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Research article

Selecting corporate strategies using an Analytic Network Process Model: A case study

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Abstract
The selection of organizational strategies should be approached with a systemic process that interrelates the decision elements. The objective of this paper is to present an organizational decision framework that incorporates the key elements in a decision-making process to select the best strategic option, considering the interdependence among all of them. A large Colombian company in the manufacturing sector is used as a case study. The Strengths, Weaknesses, Opportunities, Threats and Opportunities (SWOT) and the Analytical Network Process (ANP) approaches were combined for this purpose. The network integrates SWOT, Porter's generic strategies, corporate strategies, and, as a new addition, key success factors (KSF). The results include the simultaneous ranking of the generic strategies and associated corporate strategies, as well as the ranking of the influence the key criteria clusters on the prioritized strategies.

Keywords: ANP; SWOT; strategy; multi-criteria; decision-making.

Selección de estrategias corporativas aplicando un Modelo de Proceso Analítico en red: un estudio de caso

Resumen
La selección de estrategias organizacionales debe abordarse con un proceso sistémico que interrelacione los elementos de decisión. El objetivo de este trabajo es presentar un marco de decisión organizacional que incorpore los elementos clave en un proceso de toma de decisiones para seleccionar la mejor opción estratégica, considerando la interdependencia entre todos ellos. Se utiliza como caso de estudio una empresa grande colombiana del sector manufacturero. Para ello se combinaron los enfoques de Debilidades, Amenazas, Fortalezas y Oportunidades (DOFA) y el Proceso Analítico de Redes (ANP por su sigla en inglés). La red integra la DOFA, las estrategias genéricas de Porter, las estrategias corporativas y, como novedad, los factores clave del éxito (FCE). Los resultados incluyen la jerarquización simultánea de las estrategias genéricas y las estrategias corporativas asociadas, así como la jerarquización de la influencia de los grupos de criterios clave en las estrategias priorizadas.

Palabras clave: ANP; DOFA; estrategia; multicriterio; toma de decisiones.

Seleção de estratégias corporativas aplicando um modelo de Processo Analítico Hierárquico: um estudo de caso

Resumo
O objetivo deste trabalho é apresentar um quadro de decisão que incorpore sinergicamente todos os elementos-chave em um processo de tomada de decisão que contribua metodologicamente para a seleção da melhor opção estratégica, considerando a interdependência entre todos os elementos que intervêm em uma decisão a nível empresarial. Nesse sentido, foram combinadas como metodologia as abordagens de fraquezas, oportunidades, forças e ameaças (SWOT pela sua sigla em inglés) e Processo Analítico Hierárquico (ANP pela sua sigla em ingles), considerando como elementos os fatores-chave de sucesso, as estratégias genéricas de Porter e as estratégias corporativas aplicadas a um estudo de caso na colômbia. O resultado mais relevante é a hierarquia das diferentes estratégias genéricas: estratégia de diferenciação, abordagem estratégica e liderança em custos, bem como as estratégias competitivas que estão associadas às genéricas.

Palavras-chave: ANP; SWOT; estratégia; multicritério; tomada de decisão.

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1. Introduction

One distinctive feature of management is the importance it attaches to making strategic decisions. As more markets become global, the number of dependencies between the factors that arise in a decision grows exponentially. Furthermore, evolving technologies drive changes in markets and products must change with them (Ervural, Zaim, Demirel, Aydin, & Delen, 2018). Some industries change faster than others, but change is now the norm rather than the exception.

In this field, Wheelen et al. (2015) focus on making the strategy formulation process more effective to respond to the complexity of the competitive environment through the implementation of decision techniques such as multi-criteria analysis, as well as robust and flexible tools for all types of organizations.

In this sense, facing the challenge of change gives companies the options to react, anticipate or lead the market in terms of their own strategies. These are defined as the reconciliation that an organization makes between its internal resources and its capacities, the opportunities and the risks or threats created by its external factors. They define the essence of strategic planning when relating a company with its environment (Porter, 1997). Although there are innovative tools to analyze the decision-making problem of a company, this publication aims to analyze the synergy of traditional tools that provide a frame of reference for the future adoption of corporate, competitive, and functional strategies in combination with the different key success factors identified by each type of company.

