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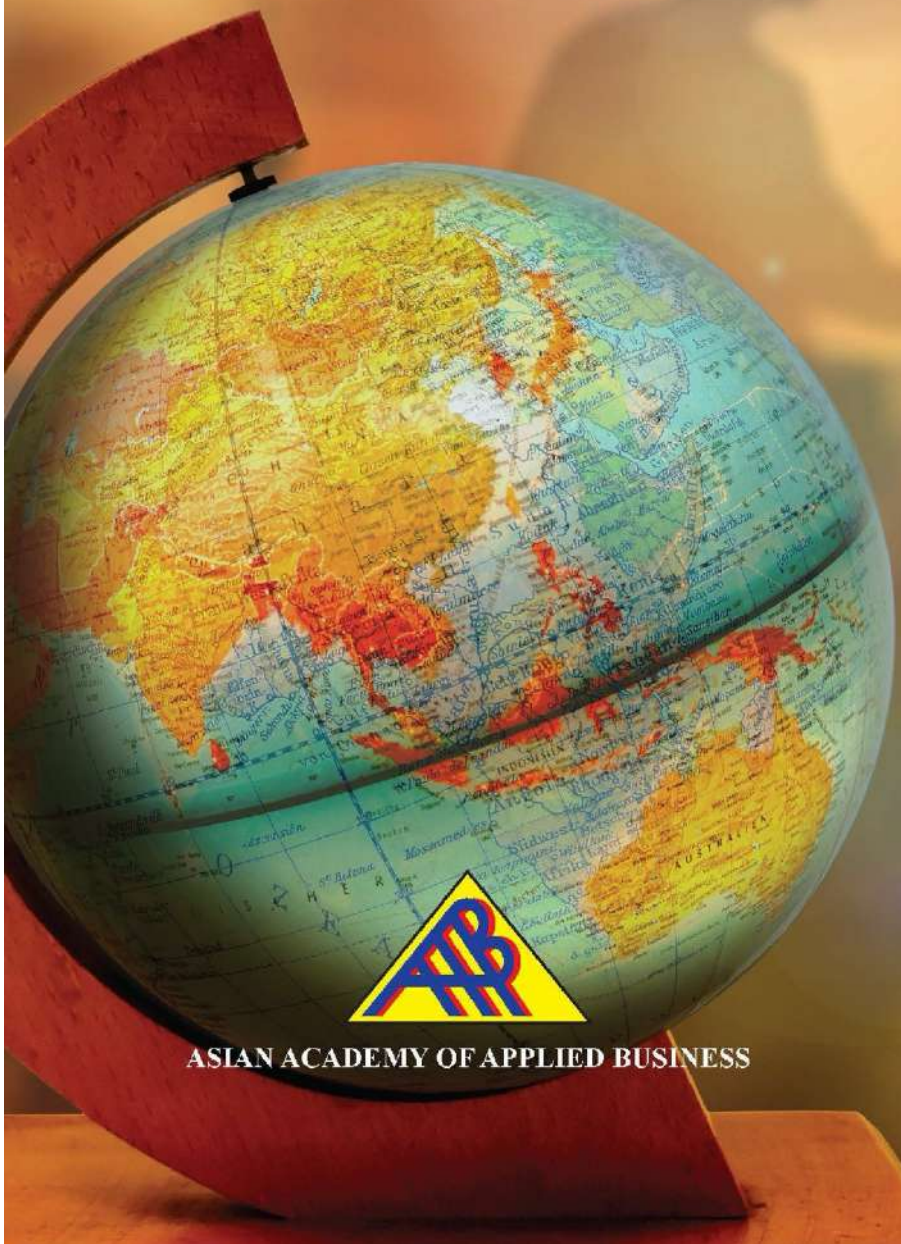

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Strategic analysis using SWOT-AHP: A case study on Dairy Industry in India

By

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ABSTRACT

In India, the dairy industry represents an element of agriculture, particularly dairy cooperatives contributing a major role in agricultural growth. This study analyzes key factors in the dairy manufacturing process and proposes a decision framework that addresses its implications Data was obtained from dairy producers, including farmers, executives, and key informants from processing units, in order to identify strengths, weaknesses, opportunities, and threats. This includes establishing the dairy industry's objectives and crucial factors (CFs), both internally and externally. SWOT exploration does not provide a basis for analyzing CF priorities. Therefore, the analytic hierarchy technique is used to determine these priorities. The CFs have also been ranked according to their respective relevance. The outcomes of this study show that the SWOT-based methodology provides critical sensitivity when examining supply chain strategies for the dairy sector.

Keywords: dairy industry, dairy supply chain (DSC), agri-food sector, SWOT analysis, analytic hierarchy process (AHP), SWOT-AHP, critical factors (CF)

INTRODUCTION

An important part of the agricultural economy and food sector of India is the dairy industry. India is the world's biggest producer of milk, which has a substantial impact on both domestic livelihoods and international trade. India also contributes to global dairy production. It contributes to the socioeconomic development of rural communities while also offering vital nutrients for good health. In order for India's milk supply chain to function more effectively, safely, and competitively, a number of issues need to be carefully considered.

Following supplier management, inventory control, and technical developments, quality management is an important component of DSC (Mor, et. al, 2018). To increase food safety and product quality, the dairy sector must operate at peak efficiency (Bhardwaj, et.al, 2016) (Mor, et. al, 2018). To reach the rural market, both food producers and processors must focus on effective marketing strategies (Mor, et. al, 2018).
In order to strategically analyze the dairy industry, all relevant external and internal factors that affect the industry's performance must be examined. Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis and the Analytic Hierarchy Process (AHP) are two effective techniques to use when conducting this kind of analysis. The SWOT analysis is a useful technique for determining and categorizing the critical and significant factors impacting a given industry. However, these factors are ranked in order of relative significance by the analytic hierarchy process (AHP).

SWOT AND AHP MODEL

SWOT Analysis

To evaluate a project or company activity, a strategic planning approach known as the SWOT analysis is initially used. Strength, Weakness, Opportunities, and Threats is an acronym represented by four quadrants on a two-by-two grid, each representing positive and negative internal and external issues. Opportunities and dangers represent external elements impacting the firm, whereas strengths and weaknesses reflect internal advantages and negatives. While the latter discusses future trends in the field under consideration, as well as the state of the economy, funding resources, demographics, physical environment, legislation, and local, national, or internal events, the former focuses on the strengths and weaknesses of human resources, physical resources, financial resources, activities and processes, and experiences (Vu and Trinh, 2021). Figure 1 shows the SWOT analysis framework for industries to use and analyse internal and external environments.

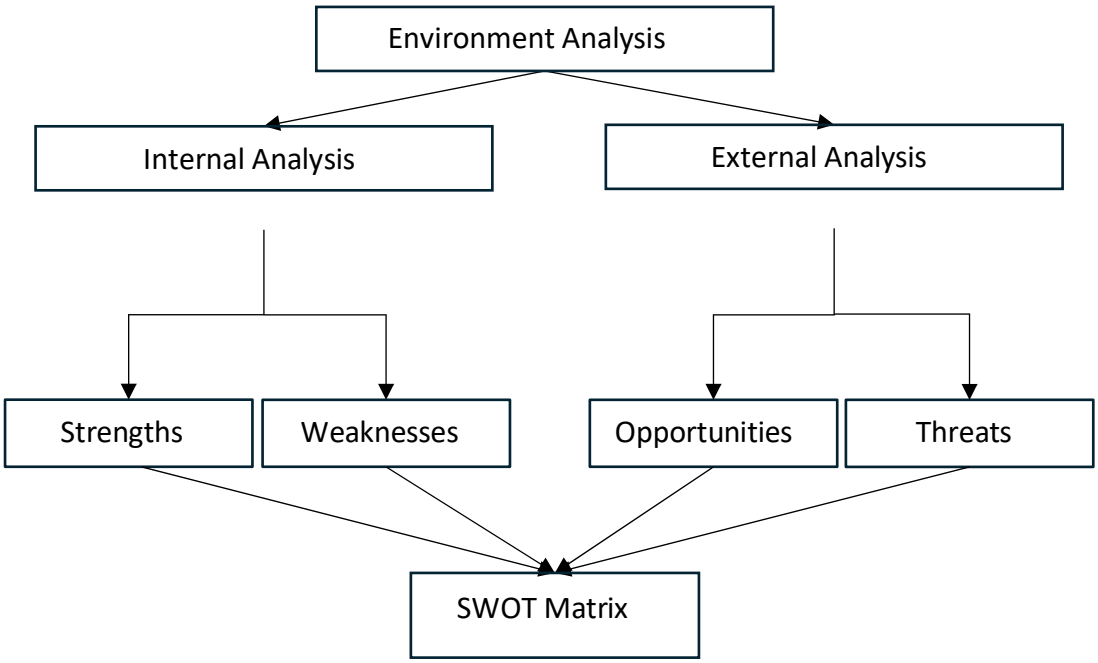

Figure 1. SWOT analysis framework

Analytic Hierarchy Process

The well-known AHP approach, invented by Thomas Saaty, allows for the examination and segmentation of a complex problem requiring decision-making into several separate structures. AHP may also be used by decision-makers to identify the relative weights of criterion and subcriteria through pairwise comparisons (Saaty, 2008; Sherekar & Tatikonda, 2016. The steps in AHP are as follows:

1. Prioritizing and evaluating CFs is a step in goal preparation.
2. Using the input from experts, create a paired assessment matrix. A pairwise assessment matrix between the factors is produced by Saaty's scale (refer Table 1).
3. Finding Eigenvalues, Eigenvectors, and Comparative Weights: Eigenvalues, Eigenvectors, and the relative location of CFs are found using pairwise comparison matrices.
4. When confirming the reliability of pairwise comparisons, the consistency ratio (CR) is employed.

$$CR = CI / RI$$

The random consistency index (RI) is based on the value of n, while the consistency index (CI) is computed as $(\lambda max - n)/ (n - 1)$, where λmax is the maximum average value. $CR \leq 0.10$ is necessary for improved consistency (Kumar, et. al, 2011). The suitable values for a random index are displayed in Table 2 (Saaty, 1980).

Table 1. Pairwise comparison scale

Score	Score Definition
1	Both factors are equally important
3	One factor has slightly more importance than the other
5	One factor is significantly more important than the other
7	One factor is much more important than the other
9	One factor is vastly more important than the other
2, 4, 6, 8	A value that falls between two nearby assessments

Table 2. Random Index (R.I.) (adapted from Mor, et. al, 2019)

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
R.I.	**0**	**0**	**0.58**	**0.98**	**1.12**	**1.24**	**1.32**	**1.41**

Methodology and Application

To summarize the factors and sub-factors related to the strengths, weaknesses, opportunities, and threats (SWOT) of India's milk processing system, a pre-tested schedule was used to collect data from dairy producer members, including dairy farmers, shop floor executives, and key informants of milk processing units. This entails establishing the dairy industry's aim as well as the internal and external critical factors (CFs) through pairwise comparisons of the most essential SWOT concerns and evaluations using the eigenvalue method. The process includes three steps: factorization, innerdependency matrix computation, and factor weight calculation. The first step is to identify the CFs and subfactors. Several more techniques, including ELECTRE, TOPSIS, ISM, DEA, and Extended PROMETHEE, have been developed to deal with comparable circumstances (Ho, 2008). However, AHP is frequently suggested due to its broad application and user-friendliness. AHP is used to help with multi-criteria judgments by dividing the problem into discrete analytical and hierarchical components. This approach produces extremely satisfying results and has been applied in a variety of domains, including process planning, alternative selection, optimization, and resource allocation. AHP successfully incorporates both qualitative and quantitative aspects when rating available choices (Yang, 2010; Harputlugil et. al, 2011). As a result, in the current study, the researchers used AHP to examine the key aspects of DSC processes. Figure 2 shows a flowchart illustrating the process.

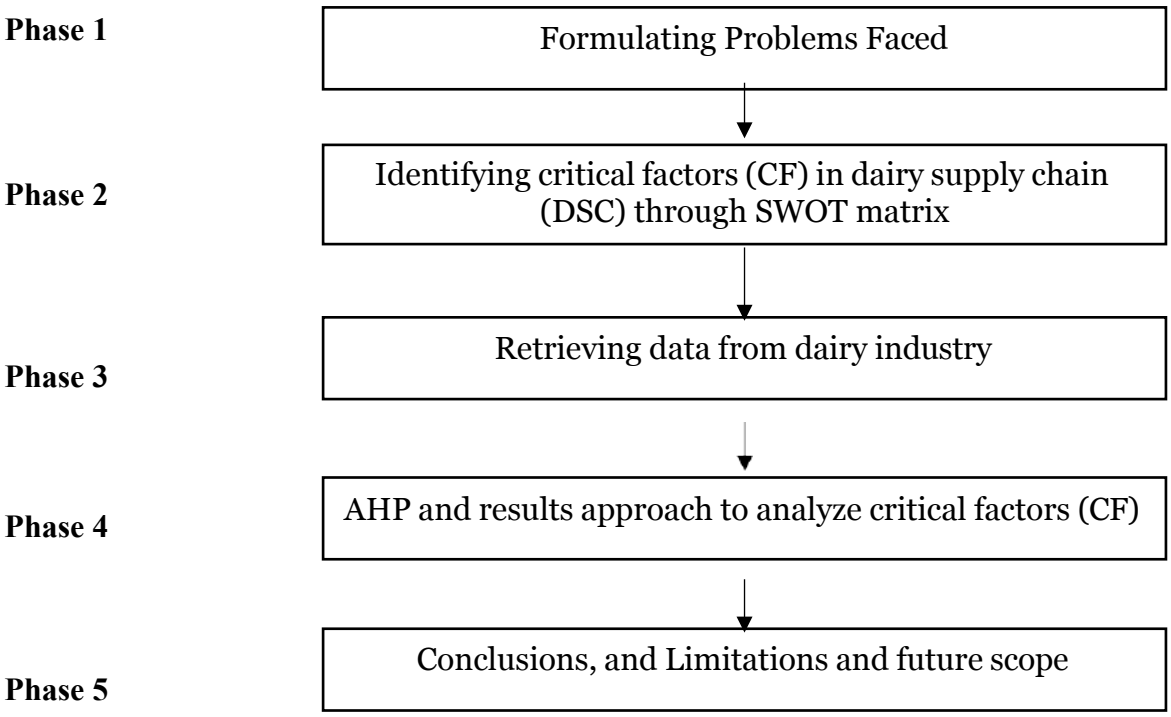

Figure 2. Phases of proposed methodology

Application of AHP

After a pilot study and a review of the literature (see Section 4), all 17 CFs are being considered for AHP. The data is gathered from milk processing companies in northern India, and the gathered information is analyzed to rank the SWOT factors. The SWOT factor hierarchy model (Figure 3) is shown below, and it displays several SWOT factors along with their respective sub-criteria.

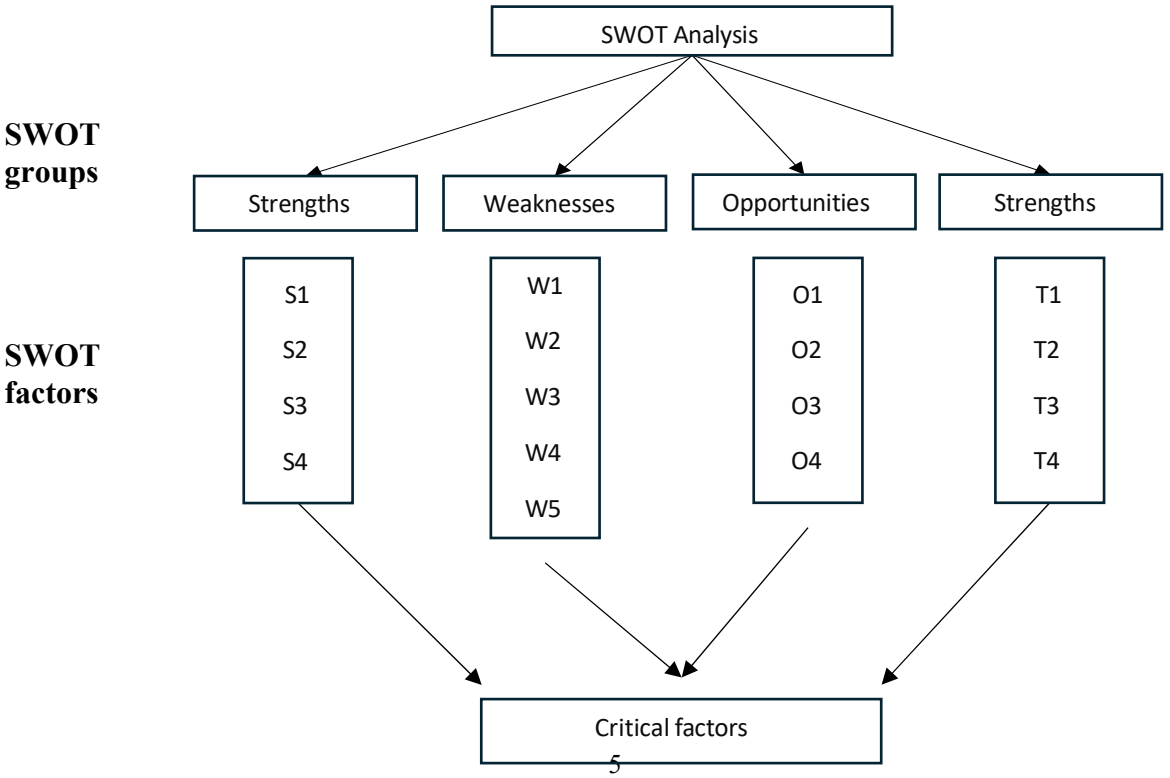

Figure 3. Hierarchical structure of the SWOT matrix

Pairwise Assessment Matrix

The tables below include a variety of pairwise assessment matrices for the examination of SWOT factor(s). In this study, the Critical Factors (CFs) of Distribution and Supply Chain Management (DSCM) practices were evaluated using Saaty's (1980) nine-point scale. Five academic specialists and five dairy executives gave their thoughts to the SWOT analysis. The SWOT groups were then compared pairwise using Saaty's nine- point comparison scale in consultation with the expert panel. Each SWOT category was extensively evaluated in comparison to the others. The professionals shared their knowledge in constructing comparison matrices and specifying the dependencies necessary to perform pairwise comparisons.

Table 3. Pairwise comparisons of SWOT factors (adapted from Mor et. al, 2019)

SWOT Groups	S	W	O	T	Importance Degrees of SWOT Groups
Strengths (S)	1	2.00	5.00	9.00	0.530
Weaknesses (W)	0.50	1	3.00	7.00	0.308
Opportunities (O)	0.20	0.33	1	3.00	0.115
Threats (T)	0.11	0.14	0.33	1	0.047
CR= 1.3					

Table 4. Comparison Matrix of Strengths Group (adapted from Mor et. al, 2019)

Strengths (S)	**S1**	**S2**	**S3**	**S4**	**Importance Degrees**
S1. Well trained and skilled workforce offered at all stages to assist R&D and industry processes (RD).	1	2.00	4.00	6.00	0.510
S2. Offers job opportunities to the rural population, particularly benefiting women. (WE).	0.50	1	2.00	4.00	0.271
S3. Ensures a consistent income source for farmers. (FI).	0.25	0.50	1	53.00	0.152
S4. The implementation of a two-axis payment system (based on Fat and SNF) ensures farmers receive a fair price for their milk production.	0.17	0.25	0.33	1	0.067
CR= 0.017					

Table 5. Comparison Matrix of Weaknesses Group (adapted from Mor et. al, 2019)

Weaknesses (W)	W1	W2	W3	W4	W5	Importance Degrees
W1. Dairy industry is grappling with the issue of water wastage. (WW).	1	2.00	4.00	3.00	7.00	0.397
W2. Indian dairy market comprises both unorganized and organized sectors, with only 20% being organized. (OU).	0.50	1	4.00	5.00	7.00	0.340
W3. The distribution sector requires enhancements and investments in logistics and transportation (TF).	0.25	0.25	1	1.00	5.00	0.110
W4. Absence of water treatment facilities for processed water. (WT).	0.33	0.20	1.00	1	6.00	0.119
W5. Use of plastic films poses significant environmental and health risks (PF).	0.14	0.14	0.20	0.17	1	0.034
CR= 0.071						

Table 6. Comparison Matrix of Opportunities Group (adapted from Mor et. al, 2019)

Opportunities (O)	O1	O2	O3	O4	Importance Degrees
O1. Due to low production costs, there is a high potential for export (EP).	1	1.00	2.00	7.00	0.381
O2. Through implementing a dynamic payment system, farmers' profits will increase and their relationship with the organization will be strengthened (DPS).	1.00	1	2.00	6.00	0.367
O3. Improving the information flow throughout the dairy supply chain can be achieved by implementing effective information systems (IT).	0.50	0.50	1	4.00	0.197
O4. Utilising robotic milk collection processes (AMC).	0.14	0.17	0.25	1	0.055
CR=0.030					

Table 7. Comparison Matrix of Threats Group

Threats (T)	T1	T2	T3	T4	**Importance Degrees**
T1. If the dynamic payment system is not integrated into the dairy industry's milk procurement policy, there are problems with trust and low supplier satisfaction (SS).	1	4.00	6.00	4.00	0.591
T2. Due to dairy products' high price sensitivity, consumers are unwilling to pay more for higher-quality goods (HP).	0.25	1	2.00	3.00	0.209
T3. As more firms enter the market, competition is progressively growing (MC).	0.17	0.50	1	1.00	0.098
T4. To create novel and inventive products, a substantial investment is needed in the R&D sector (RDI).	0.25	0.33	1.00	1	0.102
CR=0.038					

Table 8. SWOT matrix (adapted from Mor et. al, 2019)

Strengths (S)	**Weaknesses (W)**
S1. Well trained and skilled workforce offered at all stages to assist R&D and industry processes (RD). S2. Offers job opportunities to the rural population, particularly benefiting women. (WE). S3. Ensures a consistent income source for farmers. (FI). S4. The implementation of a two-axis payment system (based on Fat and SNF) ensures farmers receive a fair price for their milk production.	W1. Dairy industry is grappling with the issue of water wastage. (WW). W2. Indian dairy market comprises both unorganized and organized sectors, with only 20% being organized. (OU). W3. The distribution sector requires enhancements and investments in logistics and transportation (TF). W4. Absence of water treatment facilities for processed water. (WT). W5. Use of plastic films poses significant environmental and health risks (PF).
Opportunities (O)	**Threats (T)**
O1. Due to low production costs, there is a high potential for export (EP). O2. Through implementing a dynamic payment system, farmers' profits will increase and their relationship with the organization will be strengthened (DPS). O3. Improving the information flow throughout the dairy supply chain can be achieved by implementing effective information systems (IT). O4. Utilising robotic milk collection processes (AMC).	T1. If the dynamic payment system is not integrated into the dairy industry's milk procurement policy, there are problems with trust and low supplier satisfaction. (SS) T2. Due to dairy products' high price sensitivity, consumers are unwilling to pay more for higher-quality goods (HP). T3. As more firms enter the market, competition is progressively growing (MC). T4. To create novel and inventive products, a substantial investment is needed in the R&D sector (RDI).

