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Enhancing Strategic Decision-Making in Tire Manufacturing through an Integrated SWOT–AHP Approach.

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ABSTRACT

A popular technique for analyzing a company's or industry's strengths and weaknesses (internal factors) as well as opportunities and threats (external elements) of the marketplace environment is the SWOT analysis. SWOT analysis is the fundamental framework for conducting decision-situation analysis. Due to the inability to rank the importance of the SWOT components in this study, we suggested enhancing SWOT analysis using the multi-criteria Analytic Hierarchy Process (AHP) decision-making technique. Using the eigenvalue computation, the AHP technique compares factors or criteria pairwise to determine their priority. The purpose of implementing the integrated approach is to enhance strategic planning's quantitative aspect.

Keywords: SWOT, AHP, Strategic analysis, Tire Manufacturing

INTRODUCTION

The tire manufacturing sector is an active and fiercely competitive one, and businesses are always looking for new and creative ways to ensure they remain ahead of the trend. This case study examines how a top tire manufacturer used the Analytic Hierarchy Process (AHP) in conjunction with the SWOT (Strengths, Weaknesses, Opportunities, and Threats) strategic analysis framework. This case study explores how the tire manufacturing company can methodically evaluate its external environment and internal capabilities by combining the AHP and SWOT approaches. The organization may pinpoint areas for enhancement, market opportunities to seize, risks to be minimized, and essential skills by performing a SWOT analysis. The outcomes obtained form the basis for the later use of AHP, thereby rendering it easier to rank strategic initiatives according to their significance and fit with the objectives of the company. By evaluating the detected SWOT factors using pairwise comparisons, the recommended approach is achieved (Shinno et al., 2006). Subsequently, eigenvalue analysis of comparison matrices is used in the Analytic Hierarchy Process (AHP) to assess the corresponding importance of each SWOT component to establish priorities. The findings of this study demonstrate the advantages of the SWOT-AHP method for evaluating strategic choices. The reason for this chosen industry is because the tyre industry is a significant sector in the global economy, with a large market size and a wide range of applications across various industries, including automotive, aerospace, and construction. This company can be used as a real-world example that can be applied to various industries, making it a practical case study for demonstrating the application of SWOT-AHP analysis in strategic decision-making.

SWOT ANALYSIS

A form of contextual analysis known as SWOT analysis is used to propose strategies after conducting an assessment of both external and internal components, such as opportunities and threats, in addition to internal resources, such as strengths, strategies, and weaknesses (Noh, 2006). Future business tactics must take into account external as well as internal variables, and SWOT analysis helps to develop simple yet effective strategies. Numerous industries, notably the automotive sector (D'Adamo et al., 2020; Rauch et al., 2015; Wang et al., 2020), have benefited from such kinds of study to establish goals and make key choices. SWOT analysis is still used today and has been for a while when proposing strategies.