In relation to the problem that justifies this study, specifically in the field of corporate strategy formulation based on complementing SWOT analysis with other prioritization tools to refine the selection and improve its effectiveness, although authors have agreed that the dependence between decision elements cannot be overlooked, few of them have applied SWOT-ANP approaches to evaluate and select them. In fact, one of the most comprehensive studies is the one by Sanny et al. (2018), who analyze the internal and external environment of companies to formulate alternative strategies during the planning process and use various multi-criteria hybrids such as Fuzzy ANP, ANP and Fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) to finally select the best alternative strategy. Moreover, looking for criteria that influence the occurrence of damage based on data from cooperatives and SMEs in Batik Madura, Khotimah et al. (2017) used SWOT Analysis combined with FANP method to determine the most appropriate business strategy to be applied in SMEs. However, among the decision elements related to corporate strategy selection, neither a key cluster such as the key success factors, nor Porter's generic strategy cluster has been considered as an additional conditioner, thus reducing the completeness of the decision. The other constituent concepts of the study framework for this paper are illustrated below.

1.1 Key or critical success factors

According to Rockart (1982), these are general objectives adopted as performance requirements that an organization must meet to achieve its strategic objectives; this concept is validated by Mohammadi (2021). Their achievement leads to generate significant and economic value for the organization (Tu et. al, 2018). KSFs are the key areas whose results, once achieved, will ensure organizational success (Mohr & Spekman, 1994). "They are a set of limited factors that, when applied and reinforced in an organization, give competitive advantage" (Mosadeghrad et al., 2022). According to Hastig & Sodhi (2020), KSTs for implementation are "companies' capabilities; collaboration; technology maturity; supply chain practices; leadership; and governance of the traceability efforts". Managers can use KSFs as descriptions, predictors and guidelines for levels of achievement (Vedder, 1992). For example, a critical success factor can be set to increase brand awareness; this is an ambitious goal that generates significant value and market share for the organization. Other uses are as a management measure in various disciplines, such as manufacturing (Mohr & Spekman, 1994) and quality management (Seetharaman et al., 2006). Although some KSFs have been recognized in the literature, the existing critical factor analysis approach does not provide a way to analyze the relationships between factors, and empirically verify how these factors affect organizational performance (Tu et. al, 2018).

1.2 Porter's Generic Strategies

According to Porter's (1997) competitive strategy, there are several competitive strategies that organizations can employ to create added value and differentiate them selves from their competitors. The generic strategies originally distinguish the following: cost leadership, differentiation, and focus.

Cost leadership or low-cost strategy. Through this competitive strategy, organizations seek to optimize their processes. It aims to reduce costs compared to the competition and increase their profit margin. The result is to take advantage of an opportunity to offer products at a lower price than the competition. Low cost can be achieved through corporate strategies such as vertical or direct integration, horizontal strategy, market penetration strategy, among others; and variables such as economies of scale, lower labor costs, standardization and simplification (products and processes), process outsourcing, control of fixed costs, among others.

Differentiation strategy. This strategy aims to create a unique image. Products become important if one or more of the product properties are unique, so it is based on product characteristics as well as brand image. In return, buyers are willing to pay a higher price for this unique product in exchange for receiving "differentiated" or even customized values. Differentiation can be based

on corporate strategies such as product development, unrelated diversification, or variables such as superior quality, product innovations, image, product design and properties, brand name, among others.

Focus strategy. This strategy aims to compete in a niche market instead of the total market. This allows the producer to know the segments it is targeting, which makes it possible to respond better to consumers' needs. The focus can be on cost or differentiation.

1.3 Corporate strategies

Through corporate strategy, an organization seeks to design a specific plan that defines the actions to be taken for growing satisfactorily over time, i.e., it is the road map or guide that must be followed to achieve the proposed objectives (Barbosa et al., 2020). Corporate strategy makes it possible to better understand and maintain a broad or specific focus on the market in which the organization operates, know what the products should be like to satisfy the needs of the target customer segment, and establish which actions are most profitable. In the end, it provides a complete vision of the activities to be carried out in the medium and long term, as well as the points to be strengthened to achieve the established goals. The strategies to be evaluated in this study fall into categories (Hitt et al., 2019) such as: a) stability strategies, through which the company's situation is maintained, as well as its performance and profitability, e.g., related diversification strategy and Product development strategy; b) growth strategies focused on increasing sales, profits, and brand value through the creation of new products or the introduction in new markets; c) contraction strategies focused on reducing the company's volume of operations, e.g., the number of references or selecting the most profitable segments. Some well-known contraction strategies are Divestment strategy, Downsizing strategy, and even Liquidation strategy.