Table 9. Overall Priority Scores of SWOT factors (adapted from Mor, et. al, 2019)

SWOT Group	Group Priority	SWOT Factors	Factors Priority within the Group	Overall Priority of Factor
Strengths	0.530	S1. Well trained and skilled workforce offered at all stages to assist R&D and industry processes (RD).	0.510	0.270
		S2. Offers job opportunities to the rural population, particularly benefiting women. (WE).	0.271	0.144
		S3. Ensures a consistent income source for farmers. (FI).	0.152	0.081
		S4. The implementation of a two-axis payment system (based on Fat and SNF) ensures farmers receive a fair price for their milk production.	0.067	0.036
Weaknesses	0.308	W1. Dairy industry is grappling with the issue of water wastage. (WW).	0.397	0.122
		W2. Indian dairy market comprises both unorganized and organized sectors, with only 20% being organized. (OU).	0.340	0.105
		W3. The distribution sector requires enhancements and investments in logistics and transportation (TF).	0.110	0.034
		W4. Absence of water treatment facilities for processed water. (WT).	0.119	0.037
		W5. Use of plastic films poses significant environmental and health risks (PF).	0.034	0.011
Opportunities	0.115	O1. Due to low production costs, there is a high potential for export (EP).	0.381	0.044
		O2. Through implementing a dynamic payment system, farmers' profits will increase and their relationship with the organization	0.367	0.042

		will be strengthened (DPS).		
		O3. Improving the information flow throughout the dairy supply chain can be achieved by implementing effective information systems (IT).	0.197	0.023
		O4. Utilising robotic milk collection processes (AMC).	0.055	0.006
Threats	0.047	T1. If the dynamic payment system is not integrated into the dairy industry's milk procurement policy, there are problems with trust and low supplier satisfaction. (SS) T2. Due to dairy products' high price sensitivity, consumers are unwilling to pay more for higher-quality goods (HP). T3. As more firms enter the market, competition is progressively growing (MC). T4. To create novel and inventive products, a substantial investment is needed in the R&D sector (RDI).	0.591	0.028
		T1. If the dynamic payment system is not integrated into the dairy industry's milk procurement policy, there are problems with trust and low supplier satisfaction. (SS) T2. Due to dairy products' high price sensitivity, consumers are unwilling to pay more for higher-quality goods (HP). T3. As more firms enter the market, competition is progressively growing (MC). T4. To create novel and inventive products, a substantial investment is needed in the R&D sector (RDI).	0.209	0.010

		T1. If the dynamic payment system is not integrated into the dairy industry's milk procurement policy, there are problems with trust and low supplier satisfaction. (SS) T2. Due to dairy products' high price sensitivity, consumers are unwilling to pay more for higher-quality goods (HP). T3. As more firms enter the market, competition is progressively growing (MC). T4. To create novel and inventive products, a substantial investment is needed in the R&D sector (RDI).	0.098	0.005
		T1. If the dynamic payment system is not integrated into the dairy industry's milk procurement policy, there are problems with trust and low supplier satisfaction. (SS) T2. Due to dairy products' high price sensitivity, consumers are unwilling to pay more for higher-quality goods (HP). T3. As more firms enter the market, competition is progressively growing (MC). T4. To create novel and inventive products, a substantial investment is needed in the R&D sector (RDI).	0.102	0.005

Based on Table 3-9, comparing dairy sector matrices for strengths, weaknesses, opportunities, and threats yielded critical insights. A two-axis payment system (0.067) is a driver, as is the availability of highly qualified technical labor and jobs, with a focus on rural populations, including women (0.271). The key difficulties emphasized in this area are large amounts of fresh water waste (0.397), a chaotic marketing sector for this product (0.340), and the safety of employing plastic sheets (0.034). On the other side, opportunities in this industry are driven by the ability to export due to lower manufacturing costs (0.381) or greater relationships/profits through adaptable payment channels. (0.367) In contrast, automated milk collecting points might have small impacts (0.055).

A dynamic payment system is not maintained at low supplier satisfaction rates of 0.591, high price sensitivity of 0.209, and improved market competitiveness of 0.098, which

is a non-major concern when discussing this broad application. These consistency ratios, on the other hand, demonstrate consistent evaluations, signaling that when dealing with risks and capitalizing on development opportunities, strategic concern should be focused on water resource management, marketing structures, export potential, and payment modes. Lower supplier satisfaction is mostly caused by low danger (0.591) and elasticity of demand (0.209), although more competition provides modest risks (0.098). As a result, the overall consistency ratio of these matrices emphasizes the need for a strategic focus on water resource management, market organization principles, export possibilities, and payment methods for risk reduction and growth opportunity optimization.

CONCLUSION

This paper proposes an AHP-based paradigm for identifying and assessing CFs in the dairy supply chain. This study relies on expert opinions and data from many dairy units to inform its results. 17 critical factors (CFs) are carried over for ranking, including four strengths, five weaknesses, four opportunities, and four threats. The authors selected 17 CFs in their respective groups and the overall output of SWOT analysis in a second stage. 17 CFs are considered for inclusion when identifying the most important ones within any given SWOT category. To this end, it is recommended that the SWOT and AHP approach which is therefore applied research in dairy industry. The researcher shows that there is much emphasis placed on PF in relation to other factors. Thus, order of importance is PF, IT, SS, WE. Small dairy farmers have to be included in the forthcoming dairy sector. A greater investment is required in the empowerment of rural development and women through dairy industry. Farmers will gain more if service quality increases and at the same time service delivery costs decrease.

LIMITATIONS

The dairy industry, like other sectors, operates in a dynamic environment whereby factors such as market conditions, consumer preference and regulatory landscapes can affect the SWOT analysis to be relevant and constant over time. Not to mention, the AHP method can face challenges to adapt from these changes because the weights assigned to the factors can be outdated in a short period of time.

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Strategic Analysis Using SWOT-AHP: Beach Tourism in Sabah, Malaysia

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Abstract

The popularity of beach tourism in Sabah has increased after the COVID-19 pandemic ended, this study aims to analyze what factors should be taken seriously to boost the competitiveness of the beach tourism industry in Sabah. Strategic analysis of beach tourism in Sabah, Malaysia, by utilizing the SWOT (Strengths, Weaknesses, Opportunities, and Threats) framework in combination with the Analytic Hierarchy Process (AHP). This is a descriptive research design. The problem itself contains many SWOT criteria, which have been reviewed in three phases with the assistance of industry external experts and AHP guidelines. This study introduces a hybrid SWOT-AHP strategic analysis in this area. The influencing elements have been assessed and rated to determine the most important factors on which the industry should focus.

Keywords: SWOT, AHP, Strategic analysis, SWOT-AHP, Beach tourism

INTRODUCTION

Sabah is a Malaysian state renowned for its breathtaking natural beauty and diverse ecosystems. One of its most popular tourist attractions is the magnificent beaches, which provide a variety of activities (OutbackVenture, 2023). Sabah's most popular beaches are Tanjung Aru Beach, Mabul Island, Tip of Borneo Beach, and others. People have also nominated Tanjung Aru Beach as one of the world's best sunset spots. It has a significant economic and cultural impact on Sabah. Despite its advantages, issues such as tourism competition and environmental problems exist. This study uses the SWOT-AHP framework to systematically assess and prioritise factors influencing Sabah beach tourism. By combining qualitative and quantitative methodologies, this study hopes to provide practical insights to improve the sector's sustainability and competitiveness, ensuring Sabah's status as a major beach tourism destination.

SWOT AND AHP MODEL

SWOT Analysis

SWOT stands for Strengths, Weaknesses, Opportunities, and Threats. The first two factors (strengths and weaknesses) are related to internal organizational factors, while opportunities and threats cover a wider context or environment in which the entity operates. The organisation has control over internal elements, but not over external ones. One of the most popular techniques for managing is SWOT analysis, which managers utilise as a tool for developing strategies. frequently employed as a tool to analyse both external and internal elements in order to develop a methodical strategy and provide assistance in addressing the issue. The most crucial elements for the future of enterprises are those that are both internal and external. These are referred regarded as strategic elements, and the SWOT matrix shows them. The formulation and implementation of a strategy that produces a positive interaction between the internal and external forces is the aim of the strategic planning process, of which the SWOT analysis is one of the preliminary stages. Figure 1 illustrates how SWOT analysis fits into an environment.

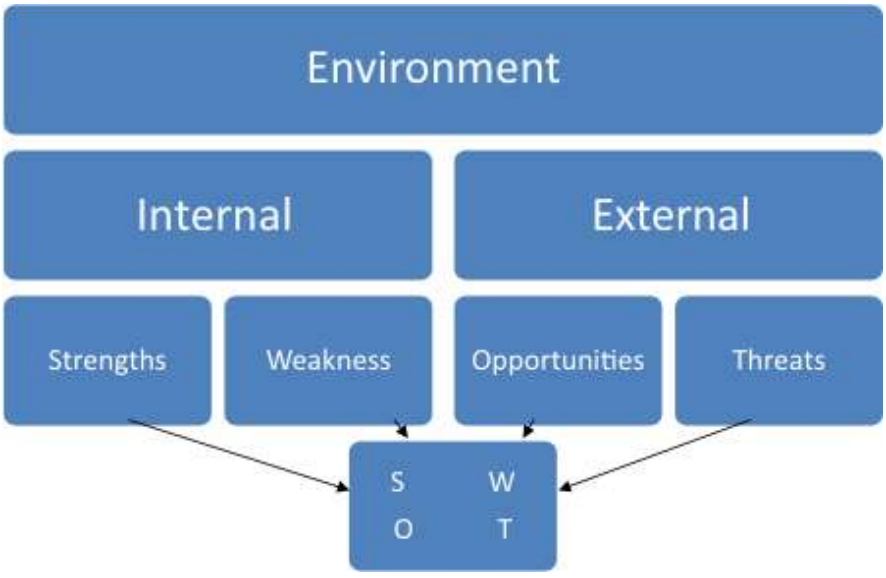

Figure 1: SWOT analysis framework

Analytic Hierarchy Process

The Analytical Hierarchy Process (AHP) is a known method used for decision making that considers factors. It helps in alternatives based on the importance of different criteria. AHP allows for structuring the problem and comparing pairs of components within a hierarchy. By the end of the process a mathematical model is developed by assigning weights, to all parts of the hierarchy. AHP addresses decision making problems by defining goals, criteria and options assessing criteria on a scale from 1 to 9 pairing alternatives and establishing priorities for alternatives. Through AHP ranked alternatives and weight coefficients for criteria are determined based on objectives. The approach effectively identifies decision making inconsistencies by monitoring them throughout the process. The results provide indications that support decision justifications. Saaty introduced the AHP technique in 1977 as it has become widely popular, for addressing criteria decisions in scenarios.

Table 1: Pairwise comparison scale

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

The AHP technique is based on three guiding concepts: first, the structure of the model; second, a comparative evaluation of the alternatives and/or criteria; and third, a synthesis of the priorities. AHP has been extensively used in the literature to address a variety of decision-making-related issues. A decision issue is set up hierarchically in the first step. AHP initially deconstructs a complex multicriteria decision-making problem into a hierarchy of related decision elements (criteria, decision alternatives). The Analytic Hierarchy Process (AHP) groups the objectives, selection criteria, and choices into a hierarchical structure resembling a family tree. The three levels of a minimal hierarchy are as follows: the top level represents the problem's aim, while the middle level is guided by several criteria. The alternatives, which comprise the lowest level, are made up of possibilities.

The AHP is utilised in this study to prioritise the SWOT elements. After the problem is broken down and a hierarchy is created, the process of prioritising criteria is initiated in order to ascertain their respective levels of significance. Based on the predetermined criteria in the higher level, the criteria in each level are compared pairwise based on their respective levels of

influence. Multiple pairwise comparisons in AHP are predicated on a nine-level standardised comparison scale.

Let C = {Cj | j = 1, 2, . . . , n} be the set of criteria. The result of the pairwise comparison on n criteria can be summarized in an (n x n) evaluation matrix A in which every element a ij (i, j = 1, 2, . . . , n) is the quotient of weights of the criteria. This pairwise comparison can be shown by a square and reciprocal matrix.

$$A = (a_{ij})_{nxn} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ a_{n1} & a_{n2} & . & a_{nn} \end{bmatrix}$$

The final step is normalising each matrix and determining their relative weights. The largest eigenvalue is represented by the right eigenvector (w), which gives the relative weights in the following manner:

$$A_w = \lambda_{max} . w$$

Assuming perfect consistency in the pairwise comparisons, matrix A has rank 1 and $_{max} = n$.. In this instance, normalising any of A's rows or columns will yield weights. It should be noted that there is a correlation between the quality of the AHP output and the consistency of the pairwise comparison judgments. The relationship between A: $a_{ij}\ x\ a_{jk} = a_{jk}$.defines consistency. The Consistency Index (CI) may be calculated using the formula below:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

One can determine whether the evaluations are sufficiently consistent by looking at the final consistency ratio (CR). As seen as below, the CR is computed as the ratio of the CI and the random index (RI).

$$CR = \frac{CI}{RI}$$

The recognised upper bound for CR is 0.1. To increase consistency, the review process needs to be repeated if the final consistency ratio is higher than this threshold.

SWOT-AHP Model

The SWOT-AHP model combines two strategic analytical techniques: Analytic Hierarchy Process (AHP) and Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. SWOT analysis enables a company to examine both internal and external issues, whereas AHP is a methodical decision-making approach. In this study, the AHP structure was derived from the SWOT matrix and separated into three components (Devi Cipta Anggraini, 2018). The stages model was developed to establish a SWOT-AHP-based strategic management model. First, we identified the SWOT using SWOT analysis, and then we identified relevant external and internal environments. Second, change factors, and third, design an evaluation model. (Figure 3) (Arica dwi susanto, 2019).

METHODOLOGY AND APPLICATION

The primary objective behind using the AHP within the SWOT framework is to carefully evaluate the SWOT variables and make them comparable in terms of weightiness. The three portions of the AHP structure in this study are (a) the decision's objective, (b) the SWOT groups, and (c) the factors (sub-criteria) that are contained inside each SWOT group. The AHP structure is generated from the SWOT matrix. The SWOT framework is represented hierarchically in Figure 2.

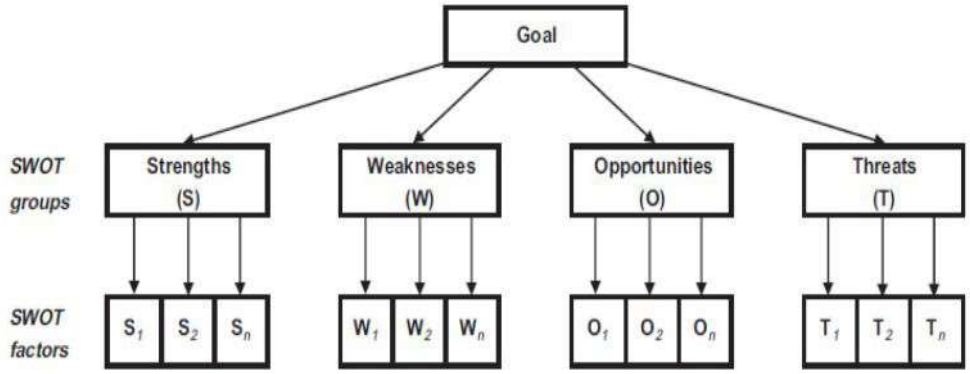

Figure 2: Hierarchical structure of the SWOT matrix

In the case study that follows, the beach tourist sector in Sabah, Malaysia, is examined using an upgraded AHP based on SWOT analysis. A literature research and secondary data analysis were conducted to identify and assess the SWOT. To create a strategic management model based on the SWOT-AHP framework, we constructed the model in three stages: building model, modifying SWOT model, and building evaluation model (Figure 3). Initially, a matrix is developed and a SWOT analysis is conducted. The SWOT matrix defines and includes the important internal environment and features.

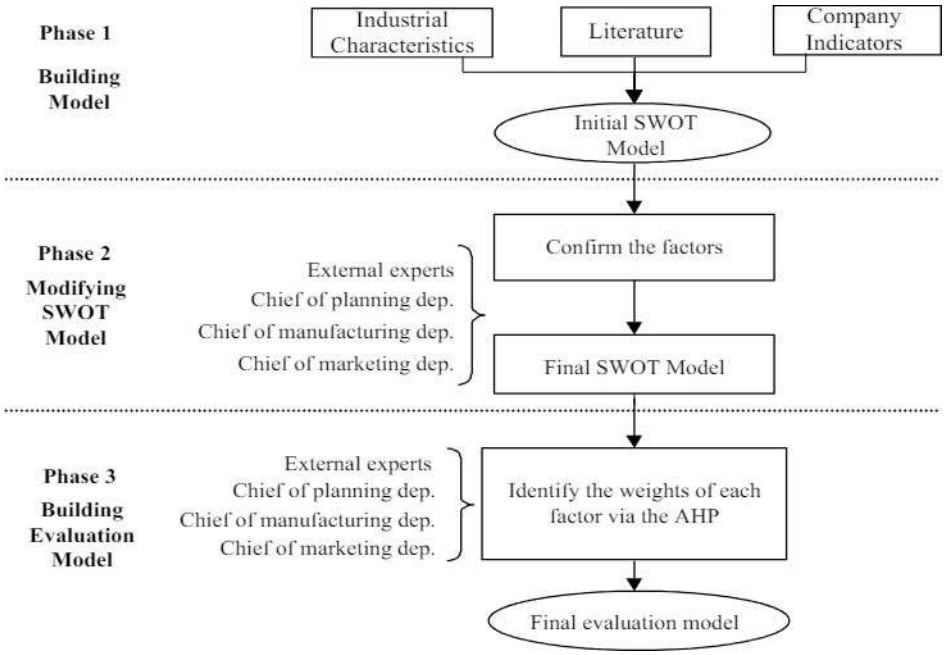

Figure 3: Phases of the suggested approach

Table 2: SWOT Matrix

Strengths (S)	Weaknesses (W)
(S1) Diverse Marine Biodiversity (Saleem et al., 2020) **(S2)** Cultural Heritage (Burgess & Borges, 2018) **(S3)** Adventure Activities (Ross et al., 2017) **(S4)** Protected Areas (World Wildlife Fund, 2021) **(S5)** Tourism Infrastructure	**(W1)** Accessibility Challenges (Asian Development Bank, 2017) **(W2)** Waste Management Issues (The Star, 2020) **(W3)** Seasonal Weather Patterns (Sabah Tourism Board, 2020) **(W4)** Infrastructure Maintenance (Aziz et al., 2020) **(W5)** Limited Product Development (UNDP, 2020)
Opportunities (O)	**Threats (T)**
(O1) Sustainable Tourism Practices (Dinu et al., 2019) **(O2)** Digital Marketing (Gan & Frederick, 2016) **(O3)** Diversification of Tourism Products (Sabah Tourism Board, 2021) **(O4)** Government Support (Ministry of Tourism, Arts and Culture Malaysia, 2020) **(O5)** Collaborative Partnerships (Samsuddin et al., 2019)	**(T1)** Climate Change (Ross et al., 2017) **(T2)** Competition Regional Destinations (Gan & Frederick, 2016) **(T3)** Political Instability (Burgess & Borges, 2018) **(T4)** Over-Tourism (Rasdi et al., 2021) **(T5)** Natural Disasters (Ghazali et al., 2018)

SWOT matrix is subjected to an AHP. Using a Saaty's (1980) comparison scale ranging from 1 to 9, pairwise comparisons of the SWOT groups are first conducted. Table 3 displays the outcomes of the comparison. Second, the aspects of SWOT matrices are compared with each SWOT group in mind. The expert team in the application completes all pairwise comparisons. Three beach tourism experts from the industry and the authors of this study made up the expert team.