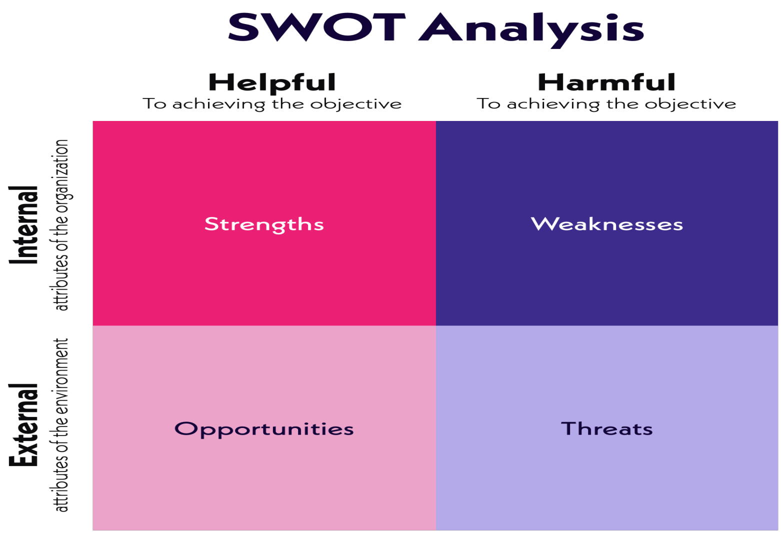

Figure 1: SWOT analysis framework

ANALYTIC HIERARCHY PROCESS

An intricate problem can be broken down into a multilevel hierarchical structure of goal, requirements, and options using the Analytic Hierarchy Process (AHP), a multi-criteria decision-making approach that may assist in clarifying an overall selection procedure (Sharma et al., 2008). To identify the corresponding value of a element at every stage of the hierarchy as well as to weigh the choices at the most fundamental level of the hierarchy and select the most beneficial selection among them by AHP conducting pairwise comparisons. AHP is an excellent method to formulate selections, notably when partiality is present. It is a useful tool for solving issues when the option requirements can be divided into smaller categories in a structured manner (Tuzmen & Sipahi, 2011). In multilevel systems of hierarchy, AHP serves to extract relative priority on absolute ranges from ongoing and distinct paired comparisons. Adopting a comparison scale (see Table 1) developed by Saaty (1980) to give a number to each criteria that represents its respective importance carries out the ranking technique. These factors' pairwise comparison matrices offer a way to determine their importance.

Numerical values	Description	Explanation
1	Equal importance of both elements	Two elements contribute equally
3	Moderate importance of one element over another	Experience and judgment favour one element over another
5	Strong importance of one element over another	An element is strongly favoured
7	Very importance of one element over another	An element is very strongly dominant
9	Extreme importance of one element over another	An element is favoured by at least on order of magnitude
2, 4, 6, 8	Intermediate values between two adjacent judgments	Used to compromise between two judgments

Table 1: Pairwise comparison scale

Three guiding concepts form the basis of the AHP technique: first, the model's structure; second, a comparative assessment of the alternatives and potentially requirements; and third, an overview of the priorities. AHP has been extensively utilized in academic research to address a wide range of decision-making issues (Lee et al., 2011). In the initial stage, a decision problem is structured systematically. An sophisticated multi-criteria decision-making problem is first dividing by AHP into a hierarchy of connected decision factors (requirements, decision alternatives). The goals, standards for making decisions, and available options are grouped using the Analytic Hierarchy Process (AHP) in a manner akin to a ancestral tree. A hierarchy comprises three sections at minimum: the problem's general objective at the highest section, a set of parameters in the middle that outline the alternatives, and the alternatives at the bottom.Whenever the problem is broken down and a hierarchy has been established, the process of prioritizing factors is initiated to ascertain their respective levels of significance. Depending on the predetermined criteria in the higher level, the standards established in all stages are compared pairwise proportional to their respective degrees of influence. Multiple pairwise comparisons in AHP are predicated on a nine-level standardized comparison scale (Albayrak et al., 2004). Let C = {Cj | j = 1, 2,..., n} be the set of criteria. An (n x n) evaluation matrix M, in which each element a ij (i, j = 1, 2,..., n) is the quotient of weights of the criteria, can be used to describe the outcome of the pairwise comparison on n criteria. A square and reciprocal matrix can be used to illustrate this. The recognized upper bound for CR is 0.1. To increase consistency, the review process must be repeated if the final consistency ratio is higher than this threshold.

n	1	2	3	4	5	6	7	8	9	10
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

Table 2: Random index

SWOT-AHP MODEL

Using the eigenvalue computation, AHP compares evaluation factors pairwise to determine their priority. Normally, a SWOT analysis does not measure the components' weightiness to ascertain how each factor affects the suggested approach options. To address this shortcoming, the model has been included and examined through the AHP and its eigenvalue calculation procedure, and the SWOT model is transformed into a hierarchical structure (Kangas et al., 2001; Kajanusa et al., 2004).The aim of applying the Analytic Hierarchy Process (AHP) to the SWOT framework is to carefully identify and compare the degree of significance of the SWOT variables. Three stages are involved in using the suggested method (Gallego- Ayala & Juizo, 2011):

- Listing the significant external (opportunities and threats) and internal (strengths and weaknesses) elements that contribute to the strategic planning process is the first stage in creating a SWOT analysis.

- Pairwise comparisons are used in the second stage to determine each SWOT group's weights.