The present work approaches the study of the formulation of corporate and competitive strategies through the development of a proposed systemic methodology that integrates the main concepts of this stage of strategic planning, the SWOT reconciliation technique, and a multi-criteria decision method to define the prioritization of strategic alternatives by applying it to an organization selected as a case study.

ANP (Analytic Network Process) is the generalization of the AHP (Analytic Hierarchy Process) method (Khan & Ali, 2020). In AHP direct influence is generated between criteria, subcriteria, and alternatives, while in ANP complex systems are analyzed and hierarchies are replaced by networks because it allows establishing the influences or dependencies that exist between some decision elements. This means that just as the criteria or sub-criteria influence the alternatives, so could the alternatives influence criteria, sub-criteria and other elements related to the decision (Saaty, 2016).

This paper consists of seven sections organized as follows: Section two presents the literature background on research trends and application of SWOT-ANP analysis; Section three presents the methodology developed to achieve the research objective; Section four contains the development of the methodology applied to a case study; Section five shows the results and their discussion; Section six presents the conclusions.

2. Conceptual background

In addition to the works of Sanny et al. (2018) & Khotimah et al. (2017), and to find research trends and application of SWOT-PSA analysis in different contexts related to strategic decision making, a bibliometric analysis was performed for a time horizon in searches between 2007 and 2023 obtaining the results shown in Figure 1. The search equation used for this analysis was **"anp AND swot AND strateg*"** in the database SCOPUS with the filter Article Title, Abstract and Keywords. In the Web of Science database, the search equation was "All fields". The search yielded 106 articles that were unified through the Mendeley bibliographic manager, which was used to export them with the .RIS extension to the VosViewer® software. Note the close relationship between the SWOT analysis and the decision-making processes for strategic planning considering the key internal and external factors.

The results in Figure 1 highlight the use of multicriteria methods such as ANP and AHP, together with hybrid methods such as fuzzy theory and TOPSIS they support the processes of strategic analysis, application of SWOT analysis, evaluation of key success factors, among other decision elements in organizations.

In this sense, correlated authors stand out and are shown in Figure 2. This is the case of Kabak et al. (2016), who in their collaborations have investigated and applied multi-criteria methods to prioritize energy policies in countries such as Turkey. Those policies have been first evaluated by means of SWOT analysis to then achieve their prioritization (Genç et al., 2018). Kabak, in other of his collaborations with Dağdeviren & Burmaoğlu in 2016, analyze the situation of energy strategy in Turkey using a hybrid model combining SWOT with fuzzy ANP, their main achievement was the evaluation of 4 factors and 21 sub-factors to prioritize 7 energy policies as alternatives; also the accuracy of the information coming from the decision stakeholders was achieved by means of FANP (fuzzy ANP) (Kabak et al., 2012, 2016). In the same sector, Akçaba & Eminer (2022) propose an integrated ANP-SWOT- Fuzzy FTOPSIS approach to identify strategic energy alternatives for the energy sector in Northern Cyprus. In the energy field, Kaytez (2022) also applied a hybrid Fuzzy Network Analytical Process (FANP) approach based on SWOT to assess the future development of wind energy capacities in Turkey in light of the sectoral effects of the Covid-19 outbreak in

2020. In pandemic times, Sobhani et al. (2022) also used SWOT-ANP models to identify optimal strategies to cope with the Iranian tourism crisis generated by COVID-19 and increase resilience to its effects.

Some authors are not listed with direct correlations but are within the results of the bibliometric study and constitute an important reference for the present article. That is the case of Arsić et al. (2017), who built a model in which, combining SWOT analysis of the situation and the ANP method, identified sustainable development and environmental protection scenarios that would enable the company to achieve its vision. In this context of sustainable solid waste management, using ANP and SWOT, Pongpimol et al. (2020) examined issues affecting end-of-life (EOL) management of flexible packaging. In the same vein, Islami & Farajollahi (2022) used SWOT-ANP to investigate and prioritize strategies to improve livelihoods in Bagherabad, a village of Sanandaj city, based on natural resource approaches. In the field of sustainable energy, Yontar & Derse (2022) applied an integrated AHP/ANP methodology with SWOT Analysis SWOT Matrix to determine strategies of the Sustainable Energy Action Plan for the Yenişehir region in the Turkish province of Mersin. Živković et al. (2015) formulated models for prioritization of strategies generated at the university level, in the case of the Technical Faculty of Bor, University of Belgrade, Serbia, also prioritizing factors and sub-factors associated with this type of decision. The authors constructed a four-level hierarchical ANP model: "Objective (selection of the best strategy) - SWOT factors - SWOT sub-factors - alternative strategies, which establish the interaction between the clusters at different hierarchical levels of the model, as well as the interactions between the elements within each cluster".