Table 3: Pairwise comparisons of SWOT factors

SWOT Groups	S	W	O	T	Importance percentages of SWOT Groups
Strengths (S)	1	0.14	0.20	0.11	3.9%
Weaknesses (W)	7.00	1	3.00	0.33	25.3%
Opportunities (O)	5.00	0.33	1	0.14	11.4%
Threats (T)	9.00	3.00	7.00	1	59.4%
CR = 7.5%					

Table 4: Comparison Matrix of Strengths Group

Strengths	S1	S2	S3	S4	S5	Importance percentages
(S1) Diverse Marine Biodiversity	1	0.20	0.25	0.25	3.00	8.7%
(S2) Cultural Heritage	5.00	1	1.00	1.00	4.00	29.0%
(S3) Adventure Activities	4.00	1.00	1	2.00	6.00	33.8%
(S4) Protected Areas	4.00	1.00	0.50	1	3.00	23.0%
(S5) Tourism Infrastructure	0.33	0.25	0.17	0.33	1	5.5%
CR = 5.0%						

Table 5: Comparison Matrix of Weaknesses Group

Weaknesses	S1	S2	S3	S4	S5	Importance percentages
(W1) Accessibility Challenges	1	0.11	0.50	3.00	3.00	10.0%
(W2) Waste Management Issues	9.00	1	6.00	7.00	8.00	62.3%
(W3) Seasonal Weather	2.00	0.17	1	5.00	6.00	18.5%
(W4) Infrastructure Maintenance	0.33	0.14	0.20	1	1.00	4.7%
(W5) Limited Product Development	0.33	0.12	0.17	1.00	1	4.4%
CR =7.2%						

Table 6: Comparison Matrix of Opportunities Group

Opportunities	S1	S2	S3	S4	S5	Importance percentages
(O1) Sustainable Tourism Practices	1	2.00	7.00	1.00	6.00	35.4%
(O2) Digital Marketing	0.50	1	6.00	0.50	1.00	17.1%
(O3) Diversification of Tourism Products	0.14	0.17	1	0.17	1.00	5.0%
(O4) Government Support	1.00	2.00	6.00	1	6.00	34.5%
(O5) Collaborative Partnerships	0.17	1.00	1.00	0.17	1	7.9%
CR = 6.1%						

Table 7: Comparison Matrix of Threats Group

Threats	S1	S2	S3	S4	S5	Importance percentages
(T1) Climate Change	1	0.50	7.00	6.00	5.00	31.3%
(T2) Competition Regional Destinations	2.00	1	9.00	8.00	7.00	49.2%
(T3) Political Instability	0.14	0.11	1	1.00	0.25	3.9%
(T4) Over-Tourism	0.17	0.12	1.00	1	0.20	4.1%
(T5) Natural Disasters	0.20	0.14	4.00	5.00	1	11.5%
CR = 6.6%						

Lastly, the SWOT components' total priority scores are determined. In Table 7, overall priorities are displayed.

Table 8: Overall Priority Scores of SWOT Factors

Swot Group	Group Priority	Swot Factors	Factor Priority within the Group	Overall Priority of Factor
Strengths	3.9%	Diverse Marine Biodiversity	8.7%	1.6%
		Cultural Heritage	29.0%	2.6%
		Adventure Activities	**33.8%**	**3.1%**

		Protected Areas	23.0%	2.0%
		Tourism Infrastructure	5.5%	1.5%
Weaknesses	25.3%	Accessibility Challenges	10.0%	2.3%
		Waste Management Issues	**62.3%**	**14.8%**
		Seasonal Weather Patterns	18.5%	6.6%
		Infrastructure Maintenance	4.7%	0.9%
		Limited Product Development	4.4%	1.1%
Opportunities	11.4%	**Sustainable Tourism Practices**	**35.4%**	**8.5%**
		Digital Marketing	17.1%	4.9%
		Diversification of Tourism Products	5.0%	2.2%
		Government Support	**34.5%**	**8.9%**
		Collaborative Partnerships	7.9%	3.8%
Threats	59.4%	Climate	31.3%	9.0%
		Competition Regional Destinations	**49.2%**	**19.4%**
		Political Instability	3.9%	0.9%
		Over-Tourism	4.1%	1.0%
		Natural Disasters	11.5%	4.8%

The results of the AHP analysis show that, when taking into account the internal and external surroundings of beach tourism, competing regional destinations are the most significant difficulties.

CONCLUSION

In this article, we use a combination of SWOT and AHP approaches to identify crucial strategic components for the beach tourism industry. The results indicate the priority rating of each SWOT group as follows: Threats (59.4%), Weaknesses (25.3%), Opportunities (11.4%), and Strengths (3.9%). The study indicates that "competition regional destinations" from the threats group is the most significant SWOT component. This issue, which has an overall priority value of 19.4%, is the most crucial one to take into account. Prioritising waste management issues (14.8%), government support (8.9%), sustainable tourism practices (8.5%), and adventure activities (3.1%) are other noteworthy reasons. A management strategy or support for a crucial decision could be built using the SWOT elements' assessed priorities. The findings of this study can also be utilised to provide a list of suitable strategy choices for an organisation. Future studies could enhance the AHP method's use of a fuzzy logic framework to analyse ambiguous scenarios more successfully. Moreover, the AHP can be

substituted with any multi-criteria decision-making method, and the outcomes can be contrasted.

LIMITATION

There are a few limitations to the SWOT-AHP method's strategic study of beach tourism in Sabah, Malaysia. First off, in contrast to a multi-method approach, the study only uses the Analytic Hierarchy Process (AHP) to assess the strategic factors, which may limit the breadth and depth of findings. Second, because the focus is limited to Malaysia's Sabah area, it may miss more general regional or worldwide trends and factors that could have an impact on the beach tourist sector. Finally, the study is limited to the beach tourist industry, leaving out other pertinent tourism subsectors or business ventures that might have an influence on the broader strategic planning process. These drawbacks imply that, even while the SWOT-AHP method offers insightful information, a more comprehensive and varied approach could be required for an all-encompassing strategic analysis.

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Integrating SWOT and AHP Approaches to Strengthen Strategic Planning in Malaysia's Food Delivery Industry

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ABSTRACT

The goal of this research is to combine the Analytical Hierarchy Process (AHP) with the SWOT analysis to provide a thorough strategic planning framework for food delivery services in Malaysia. Through the creation of practical solutions to address these concerns and enhance overall performance, this integrated approach seeks to give a thorough understanding of the internal and external factors driving the food delivery business in Malaysia. The most important factors that need to be addressed right away can be found by using the SWOT analysis to identify the main strengths, weaknesses, opportunities, and threats. The AHP will then assess and rank these factors according to their relative significance and effect on food delivery services.

Keywords: ecotourism, sustainability, bibliometric analysis

INTRODUCTION

Due to rising customer demand for convenience and a wide variety of eating alternatives, Malaysia's food delivery market has grown rapidly over the last ten years. To capitalize on this expanding market, industry leaders like Food Panda and Grab have rapidly extended their operations (Euromonitor International, 2023). Intense competition, high operating costs, and shifting consumer tastes are some of the obstacles the business faces despite its success. To maintain their competitive edge and keep up their current development trajectory, these businesses need to have effective strategic planning. A popular method for strategic planning is SWOT analysis, which provides a framework for assessing an organization's internal and external environments. According to Gurel and Tat (2017), the qualitative aspect of classic SWOT analysis might pose limitations, making it challenging to prioritize certain elements. Analytic Hierarchy Process (AHP) integration with SWOT analysis offers a more quantitative and organized method of decision-making to get over this restriction (Saaty, 2008). By integrating SWOT analysis and AHP, this study seeks to improve the strategic planning procedures used by food delivery businesses in Malaysia. The study's goal is to provide a solid foundation for making strategic decisions by identifying and ranking the major elements influencing the sector. According to Kangas et al. (2001) and Kurttila et al. (2000), the fusion of SWOT and AHP techniques has been effectively utilized in a number of sectors, yielding insightful information and practical plans. This integrated strategy will assist businesses such as Food Panda and Grab in improving their operational efficiency, adjusting their plans, and navigating the competitive environment in the context of Malaysian food delivery services.

SWOT ANALYSIS

A strategic planning tool, the SWOT analysis model divides these elements into a four-quadrant matrix to assist firms in identifying and assessing their external opportunities and threats as well as their internal strengths and weaknesses. Whereas opportunities and threats are caused by outside forces like market trends and competitive pressures, strengths and weaknesses are internal qualities like resources and talents. By offering a thorough framework for strategic decision-making, this model helps businesses take advantage of opportunities, strengthen their positions, solve their weaknesses, and reduce risks (Gürel & Tat, 2017). Figure 1 illustrates how an environment scan uses SWOT analysis.

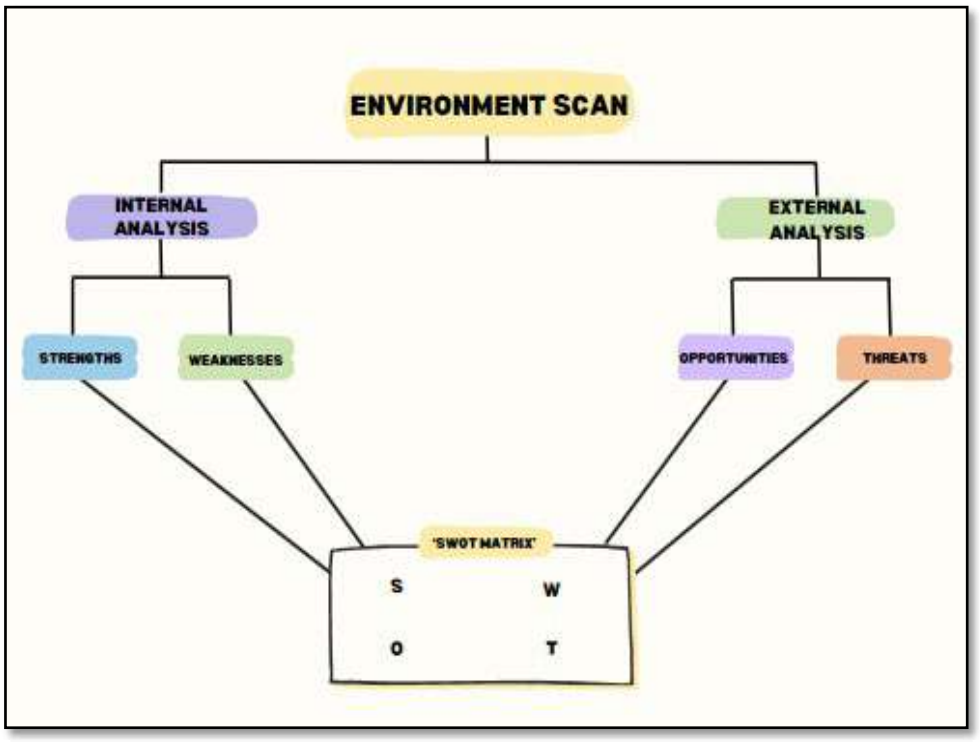

Figure 1: SWOT Analysis Framework

Analytic Hierarchy Process

In the 1970s, Thomas Saaty created the Analytic Hierarchy Process (AHP), a process for making decisions. It is an organized method for handling difficult choices by first dividing them into a hierarchy of requirements and options and then methodically evaluating and ranking each one according to pairwise comparisons. When applying AHP, decision-makers often use a scale from 1 to 9 to assign numerical values to express their preferences or assessments of the relative significance of certain criteria or alternatives. Decision-makers can then determine which solutions are the most advantageous by synthesizing these values using mathematical techniques to create priority ratings. In a variety of domains, such as business, engineering, and public policy, AHP offers a strict and transparent framework for decision-making (Saaty, 2008).

Numerical Values	Description	Explanation
1	Equal Importance of both elements	Two elements contribute equally
3	Moderate importance of one element over another	Experience and judgement 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 judgements	Used to compromise between two judgements

Table 1: Pairwise comparison scale

This table displays the Analytic Hierarchy Process (AHP) pairwise comparison scale for decision-making. With intermediate values (2, 4, 6, 8) used to represent compromise between adjacent judgments, the scale uses numerical values from 1 to 9 to quantify the relative importance of two items. As one element is prioritized above another, its value increases from 1 (equal significance) to 3 (moderate importance) to 9 (extreme importance). A systematic and uniform approach to assessing several criteria in decision analysis is ensured by the explanations that give context and show that higher values indicate a stronger judgment favoring one aspect considerably over another.

In this research, we prioritize the SWOT aspects using the Analytic Hierarchy Process (AHP). Prioritization is the process of establishing the relative relevance of the criteria once the problem has been broken down and the hierarchy has been created. Based on the predetermined criteria at the higher level, the criteria at each level are compared pairwise based on their relative levels of effect. In AHP, a standardized comparison scale with nine levels serves as the foundation for several pairwise comparison.

Let the collection of criteria be represented as C = {Cj | j = 1, 2,..., n}. An (n x n) evaluation matrix A may be used to describe the outcome of the pairwise comparison on n criteria. In this matrix, each element ij (i, j = 1, 2,..., n) represents the weight of the criterion as a ratio. An example of this pairwise comparison is provided by a square and reciprocal matrix.

$$A = (a_{ij})_{nxn} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ a_{n1} & a_{n2} & . & a_{nn} \end{bmatrix}$$

For the final step, each matrix is normalized and be found the relative weights. The relative weights are given by the right eigenvector (max), as:

$$A_w = \lambda_{max} . w$$

The matrix A max = n is the result of perfect consistency in pairwise comparisons. In this particular case, any of A's rows or columns can be normalized to get weights. Note that consistency in the pairwise comparison evaluations is correlated with the quality of the AHP output. The consistency is defined by the relation between the entries of A: aij x ajk = aik. The Consistency Index (CI) can be calculated, using the following formula:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

The assessments' level of consistency may be determined by utilizing the final consistency ratio (CR). According to Equation 4, the CR is determined by dividing the CI by the random index (RI).

$$CR = \frac{CI}{RI}$$

The recognized top limit for CR is 0.1. In order to increase consistency, the assessment process must be repeated if the final consistency ratio is higher than this value.

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

In the SWOT-AHP framework, pairwise comparisons using eigenvalue calculations are utilized to prioritize assessment elements using the Analytical Hierarchy Process (AHP). Conventional SWOT analysis usually fails to clearly define the influence of each component on strategic options because it does not quantify each aspect's relevance (Kangas et al., 2001). Kurttila et al. (2000) state that the Analytic Hierarchy Process (AHP) facilitates a methodical way to ascertain the relative significance of criteria and to evaluate decision alternatives correspondingly by transforming the SWOT framework into a hierarchical structure.To measure and compare the strengths and weaknesses of each SWOT element in a methodical manner is the main goal of incorporating AHP into the SWOT framework (Kangas et al., 2001). Three crucial phases are included in the suggested procedure. As the foundation for the SWOT analysis, the first step in strategic planning is to identify important external (opportunities and threats) and internal (strengths and weaknesses) aspects. To ascertain the weights of each SWOT category, pairwise comparisons should be made. The relative priorities of each component inside the SWOT groupings are then determined using AHP. Next, multiply the local weights of the factors by the corresponding group weights to obtain the overall factor weight rank.

To measure and compare the strengths and weaknesses of each SWOT element in a methodical manner is the main goal of incorporating AHP into the SWOT framework (Kangas et al., 2001). Three crucial phases are included in the suggested procedure. As the foundation for the SWOT analysis, the first step in strategic planning is to identify important external (opportunities and threats) and internal (strengths and weaknesses) aspects. To ascertain the weights of each SWOT category, pairwise comparisons should be made. The relative priorities of each component inside the SWOT groupings are then determined using AHP. Next, multiply the local weights of the factors by the corresponding group weights to obtain the overall factor weight rank. Additional uses include coming up with plans for the safe transportation of bulk liquid chemicals in tankers (Seyedalikhani et al., 2011), assessing machine tool manufacturers' worldwide competitiveness (Görener, 2012), and deciding on business strategies for the textile sector (Kurtilla et al., 2000). The approach has also been used to create strategies for the Turkish chemicals industry (Uçkun et al., 2010), analyze marine casualties in the Strait of Istanbul (Kaptan et al., 2011), choose shipping registries for the maritime transportation sector (Fahimnia et al., 2013), and administer integrated water resources management in Mozambique (Lahtinen et al., 2009).

METHODOLOGY AND APPLICATION

The primary goal of applying the Analytic Hierarchy Process (AHP) to the SWOT framework is to methodically evaluate the SWOT criteria and assign weights to them based on their relative importance. The three components of the AHP structure in this study are the aim to be attained by the decision, the SWOT groups, and the elements contained within each SWOT group (sub-criteria). The AHP structure is derived from the SWOT matrix. Fig. 2 displays the hierarchical depiction of the SWOT framework

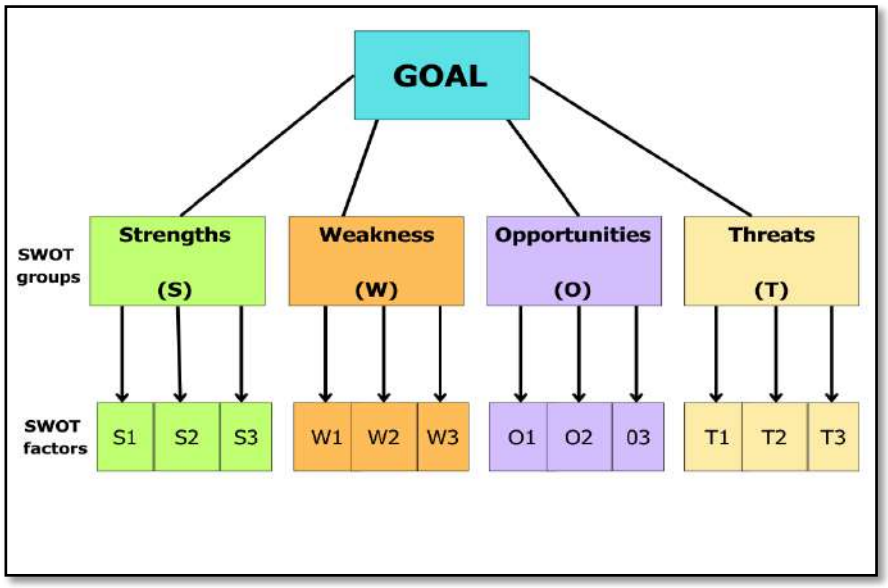

Figure 2: Hierarchical structure of the SWOT matrix

In this case study, a company that makes cooker hoods in Istanbul, Turkey, is the subject of a SWOT analysis that optimizes the AHP. Over 50 nations worldwide are typically recipients of the company's exports. Pairwise comparisons were conducted using a comparison scale, and the relative significance of each pair of SWOT criteria was measured. The vector weights or priorities for the groups and components under analysis might be determined using the aggregated matrix that was produced following the digitization of the SWOT frame using AHP.

We constructed a three-phase model consisting of establishing an initial job, adjusting components, and building an assessment model (Figure 1) in order to create a strategic management model based on SWOT-AHP. SWOT analysis is done first, followed by matrix structure. The SWOT matrix defines and incorporates the pertinent internal environment and elements.

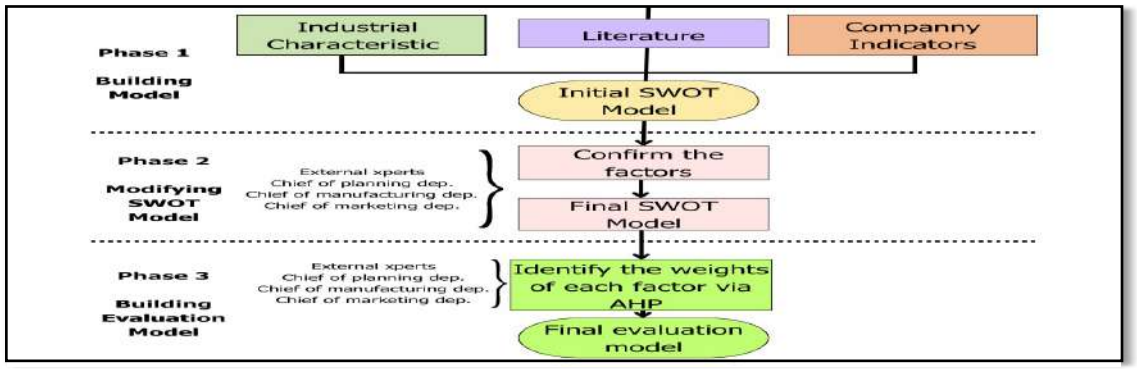

Figure 3: Phases of proposed methodology

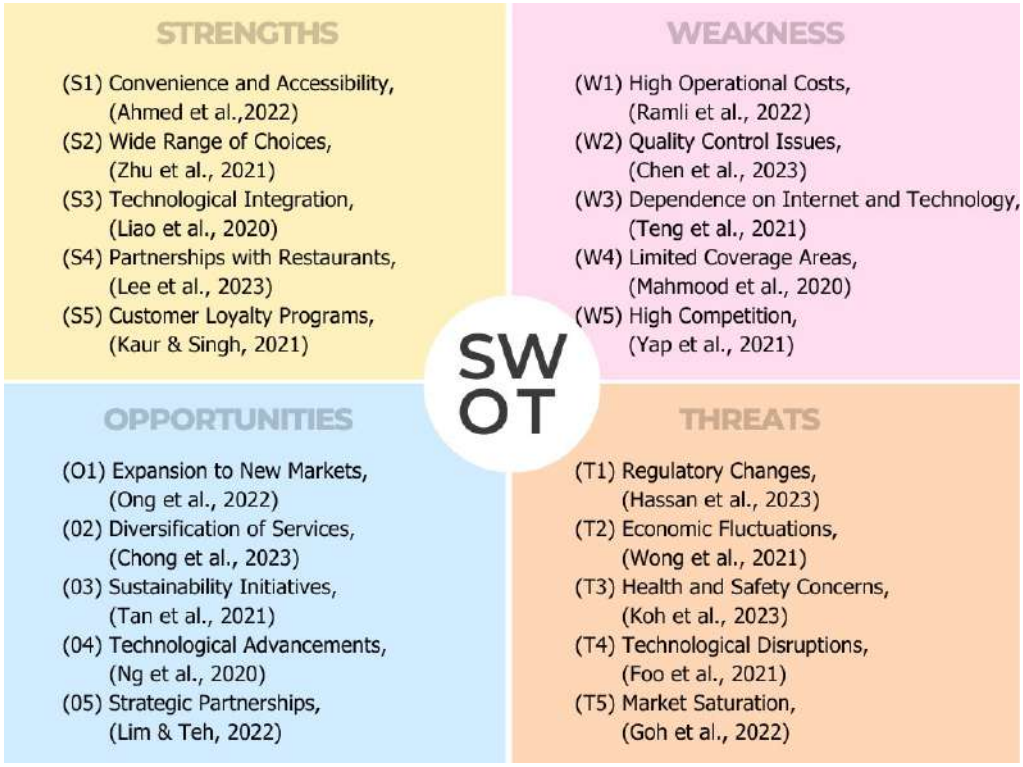

Table 3: SWOT matrix

The SWOT matrix is subjected to AHP. First, using a Saaty's (1980) comparison scale ranging from 1 to 9, pairwise comparisons of the SWOT groups are done. Table 4 displays the comparing findings. Second, all of the SWOT groups are taken into consideration while comparing the aspects of SWOT matrices. Each pairwise comparison in the group of professionals handles the application. Three department managers from the company as well as the writers of this report made up the expert team.

