi, S. (2011). *"Studi Penerapan ISO 9001 pada layanan administrasi di perguruan tinggi XYZ"* / Study of the Application of ISO 9001 in administrative services at XYZ higher education. *Jurnal Standardisasi, 13*(3), 155-162.

Nurcahyo, R., Zulfadlillah, & Habiburrahman, M. (2021). Relationship between ISO 9001:2015 and operational and business performance of manufacturing industries in a developing country (Indonesia). *Heliyon, 7*(1), e05537. doi:https://doi.org/10.1016/j.heliyon.2020.e05537

Pranoto, S., & Nurcahyo, R. (2014). *Implementation of integrated system Six Sigma and importance-performance analysis for quality improvement of HSDPA telecommunication network and customer satisfaction.* Paper presented at the Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management.

Reitz, R. D., Ogawa, H., Payri, R., Fansler, T., Kokjohn, S., Moriyoshi, Y., . . . Zhao, H. (2020). IJER editorial: The future of the internal combustion engine. *International Journal of Engine Research, 21*(1), 3-10. doi:10.1177/1468087419877990

Saptioratri Budiono, H. D., Nurcahyo, R., & Habiburrahman, M. (2021). Relationship between manufacturing complexity, strategy, and performance of manufacturing industries in Indonesia. *Heliyon, 7*(6), e07225. doi:https://doi.org/10.1016/j.heliyon.2021.e07225

Sparks, T., & Chase, G. (2013). *Filters and Filtration Handbook*. UK: Butterworth-Heinemann.