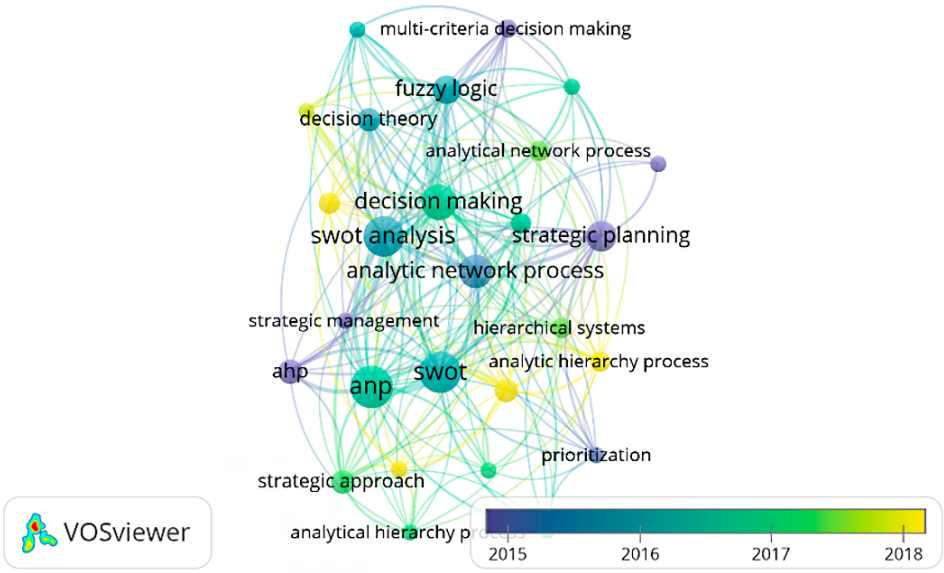

Figure 1. Network of co-occurring terms for the use of SWOT in strategic decision models.
Source: own elaboration, supported by VosViewer®.

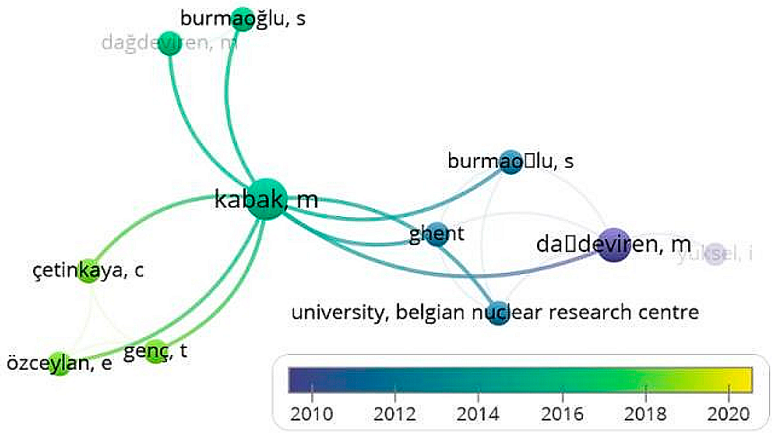

Figure 2. Author network on the use of SWOT in strategic decision models.
Source: own elaboration, supported by VosViewer®.

Other authors complemented multicriteria analysis techniques with ANP-SWOT in decision-making in different fields. With the aim of improving the analytical dimension of SWOT with group decision-making, Yüksel (2012) proposed an integrated ANP and Fuzzy TOPSIS model showing that it is applicable to SWOT analysis and strategy selection. In the same vein, Kaymaz et al. (2022) evaluated the socio-economic structure of Erzurum with AHP and digitized SWOT analysis considering the Sustainable Development Goals (SDGs). Voronova et al. (2018) conducted a comparative analysis of development strategy selection using the SWOT-ANP to develop a company strategy. Based on a SWOT-ANP approach, to propose strategies for energy efficiency improvement of the building sector in Iran, Borjoeifar et al. (2021) conducted a study to evaluate the branding strategies of the medicinal herb *Ferula assa-foetida*, a species of the Umbelliferae family in Kerman province, also located in Iran. Lak et al. (2020) investigated and analyzed the potential of heritage tourism to help regenerate the historic city of Birjand, Iran, using urban cultural capital based on a SWOT-ANP approach. Khojaste-Sarakhsi et al. (2019) found that modification of the energy tariff system was the most important strategy.