SWOT Groups	**S**	**W**	**O**	**T**	**Importance Degrees of SWOT Groups**
Strengths (S)	1.000	2.000	4.000	7.000	0.515
Weakness (W)	0.500	1.000	2.000	5.000	0.279
Opportunities (O)	0.250	0.500	1.000	3.000	0.147
Threats (T)	0.140	0.200	0.333	1.00	0.059
CR= 1.0%					

Table 4: Pairwise comparisons of SWOT factors

The most crucial element in Malaysian food delivery services is strengths (importance degree: 0.515), which emphasizes the necessity to take use of internal advantages including convenience, technology integration, and restaurant alliances. This is shown in the pairwise comparison matrix for SWOT aspects. The necessity of tackling high operating expenses and quality control difficulties is shown by the following priority, weaknesses (0.279). Although less significant than internal variables, opportunities (0.147) have a considerable relevance and signal possible advantages from market expansion and service diversification. The least important risk is threats (0.059), suggesting that external hazards like market saturation and regulatory changes are not as urgent as they once were. This strategic emphasis emphasizes how important it is to build on strengths and minimize flaws in order to succeed.

Strengths	**S1**	**S2**	**S3**	**S4**	**S5**	**Importance Degrees**
(S1) Convenience and Accessibility	1.000	2.000	3.000	4.000	9.000	0.421
(S2) Wide Range of Choices	0.500	1.000	2.000	4.000	6.000	0.275
(S3) Technological Integration	0.333	0.500	1.00	2.000	7.000	0.170
(S4) Partnerships with Restaurants,	0.250	0.250	0.500	1.000	5.000	0.101
(S5) Customer Loyalty Programs	0.110	0.170	0.140	0.200	1.00	0.033
CR = 4.0%						

Table 5: Comparison Matrix of Strengths Group

"Convenience and Accessibility" (S1) is the most important strength with a significance degree of 0.421, indicating that it should be the key emphasis for leveraging competitive advantage, according to the comparison matrix for the strengths group in food delivery services, as revealed in Table 5. With a 0.275 significance degree, "Wide Range of Choices" (S2) is the next most important factor, highlighting the importance of providing clients with several options. Its function in improving service efficiency is shown by the moderate importance degree of 0.170 for "Technological Integration" (S3). The significance degrees of "Customer Loyalty Programs" (S5) and "Partnerships with Restaurants" (S4) are lower than those of convenience and choice, indicating that although these areas are good, they are not as important. Coupled comparisons are dependable and constant when the consistency ratio (CR) reaches 4.0%.

Weakness	W1	W2	W3	W4	W5	Importance Degrees
(W1) High Operational Costs	1.000	2.000	4.000	7.000	9.000	0.470
(W2) Quality Control Issues	0.500	1.000	2.000	4.000	8.000	0.275
(W3) Dependence on Internet and Technology	0.250	0.500	1.00	3.000	6.000	0.158
(W4) Limited Coverage Areas	0.140	0.250	0.330	1.000	5.000	0.080
(W5) High Competition	0.110	0.120	0.170	0.200	1.00	0.033
CR = 5.0%						

Table 6: Comparison Weakness of Strengths Group

According to the comparison matrix, the most essential weakness in food delivery services is "High Operational Costs" (W1), with a significance degree of 0.470. This suggests that controlling and lowering operational costs is crucial for strategic progress. The second major worry, "Quality Control Issues" (W2), has a significance degree of 0.275, emphasizing the necessity of strict quality management procedures. The moderate significance degree of 0.158 for "Dependence on Internet and Technology" (W3) indicates that, although necessary, dependence on technology carries a significant danger. With relevance ratings of 0.080 and 0.033, respectively, "Limited Coverage Areas" (W4) and "High Competition" (W5) are less important flaws that nonetheless require correction. The consistency ratio (CR) of 3.65% indicates that a good level of consistency in the pairwise comparison are reliable and consistent.

Opportunities	O1	O2	O3	O4	O5	Importance Degrees
(O1) Expansion to New Markets	1.000	2.000	5.000	7.000	9.000	0.474
(O2) Diversification of Services	0.500	1.000	2.000	8.000	9.000	0.297
(O3) Sustainability Initiatives	0.200	0.500	1.00	3.000	6.000	0.143
(O4) Technological Advancements	0.140	0.120	0.330	1.000	2.000	0.052
(O5) Strategic Partnerships	0.110	0.110	0.170	0.500	1.000	0.033
CR = 3.6%						

Table 7: Comparison Opportunities of Strengths Group

Expanding market presence need to be the main strategic priority, as shown by the comparison matrix for opportunities in food delivery services, which ranks "Expansion to New Markets" (O1) as the most significant opportunity with a significance degree of 0.474. "Diversification of Services" (O2) comes next, with a significance of 0.297, suggesting that providing a greater variety of services is also essential for expansion. The name "Sustainability Initiatives" (O3) indicates the growing significance of sustainable practices, with a modest importance degree of 0.143. "Strategic Partnerships" (O5) and "Technological Advancements" (O4) have significance degrees that are lower than those of market expansion and service diversification, indicating that although these possibilities are good, they are not as important. Pairwise comparisons are deemed dependable and consistent based on their consistency ratio (CR) of 3.6%.

Threats	**T1**	**T2**	**T3**	**T4**	**T5**	**Importance Degrees**
(T1) Regulatory Changes	1.000	2.000	4.000	8.000	9.000	0.479
(T2) Economic Fluctuations	0.500	1.000	2.000	4.000	6.000	0.249
(T3) Health and Safety Concerns	0.250	0.500	1.00	4.000	6.000	0.170
(T4) Technological Disruptions	0.120	0.250	0.250	1.000	4.000	0.070
(T5) Market Saturation	0.110	0.170	0.170	0.250	1.000	0.033
CR = 5.5%						

Table 8: Comparison Threats of Strengths Group

"Regulatory Changes" (T1) is the most serious threat in the food delivery services comparison matrix, with a significance degree of 0.479, highlighting the crucial influence of regulatory changes on the sector. "Economic Fluctuations" (T2) comes next, showing how susceptible the sector is to changes in the economy with a degree of 0.249. "Health and Safety Concerns" (T3) has a moderate importance degree of 0.170, indicating the continuous significance of upholding elevated standards for health and safety. The risks of "market saturation" (T5) and "technological disruptions" (T4) are rated as less serious, with degrees of 0.070 and 0.033, respectively. This suggests that although these problems exist, they are not as urgent as regulatory and economic ones. Consistency and reliability are indicated by the paired comparisons' consistency ratio (CR) of 5.5%.

SWOT Groups	Group Priority	Swot Factors	Factor Priority within the Group	Overal Priority of Factor
Strengths	0.515	**Convenience and Accessibility**	**0.421**	**0.217**
		Wide Range of Choices	0.275	0.142
		Technological Integration	0.170	0.088
		Partnerships with Restaurants,	0.101	0.052
		Customer Loyalty Programs	0.033	0.017
Weakness	0.279	**High Operational Costs**	**0.470**	**0.131**
		Quality Control Issues	0.275	0.077
		Dependence on Internet and Technology	0.158	0.044
		Limited Coverage Areas	0.080	0.022
		High Competition	0.033	0.009
Opportunities	0.147	**Expansion to New Markets**	**0.474**	**0.225**
		Diversification of Services	0.297	0.044
		Sustainability Initiatives	0.143	0.021
		Technological Advancements	0.052	0.008
		Strategic Partnerships	0.033	0.005
Threats	0.059	**Regulatory Changes**	**0.479**	**0.028**
		Economic Fluctuations	0.249	0.015
		Health and Safety Concerns	0.170	0.010
		Technological Disruptions	0.070	0.004
		Market Saturation	0.033	0.002

Table 9. Overall Priority Scores of SWOT Factors.

The AHP analysis results indicate that rising living standarts and increasing modern buildings are the most important issues considering a cooker hoods manufacture's internal and external environments.

CONCLUSION

In this study, we have combined SWOT and AHP methodologies to identify important strategic determinants for manufacturing firms. The results display each SWOT group priority in the following order: Possibilities (14.7%), Weaknesses (27.9%), Strengths (group weight 51.5%), and Threats (5.9%). "Rising living standards and increasing modern buildings" from the Opportunities group is the most significant aspect in the SWOT analysis, according to the analysis. With an overall importance score of 0.225, this issue is the most crucial one to take into account. Additional important variables are prioritized as follows: Convenience and accessibility (21.7%), regulatory changes (2.8%), high operational costs (13.1%), and expansion into new markets (22.5%). A management strategy or support for a crucial decision might be built using the SWOT elements' assessed priorities. The outcomes might be utilized to create a group of suitable strategy options for the company. Future studies might enhance the analysis of instances containing uncertainty more successfully by combining the fuzzy logic framework with the AHP approach. Additionally, any multi-criteria decision-making method can be used in place of the AHP, and the outcomes can be contrasted.

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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.

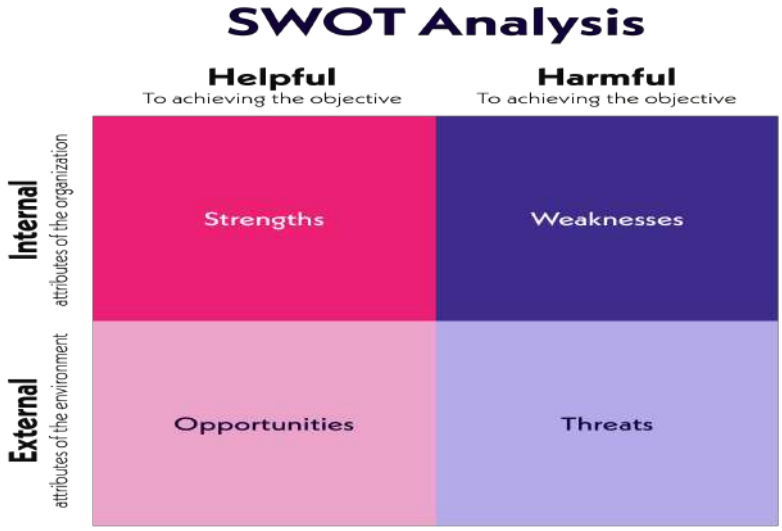

Figure 1: SWOT analysis framework

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).

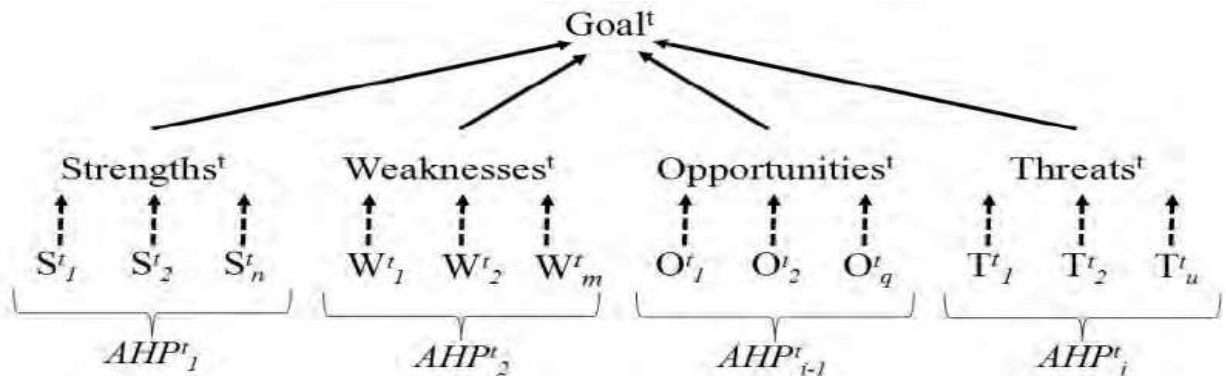

Figure 2: Hierarchical structure of the SWOT matrix

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.

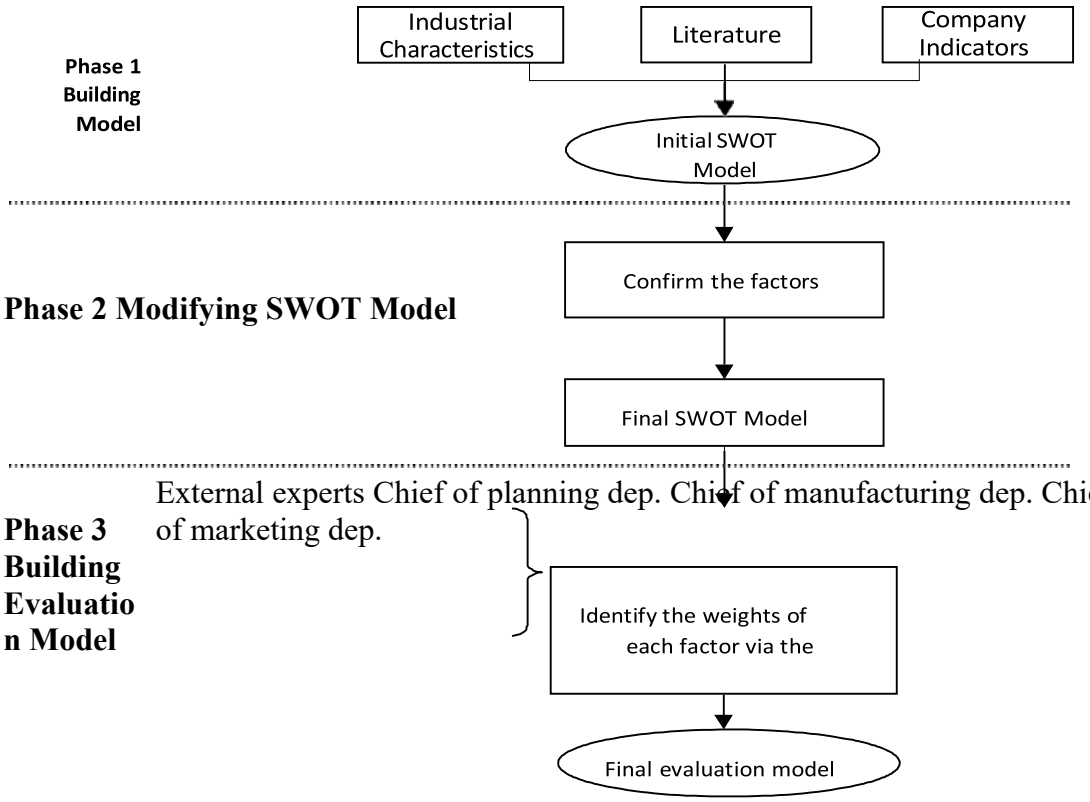

Figure 3: Phases of proposed methodology

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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Application of Combined SWOT and AHP: A Case Study for a Agricultural Firm

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ABSTRACT

SWOT is a familiar business and marketing perspective which can help the management and all the interested parties to catch the main points in the organization or industry, its assets and liabilities, and opportunities and threats in the market. SWOT analysis can be considered as one of the most basic tools for decision-making since it offers an analysis of a situation. The purpose of this research is to design a strategy that could help to solve the main issue, namely absence of the clear prioritization of the criteria used within the SWOT analysis. To make the use of SWOT analysis more effective, the current study recommends applying another MCDM technique, namely, the Analytic Hierarchy Process (AHP). The AHP is another method of assessing factors or criterion by pair wise comparison through eigenvalue which is a typical method of comparing factors as well as criterion. The identified integrated approach is based on the necessity to solve the issues regarding quantitative effectiveness of strategic planning.

Keywords: SWOT, Analytic Hierarchy Process (AHP), Decision-making, Agricultural

INTRODUCTION

This suggests that there must be a fit between business management and the internal/external environment in which the Company operates for it to succeed. SWOT is one of the most effective tools practitioners apply to understand the sum of forces that are beneficial and those that are detrimental in overall organizations' performance.

SWOT analysis is one of the most significant tools of strategic planning that help to identify all the strengths and weaknesses of the particular business or project, as well as to define all the opportunities and threats that can occur. It is method used in the field of strategic management and analytical strategy for both situations. SWOT analysis may not effectively assess the importance of variables in a particular context and leaves incapable of assessing decision prospects depending on helpful criteria (Nguyen &

Truong, 2022).

Based on the evaluation result of the previous recommendation, this study developed a quantitative AHP to conduct the SWOT analysis in order to order the weightings of SWOT factors. The approach involves successively comparing the components of the SWOT model to identify them. The eigenvalue technique was used to evaluate the importance and ranking of SWOT criteria in the Analytical Hierarchy Process comparison matrices of the Analytical Network Process (Yavuz & Baycan, 2013). The study demonstrates how the SWOT-AHP conceptual framework may be utilized to analyse strategic decisions.

SWOT AND AHP MODEL

SWOT Analysis

SWOT on its part is extensively used in making an analysis of the internal and external environments to get a framework and backing for the decisions made.

Strategic factors involve the strategic components that include internal and external factors that are of primary significance to the firm. The factors are classified into four distinct sections referred to as SWOT groups: named as the SWOT analysis that includes strengths, weaknesses, opportunities, and threats. The justification of using SWOT when making strategic plans and decisions is to find a suitable and efficient strategy that can accommodate the inside and outside environment in the firm. In addition, it is crucial that the selected strategy matches the aims of the current and upcoming decision-making processes. SWOT is a method, which means a systematic study and reasonable assessment of factors, which are relevant in terms of a new product, technology, management or planning. SWOT analysis is shown Figure 1 as a component of an environmental scan of the organization.

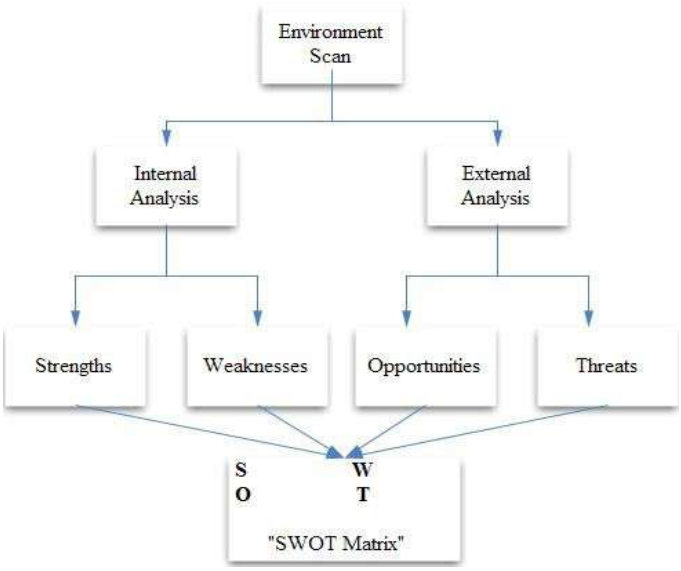

Figure 1: SWOT analysis framework

Analytic Hierarchy Process

AHP, an example of a multi-criteria decision-making technique, can be utilized to implement each stage of the decision-making process. It breaks down the complex challenges into several levels of simpler structures, including options, criteria, and sub-objectives. The Analytic Hierarchy Process (AHP) is a distinctive method that entails comparing variables at different levels of a hierarchy and evaluating the alternatives at the final level of the hierarchical model. Therefore, AHP is a highly effective tool for decision making that should be used in situations where subjectivity is a factor. This strategy is applicable when the choice parameters are clearly specified and can be analyzed in relation to sub-criteria, as in the context of problem solving.

It is utilized to determine priorities on absolute quantitative scales by comparing both discrete and continuous pairs in a hierarchical framework with multiple levels. The mechanism for prioritization is developed a comparison scale that is utilized to assign a numerical number to the importance of a condition (Saaty, 1980). Project members rank the identified criteria. Moreover, the selection of these components and their levels of significance is determined by creating a matrix for pairwise comparisons.

Table 1: Pairwise comparison scale

Importance	Explanation
1	Two criterion contribute equally to the objective
3	Experience and judgement slightly favor one over another
5	Experience and judgment strongly favor one over another
7	Criterion is strongly favored and its dominance is demonstrated in practice
9	Importance of one over another affirmed on the highest possible order
2, 4, 6, 8	Used to represent compromise between the priorities listed above

The Analytic Hierarchy Process (AHP) is based on three core principles: ranking the ideas, evaluating the criteria and/or alternatives, and integrating the priorities inside the model's architecture. The paper demonstrates the extensive utilization of AHP in the literature for tackling various decision-making difficulties. The key choice problem in the first phase is organized hierarchically. Firstly, the Analytic Hierarchy Process (AHP) breaks down a complicated and contradictory decision with various criteria into a set of interconnected decision pieces, such as criteria and decision alternatives (Ibrahim et al., 2021). The AHP synthesizes the objectives, decision criteria, and alternatives in a hierarchical structure that resembles a branch of a family tree. The final objective is situated at the apex of the delineated hierarchy of objectives, which must consist of at least three tiers. The middle level consists of a set of criteria that determine the available possibilities, while the bottom level is composed of the actual options themselves.

In this instance, the authors utilize the Analytic Hierarchy Process (AHP) to assist in determining the relative importance of different elements inside the SWOT analysis. Hierarchy completion is conducted to ascertain the importance of the criterion once the hierarchical structure has been established and the problem has been divided. The criteria are systematically compared at each level, with particular attention given to the defined criteria and their respective degrees of importance at higher levels. The Analytic Hierarchy Process (AHP) employs a 9-point crosswise comparison scale to simplify the evaluation process, as it often involves numerous comparisons.

Define the collection of related criteria as C = { Cj | j = 1, 2, ……n } In a square evaluation matrix of dimension (n x n), each entity an i,j [i, j =1,2,...,n] reflects the ratio of the weights of two criteria. Additionally, it can be succinctly summarized by comparing n numbers of criteria in a pairwise manner. The process of comparing pairs can be accomplished by utilizing a scale and reciprocal matrix, as demonstrated in Equation (1).

$$A=(a_{ij})_{n\times n}=\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ a_{n1} & a_{n2} & \cdot & a_{nn} \end{bmatrix}$$

The final step entails the normalization of each matrix and the determination of the weights of its relatives. The right eigenvector (w) that corresponds to the largest eigenvalue (λ_{max}) is the source of the relative weight.