- The AHP is then utilized in the third stage to determine the relative importance of each component inside the SWOT groups. The local weights of the factors are then multiplied by the particular group weight to give the overall factor weight rank.

In order to make components comparable and encourage a more numerical basis in the development of strategies, Kurttila et al. (2000) created a comprehensive SWOT analysis with AHP. This better technique has been look into and adopted in a plenty of different industries. For example, it has been applied to predict offshore decisions for sport marketing (Lee et al., 2011), assess practices for overseeing forest properties (Kangas et al., 2003), assess the marketing scheme for Sri Lanka's tourism revival (Wickramasinghe & Takano, 2010), analyze the global competitiveness of machine tool manufacturers, formulate secure bulk chemical transportation strategies in tankers (Arslan and Er, 2008), determine business strategies in textile firms, establish strategies for the Turkish chemicals industry, analyze Naval mishaps at the Istanbul Strait, choose shipping registers in the seaborne transportation sector, and carefully carry out comprehensive hydrological management in Mozambique (Gallego-Ayala and Juizo, 2011).

METHODOLOGY AND APPLICATION

Decision makers can examine a specific scenario as thoroughly and precisely by using the SWOT-AHP analysis method, which provides weights to SWOT components and aspects (Kurttila et al., 2000). As a result, the SWOT-AHP analysis approach is applied in this study, which may propose strategies that incorporate both internal and external elements and take into account professional perspectives. The three components of the AHP structure in this study are the aim to be attained by the selection, the SWOT groups, and the elements featured within each SWOT group (sub-criteria). Figure 2 displays the SWOT structure's hierarchical form (Gallego- Ayala and Juizo, 2011).

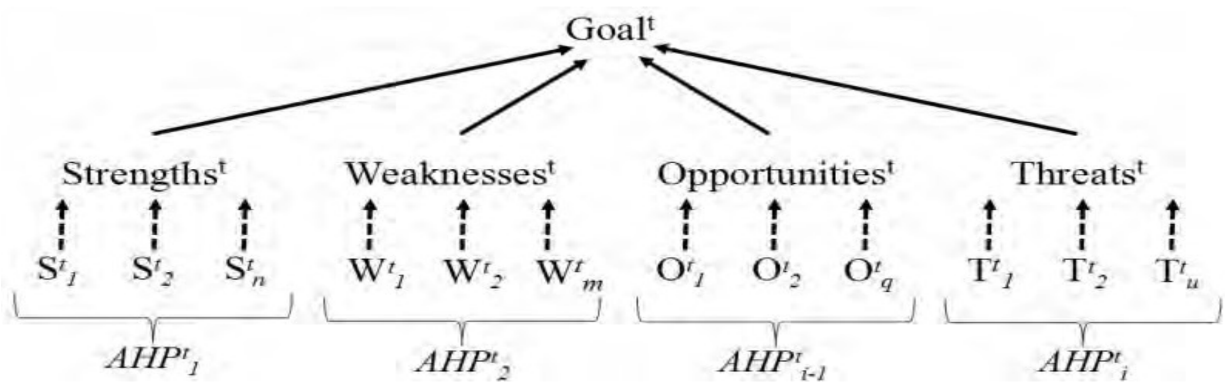

Figure 2: Hierarchical structure of the SWOT matrix

There are three phases of the model being conducted: establishing an building model, modifying factors, and building the evaluation model with the objective to create a strategic management model centered on the SWOT-AHP framework (Figure 1).

Initially a matrix is structured and a SWOT analysis is carried out. The SWOT matrix outlines and incorporates the relevant aspects of the firm's internal and external environments.