For Aceh Songket business, an Indonesian traditional weaving, Ilyas et al. (2018) detected seven problems of internal and external factors of the company using SWOT analysis to produce nine marketing strategies. The sub-criteria defined in their study to determine the best strategy were viewed in terms of the marketing mix. Then, from ANP, they determined the development of product diversification as the best strategy. Liu et al. (2018) applied it in energy service companies (ESCOs) for the construction sector in China. Based on a comprehensive ANP-SWOT analysis model, Zhang & Rao (2021) determined the essential characteristics of the best strategy for the innovation and development of the Chinese high-end medical equipment industry during the COVID-19 pandemic. Namin et al. (2019), to address the shortcomings of the assumed independence between factors and AHP decision options, implemented an ANP-based algorithm that, according to them, can perform well even when there is a dependency between the SWOT factors, illustrating its application for strategic planning in the green space of Tehran's District 19.

Quezada et al. (2019) developed a quantitative hybrid method with BSC (Balanced Scorecard) and SWOT analysis to evaluate the performance of a company in the food industry, validating it with managers, who found the method useful but time-consuming. Shahanipour et al. (2020) identified and prioritized human resource strategies in a document management area, initially conducting analysis using the SWOT matrix, and then using ANP to prioritize the strategies. The strategy for human resources maintenance, based on the extended creativity criterion, was selected as the highest priority. Wahyono et al. (2020) combined ANP with SWOT for decision-making to determine the strategy for developing robust coffee in Jember, seeking for ANP to contribute to decision-making by prioritizing alternatives. In order to strategically plan for the optimal development of aquaculture in the coastal areas of Qeshm Island, Zarei et al. (2020) especially analyzed the island's aquaculture activities within the framework of integrated coastal zone management. The authors used the ANP and Super Decision software in the SWOT matrix to evaluate and prioritize the related factors. They showed the most efficient strategies for the optimal development of aquaculture use in the coastal areas of Qeshm Island. For the same purpose, Li et al. (2020) applied it in the development of methanol vehicles. Fuzzy-logic and grey-relational ANP-based SWOT was used in the development of ceramic and tile industries by Karimi et al. (2019). Furthermore, SWOT-ANP Fuzzy TOPSIS was applied for energy development (Ervural et al., 2018). Aghasafari et al. (2020) used SWOT, fuzzy theory, and ANP to determine the best strategies for organic farming development based on global factors affecting organic farming, considering the interdependence between them under uncertainty in the decision-making environment, focusing on the Iranian province of Khorasan Razavi. They integrated the ANP method into the SWOT analysis to determine the most suitable strategy for Turkey's medical tourism. Sevim & Önder (2020) also integrated the ANP method into the SWOT analysis to determine the most suitable strategy for Turkey's medical tourism. Barati et al. (2018) developed a hybrid method for formulating and choosing strategies for rural cooperative development in Iran by combining SWOT analysis, SWOT matrix and ANP. Using the SWOT-ANP framework, Starr et al. (2019) concluded that the presence of healthy, resilient forests and the opportunities associated with increased revenue could be the driving forces behind active management of Cross-timbers, an ecoregion stretching from north-central Texas through central Oklahoma to southern Kansas. And recently, Gao et al. (2022) applied SWOT-ANP seeking to determine roadmaps and strategies for blockchain application in construction management in China. Also in China, Zhang & Paudel (2021) used the SWOT-ANP framework to identify the key elements and main strategies related to the management of small-scale forestry cooperatives under the Grain for green program (GFGP) in Xinjiang. Similarly in China, Hu et al. (2019) developed a SWOT-ANP model to prioritize carbon labeling policy in Taiwan. Wang et al. (2021) constructed a conceptual framework for the utilization of abandoned mine resources, the authors employed an integrated SWOT-ANP approach to explore suitable reuse strategies for these mines. Agnusdei et al. (2023) conducted a SWOT-ANP analysis, combined with the Axial Distance Based Aggregate Measurement (ADAM) method, showing the impact of digitization on driving circularity within agribusiness, and highlighting the most impactful strategies driving the transition to a circular economy. Oktari et al. (2023) selected knowledge management implementation strategies for coping with disasters and the Covid-19 pandemic in Indonesia. The authors used SWOT analysis to determine the strategies