Aw= max.w

The maximum value of matrix A is n if the pairwise comparisons are entirely consistent. In this case, the weights can be determined by normalizing either the rows or columns of matrix A. The consistency of the judgement made during pairwise comparisons is directly correlated with the quality of the AHP's output. The relationship between the entries of A determines its consistency: $_i$ x $_i$ = $_k$. The Consistency Index (CI) can be computed using the subsequent formula:

$$CI=\frac{\lambda_{max}-n}{n-1}$$

Using the final consistency ratio (CR) can conclude whether the evaluations are sufficiently consistent. The CR is calculated as the ratio of the CI and the random index (RI), as indicated in Eq. 4

$$CR=\frac{CI}{RI}$$

The accepted upper limit for CR is 0.1. The evaluation procedure must be repeated in order to enhance consistency if the final consistency ratio exceeds this value.

Table 2: Random index [6, 20]

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

SWOT-AHP Model

The eigenvalue method in AHP is used to assess the relative significance of evaluation factors and make pairwise comparisons between them. At times, it can be challenging to assess the significance of the aspects that pertain to the business in order to determine their influence on the proposed strategic options in the SWOT analysis. It is not feasible to use a SWOT analysis to rank decision alternatives based on these criteria or to gradually determine the relative importance of the factors. In order to address this deficiency, the model is integrated and examined using the Analytic Hierarchy Process (AHP) and its eigenvalue calculation approach. Subsequently, the SWOT framework is reconfigured into a CPA HP structure.

Firstly, it is essential to systematically evaluate and compare the aspects under consideration in the SWOT analysis, in accordance with the specifications of the Analytic Hierarchy Process (AHP) approach. This has been achieved by employing the prescribed approach, which has been executed in three separate stages.

Prior to commencing the construction of the fundamental strategic planning model, known as the SWOT analysis, it is necessary to compile a comprehensive inventory of all external threats and opportunities that are relevant to the organization, as well as all internal strengths and weaknesses that may be encountered.

Pairwise comparisons are utilized in the second phase of the construction process to evaluate the relative importance of each SWOT category. Thus, the third stage of the Analytic Hierarchy Process (AHP) involves ranking the elements inside the AHP framework to determine the relative importance of factors in each category using the SWOT technique. Thus, the final weights of the factors at the local level are determined by multiplying the individual weights with the weight of the group in question, resulting in the overall rank of the component weights.

The study conducted employed the Analytic Hierarchy Process (AHP) tool in conjunction with the integration of the Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis (Kurttila et al. ,2000). The process of planning was enhanced by organizing and aligning the evaluated components, and by introducing a more analytical approach. SWOT and AHP have been extensively utilized and examined in diverse sectors of application. The combined utilization of these tools is considered one of the most commonly employed methodologies in this domain. From an application perspective, it has been utilized to determine outsourcing solutions for sport marketing, assess and choose management strategies for a forestland estate, analyse and determine the strategic marketing plan for the revival of the Sri Lankan tourism industry, devise strategies for managing natural resources, evaluate the competitiveness of a global machine tool manufacturing industry, and identify solutions for the safe transportation of bulk products.

METHODOLOGY AND APPLICATION

The primary goal of integrating the AHP into the SWOT framework is to conduct a systematic evaluation of the SWOT factors and to reconcile their relative importance. The AHP structure in this study is derived from the SWOT matrix and is further divided into three components: (a) the decision's objective, (b) the SWOT groups, and (c) the factors within each SWOT group (sub-criteria). The SWOT structure's hierarchical

representation is illustrated in Fig. 2.

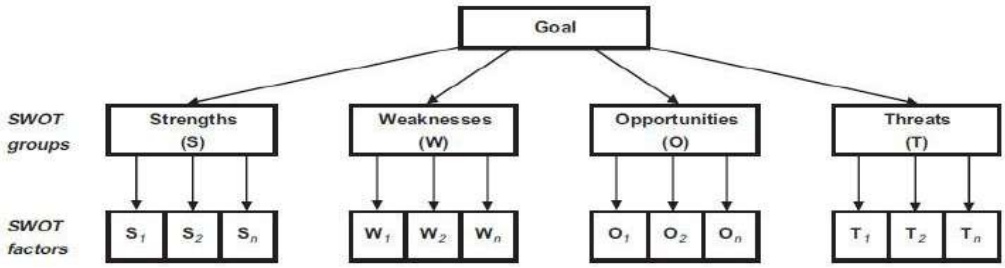

Figure 2: Hierarchical structure of the SWOT matrix.

In the following case study, the Analytic Hierarchy Process (AHP) is enhanced by performing a SWOT analysis on a company based in Istanbul, Turkey, that specializes in manufacturing cooker hoods. The company generally ships its products to over 50 countries globally. We utilized Saaty's comparison scale to perform pairwise comparisons and determine the relative importance of each pair of SWOT factors. After digitizing the SWOT frame using AHP, the vector weights or priorities for the groups and factors being analyzed can be determined using the aggregated matrix that was obtained. We have devised a strategic management model consisting of three distinct phases, namely the creation of an initial task, the adjustment of factors, and the establishment of an evaluation model (Figure 1). This model is built upon the SWOT-AHP framework. Firstly, the SWOT analysis is carried out, and the matrix is structured. The SWOT matrix delineates and assembles the relevant factors and internal environment.

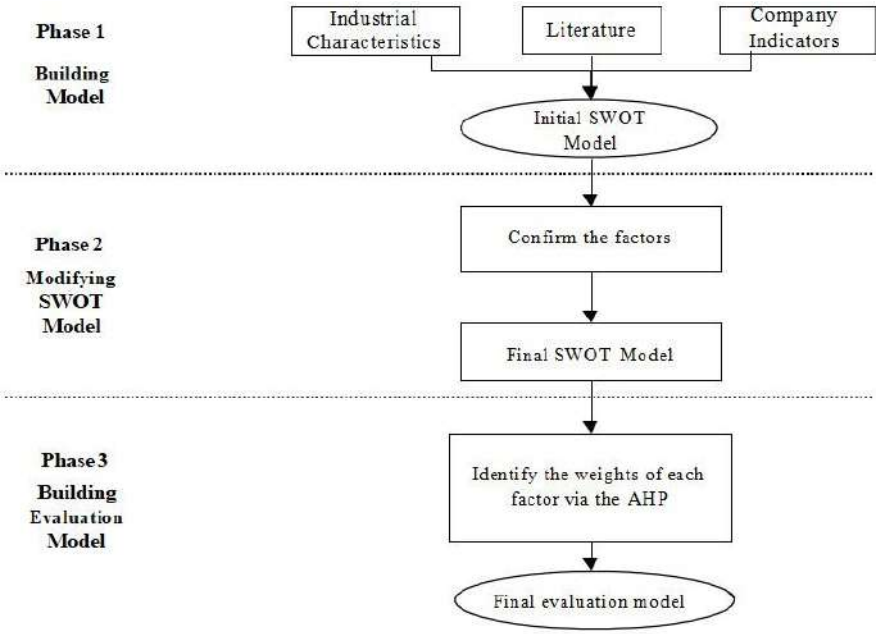

Figure 3: Phases of proposed methodology

Table 3: SWOT Matrix

Strength (S)	**Weaknesses (W)**
(S1) Favorable Climate and Soil **(S2)** Established Infrastructure **(S3)** Government Support **(S4)** Skilled Labor Force **(S5)** Large Plantation Areas	**(W1)** Environmental Concerns **(W2)** Labor Issues **(W3)** Market Dependence **(W4)** Sustainability Issues **(W5)** Infrastructure Maintenance
Opportunities (O)	**Threat (T)**
(O1) Growing Global Demand **(O2)** Sustainable Practices **(O3)** Diversification **(O4)** Research and Development **(O5)** Trade Agreements	**(T1)** Environmental Regulations **(T2)** Market Fluctuations **(T3)** Competition **(T4)** Climate Change **(T5)** Activism and Boycotts

Strengths, Weaknesses, Opportunities, and Threats (SWOT) matrix analysis is conducted using the Analytic Hierarchy Process (AHP). Comparison scale is employed to conduct pairwise comparisons of the SWOT group, with a rating range of 1 to 9. Table 4 illustrates the comparative results. Subsequently, a comparison scale is implemented to evaluate the components of the SWOT matrix. Table 4 illustrates the comparative results. Additionally, considering each SWOT category. The application's comparisons between pairs are conducted by a team of professionals. A team of experts was established, which included members from three distinct departments. The authors of this document and the individuals responsible for managing the firm.

Table 4: Pairwise comparison of SWOT factors

SWOT Groups	**S**	**W**	**O**	**T**	**Importance Degrees of SWOT Groups**
Strengths (S)	1.000	0.500	0.140	0.170	0.064
Weaknesses (W)	2.000	1.000	1.000	0.250	0.174
Opportunities (O)	7.000	1.000	1.000	1.000	0.327
Threats (T)	6.000	4.000	1.000	1.000	0.435

CR= 8.5%

Table 5: Comparison Matrix of Strengths Group

Strengths	S1	S2	S3	S4	S5	Importance Degrees
Favorable Climate and Soil (S1)	1.000	0.170	0.170	0.200	0.120	0.038
Established Infrastructure (S2)	6.000	1.000	3.000	2.000	4.000	0.417
Government Support (S3)	6.000	0.330	1.000	0.500	1.000	0.150
SkilledLabor Force (S4)	5.000	0.500	2.000	1.000	2.000	0.237
Large Plantation Areas (S5)	8.000	0.250	1.000	0.500	1.000	0.158

CR = 6.1%

Table 6: Comparison Matrix of Weaknesses Group

Weaknesses	W1	W2	W3	W4	W5	Importance Degrees
Environmental Concerns (W1)	1.000	1.000	0.170	0.140	0.500	0.006
LaborIssues (W2)	1.000	1.000	0.140	0.170	0.500	0.059
Market Dependence (W3)	6.000	7.000	1.000	2.000	3.000	0.440
Sustainability Issues (W4)	7.000	6.000	0.500	1.000	2.000	0.309
Infrastructure Maintenance (W5)	2.000	2.000	0.330	0.500	1.000	0.132

Consistency Ratio (CR) = 1.5%

Table 7: Comparison Matrix of Opportunities Group

Opportunities	O1	O2	O3	O4	O5	Importance Degrees
Growing Global Demand (O1)	1.000	0.250	0.140	0.140	0.200	0.370
Sustainable Practices (O2)	4.000	1.000	0.200	0.170	1.000	0.102
Diversification (O3)	7.000	5.000	1.000	1.000	1.000	0.306
Research and Development (O4)	7.000	6.000	1.000	1.000	3.000	0.388
Trade Agreements (O5)	5.000	1.000	1.000	0.330	1.000	0.167

Consistency Ration (CR) = 7.0%

Table 8: Comparison Matrix of Threats Group

Threats	T1	T2	T3	T4	T5	Importance Degrees
Environmental Regulations (T1)	1.000	1.000	1.000	0.2000	5.000	0.152
Market Fluctuations (T2)	1.000	1.000	1.000	0.200	4.000	0.142
Competition (T3)	1.000	1.000	1.000	0.330	2.000	0.135
Climate Change (T4)	5.000	5.000	3.000	1.000	6.000	0.519
Activism and Boycotts (T5)	0.2000	0.250	0.500	0.170	1.000	0.052

Consistency Ration (CR) = 4.9%

Finally, the SWOT factors are assessed and assigned priority scores. The table labelled as Table 9 displays the main priorities in a comprehensive manner.

Table 9: Overall Priority Scores of SWOT Factors

SWOT Group	Group Prioriy	SWOT Factors	Factor Priority within the Group	Overall Priority of Factor
Strengths	0.064	Favorable Climate and Soil	0.038	0.002
		Established Infrastructure	**0.417**	**0.027**
		Government Support	0.150	0.010
		Skilled Labor Force	0.237	0.015
		Large Plantation Areas	0.158	0.010
Weaknesses	0.174	Environmental Concerns	0.006	0.001
		Labor Issues	0.059	0.010
		Market Dependence	**0.440**	**0.076**
		Sustainability Issues	0.309	0.053
		Infrastructure Maintenance	0.132	0.223
Opportunities	0.327	Growing Global Demand	0.370	0.121
		Sustainable Practices	0.102	0.033
		Diversification	0.306	0.100
		Research and Development	**0.388**	**0.127**
		Trade Agreements	0.167	0.055
Threats	0.435	Environmental Regulations	0.152	0.066
		Market Fluctuations	0.142	0.062
		Competition	0.135	0.059
		Climate Change	**0.519**	**0.226**
		Activism and Boycotts	0.052	0.023

CONCLUSION

According to the given SWOT analysis, the factors with the greatest overall priority suggest important areas that the organization should focus on. The key advantages of the region include the well-developed infrastructure (0.027) and highly skilled labour force (0.015), which are further bolstered by moderate government support and expansive plantation areas. Nevertheless, there are significant obstacles that need to be addressed strategically, such as the reliance on the market (0.076) and concerns regarding sustainability (0.053). The opportunities are driven by research and development (0.127) and increasing global demand (0.121), highlighting the potential for innovation and market growth. In contrast, climate change (0.226) and environmental regulations (0.066) are the primary threats, highlighting the necessity for proactive environmental strategies. In summary, the analysis emphasizes the importance of utilizing existing infrastructure strengths and research opportunities, while also addressing any vulnerabilities in the market and environment.

LIMITATION

A distinction has been made between some important features as understood by the current and past personnel within the organization. However, the rank of these factors has been identified using Doing Business's Analytical Hierarchy Process (AHP) on a sample including domains like government support, skilled workforce, large plantations availability, environmental factors, workers and its rights, market reliance, increasing global market demand, research and development, international relations, environmental constraints, competition, and climatic changes. Subsequent researchers are encouraged to compare results of SWOT analysis with expert ratings aiming at having deep and wide-angle perception about the subject.

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Strategic analysis using SWOT-AHP: A case study for a Pharmaceutical Industry in Malaysia

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ABSTRACT

This study uses SWOT and AHP analysis to assess the strategic landscape of the pharmaceutical industry. It identifies key internal and external factors impacting pharmaceutical companies and develops a strategic approach for improved performance. The analysis highlights strengths such as robust research and development capabilities but also challenges like patent expirations and high drug development costs. Opportunities include personalized medicine and emerging markets, while stringent regulations and generic competition pose significant threats. The findings provide valuable insights for pharmaceutical company executives to develop strategic plans focused on cost efficiency, product innovation, and adaptation to emerging trends in the global market.

Keywords: Pharmaceutical Industry, SWOT Analysis, AHP, Strategic Management, Pharmaceutical Companies.

INTRODUCTION

In the ever-competitive world of pharmaceuticals, success hinges on strategic planning that capitalizes on a company's internal strengths and anticipates external threats (Giacobbe et al., 2020). SWOT analysis, a cornerstone strategic tool, identifies a company's internal capabilities (strengths and weaknesses) and external environment (opportunities and threats) (Hill et al., 2021). However, effectively allocating resources requires prioritizing these factors based on their strategic importance. This study addresses this need by integrating SWOT analysis with the Analytic Hierarchy Process (AHP). AHP, developed by Saaty (1980) provides a structured and quantitative method for weighting factors in complex decision-making scenarios. By combining SWOT and

AHP, this research aims to identify and prioritize key factors impacting performance within the pharmaceutical industry, ultimately leading to informed strategic decision-making.

SWOT AND AHP MODEL

SWOT Analysis

A SWOT analysis helps us look at what's going on inside and outside a company at the same time. It gives us a way to make decisions in a organized way (Kurttila et al., 2000; Kangas et al., 2003; Yuksel et al., 2007). This method puts factors into four groups called SWOT: strengths, weaknesses, opportunities, and threats. Using SWOT analysis to make decisions is to find a strategy that matches the strengths and weaknesses of a company with the opportunities and threats in the market (Kangas et a., 2001). Also, the plan we choose must match the goals of the people making the decision now and in the future (Kajanusa et al., 2004). SWOT analysis means thinking carefully and evaluating all the important things about new products, technologies, management, or planning. Figure 1 shows how SWOT analysis fits with an environmental scan (Kahraman et al., 2008).

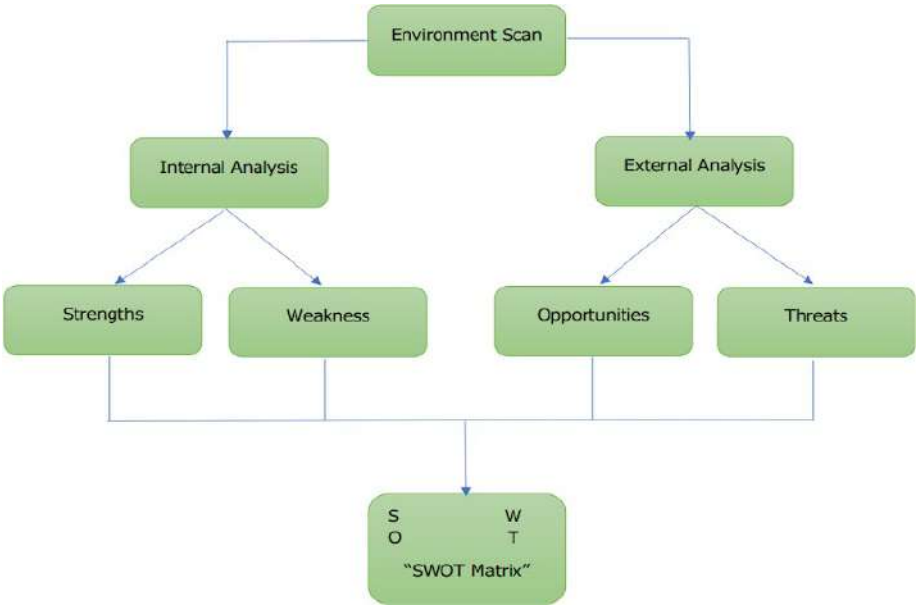

Figure 1: SWOT analysis framework

SWOT Analytic Framework

The Analytic Hierarchy Process (AHP) (Sharmaa et al., 2008) is a way to make decisions when you have many things to consider. It works by dividing a difficult problem into three levels: what you want to achieve, what's important, and what choices you have. AHP compares factors to decide which ones are most important at each level, so you can pick the best option. This method is very helpful when dealing with personal opinions and when the decision factors can be organized in a hierarchy with smaller factors (Tuzmen and Sipahi, 2011).

AHP uses numbers to show how important different criteria are when comparing them in pairs (Saaty and Vargas, 1996). The information is put into tables to figure out how important each factor is (Sharmaa et al., 2008).

Table 1: Comparing things two at a time. (Yuksel et al., 2007, Saaty, 1996)

Importance	Explanation
1	Two factors are equally important in achieving the goal.
3	Experience and thinking a little bit prefer one over another.
5	Experience and insight strongly suggest that one is better than the other.
7	Criterion is really liked and it's shown to be the best in real life.
9	The importance of one thing over another is very clear and obvious.
2,4,6,8	Used to show a middle ground between the important things listed before.

The Analytic Hierarchy Process (AHP) is based on three main ideas: organizing the decision model, comparing criteria and options, and determining priorities. AHP has been widely used in research to solve many decision-making problems (Lee and Walsh, 2011; Kurttila et al., 2000; Kangas et al., 2001; Kajanusa et al., 2001; Pesonen et al., 2001; Arslan and Tuaran, 2009; Gallego-Ayala and Juizo, 2011; Dincer and Gorener, 2011). The first step is to organize the decision problem in a step-by-step format (Dagdeviren et al., 2009). AHP starts by breaking down a complicated decision problem into smaller parts. These parts include different things to consider and different options to choose from. In AHP, the goals, factors, and choices are organized in a hierarchy like a family tree. A hierarchy usually has at least three levels: the main goal at the top, the criteria that define the options in the middle, and the options themselves at the bottom (Albayrak and Erensal, 2004).

In this study, AHP used to decide which SWOT elements are the most important. Once the study figure out what the problem is and who needs to solve it, this study start to decide which things are most important. At each level, the criteria are compared in pairs based on how much they affect things and how they relate to the criteria in the level above. In AHP, this study compare things using a scale that goes from 1 to 9 (Albayrak and Erensal, 2004).

Think about a group of rules $C = \{Cj \mid j = 1, 2, . , n\}$ Comparing n things in pairs, this study can put the results into a table with n rows and n columns. Each number in the table shows how important one thing is compared to another. This comparison is shown by a square and reciprocal matrix in Equation (1).

$$A = (a_{ij})_{nxn} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ a_{n1} & a_{n2} & . & a_{nn} \end{bmatrix}$$

In the last step, each group of numbers is made fair to see which ones are more important. These weights come from the right eigenvector, which is represented as Î»_max.

$A_w = \lambda_{max}.w$

If the pairwise comparisons all match up, the matrix A will have the highest eigenvalue (λ_max) equal to the size of the matrix, which is n. In this situation, we can find the weights by making the numbers in each row or column of matrix A (Albayrak and Erensal, 2004; Borajee and Yakchali, 2011; Wang and Yang, 2007) all add up to 1. The accuracy of the results from the Analytic Hierarchy Process (AHP) depends on how consistent the comparisons are. Consistency is about how the numbers in matrix A are connected: when you multiply certain numbers, the result is another specific number. The Consistency Index (CI) can be calculated using the formula given in reference (Saaty, 1980):

$$CI = \frac{\lambda_{max} - n}{n-1}$$

The final consistency ratio (CR) shows us if the evaluations are consistent enough. The CR is calculated by dividing the Consistency Index (CI) by the Random Index (RI), as shown in Equation 4 (Borajee and Yakchali, 2011).

CR = CI / RI

The highest number for the Consistency Ratio (CR) is 0. 1 If the final CR is too high, the evaluation process needs to be done again to make sure it's consistent (Borajee and Yakchali, 2011).