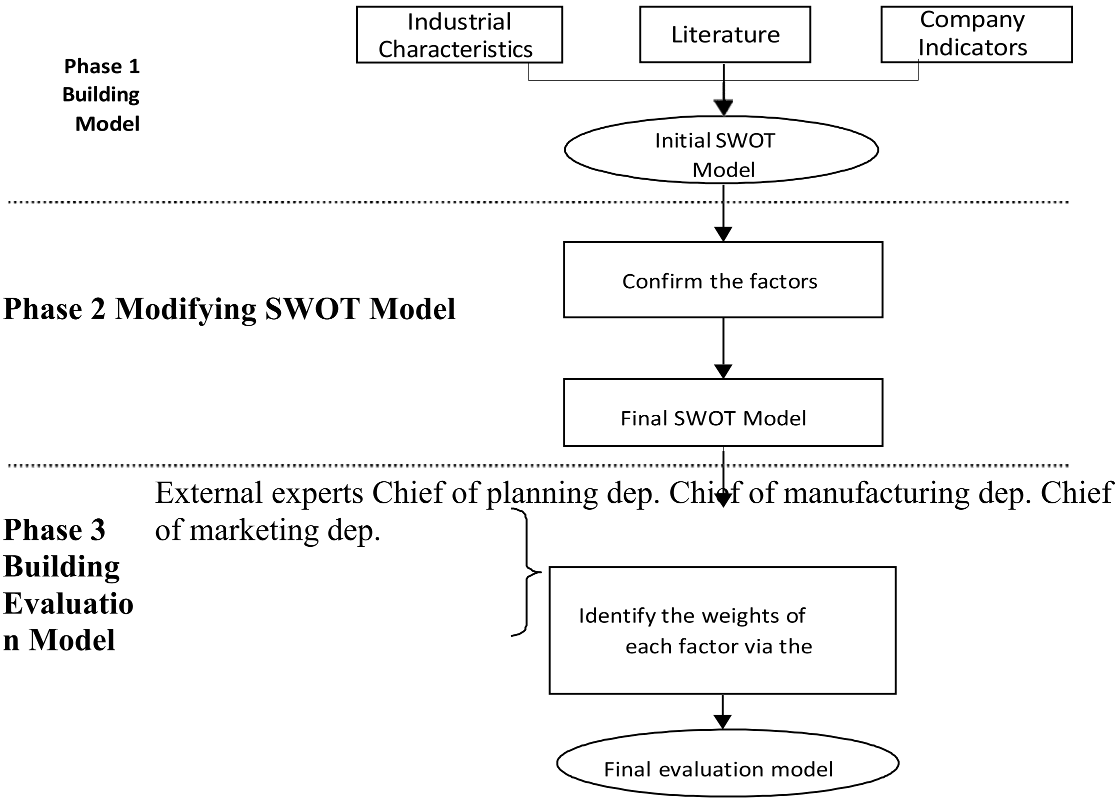

Figure 3: Phases of proposed methodology

Strengths (S)	**Weaknesses (W)**
(S1) Technologies advancements (S2) Established market players (S3) Wide range of products (S4) Global market share	(W1) Environmental impact (W2) Price pressures (W3) Financial challenges in sustainable manufacturing (W4) Volatile raw material prices
Opportunities (O)	**Threats (T)**
(O1) Growing demand for electric vehicles (O2) Increasing focus on sustainability (O3) Expansion into emerging markets (O4) Technological innovations	(T1) Intense competition (T2) Economic fluctuations (T3) Environmental regulations (T4) New entrants and disruptor

Table 3: SWOT matrix

SWOT matrix is subjected to an AHP. By applying a Saaty's (1980) comparison scale ranging from 1 to 9, pairwise comparisons of the SWOT groups are first conducted. Table 4 displays the outcomes of the comparison. After that, the aspects of SWOT matrices are compared with each SWOT group in consideration.

SWOT GROUPS	**S**	**W**	**O**	**T**	**Importance Degree of SWOT Groups**
Strengths (S)	1.00	5.00	4.00	3.00	0.334
Weaknesses (W)	0.20	1.00	4.00	3.00	0.241
Opportunities (O)	2.00	4.00	1.00	3.00	0.244
Threats (T)	0.33	1.00	2.00	1.00	0.180

Table 4: Pairwise Comparison of SWOT Factors

Table 4 presents a pairwise comparison matrix for SWOT factors. The organization's Strengths (S) are the most important factor, with a weight of 0.334. They are 5 times more important than weaknesses (W), 4 times more important than Opportunities (O), and 3 times more important than Threats (T).

Weaknesses (W), on the other hand, have the second lowest importance, with a weight of 0.241. They are 1/5 (0.20) as important as Strengths (S), considered 3 times important than Threats (T), but 4 times more important than opportunities (O).