and ANP to prioritize them. Likewise, in Indonesia, Ali & Kassim (2021) trying to raise the development of waqf forests in the country, used SWOT and ANP methods to identify and prioritize the best strategy. Also in Indonesia, in order to formulate strategies to improve the e-waste management supply chain, Wibowo et al. (2021) used the Decision-Making Trial and Evaluation Laboratory (DEMATEL), ANP, SWOT, and the Quantitative Strategic Planning Matrix (QSPM). Hasiba et al. (2021) developed for Micro Waqf Bank (BWM), an Islamic microfinance institution in Indonesia, a study to define the main survival and maintenance strategies. The study employed a SWOT-ANP analysis. In another banking case, in the face of the difficulties that the European banking sector went through during and after the global financial crisis (GFC), Dinçer et al. (2018), assessed aspects related to the sustainability of the sector and proposed competitive strategies for European policy makers. The authors applied SWOT analysis, an integrated DEMATEL-ANP model (DANP) and fuzzy TOPSIS. Finally, it is worth citing the work of Zakeri et al. (2019), who implemented another approach complementary to SOWT in the process of strategy formulation, selection, and prioritization in unpredictable situations in a mathematical framework, known as strategy interaction model (SIM), in a dairy company located in northern Iran. The authors argue that the SIM approach possesses the advantages of AHP, ANP and other multicriteria decision making (MCDM) techniques applied to SWOT analysis.

The usefulness of decision-making approaches is evident. They allow companies to adapt a selection method in their strategic analysis to prioritize their business actions, and also improve the benefits of SWOT in terms of the influences between the strategic elements and factors.

3. Materials and methods

First, the methodological framework is shown in Figure 3, which integrates the four combined concepts.

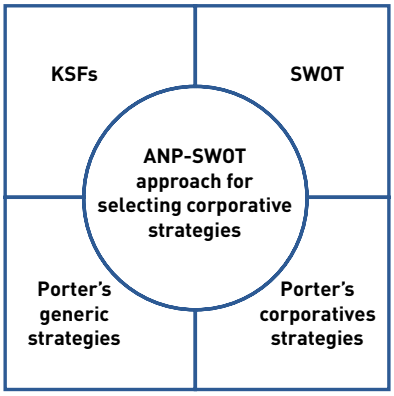

Figure 3. Research methodological framework.
Source: own elaboration.

This methodological framework was developed in the following phases:

a. Problem definition in terms of the current gap in the modeling, which combines the four concepts.
b. Selection of the case study.
c. Literature review, with the objective of finding research trends and application of SWOT analysis in the context of strategic business decision making.
d. Meetings with managers of the case study organization to carry out the information gathering plan related to the strategies and other decision elements such as the selection of experts, construction of the SWOT matrix, the definition of the KSF, and identification of potential strategies.
e. Modeling procedure to select corporate strategies.
f. Analysis of results.

The modeling procedure for strategy selection (Figure 4) made it possible to work with relevant information on the elements of the ANP to prioritize both generic and corporate strategies, from the identification of decision elements to the prioritization of alternatives and factors related to the decision. Figure 4 presents the structure of this methodological procedure with a process approach.