Table 2: Random Index (Saaty, 1996; Saaty and Vargas, 1991)

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

SWOT-AHP Model

The Analytic Hierarchy Process (AHP) is a method where factors are compared in pairs to figure out which is most important using math. The regular SWOT analysis doesn't have a way to measure how much each factor affects the strategic choices (Yuksel and

Dagdeviren, 2007). It doesn't give a clear way to compare the importance of different factors or to analyze different choices based on those factors. To fix this problem, the SWOT framework is changed into a step-by-step model and combined with AHP, using its eigenvalue- based method for analysis (Kangas et al., 2001; Kajanusa et al., 2001)

The goal of applying AHP within the SWOT context is to methodically assess and compare the magnitudes of SWOT factors (Wickramasinghe and Takano, 2010). The suggested approach is executed in three phases (Gallego- Ayala and Juizo, 2011):

-SWOT Identification: We begin by identifying and listing key internal (strengths & weaknesses) and external (opportunities & threats) factors impacting your strategic plan (i.e., SWOT analysis).
-Category Weighting: Next, pairwise comparisons determine the relative importance of each SWOT category (Strengths, Weaknesses, etc.). This assigns weights to each category.
-Factor Weighting: Finally, AHP helps us determine the importance of individual factors within each category. Overall factor weight considers both its category weight and its importance within that category, resulting in a final ranking for strategic planning.

Building on the work of Kurttila et al., (2000) who developed a combined SWOT- AHP method to make strategic factors more comparable and strengthen the quantitative foundation of strategic planning (Gao and Peng, 2011), this approach has been widely applied and studied in various disciplines (Lee and Walsh, 2011; Kangas et al, 2003; Wickramasinghe and Takano, 2010; etc). Examples of its use include informing outsourcing decisions in sports marketing (Lee and Walsh, 2011), assessing management strategies for a forest property (Kangas et al, 2003), and evaluating a tourism revival marketing plan in Sri Lanka (Wickramasinghe and Takano, 2010). The integrated SWOT-AHP method has also been used in diverse fields such as natural resource management (Pesonen et al., 2001), examining the global competitiveness of machine tool manufacturers (Shinno, 2006), developing a safe transport strategy for bulk liquid chemicals (Arslan and Er, 2008), defining a business strategy for a textile company [14], outlining a strategy for the Turkish chemical industry (Taskin and Güneri, 2005), investigating marine accidents in the Strait of Istanbul (Arslan, and Tuaran, 2009), guiding shipping registry selection in maritime transportation (Kandakoglu, 2009), and implementing water resource management strategies in Mozambique (Gallego- Ayala and Juizo, 2011).

METHODOLOGY AND APPLICATION

The goal of using the Analytic Hierarchy Process (AHP) in the SWOT analysis is to carefully compare and rank the SWOT factors based on their importance (Kangas et al, 2003). In this study, we used the AHP model, which is made from the SWOT matrix and has three parts: (a) the goal we want to achieve with decision-making, (b) the SWOT categories, and (c) the specific factors within each SWOT category, which are considered sub-criteria. Figure 2 shows the way things are arranged in the SWOT analysis. Rewrite this text in simpler words (Gallego- Ayala and Juizo, 2011).

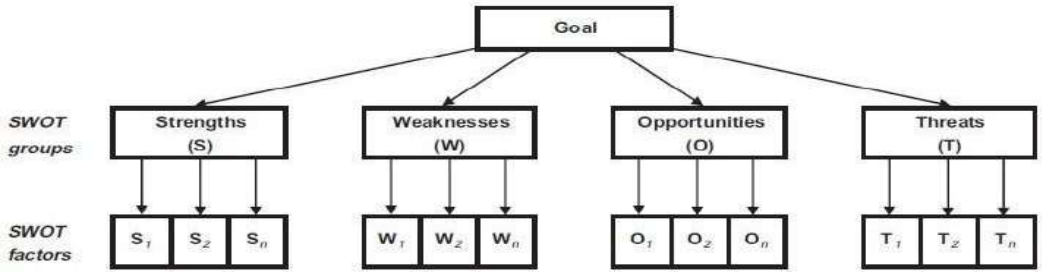

Figure 2: Layered of the SWOT matrix analysis (Gallego- Ayala and Juizo, 2011)

In this case study, we used a better way to look at the company's strengths, weaknesses, opportunities, and threats. We also used a method called the Analytic Hierarchy Process. We looked at a company in Istanbul, Turkey that makes cooker hoods. The company usually sells its products to more than 50 countries around the world. We use a scale from one to nine to compare things and figure out which factors are more important than others. After the SWOT framework is converted into digital form using AHP, the combined matrix helps to figure out which groups and factors are most important.

We created a three-step model to make a strategic management plan. First we set up the plan, then we changed some things, and finally we made a way to evaluate it. (Figure 1).

First, we do a SWOT analysis and make a chart. The important factors from both inside and outside the company are found and included in the SWOT matrix.

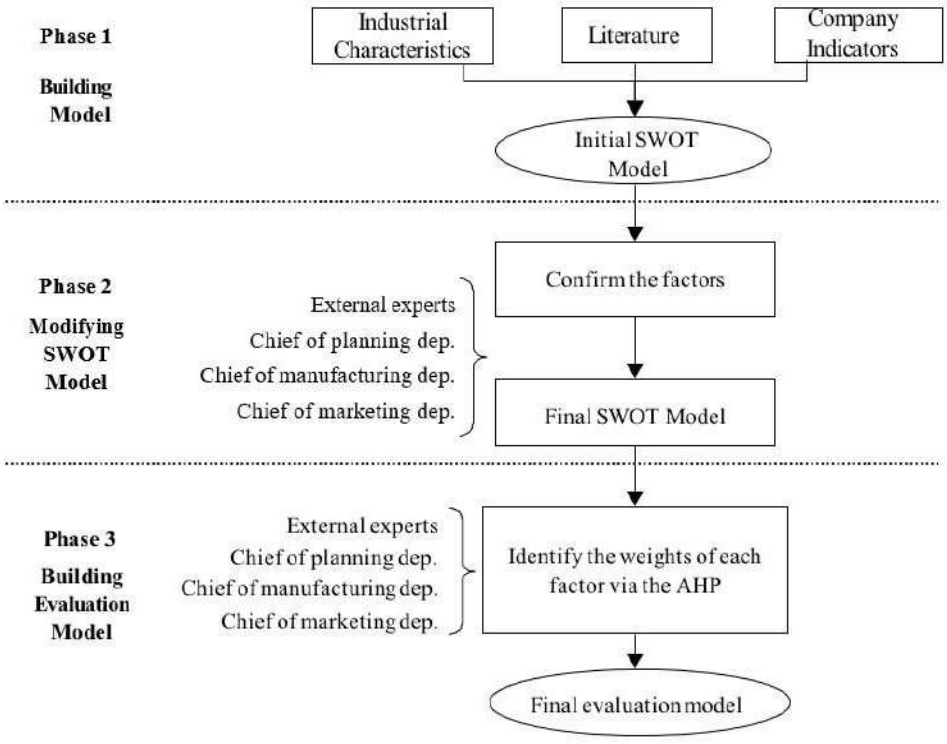

Figure 3: The different phases of proposed method
Table 3: SWOT Matrix

Strengths (S)	**Weakness (W)**
(S1) Dominant domestic market position (S2) Focus on research and development (S3) Robust logistics and distribution capabilities (S4) Government support and regulatory framework (S5) Skilled workforce	(W1) Reliance on imports (W2) Limited manufacturing capabilities (W3) Regulatory challenges (W4) Shortage of skilled personnel
Opportunities (O)	**Threats (T)**
(O1) Aging population and rising healthcare demand (O2) Expansion into export markets (O3) Adoption of digital technologies (O4) Collaboration with international partners (O5) Diversification into specialty and niche products	(T1) Intense competition from regional and global players (T2) Pricing pressures and cost containment measures (T3) Regulatory changes and policy uncertainties (T4) Supply chain disruptions (T5) Emergence of new technologies and treatment modalities

The AHP is used for the SWOT matrix. At first, a team of experts, including three managers from the company and the authors of this paper, compares the strengths, weaknesses, opportunities, and threats using a scale from 1 to 9. The findings from these comparisons are shown in Table 4.

Table 4: Pairwise comparisons of SWOT factors

SWOT Groups	**S**	**W**	**O**	**T**	**Importance degrees of SWOT Groups**
Strengths (S)	1.00	1.00	1.00	6.00	0.311
Weakness (W)	1.00	1.00	0.50	5.00	0.251
Opportunities (O)	1.00	2.00	1.00	7.00	**0.386**
Threats (T)	0.17	0.20	0.14	1.00	0.052
CR = 1.5%					

Table 5: Comparison Matrix of Strengths Group

Strengths	S1	S2	S3	S4	S5	Importance Degrees
(S1)Dominant domestic market position	1.00	2.00	1.00	4.00	8.00	**0.351**
(S2) Focus on research and development	0.50	1.00	1.00	2.00	6.00	0.221
(S3) Robust logistics and distribution capabilities	1.00	1.00	1.00	4.00	7.00	0.299
(S4) Government support and regulatory framework	0.25	0.50	0.25	1.00	2.00	0.088
(S5) Skilled workforce	0.12	0.17	0.14	0.50	1.00	0.041
CR = 1.2%						

Table 6: Comparison Matrix of Weaknesses Group

Weakness	W1	W2	W3	W4	Importance Degrees
(W1) Reliance on imports	1.00	4.00	2.00	6.00	**0.523**
(W2) Limited manufacturing capabilities	0.25	1.00	0.50	1.00	0.119
(W3) Regulatory challenges	0.50	2.00	1.00	3.00	0.261
(W4) Shortage of skilled personnel	0.17	1.00	0.33	1.00	0.097
CR = 0.8%					

Table 7: Comparison Matrix of Opportunities Group

Opportunities	O1	O2	O3	O4	O5	Importance Degrees
(O1) Aging population and rising healthcare demand	1.00	2.00	6.00	4.00	4.00	**0.458**
(O2) Expansion into export markets	0.50	1.00	2.00	2.00	4.00	0.232
(O3) Adoption of digital technologies	0.17	0.50	1.00	1.00	2.00	0.109
(O4) Collaboration with international partners	0.25	0.50	1.00	1.00	4.00	0.14
(O5) Diversification into specialty and niche products	0.25	0.25	0.50	0.25	1.00	0.062
CR = 4.5%						

Table 8: Comparison Matrix of Threats Group

Threats	T1	T2	T3	T4	T5	Importance Degrees
(T1) Intense competition from regional and global players	1.00	1.00	4.00	3.00	5.00	0.335
(T2) Pricing pressures and cost containment measures	1.00	1.00	6.00	2.00	7.00	**0.362**
(T3) Regulatory changes and policy uncertainties	0.25	0.17	1.00	1.00	5.00	0.112
(T4) Supply chain disruptions	0.33	0.50	1.00	1.00	7.00	0.153
(T5) Emergence of new technologies and treatment modalities	0.20	0.14	0.20	0.14	1.00	0.038
CR = 7.7%						

Finally, we calculate the overall priority scores for the SWOT factors. The most important things are listed in Table 9.

Table 9: Overall Priority Scores of SWOT Factors

SWOT group	Group priority	SWOT factors	Factor priority within the group	Overall priority of factor
Strengths	0.311	**(S1) Dominant domestic market position**	**0.351**	**0.109**
		(S2) Focus on research and development	0.221	0.069
		(S3) Robust logistics and distribution capabilities	0.299	0.093
		(S4) Government support and regulatory framework	0.088	0.027
		(S5) Skilled workforce	0.041	0.013
Weakness	0.251	**(W1) Reliance on imports**	**0.523**	**0.131**
		(W2) Limited manufacturing capabilities	0.119	0.03
		(W3) Regulatory challenges	0.261	0.066
		(W4) Shortage of skilled personnel	0.097	0.024
Opportunities	0.386	**(O1) Aging population and rising healthcare demand**	**0.458**	**0.177**
		(O2) Expansion into export markets	0.232	0.09
		(O3) Adoption of digital technologies	0.109	0.042
		(O4) Collaboration with international partners	0.14	0.054
		(O5) Diversification into specialty and niche products	0.062	0.024
Threats	0.052	(T1) Intense competition from regional and global players	0.335	0.017
		(T2) Pricing pressures and cost containment measures	**0.362**	**0.019**
		(T3) Regulatory changes and policy uncertainties	0.112	0.006
		(T4) Supply chain disruptions	0.153	0.008
		(T5) Emergence of new technologies and treatment modalities	0.038	0.002

The AHP analysis shows that people's lives are getting better and more modern buildings are being built.

LIMITATION

The paper's limitations include the inherent subjectivity in AHP pairwise comparisons, the complexity of the AHP model with numerous factors, challenges in maintaining consistency in judgments, the dynamic nature of the pharmaceutical industry that may not be fully captured by the analysis, reliance on the quality and availability of data, potential difficulties in generalizing the case study results, the resource-intensive nature of the process, the need for stakeholder engagement, the quantitative focus that may overlook qualitative aspects, and the assumption of independence between factors which may not always hold true in practice.

CONCLUSION

This paper conducts a strategic analysis of the pharmaceutical industry in Malaysia using the SWOT (Strengths, Weaknesses, Opportunities, Threats) and AHP (Analytic Hierarchy Process) methodologies. It evaluates internal and external factors affecting the industry and prioritizes them to inform strategic decision-making. The study identifies key strengths like R&D capabilities and market position, weaknesses such as high development costs and import reliance, opportunities presented by healthcare demand and export markets, and threats from competition and regulatory changes. The AHP integration provides a quantitative approach to SWOT analysis, enhancing the strategic planning process. The paper concludes with prioritized strategic factors for the industry, acknowledging the limitations of the subjective nature of AHP, the complexity of the model, and the dynamic industry environment.

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INNOVATIVE FUSION: ENHANCING *SALACCA* SEEDS FLOUR BREADSTICKS WITH *DURIO GRAVEOLENS* THROUGH DIGITAL TRANSFORMATION

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ABSTRACT

This trend of developing new products through incorporation of functional foods into traditional food products is more and more fashionable in the food industry because of the market pull for healthy food products. This study explores the optimization of breadsticks with Sallacca seed flour and Durio Graveolens (Durian dalit) with a focus on food processing through the use of digital technologies to optimize manufacturing and application of the products. This paper assesses the nutritional, sensory and technological properties of the improved breadsticks with the aim of providing insights into the utilisation of underutilised agricultural culinary by products. Hence, the study findings suggest that the integration of components creates a positive implicative synthesis, which increases not only nutrient density but also sensory attributes of the breadsticks for ecological food processes.

Keywords: Novel ingredients, conventional food items, Sallacca seed flour, digital transformation, breadsticks.

INTRODUCTION

In the food industry at the moment there is a trend towards making food healthier and more environmentally friendly. Flours that are participated in baked foods such as Salacca seed flour can also be used to enhance nutritional value of baked products. Salacca zalacca or snake fruit seems to have seeds that are capable of being used in making flour (Sato, 2023). This research aims to diversify breadstick formulas with the incorporation of Durio Graveolens (Durian dalit) which is a nutrient-rich waste component of durian processing (Ningsih et al., 2022). Incorporation of technology advances in the food production systems to improve of use of ingredients and quality are crucial (Borodina et al., 2021). Rising health consciousness among customers leads the manufacturers to look for functional and recovery alternative ingredients (Borodina et al., 2021). With high starch and fiber, salacca seed flour is a healthier food which has been praised by Sato in 2023. Further, durian dalit contains dozens of nutrients, energy, carbohydrates, proteins, and minerals that enhance the nutritional value of the breadstick (Ningsih et al., 2022). All these ingredient integrations evidence move in line with the current industry trends towards sustainability and minimisation of wastage (Borodina et al., 2021).

Application of technology in food production involves implementing modern techniques to improve cycle, quality, and meet consumers needs as pointed by Chandrayan et al., (2022). This paper seeks to examine how digital tools can help in implementing Salacca seed flour and Durio Graveolens (Durian dalit) into breadsticks with optimal production and nutritional benefits. The study will seek to establish how these untapped commodities could be used to create new fMC foods that suit the appetite of the lean-looking, health-conscious consumer of the 21 st century mainly through eating superior and

sustainably sourced foods, which are nutritious. This change requires assessment of substitution ingredients which improves food nutrient density while at the same time offers a sustainable environment. For instance, there is salacca seed flour obtained from seeds of Salacca zalacca, or the snake fruit. Conventionally the seeds are often left on the ground hence producing a huge loss of nutritional value. Previous research has focused on specific health benefits of the flour derived from Salacca seed; it is rich in dietary fibre, antioxidant and nutrients and recommended for enhancing baked products (Aminudin et al., 2022). Besides Salacca seed flour, the utilization of Durio Graveolens (Durian dalit) which a byproduct of durian processing presents another opportunity of food formulation improvement possibilities. Durio graveolens (Durian dalit) is well known for preparation of food products that has numerous bioactive compounds like vitamins minerals and antioxidants.

Important quality traits and potentially health-promoting attributes of Durio Graveolens are established, thus promoting the use of the product in food products to capture the growing market of functional foods as identified by Fidelis et al. (2020). Using these underused by-products means less waste and targeting those health-conscious customers. Thus, the further digitalization in food production is essential to harmonize the employment of vitamins and to improve the quality of products. Technological progress in food manufacturers apply results in efficiency in analysing raw materials for better production of good products. For instance, tools for sourcing ingredients can explore more accurate solutions to enhance ingredients' nutritional quality as well as minimize waste (Falcão et al., 2022). This technological integration is acutely vital if the growing consumer pressure affecting food choices in terms of transparency and sustainability is to be dealt with. On the same note, the application of novel ingredients such as Sallacca seed flour and Durio Graveolens of the functional food category. According to the FAO, functional foods are Neo-foods characterized by health promoting effects that go beyond the traditional nutritional profile, attributed to phytochemicals. The increasing concern with functional food is driven by the consumer's changing palate towards healthier foods and a desire for the food to have added benefit to help improve one's quality of life(Lin et al., 2023). As a result, creating breadsticks and other similar baked products with these innovative flours address this need and encourage the sustainability of the food business.

The potential health impact connected to the bioactive compounds in the replacement flours is well researched. Some of these compounds are polyphenols, flavonoids, as well as antioxidants which have multiple health benefits that include; anti-inflammatory and antioxidant (Shishtar et al ., 2020). Their inclusion in foods also improves the functional properties of these foods to appeal to the conscious client. Moreover, the antiproliferative and counter inflammatory effects of these bioactive compounds put them at the center of formulation of foods that may help prevent chronic diseases (Shahidi et al., 2019). Exclusively focusing on change for the better in our overall well-being, it also provides benefits toward efficient food production. It is often found that many food manufacturers discard the by-products, but they can be utilized to support a circular economy such as Salacca seeds and Durio Graveolens. This strategy also considers the environmental impacts and factors and it is in harmony with the customer demands of the PGS standards and the demand for organic and fair trade ingredients (Xu et al., 2021). Food sustainability is becoming more important as consumers want brands and companies connected to food production to provide information on environmental impacts.

The technological improvement in food processing helps to introduce other substitutes in the food. Skills like microencapsulation increase solubility and dispersion of bioactive compounds that maintain their effectiveness (Zamora-Ros et al., 2018). This discovery is essential in the creation of functional foods that meet the consumers' quality and effectiveness needs. The application of functional foods and bioactive compounds is shifting due to the increased focus on regulatory legislation of health claims. In line with this, and as the functional food market size increases, food manufacturers face complex sitting and need to meet regulatory obligations in order to avoid negative backlash from the consumers (Toledo-Madrid et al., 2018). This aspect of new product development is critical as

tolerances help determine the market acceptance of the new food products with non-traditional ingredients.

Thus, the analysis of innovative flours such as Salacca seed flour and Durio Graveolens (Durian dalit) offers considerable potential in the food industry. health and sustainable innovation, food manufacturers can build products that match customer needs, and at the same time, form a functional food system. Such ingredients have been adopted in food formulation, for example in bread sticks to enhance the ability to create functional foods in current consumer health trends thus making positive impacts in consumer and environmental health.

LITERATURE REVIEW

The use of alternative flours in food products has been thoroughly examined, showcasing their potential to enhance nutritional profiles and sensory characteristics. Salacca seed flour demonstrates notable antioxidant properties, contributing to the health benefits of baked goods (Werdyani et al., 2017). Research indicates that incorporating such flours can improve functional properties, including greater water absorption and enhanced dough elasticity (Şimşek & Süfer, 2021). Likewise, Durio Graveolens (Durian dalit) has gained attention for its nutritional profile, containing essential fatty acids and bioactive compounds beneficial to health (Ningsih et al., 2022). Studies show that durian seeds can be processed into flour, offering a sustainable alternative to traditional wheat flour (Ningsih et al., 2022). Combining Salacca seed flour and Durio Graveolens (Durian dalit) in breadsticks exemplifies a novel method to enhance both the nutritional and sensory attributes of the final product.

An understanding of the various alternative flours in food has also been provided elucidating their ability to improve the nutritional content and quality attributes of food products. Specifically, Salacca seed flour rich in antioxidants improves the characteristics of baked products (Werdyani et al., 2017). It shows that the incorporation of such flours can better functional properties like higher water absorbance and higher dough extensibility (Şimşek & Süfer, 2021). Similarly, Durio Graveolens (Durian dalit) is now considered a good nutritive value with essential fatty acids and bioactive compounds that are healthy for the body (Ningsih et al., 2022). Studies suggest that durian seeds can be turn into a flour form, thus providing better solution than wheat flour (Ningsih et al., 2022). Including Salacca seed flour and Durio Graveolens (Durian dalit) in breadstick fabrication is innovative to improve the nutritional value and textural profile of the breadsticks.

The relevance of digital transformation in the food value chain is therefore quite apparent. It is also possible to monitor and control at least some aspects of the production process in real-time, and maintain the nutritional value of ingredients that comprise confectionery products (Borodina et al., 2021). Further, customer's data analysis enables predictions of the customers' needs, shape, and form of the products and formulations (Chandrayan et al., 2022). This literature review underscores the need to include innovation ingredients and digital technologies for better nutritional and environmental food products. The search for better flours has been rising as consumer increasingly seek the modification of their diet. It regards Salacca seed flour as baked products' fortification since it is credited with antioxidant potential. In the same year, Werdyani et al realized that the incorporation of Salacca seed flour enhances nutritional quality and the sensory acceptance of the food products. Furthermore, multicomponent flours improve functional characteristics of the baking products, including the ability to acquire and retain water, and the dough cohesion, which is especially important for the quality of baked goods (Grela et al., 2017; Silav-Tuzlu & Tacer-Caba, 2021).