Opportunities (O) are the second most important factor, with a weight of 0.244. Opportunities (O) is seen as 2 times more important than its Strengths (S), 4 times more important than its Weaknesses (W), and 3 times more important than its Threats (T).

Threats (T) are the least important factor, with a weight of 0.18. The firm views threats as 1/3 (0.33) as important as its Strengths (S) and equally important as its weaknesses (W) and 2 times more important than Opportunities (O).

Strengths	S1	S2	S3	S4	Importance Degrees
(S1) Technologies advancements	1.00	0.14	5.00	0.17	0.052
(S2) Established market players	7.00	1.00	5.00	2.00	0.148
(S3) Wide range of products	0.20	0.20	1.00	0.25	0.019
(S4) Global market share	6.00	0.50	4.00	1.00	0.116

Table 5: Comparison Matrix of Strengths Group

S2 is the most important, with an importance degree of 0.148. It is considered 7 times more important than S1, 5 times more important than S3, and 2 times more important than S4.

S4 is the second most important, with an importance degree of 0.116. It is seen as 6 times more important than S1 and 4 times more important than S3, but 0.50 less important than S2.

S1 has the second-lowest importance degree at 0.052. It is view as 1/7 (0.14) as important as S2, 5 times less important than S3, and 6 times less important than S4.

S3 has an importance degree of 0.019, making it the least important of the four strengths. It is considered 5 times less important than S1 (0.20), S2(0.20) and S4 (0.25).

Weaknesses	W1	W2	W3	W4	Importance Degrees
(W1) Environmental impact	1.00	1.00	0.50	1.00	0.073
(W2) Price pressures	1.00	1.00	1.00	1.00	0.060
(W3) Financial challenges in sustainable manufacturing	2.00	1.00	1.00	3.00	0.057
(W4) Volatile raw material prices	1.00	1.00	0.33	1.00	0.051

Table 6: Comparison Matrix of Weaknesses Group

W1 has an importance degree of 0.073, making it the most important weaknesses among the four. W1 is considered equally important as W2 (1.00) and W4 (1.00), but twice as important than W3 (0.5).

W2 has an importance degree of 0.06, making it the second most important weakness. W2 is seen as equally important as W1, W3, and W4, with the value of 1 each.

W3 has an importance degree of 0.057, making it the third most important weakness. W3 is considered twice as important as W4 (3.00), and same important as W2 (1.00) but only half as important as W1 (2.00).

W4 has an importance degree of 0.051, making it the least important weakness among the four. W4 is seen as equally important as W1 (1.00) and W2 (1.00), but three times less important than W3 (0.33).

Opportunities	**O1**	**O2**	**O3**	**O4**	**Importance Degrees**
(O1) Growing demand for electric vehicles	1.00	0.25	0.25	1.00	0.030
(O2) Increasing focus on sustainability	4.00	1.00	1.00	1.00	0.078
(O3) Expansion into emerging markets	4.00	1.00	1.00	1.00	0.079
(O4) Technological innovations	1.00	1.00	1.00	1.00	0.058

Table 7: Comparison Matrix of Opportunities Group

O2 has an importance degree of 0.078, making it the most important opportunity among the four. O2 is considered 4 times more important than O1, O3 (1.00), and O4 (1.00).

O3 has an importance degree of 0.079, making it equally important to O2 and O3, 1.00 each. O3 is also considered 4 times more important than O1.

O1 has an importance degree of 0.03, making it the least important opportunity among the four. O1 is seen as 1/4 (0.25) as important as O2 and O3, and only as important as O4.

O4 has an importance degree of 0.058, making it the second least important opportunity. O4 is seen as equally important as O1, but only half as important as O2 and O3.

Threats	**T1**	**T2**	**T3**	**T4**	**Importance Degrees**
(T1) Intense competition	1.00	1.00	2.00	2.00	0.050
(T2) Economic fluctuations	1.00	1.00	1.00	2.00	0.042
(T3) Environmental regulations	0.50	1.00	1.00	0.50	0.043
(T4) New entrants and disruptor	0.50	0.50	2.00	1.00	0.044

Table 8: Comparison Matrix of Threats Group

T1 has an importance degree of 0.05, making it the most important threat among the four. T1 is considered equally important as T2, but twice as important as T3 and T4

T4 has an importance degree of 0.044, making it the second most important threat. T4 is seen as equally important as T3, but half as important as T1 and T2.