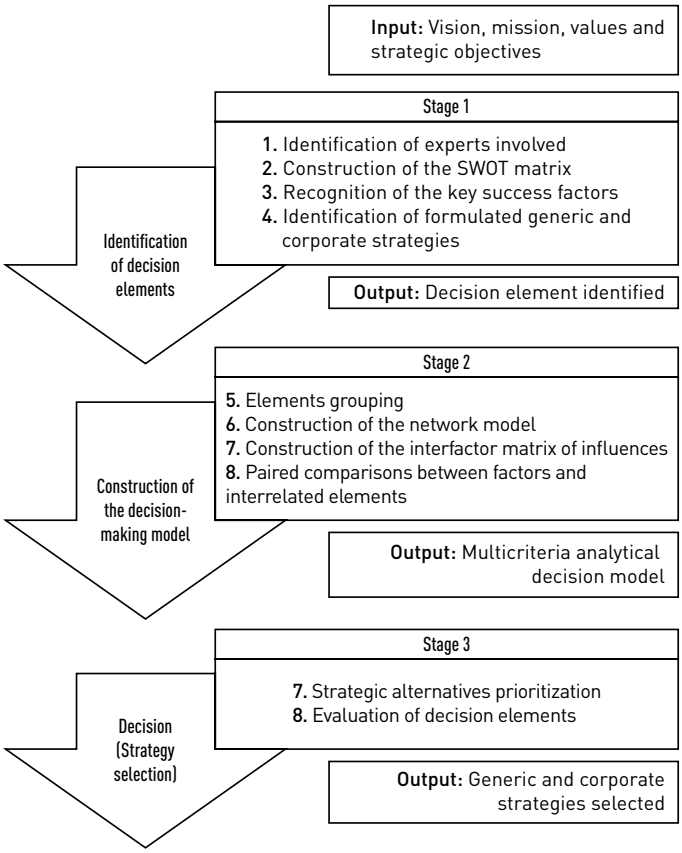

Figure 4. Modeling procedure for selecting corporate strategies.
Source: own elaboration.

The first stage, dedicated to the identification of decision elements, was developed in the meetings with managers. Stages 2 and 3 were developed under the conceptual model of the ANP methodology, integrating

the decision elements defined in stage 1. In the second stage, the identified decision elements are grouped into clusters based on their affinity to determine these. In this phase, the participating experts, acting as evaluators, determine what influence each element has and receives in relation to the others. An element of a cluster in the network may have influence on some or all of the elements of that same cluster or of a different cluster in the network. The relationship between elements in the same cluster is called feedback and the relationship between elements in different clusters is called interdependence. From these interrelationships, the network model of the problem and the inter-factor matrix of influences are constructed to continue with the paired comparison between factors and interrelated elements, and to complete the multicriteria analytical decision model. Finally, in stage 3, the decision model is processed with the support of a software, which guides the decision making, it yielded a prioritization of the strategic alternatives, both generic and corporate. In this research, by means of a proprietary application developed in Excel, the interrelationships between all the elements were explored and some relevant influence relationships were highlighted. The general conceptual model is explained below:

a. Structure of the network model: it consists of identifying and grouping all the elements associated with the decision in clusters called Kn (Figure 5), according to the ANP methodology proposed by Saaty (2016) in the book "Decision making in complex environments".

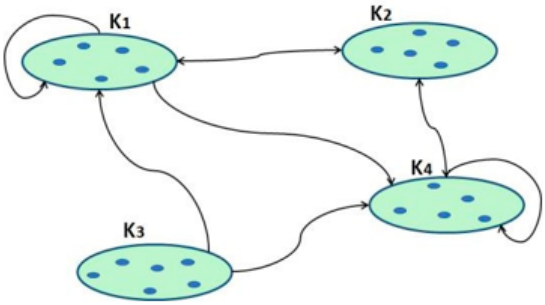

Figure 5. Elements grouped into clusters.
Source: own elaboration.

b. Interfactorial matrix: the influence of each element eij is established for each related element eji by means of a panel of experts who determine with a score of "1" when one element influences another and "0" when no influence of any kind is evident. In Figure 5 these influences are represented by arrows, the ones entering the same cluster indicate that there are influences between the elements of the same group. This step is also part of the proposal by Rozann Saaty (2016) in her book "Decision making in complex environments".

c. Paired comparison: similar to the AHP method, a pairwise comparison is made between the elements that have influences equal to 1 and in the framework of a matrix the local priority vector is obtained between the related elements, as well as to define the importance of the clusters; here, Equation 1 is followed:

$$Vp = A \times w \tag{1}$$

Where A is the paired comparison matrix multiplied by the priority vector w of this comparison to obtain the weighted vector Vp of matrix A, which, according to Equation 2, is multiplied again by the priority vector w to obtain a consistency vector Vc.

$$Vc = Vp \times w \tag{2}$$

Then the values of Vc are averaged to obtain the largest eigenvalue of A, called $\lambda máx$. With this value, we proceed to determine the consistency index Ci under Equation 3. The consistency index is related to the way of obtaining the vector of priorities using the geometric mean by rows procedure, which is equivalent to using the logarithmic least squares method.

$$I_C = \frac{\lambda_{max}{}^{-n}}{n\text{-}1} \tag{3}$$

Where n corresponds to the number of alternatives being evaluated. Once C_i has been calculated, the consistency coefficient CR is determined by taking the random index RI associated with the number of alternatives proposed by Saaty (1980) in his book "The Analytic Hierarchy Process", RI is the expected value of Ci, according to Equation 4. The acceptable limit of C_R is 0.1.