Apart from the Salacca seed flour as the ingredient, the other candidacy from the perspective of nutrients' desirable values is the durian seed flour, which contains the essential fatty acids and bio-active compounds (Van, 2023). Ningsih et al. (2022) indicated that durian seeds can be pitch into flour

which can effectively replace the commercial wheat flour. Incorporation of Salacca and durian seed flours into products such as breadsticks show a new approach where development of products satisfying the consumers' health concerns also contributes to better nutritional qualities and enhanced palatability (Van 2023; Matthew et al., 2021). The effects on digitalization on food manufacturing still represent another important research area. Most digital tools are useful in tracking and adjusting the manufacturing flow in real time, while preserving the nutrient content of the ingredients (Díaz-Batalla et al., 2018). Borodina et al., 2021 acknowledged that, data analytics bring understanding of consumers' preferences in terms of new products to be developed and formulated. Innovative ingredients for food products and digital technologies are necessary to create a healthier, more sustainable food product that fits into the new generation consumerism (Díaz-Batalla et al., 2018; Chatziharalambous et al., 2023).

However, knowledge of the nutrient composition of different sources of the various types of alternative flours suggest the potential for enhancing the quality of food products. For example, the supplementation of jackfruit seed flour improves the nutritional and sensory properties of cookies, as (Van, 2023) noted. The investigation showed that partial replacement of wheat flour with jackfruit seed flour for cookies produced improved nutritional content, suggesting that other flows hold strong potential for improving the formulation of healthier foods (Van, 2023; Akintable et al., 2019). In a study concerning the effectiveness of gluten free products, some researchers defined that the addition of the chia seeds and Buckwheat flour improve the quality and shelf life of gluten-free biscuits (Zlateva et al., 2022). Similarly, Silav-Tuzlu and Tacer-Caba (2021) noted that these flours enhanced the nutritional profile of the biscuits besides enhancement of health benefits for people with dietary problems; obesity, diabetics, etc. That is why; there is a great need to search for one or even many plant sourced flours to cater for the new growing niche of; gluten-free and healthy food products.

The way these different forms of the various processes that go into the production of the various alternative flours also affects the nutrient value as well. For instance, during germination and fermentation of seeds, the researchers showed that antinutritional constituents reduced while micronutrient bioavailability enhanced (Idowu & Akinsola, 2017;. Soaking and boiling where reported to improve the proximate composition and other analytical properties of pumpkin seed flour for health enhancing food products (Akintade et al., 2019) Also, theเฉพาะ incorporation of legume flours with that of Prosopis was found to improve nutritional values and functional characteristics of foods. Díaz-Batalla et al (2018) alluded that the extrusion of mesquite seed flour by cooking has entailed changes that enhanced its nutritional value since the application of heat. This underlined the prospect of the creation of legume flours as functional components in various foods uses (Ayo-Omiegbe, 2019; Ding et al., 2018). More over, it can be defined that the sensory properties of the food products are function of the type of the used alternative flour. Chatziharalambous et al. (2023) found that the fortification of wheat crackers through the addition of cereal, legume and agricultural by-product flours boosted the total phenolic content, antioxidant activity and the total sensory acceptance of crackers. (Sharma et al., 2017).

Such findings bring into focus, the right selection of the other flours in foods with the view of enhancing the nutrition value, a quality aspect and values (Sharma et al., 2017; HIBA, 2023). Hence by employing the literature review analysis it is effective to point that there is enhanced consciousness about the beneficial characteristics associated with the use of the various types of flours in foods. The incorporation of flours from seeds for instance Salacca, durian, Jackfruits and legumes in baked products enhance both the nutritional value and the qualities of the baked product. Moreover taking digital technologies into food production systems it is possible to enhance formation of better, health promoting food products. As customer tastes evolve over time, one of the most significant and on-going pressures for innovation within the food industry relates to the use of numerous plant based flours.

METHODOLOGY

As for the present research, a systematic endeavour was made in attempt to identify the attributes of Napoletano breadsticks incorporated with Salacca seed flour and Durio Graveolens (Durian dalit). Salacca seed flour was prepared from dried and grounded seeds and Durio Graveolens (Durian dalit) was obtained from pulp residue after extracting fruit (Ningsih et al., 2022). The specific nutrient compositions of both ingredient and ginger, also protein and fibre profile, and antioxidant value were determined (Werdyani et al., 2017). The use of traditional methods of analysis like high performance liquid chromatography (HPLC) was used in analysis of the chemical characteristic of the ingredients (Jukić et al., 2018). The breadsticks were prepared by incorporating varying levels of Salacca seed flour and Durio Graveolens (Durian dalit) and then baked under optimized condition where the main thrust was the determination of P.L.L.D.S. and texture characteristics. Consumer acceptability was assessed by sensory analysis where judges who were trained were used to score aroma, flavour, texture and blended liking. To account for the significance of the difference between the various formulations, cross sectional descriptive statistics tests were conducted. Consequently, the aim of this study was to identify the optimum ratio of incorporation of Salacca seed flour to Durio Graveolens or the durian dalit that has the highest nutrition and sensory appeal. This has provided a direct way to evaluate the possibilities of these novel parts which is necessary for making breadsticks.

The paper employed a systematic approach to study incorporation of Salacca seed flour and Durio Graveolens (Durian dalit) into biscuits. Salacca seed flour was prepared by drying milled seeds while Durio Graveolens (Durian dalit) was collected from the remaining part after shedding of the fruiting body. Proximate analysis of the two ingredients of the product as well as the antioxidant contents of protein and fiber were achieved (Husin et al., 2018). A number of previous studies suggest that Salacca seeds consist of glucomannan which serves a functional feature as the seeds are processed as flour (Nugroho, 2023). This characteristic is useful and valuable more so since it improves the nutritive value of the breadsticks than the wheat products. The chemicals of the ingredients were identified analytically using methods such as High performance liquid chromatography, HPLC. As mentioned above, HPLC has been employed for years now in the analysis of nutrient contents in foods, and the quantity of proteins, fibers and antioxidants (Zamakshshari et al., 2023). This appears to have great compatibility when addressing the food analysis science standards that were established concerning the determination of the nutritional values of foods such as the bread sticks in this study. Additionally Durio Graveolens (Durian dalit) which contains antioxidants enhances the extent of the final product towards the overall dietary nutrition security highly(Jasamai et al. 2018).

The characteristics of incorporation and usage of Salacca seed flour and Durio Graveolens (Durian dalit) in breadsticks and baked at optimum baking conditions have been studied, and their sensory and textural evaluation has been done. It was a balance in formulation to provide the right nutrients and get to the right textures, colours and flavours. Consumers' satisfaction was assessed using sensory examination with the aid of 9-point hedonic scales for aroma, taste, texture and overall acceptability judged by the panelists. This method of sensory evaluation is useful because it helps to compare consumers' preferences as to which formulation should be used at the time of market entry (Sharma, 2022). The depot formulations were comparing their exposures using the adapted statistical analyses. This research was aimed at establishing that proportion of Salacca seed flour to Durio Graveolens (Durian dalit), in which the nutritional value of the complementary feed could be enhanced and at the same time its acceptability improved. Data which was gathered from sensory evaluation processes include data from sensory organs were also put through rigorous tests such as Analysis of Variance (ANOVA) to make the result more believe. This is quite a rigid statistical admeasurement, which is however crucial in arriving at effective conclusions regarding the enhancement of the quality of the breadsticks by the elements blends.

In addition to the sensory evaluations the textural characteristics of the breadsticks were also measured using the texture profile analysis. This research finds out that texture is one of the factors

consumers have towards the acceptability of baked products, and the textural test was conducted with the help of the texture analyser which yielded parameter such as hardness, chewiness and crispness. The outcome of this research are beneficial in creating information on the feel of the mouth and eating characteristic of the breadsticks when Salacca seed flour and Durio Graveolens (Durian dalit) are integrated. In addition to the work's findings that followed the method used in the study, this work also utilised relevant literature review to situate the study's findings within the food science, nutrition and health concern sub-disciplinary domains. Some of the recent studies anchored on the nutrient analysis of durian and Salacca seed flour were also highlighted in this literature review as part of the justification for using the aforementioned flours in the project (Husin et al., 2018). Therefore, in addition to presenting new findings, the research situates the study within the existing body of literature to capitalize on the idea of future examination of other ingredients utilized in the preparation of those foods.

Last of all, the methodology revealed is a more profound one that can be employed to determine the feasibility of these new adjuvants in the production of breadsticks. The scientific method applied in this research study ensures that every aspect of preparation of the ingredients, formulation procedure, sensory analysis and statistical analysis of data is duly covered. The research strategy proposed in the study is exhaustive as it is required in the endeavour aimed at advancing research works to the application of other flours that can yield healthier and nutritious foods to enhance the overall potential of food science and technology and safety of foods.

DATA ANALYSIS & FINDINGS

The supplementation of Salacca seed flour in breadsticks formula has shown high positive impact on the nutritional quality of the product. The analysis also showed that content profiling identified that Salacca seeds consist of starch, fibre and EFA and as a result enhanced health value of the product. , Has eight varieties of Durio Graveolens (Durian dalit) containing unsaturated fats like lipids, it assists in the reduction of cholesterol thereby making the breadsticks even more nutritious for use (Ningsih et al., 2022). Through sensory analysis on the finished products organised by the research, it was evident that the addition of durian dalit had its own line of taste and smell that were liked by consumers. The textural profile analysis indicated that the crumbs exhibited desirable crispiness sensation because of the fibre content in the Salacca seed flour and Durio Graveolens (Durian dalit) (Şimşek & Süfer, 2021). Furthermore, the presentation was enhanced, and the colour of the breadstick more brownish due to the baking process (Jukić et al., 2018). These results are in agreement with the findings of the previous literature which predicated that the incorporation of the various flours could help to enhance the sensory quality of the bakery products (Şimşek & Süfer, 2021).

Other technological properties which were evaluated included water absorption and dough handling of the breadsticks. Consequently, the replacement of wheat flour by salacca seed flour raised the water absorption, elasticity and extensibility required for achieving the right dough texture for baked confectionery (Jukić et al., 2018). The development of the technology in the digital platform of processing such as automatic mixing and baking made the quality of the food to be uniform and the time required in producing the processed food was also cut short (Borodina: et al 2021). The alterations of breadsticks nutrient values when the Salacca seed flour was included have been influenced positively in terms of rich composition of Salacca seed, particularly in terms of starch, fiber and essential fatty acid. Such components initiate the following health benefits: Improves digestion: To give the long story short; the consumer of Salacca seeds containing products received numerous health rewards which are; Cardiovascular benefits because of the fat: It is a common knowledge that cholesterol is not safe for human body, therefore consumption of fruits containing non-saturated fats within the seeds of Salacca can be highly useful in reducing the levels of cholesterol in bodies of human beings. The nutritional

enhancement issue relates to the initial study on the inability to adopt other flours in the preparation of developed baked products; the present study aims to demonstrate the importance of further research (Yitayew et al., 2022).

Table 1: Nutritional, Sensory, and Technological Properties of Salacca Seed Flour-Enriched Breadsticks

Property	**Effect of Salacca Seed Flour**	**Key Findings**
Nutritional	Enhanced	Increased starch, fiber, and essential fatty acids
Sensory	Improved	Distinct aroma, flavor, crunchiness, golden-brown color
Technological	Improved	High-water absorption capacity, improved dough elasticity and extensibility
Sustainability	Positive	Reduced food waste, promoted circular economy
Health Benefits	Positive	Improved digestive health, potential cardiovascular benefits

According to sensory evaluation it was revealed that addition of Salacca seed flour enhance the nutritional quality as required and it also offered the flavor and aroma expected by the participants. Data acquired in the texture profile analysis reflected that all the breadsticks had good crisp, out of which the major share was attributed to the fibres in Salacca seed flour. This aligns with the literature that links the incorporation of high fibre components into products to enhance sensory characteristics thereby enhancing consumers appeal (Stelick et al., 2021). Furthermore, the final product was enhanced based on the appearance of the breadsticks; these changed the color to golden brown in baking by considering the preference of consumers concerning the bake products outlined by Rainero et al. (2021). The technological attributes studied in the subject were water absorption and dough handling characteristics with regards to the breadsticks. Salacca seed flour incorporated in the wheat flour dough was found to increase water absorption because of the porous nature of the wheat flour dough, increased dough elasticity and extensibility. These compound are very important in achieving the right textural profile in baked foods because they define the ability of the dough to retain gases produced during fermentation and baking (Schmidt-Combest & Warren 2018). The present study also establishes that the addition of Salacca seed flour enhances the nutritional value both for the product as well as enhances the quality of dough and the end products.

Also technological factor especially in the area of mixing as well as baking in food processing has revolutionized quality of the products and the time taken to produce those products. This technological improvement is crucial in order to maintain quality in baked commodities at the same time as executing efficiency with respect to production processes (Talens et al., 2022). The introduction of such technologies enables one to actualization of the current and continuing trend of modern food competition that affirms new approach to enhancing the quality and safety of foods. In addition to nutritional and sensory changes, the incorporation of Salacca seed flour to breadsticks could be describe in terms of sustainability. Engaging in functional foods that consume Salacca seeds remained as waste or using other by-product shows a beneficial effect for food waste consumers want more healthy foods

(Rico et al., 2018). This system makes the many kinds of wastes generated during the product production useful in creating products of similar or higher value in the food industry, hence promoting a circular economy model.

To that we can also assign that the latter is very useful for health with regards to the fact that breadsticks can be crafted out of enriched Salacca seed flour. This may help contribute to gastrointestinal health, let alone the assumption of health gains whose primary outcome stems from the consumption of foods with polyunsaturated fatty acids and antioxidants that helps keep chronic diseases away (K. Ungureanu-Iuga & Mironeasa, 2021). These health benefits are highly useful for those companies considering that many consumers are now developing consciousness of what they are consuming with regards to their nutrients requirements and as such the products would be taken by the conscious health oriented consumers. In this respect, the conclusion part of this study also contributes to supporting researched done on the use of substitute flours in bread making. Previous studies also report that incorporation of other diverse by products such as grape pomace and brewer's spent grain enhanced nutritional and sensory attributes of bakery products (Lou et al., 2021). This research goes along this notion, that ingredient substitution provides an opportunity to introduce a new, different, more healthy ingredient into the formulation to suit the current diet and health-wise consumer.

In addition, attributes such as texture, taste, and appearance of the product have equal impact on the acceptance decisions made by the consumers. The additional positive comments arising from sensory analyses indicate that the use of Salacca seed flour is in tune with the nutritional suggestions and consumers' preferences of taste and texture (Amoriello et al., 2020). This aspect is incredibly valuable for the strategic selling of new products in highlyaturated food industry. Therefore, incorporation of Salacca seed flour at various percent replacements into breadstick is theoretically feasible in several aspects mainly in terms of nutritional quality, sensory characteristictechnological functionality. The results also go further in showing the possible advantages of using different flours and by-products in the formation of more improved food products that should also be more nutritious and consumer attractive in the contemporary society (Nyhan et al., 2023). The same should be done further with a view to expanding the list of functional food products in this regard and also to provide empirical support to these findings with regard to other ingredient substitutions in various forms of baked goods.

Table 2: Comparative Analysis of Breadsticks with Salacca Seed Flour and Durio Graveolens (Durian dalit)

Feature	**Breadsticks with Salacca Seed Flour and Durio Graveolens (Durian dalit)**	**Control Breadsticks**
Nutritional Profile	Higher in starch, fiber, and essential fatty acids	Lower in nutritional value
Sensory Attributes	Distinct aroma and flavor, desirable crunchiness, golden-brown color	Less pronounced aroma and flavor, softer texture, pale color
Technological Properties	Improved dough elasticity and extensibility	Lower dough quality
Sustainability	Reduces food waste, promotes circular economy	Contributes to food waste
Health Benefits	Improved digestive health, potential cardiovascular benefits	Limited health benefits

Table 3: Comparative Analysis of Breadsticks with and Without Salacca Seed Flour

Parameter	**Breadsticks with Salacca Seed Flour**	**Breadsticks Without Salacca Seed Flour**
Nutritional Profile	Higher in starch, fiber, and essential fatty acids	Lower in starch, fiber, and essential fatty acids
Sensory Attributes	Distinct aroma and flavor, desirable crunchiness, golden-brown color	Less pronounced aroma and flavor, softer texture, pale color
Technological Properties	Higher water absorption capacity, improved dough elasticity and extensibility	Lower water absorption capacity, reduced dough elasticity and extensibility
Health Benefits	Improved digestive health, potential cardiovascular benefits	Limited health benefits
Sustainability	Contributes to reducing food waste, promotes a circular economy	May contribute to food waste
Consumer Appeal	Aligned with modern dietary preferences for healthier options	May not align with modern dietary preferences

DISCUSSION

=The use of Salacca seed flour and Durio Graveolens (Durian dalit) in breadsticks reveals a method of a new innovation in his line of enhancing nutraceutical and textural attributes of baked goods. The results presented in the present study can suggest that potential agriculturally derived ingredients can be added to foods and have both favourable effects on the environment and the health of individuals. There is the nutritional analysis which proves that the addition of the two ingredients increases the nutritional value of the breadstick and at the same time introduces flavors and textures to the breadsticks which have not been experienced before (Sato, 2023). Moreover, digital integration has emerged critical in addressing the equilibrium of the utilisation of the ingredients that are needed for the preparation of food products and in value addition. When it comes to flows in terms of production, the use of digital devices allows for corrections in real-time; the nutritional value of the nutrients that is input is retained by the procedure (Borodina et al., 2021). As a future direction of this study, the encouragement of the adoption of technology reformation will help enhance sustainable manufacturing systems in food business.

The formulation of the breadsticks using Salacca seed flour conjointly the Durio Graveolens (Durian dalit) is a completely new innovation within the field of food science and technology particularly in terms of content and palatability. Incorporation of these unused agricultural wastes helps serve the second upslash objectives of minimizing food wastage, and in the process, opens the flood gates to coming up with more healthful foods. Several studies suggest in this regard that Salacca seed flour consists of appreciable amount of dietary fiber and several nutrients which could further enhance the nutritional profile of bakery products (Matricano et al., 2021). Further, it creates new tastes and interlocking sensations , in particular the Durio Graveolens (Durian dalit) through which people can make healthy foods easily introduce to their diet (Zickafoose et al., 2022).

However, there is need to elaborate the sustainability component that is incorporated in this innovation.The use of Agricultural by products like Salacca seeds, Durio Graveolens (Durian dalit) was a morale boost to the current trend of combating food waste and encouraging sustainable food systems. From the perspective of the added value products, the agricultural food chain environment cost can be decreased by using these inputs (Krivonkia et al., 2022). This practicality is not only circular-oriented but goes further to support local agricultural utilization whereby each segment of the crop is utilised, leaving no segment of the resource unused. Consequently, similar innovation of all food products was postulated in this study asserting the possibility of sustainable food industry. Hence, other IT solutions are also useful as they areplatforms where such innovative ingredients can be best integrated, into improving food production frameworks. That which can be tracked and modulated during production, these are principles that are especially valuable in the preservation of nutrients in the grains including Salacca seed flour and Durio Graveolens (Durian dalit) (Nathan et al., 2021). Propelling the use of big data and application of advanced automation methods it is possible to bring changes in the quality and standard of foods manufactured for the consumers (Paparoidamis & Tran, 2019). Food production technology is not only enriched by capabilities to increase production efficiency but also by a desire for other food products as it opens companies' possibilities to experiment.

More studies should also be conducted on the physicochemical characteristics and sensory attributes of the breadsticks made from Salacca seed flour and the Durio Graveolens (Durian dalit), and the other beneficial properties of floour in other foodstuffs. The freedom to develop other varied products that consumer may desire is therefore high and such can significantly impact on the market of healthy snacks (Kokotovich, et al., 2021). Additionally, the degree of integration of the underutilized ingredients into Food production shall be evaluated for its feasibility hence encouraging the use in the food chain (Hutahayan & Yufra, 2019). The understanding of the market as well as the acceptance of these products shall be useful to food manufactures who wish to create new and sustainable products. However, one component that distinguishes or determines consumer acceptance of innovative food products is behavioral consumer response. It has been established in the studies that customers are moving away from unhealthy products, and look for ESC (Environmentally Sustainable product) ("Market Structure and Consumer Behavior and Resilience for MSMES Agro-Food Industry in Malang City", 2023). It suggests that there is an urgent need for proper and attractive commercialization protocols for the full merits and worth of employed Salacca seed flour and a food made of two unique tropical fruits, Durio Graveolens (Durian dalit) for nutritional and environmental uses (Cuéllar-Gálvez et al., 2018). The consumers 'interest can be secured by initiating informative campaigns in a bid to sway consumer test and subsequently subsequent consumers acceptance on these portfolio of food innovation products.

However, there is such opportunity for the interdisciplinary in food innovation which is one of the areas that should be considered. Fasten the food technologist in the agricultural and food chain in partnership with agriculturists will provide more angle to the product (Abdullah & Putit, 2023). This kind of partnership can lead to product innovation and development of new foods, which will be appealing to the consumers at the same time as it will address other societal call such as food desert and climate change as said by Rabadán (2021). Hence, both qualitative and quantitative methodological tools will be essential in the analysis of modern complexities of the food systems. It means that the food processors, policymakers, food transporters, and end-users, in general, should accept the innovative food production of Salacca seed flour and breadsticks with Durio Graveolens (Durian dalit) to be allied with the THREEWs philosophy. Then future expansion of the eating industry was attributed to the necessity to adopt such innovations to new conditions concerning the increasing population of the world as well as its need in the improved quality of food. The future research and collaboration will become the key to disclose the opportunities of these underutilized ingredients and encourage the proper application of these components in food products. More research should be directed toward understanding how all these innovations could be build on and to comprehending other products to

which they could be used. Some ideas that are now not explored are today; new formulation which may fit better to use by the consumers. Furthermore, it is an investigation of the probable efficacy of the application of organic agricultural by products to reductionist food production that can be considered sustainable.