T3 has an importance degree of 0.043, making it the third most important threat. T3 is considered half as important as T1 and T2, and equally important as T4.

T2 has an importance degree of 0.042, making it the least important threat among the four. T2 is seen as equally important as T1, but twice as important as T3 and T4.

SWOT Group	**Group Priority**	**SWOT Factors**	**Factor Priority within the Group**	**Overall Priority of the Factor**
Strengths	0.334	Technologies advancements	0.052	0.017
		Established market players	0.148	0.049
		Wide range of products	0.019	0.006
		Global market share	0.116	0.039
Weaknesses	0.241	Environmental impact	0.073	0.018
		Price pressures	0.060	0.014
		Financial challenges in sustainable manufacturing	0.057	0.014
		Volatile raw material prices	0.051	0.012
Opportunities	0.244	Growing demand for electric vehicles	0.030	0.007
		Increasing focus on sustainability	0.078	0.019
		Expansion into emerging markets	0.079	0.019
		Technological innovations	0.058	0.014
Threats	0.180	Intense competition	0.050	0.009
		Economic fluctuations	0.042	0.008
		Environmental regulations	0.043	0.008
		New entrants and disruptor	0.044	0.008

Table 9: Overall Priority Scores of SWOT Factors

Table 9 shows the overall priority scores of SWOT factors. First, from the Strengths (S) group, “Established market players” has the highest importance degree within the group, with a factor priority of 0.148. It is also the second most important factor overall, with an overall priority of 0.049. “Global market share” has a factor priority of 0.116 and an overall priority of 0.039. While “Technologies advancements” and “Wide range of products” are also considered strengths, they are relatively less important, both has a factor priority of 0.052, an overall priority of 0.017 and factor priority of 0.019 an overall priority of 0.006, respectively.

Next in the Weaknesses (W) group, “Environmental impact has the highest importance degree within the group, with a factor priority of 0.073. It is also the second most important factor overall, with an overall priority of 0.018. “Price pressures” and “Financial challenges in sustainable manufacturing” are also significant weaknesses, with a factor priority of 0.06 and 0.057, respectively, and overall priorities of 0.014 each. “Volatile raw material prices” which is considered a relatively less important weakness, has a factor priority of 0.051 and an overall priority of 0.012.

Following that, “Growing demand for electric vehicles” has the highest importance degree within the Opportunities (O) group, with a factor priority of 0.03, although it has the lowest overall priority of 0.007. “Increasing focus on sustainability” and “Expansion into emerging markets” has a factor priorities of 0.078 and 0.079, respectively, an overall priorities of 0.019 each. “Technological innovations” has a factor priority of 0.058 and an overall priority of 0.014.

Lastly, within the Threats (T) group, “Intense competition” has the highest importance degree, with a factor priority of 0.05. It is also the second most important factor overall, with an overall priority of 0.009. “Economic fluctuations”, “Environmental regulations”, and “New entrants and disruptors” are also considered significant threats, with factor priorities ranging from 0.042 to 0.044 and an overall priority of 0.008 each.

CONCLUSION

By integrating SWOT and AHP methodologies, important strategic factors for a tyre manufacturing company is identified in this study. The results indicate the priority rating of each SWOT group as follows: Strengths (33.4%), Weaknesses (24.1%), Opportunities (24.4%), and Threats (18%). The analysis indicates that "Established market players" from the Strengths category is the most crucial SWOT component. This factor, which has an overall priority value of 4.9%, is the most crucial one to take into consideration. The following significant factors are prioritized in order of importance: Environmental impact (1.8%), Growing emphasis on sustainability (1.9%), Global market share (3.9%), and Expansion into emerging markets (1.9%).

A management strategy or support for a vital choice could be built using the SWOT elements' analyzed priorities. The findings of this study are also useful to create a list of appropriate approaches solutions for a firm. Future studies might enhance the analysis of cases containing uncertainty more successfully by combining the fuzzy logic theory with the AHP approach. Additionally, the AHP can be substituted with any multi-criteria decision-making method, and the outcomes can be compared.

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