CONCLUSION

Hence the utilization of Salacca seed flour and Durio Graveolens (Durian dalit) from the baked breadsticks may be a revolution toward enhanced nutritional and sensory qualities of the baked products. Therefore, the paper discusses the innovative underutilized agricultural by-product food solutions that can influence sustainability and health in the given aspect in general. Further, another aspect being the digital applications in the production facilities is another area in food production where the requirement of ingredients may be optimized as regards to quality raising. Thus, this study's result is meaningful to the food manufacturers who have dreams to come up with healthier foods that cater the market demands.

Therefore whereby the S alacca seed flour incorporated with the fruit find of Durio Graveolens (Durian dalit) in the processing of breadsticks can be counted as a revolution in the food processing technology and product development in general with highly emphasis on the nutritional and sensory quality enhancement of baked foods. The use of these ignored biomass resources enhances the nutritional value of the final products, and meets todays global sustainable standards of food production. Scientific work has revealed that it is possible to get a positive shift in Nutritional Value Added by replacing refining flours with F & S flours and get new flavors and textures which acceptability in a consumer Market:- (Gómez & Martínez, 2017). This strategy is well underlined by the fact that there has been growing concerne with the quality of food that is consumed especially where it is not 'sacrificed' for the sake of health is concerned.

Also, the result of this research provides understanding of how such change may be utilized to enhance the production of foods. The progressing technologies can also improve the effectiveness of application of the crude materials and raise the quality of the product as well as solving the consumer needs that are a challenge to the food producers. For example: With the help of DIS & MAS and computerized learning, ingredient reactions as well as baking processes could be analyzed and improved hence enhancing homogeneity and quality of cake (Wang et al., 2020). This is equally cardinal for [the food industries to] embrace this integration as the market evolves and customers start demanding more natural and healthier food produce. Another thing important to add that a Salacca seed and Durio Graveolens (Durian dalit) can have a cooperative in the process of improving human nutrition something considered as a positive moment in the development of new foods. This research has created room for added value in the efficient removal of the wastes in the agricultural sector, and therefore in the foods sub-sector by utilizing the by-products in makeup of those aforementioned successful products. The incorporation of such ingredients also implies virtually no food loss and it positively impacts the local environment and agriculture (Hernández-López, 2023). This is in line with other approaches that are being used in the world in the efforts to decrease the impacts on the environment when producing food.

`However, the sensory analysis of the breadsticks as proposed by this study shows that the incorporation of Salacca seed flour and Durio Graveolens (Durian dalit) does not effect the quality of the resultant product.

On the other hand, the distinct tastes and mouth feel ½ which these ingredients bring to food products could be value-adds that consumers will find appealing and thus making the product more marketable (Gómez & Martínez, 2017) For example, oddities such as banana in bread and laurel in language could be peculiar tastes which could enhance the characteristics of food products in a way that

consumers would be willing to pay a premium This finding fits well in a competitive food market system where the consumer sensory attributes work as push factors to consumption. The most important aspect of food innovation is to have the capability to combine healthy foods in tasty meals. In addition, the results of the present study suggest the possible need for examining other potential substitutes in baked products. This may partly contribute to the increases in the level of health consciousness and environmental concern where operationalization of functional foods is anticipated to attract relatively higher demand. This serves a good opportunity for the food industries to diversify their products through the addition of the following hidden gem local ingredients; Salacca seed flour and Durio Graveolens popular known as Durian dalit since they are rich in bioactive compounds and nutrients as supported by Martins et al., (2020). This has, therefore, called for enhanced research on the way that formulations and processing methods can be altered in order to extract higher nutritional and sensing characteristics about these specialty products.

Last but not the least, the conclusion of the proposed work will be useful for policy-wise and educative to increase application of underutilized foods in production. Other stakeholders within the food industry can create_Table 9 awareness of the advantages of using such ingredients that will foster the adoption of better and sustainable ingredients that will respond positively to consumer satisfactions. More so, such food manufactures, researchers, and policymakers will try to actualize this agenda, which in the long run, transforms the food system into a healthier and sustainable one (Gómez & Martínez, 2017).

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Factors Influencing University Students' Intention to Purchase International Food Brands in Sabah

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Abstract

This study examines the factors influencing university students' intention to purchase international food brands in Sabah using the Theory of Planned Behavior. The study focuses on attitude, subjective norms, and perceived behavioral control as predictors of purchase intention. A quantitative cross-sectional design was applied, and data were collected through an online questionnaire from 87 university students in Sabah. The data were analysed using partial least squares structural equation modelling through SmartPLS 3.0. The findings show that attitude has a positive and significant effect on purchase intention, followed by subjective norms. Perceived behavioral control does not show a significant effect. These results suggest that emotional evaluation, brand perception, peer influence, and social approval are more important than access or affordability in shaping students' intention to buy international food brands. The study contributes to consumer behavior research by extending the application of the Theory of Planned Behavior to young consumers in East Malaysia. It also offers practical guidance for international food brands that seek to build stronger engagement with university students through lifestyle-based positioning, peer-driven campaigns, and student-focused digital marketing.

Keywords: international food brands, purchase intention, Theory of Planned Behavior, attitude, subjective norms, perceived behavioral control, university students in Sabah

1. Introduction

International food brands have become more visible in Malaysia as globalisation, digital media, urban lifestyles, and changing food preferences reshape consumer choice (Solomon, 2018; Yang et al., 2025). Products such as international fast food, packaged food, confectionery, cereals, and imported snacks are now part of the everyday consumption environment for many young consumers. University students form an important segment because they are exposed to global trends, interact actively on digital platforms, and often adopt new products earlier than older consumers (Yang et al., 2025).

Despite the growing presence of international food brands, the factors that shape purchase intention among students in East Malaysia remain underexplored. Most consumer studies focus on broader consumer groups or metropolitan markets. This creates a research gap because university students in Sabah operate within a distinct social, cultural, and economic setting. Their purchase decisions may be shaped by multicultural exposure, peer culture, digital influence, product availability, price sensitivity, and perceptions of modern lifestyles.

This study addresses that gap by examining the intention of university students in Sabah to purchase international food brands. The study adopts the Theory of Planned Behavior, which explains behavioral intention through attitude, subjective norms, and perceived behavioral control (Ajzen, 1991; Fishbein & Ajzen, 1975). This framework is suitable because food purchase decisions involve personal evaluation, social approval, and perceived ease or difficulty of buying the product (Ajzen, 1991). The study answers three research questions: how attitude affects purchase intention, how subjective norms influence purchase intention, and how perceived behavioral control shapes purchase intention.

The study contributes to the literature by providing empirical evidence from a student market in Sabah. It also provides practical insights for international food companies, local retailers, and policymakers who want to understand how young consumers respond to global food brands in a regional Malaysian context.

2. Literature Review and Hypotheses Development

2.1 Theory of Planned Behavior

The Theory of Planned Behavior explains that behavioral intention is formed by three main factors: attitude toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). Attitude refers to a person's positive or negative evaluation of performing a behavior. Subjective norms refer to perceived social pressure from important others. Perceived behavioral control refers to the perceived ease or difficulty of performing the behavior (Ajzen, 2002). In consumer behavior research, the theory has been used to explain food purchase decisions, including fast food, halal food, functional food, and sustainable food choices (Ajzen, 1991; Fishbein & Ajzen, 1975).

2.2 Purchase Intention Toward International Food Brands

Purchase intention refers to a consumer's willingness or plan to buy a product (Ajzen, 1991). In the context of international food brands, purchase intention may arise from brand image, perceived quality, taste, safety, convenience, lifestyle fit, social influence, and previous consumption experience (Solomon, 2018; Zhao et al., 2024). Among university students, purchase intention can also be shaped by peer recommendations, digital content, affordability, and accessibility (Yang et al., 2025).

2.3 Attitude and Purchase Intention

Attitude reflects students' evaluation of international food brands (Ajzen, 1991). A positive attitude may emerge when students associate international food brands with quality, safety, taste variety, attractive packaging, convenience, and a modern lifestyle (Zhao et al., 2024). When students believe that international food brands offer desirable outcomes, they are more likely to intend to purchase them (Ajzen, 1991). Therefore, the first hypothesis is proposed:

H1: Attitude toward international food brands positively influences university students' intention to purchase international food brands in Sabah.

2.4 Subjective Norms and Purchase Intention

Subjective norms reflect the influence of friends, family, classmates, social media influencers, and online communities (Ajzen, 1991). University students may try international food brands because the products are recommended by peers, displayed on social media, or perceived as socially acceptable (Yang et al., 2025). In a student environment, social approval and peer validation can encourage students to purchase brands that are popular or widely discussed (Solomon, 2018). Therefore, the second hypothesis is proposed:

H2: Subjective norms positively influence university students' intention to purchase international food brands in Sabah.

2.5 Perceived Behavioral Control and Purchase Intention

Perceived behavioral control refers to students' confidence that they can purchase international food brands (Ajzen, 2002). This includes having sufficient financial resources, access to physical or online channels, product availability, and familiarity with the purchasing process. Students who perceive fewer barriers are expected to report stronger purchase intention (Ajzen, 1991). Therefore, the third hypothesis is proposed:

H3: Perceived behavioral control positively influences university students' intention to purchase international food brands in Sabah.

3. Methodology

3.1 Research Design and Sample

This study used a quantitative cross-sectional survey design. The target population consisted of university students in Sabah. Convenience sampling was applied because the study required respondents who were accessible, willing to participate, and had exposure to international food brands. A total of 87 valid questionnaires were collected through an online survey. Respondents were recruited from Universiti Malaysia Sabah, which served as the sampling frame for this study.

3.2 Respondent Profile

Of the 87 respondents, 60 were female and 27 were male. Most respondents were aged 21 to 23 years. Undergraduate students represented 95.4% of the sample, while postgraduate students represented 4.6%. The largest programme group was International Business, followed by Accounting, Entrepreneurship, and Financial Economics.

3.3 Measures and Data Analysis

The questionnaire measured attitude, subjective norms, perceived behavioral control, and purchase intention using five-point Likert scale items. The items were adapted from established studies on the Theory of Planned Behavior and consumer behavior. Data were analysed using Partial Least Squares Structural Equation Modeling with SmartPLS 3.0. The analysis involved assessment of the measurement model and structural model.

4. Results

4.1 Measurement Model

The measurement model was assessed through indicator loadings, composite reliability, average variance extracted, and discriminant validity. Composite reliability values ranged from 0.813 to 0.875, which indicates acceptable internal consistency. AVE values ranged from 0.522 to 0.701, exceeding the minimum threshold of 0.50. Most indicator loadings were above 0.70, while the lowest loading was 0.693, which remained close to the accepted threshold. These results indicate acceptable reliability and convergent validity.

4.2 Structural Model

The structural model explained 53.9% of the variance in purchase intention. This indicates moderate explanatory power in behavioral research. The bootstrapping results showed that attitude had a positive and significant influence on purchase intention. Subjective norms also had a positive and significant influence. Perceived behavioral control did not significantly influence purchase intention.

Table 1. Hypothesis testing

Hypothesis	Relationship	Std Beta	Std Error	t-value	p-value	Decision
H1	Attitude > Purchase intention	0.422	0.119	3.544**	0.000	Supported
H2	Subjective norms > Purchase intention	0.294	0.132	2.230*	0.013	Supported
H3	Perceived behavioral control > Purchase intention	0.132	0.091	1.454	0.073	Not supported

5. Discussion

The findings show that attitude is the strongest predictor of purchase intention. Students are more likely to intend to purchase international food brands when they perceive these brands positively. Positive attitudes may come from beliefs about higher quality, attractive taste, safety, global image, convenience, and lifestyle compatibility. This result supports the Theory of Planned Behavior and indicates that personal evaluation plays a central role in students' food brand decisions.

Subjective norms also significantly influence purchase intention. This means that students' choices are shaped by friends, family, peer groups, and social media exposure. In the context of university students in Sabah, where students interact closely in academic and social settings, brand choices can become part of group identity. The result suggests that student consumers may respond strongly to peer recommendations, influencer content, online reviews, and trend-based marketing.

Perceived behavioral control does not significantly influence purchase intention. One possible explanation is that access, affordability, and purchasing confidence are not the main barriers for these respondents. Students may still intend to purchase international food brands even when they face price or access constraints because their intention is driven more strongly by attitude and social influence. This result suggests that emotional and social drivers outweigh control-related factors in this sample.

6. Conclusion

This study examined the factors influencing university students' intention to purchase international food brands in Sabah using the Theory of Planned Behavior. Based on data from 87 respondents, the findings show that attitude and subjective norms significantly influence purchase intention, while perceived behavioral control does not. The model explains 53.9% of the variance in purchase intention. The results indicate that students' intention to buy international food brands is shaped mainly by positive brand evaluation and social influence. For brands targeting young consumers in East Malaysia, emotional appeal, lifestyle relevance, peer validation, and digital visibility are important strategic priorities.

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Factors Influencing Sabahan Youths' Intention to Purchase International Fast Fashion Products

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Abstract

This study examines the factors influencing Sabahan youths' intention to purchase international fast fashion products. Drawing upon the Theory of Planned Behaviour, the study investigates the effects of brand sustainability, social factors, and product accessibility on purchase intention. A quantitative cross-sectional design was employed and data were collected from 78 youths in Sabah using an online questionnaire. The data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The findings indicate that social factors and product accessibility significantly and positively influence purchase intention, whereas brand sustainability does not significantly influence purchase intention. The findings provide important implications for international fashion retailers seeking to strengthen their presence in East Malaysia and contribute to the literature on youth consumer behaviour in emerging markets.

Keywords: Fast fashion, Purchase intention, Brand sustainability, Social factors, Product accessibility.

1. Introduction

The fast fashion industry has experienced substantial growth over the last decade due to globalisation, digitalisation, and changing consumer lifestyles (Fletcher, 2012; Chen, 2021; Joy et al., 2012). International brands such as Zara, H&M, Uniqlo and Cotton On have become increasingly popular among young consumers because they provide fashionable products at affordable prices and rapidly respond to changing fashion trends (Joy et al., 2012). The expansion of e-commerce and social media platforms has further accelerated the consumption of fast fashion products among youths (Soto-Acosta et al., 2015; Conales & Burdeos, 2024).

In Malaysia, youths are among the largest consumers of international fashion products. Sabahan youths represent an important market segment because they are highly active on social media and are constantly exposed to global fashion trends and influencer marketing (Cialdini & Goldstein, 2004; Yapp & Yapp, 2024). Despite the growing popularity of international fast fashion products, empirical evidence on the determinants of purchase intention among youths in Sabah remains limited.

Most previous studies have focused on consumers in Western countries and Peninsular Malaysia (Joy et al., 2012). Consequently, limited evidence exists regarding the factors that influence the purchase intention of young consumers in East Malaysia. This study addresses this gap by examining the effects of brand sustainability, social factors, and product accessibility on purchase intention among Sabahan youths.

2. Literature Review and Hypotheses Development

Theory of Planned Behaviour

The Theory of Planned Behaviour proposed by Ajzen (1991) explains that behavioural intention is determined by attitude, subjective norms and perceived behavioural control. This theory has been widely applied in consumer behaviour and marketing research (Ajzen, 2002; Krueger et al., 2000). In the context of fast fashion consumption, TPB provides a suitable theoretical framework for explaining consumers' intentions to purchase international fashion products.

Brand Sustainability

Brand sustainability refers to consumers' perceptions regarding the environmental and ethical practices of a company (Joy et al., 2012). Sustainable brands often adopt environmentally friendly production processes, ethical sourcing practices, and corporate social responsibility initiatives to enhance their reputation and consumer trust. Previous studies have found that consumers, particularly younger generations, are becoming increasingly concerned about sustainability issues and are more likely to support brands that demonstrate responsible practices (Stern, 2000).

H1: Brand sustainability positively influences purchase intention.

Social Factors

Social factors refer to the influence of family members, peers, social media and influencers on individual behaviour (Cialdini & Goldstein, 2004). In collectivist societies such as Malaysia, social approval and peer influence play an important role in shaping purchasing decisions (Yapp & Yapp, 2024). Previous studies have consistently demonstrated that social influence significantly affects consumers' intentions to purchase fashion products, particularly among Generation Z and young adults who are highly engaged with social networking platforms (Loo Ying Wing et al., 2023).

H2: Social factors positively influence purchase intention.

Product Accessibility

Product accessibility refers to the ease of obtaining products through physical stores and online platforms (Seiders et al., 2005). Accessibility encompasses factors such as product availability, convenience of purchase, delivery efficiency, and ease of obtaining information about products. Previous studies have shown that consumers are more likely to purchase products that are readily available and easily accessible (Krbova & Pavelek, 2015). The growth of e-commerce platforms such as Shopee, Lazada, and TikTok Shop has substantially improved product accessibility and has positively influenced consumers' online purchasing behaviour (Conales & Burdeos, 2024).

H3: Product accessibility positively influences purchase intention.

3. Methodology

This study employed a quantitative cross-sectional research design to examine the factors influencing Sabahan youths' intention to purchase international fast fashion products. A quantitative approach was deemed appropriate because the study aimed to test the relationships between brand sustainability, social factors, product accessibility, and purchase intention using statistical techniques. The target population consisted of youths residing in Sabah aged between 18 and 30 years old who had prior experience purchasing or were familiar with international fast fashion products.

A purposive sampling technique was employed because respondents were selected based on specific characteristics relevant to the objectives of the study (Etikan et al., 2016). Data were collected through a self-administered online questionnaire distributed via social media platforms (Wright, 2005). The questionnaire consisted of demographic questions and measurement items relating to purchase intention, brand sustainability, social factors, and product accessibility. A total of 78 usable responses were obtained and used for the final analysis.

All measurement items were assessed using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Data were analysed using SmartPLS 4.0 which is appropriate for prediction-oriented studies and exploratory research (Chin, 1998; Hair

et al., 2022; Henseler et al., 2009). Reliability and validity assessments followed the recommendations of Anderson and Gerbing (1988) and Sarstedt and Cheah (2019). Furthermore, collinearity assessments were conducted to minimise the risk of misleading structural relationships and common method bias (Kock & Lynn, 2012).

4. Results

A total of 78 usable responses were obtained and included in the final analysis. Female respondents represented 66.7% of the sample, while male respondents accounted for 33.3%. The majority of the respondents were between 18 and 22 years old, indicating that the sample primarily consisted of young consumers who are highly exposed to international fashion trends and digital shopping platforms.

The measurement model demonstrated satisfactory psychometric properties. Composite Reliability (CR) values ranged from 0.854 to 0.951, exceeding the recommended threshold of 0.70 (Hair et al., 2022). In addition, the Average Variance Extracted (AVE) values ranged from 0.543 to 0.797, indicating acceptable convergent validity as all values exceeded the minimum threshold of 0.50 (Hair et al., 2022). These findings suggest that the measurement items were both reliable and valid for assessing the proposed constructs.

The structural model revealed that social factors significantly influenced purchase intention ($\beta = 0.414$, $t = 2.794$, $p = 0.003$), supporting H2. Product accessibility also significantly influenced purchase intention ($\beta = 0.336$, $t = 1.844$, $p = 0.033$), supporting H3. However, brand sustainability did not significantly influence purchase intention ($\beta = 0.071$, $t = 0.441$, $p = 0.330$), resulting in the rejection of H1. Furthermore, the model explained 55.4% of the variance in purchase intention ($R^2 = 0.554$), indicating moderate predictive power (Hair et al., 2022).

5. Discussion

The findings revealed that social factors are the strongest predictor of purchase intention among Sabahan youths. The significant relationship between social factors and purchase intention indicates that family members, peers, and social media influencers play an important role in shaping consumers' purchasing decisions. This finding is consistent with previous studies that emphasised the importance of social influence and subjective norms in determining consumer behaviour and purchase intention (Cialdini & Goldstein, 2004; Yapp & Yapp, 2024). The finding also supports the Theory of Planned Behaviour, which suggests that subjective norms significantly influence an individual's behavioural intention (Ajzen, 1991). Given that young consumers are highly active on social media platforms, recommendations and opinions from peers and influencers may substantially affect their purchasing decisions regarding international fast fashion products.

The findings also demonstrated that product accessibility significantly influences purchase intention. This suggests that consumers are more likely to purchase international fast fashion products when such products are easily accessible through physical stores

and online platforms. The finding is consistent with previous studies that reported that convenience and ease of obtaining products positively influence consumer purchase decisions (Seiders et al., 2005; Krbová & Pavelek, 2015). The rapid growth of e-commerce platforms and online shopping applications has further increased consumers' ability to access international fashion products conveniently. Therefore, greater product accessibility enhances consumers' perceived behavioural control and subsequently strengthens their intention to purchase international fast fashion products.

Contrary to expectations, brand sustainability did not significantly influence purchase intention among Sabahan youths. Although young consumers increasingly express concern regarding environmental and sustainability issues, these concerns may not necessarily translate into actual purchasing behaviour. This finding is consistent with previous studies suggesting that consumers often prioritise product trends, affordability, and convenience over sustainability considerations when purchasing fast fashion products (Joy et al., 2012; Stern, 2000). The finding implies that environmental awareness among Sabahan youths may still be insufficient to influence their purchasing decisions. Consequently, sustainability initiatives implemented by international fast fashion brands may not yet constitute a primary determinant of purchase intention in the Sabah context.

6. Conclusion

This study examined the factors influencing Sabahan youths' intention to purchase international fast fashion products by investigating the effects of brand sustainability, social factors, and product accessibility on purchase intention. The findings revealed that social factors and product accessibility significantly influence purchase intention, whereas brand sustainability does not significantly influence purchase intention. The findings indicate that Sabahan youths are more likely to be influenced by peers, social media, and the accessibility of products than by sustainability considerations when making purchasing decisions.

The study contributes to the existing literature by extending the application of the Theory of Planned Behaviour in the context of international fast fashion consumption among youths in East Malaysia. Furthermore, the findings provide practical insights for international fashion retailers in developing effective marketing strategies that emphasise social influence and enhance product accessibility to attract young consumers in Sabah. Future studies are encouraged to incorporate additional variables and larger samples to further improve the understanding of consumer purchase behaviour towards international fast fashion products.

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