$$C_R = \frac{C_I}{R_I} \tag{4}$$

d. Original supermatrix: to construct this matrix, it is necessary to locate all the priority vectors w for the elements that have been compared in a paired manner with respect to the element on which they have had a direct influence equal to "1", as shown in Equation 5.

$$W = \begin{array}{c} \\ K_1 \\ \\ \\ \\ K_j \\ \\ \\ \\ K_n \\ \end{array} \begin{array}{c} \begin{array}{ccccccccc} K_1 & & & & K_j & & & K_n & \\ e_{11} & e_{12} & e_{1j} & \cdots & e_{j1} & e_{j2} & e_{jm} \cdots & e_{n1} & e_{n2} & e_{nm} \end{array} \\ \begin{bmatrix} V_{11} \ldots & V_{1j} \ldots & V_{1m} \\ \vdots & \vdots & \vdots \\ V_{i1} \ldots & V_{ij} \ldots & V_{im} \\ \vdots & \vdots & \vdots \\ V_{n1} \ldots & V_{nj} \ldots & V_{nm} \end{bmatrix} \end{array} \tag{5}$$

Where Kj corresponds to the clusters of the decision problem, eij are the elements within each cluster, and Vij represents the values of the priority vectors of the elements related by their influences organized by columns. This is a step that combines the fundamentals of Thomas Saaty & compiled by Rozann Saaty (2016), thus generalizing the AHP method.

e. Weighted supermatrix: the first step to obtain this matrix is to obtain the weights of the clusters Kj following the same procedure described in paragraph c of the paired comparisons. Once the weights of each cluster are available, the original supermatrix W is multiplied by the priority vector $\boldsymbol{Vk}$ of the clusters compared according to Equation 6 (Saaty, 2016).

$$\boldsymbol{W_p} = \begin{array}{c} \\ K_1 \\ \\ \\ K_j \\ \\ \\ K_n \\ \\ \end{array} \begin{array}{c} \begin{array}{ccccccccc} K_1 & & & K_j & & & K_n & & \\ e_{11} & e_{12} & e_{1j} \ldots & e_{j1} & e_{j2} & e_{jm} \ldots & e_{n1} & e_{n2} & e_{nm} \end{array} \\ \begin{bmatrix} V_{11} \ldots & V_{1j} \ldots & V_{1m} \\ \vdots & \vdots & \vdots \\ V_{i1} \ldots & V_{ij} \ldots & V_{im} \\ \vdots & \vdots & \vdots \\ V_{n1} \ldots & V_{nj} \ldots & V_{nm} \end{bmatrix} \end{array} \times \boldsymbol{V_k} \qquad (6)$$

f. Boundary supermatrix: results from raising to the power of 2k + 1 the weighted supermatrix Wp, where k is an arbitrarily large number; this procedure is like the concept of Markov chains as established by Saaty (2016).

g. Prioritization of alternatives: at this point, the boundary supermatrix has the same form as the weighted supermatrix, but all columns of the boundary supermatrix are equal. The scores of the prioritized alternatives are found both in the column and in the row containing the alternatives against all the elements that have influenced them and the ones they have influenced (Saaty, 2016).

4. Results - application to the case study

The methodology was applied in an organization of the manufacturing sector in Colombia with the purpose of proposing a strategic direction to obtain competitive advantages in this highly competitive sector, as well as to help the organization improve its strategic decision-making model. The case study organization has a wide experience in the production of the highest quality papers and serves diverse market needs in the segments of distributors, converters, and printers by supplying a variety of formats, colors, and grammages.

However, the evolution of some environmental variables has seriously impacted the performance of the organization, for instance: (i) technological progress, which has generated a decrease in production in the printing and publishing sector; (ii) longer winter seasons, which restrict the availability of raw materials and increases production costs; and (iii) strong foreign competition, which offers products at lower cost. Together with the collateral impacts of the COVID-19 pandemic, it has led the organization to implement staff reduction strategies, which in turn has generated a tense labor climate and negative effect on productivity, leading the organization into a vicious circle.

The development of the modeling procedure is presented below.

4.1. Stage 1. Identification of decision elements

At this stage, all the elements of the decision process were identified. The input required was information concerning the components of the strategy formulation, such as the vision, mission, values, and strategic objectives of the organization. The process at this stage allowed i) to outline and determine the experts involved in the construction of the respective information, they were appointed by senior management, e.g., senior managers responsible for the functional areas, most of them were heads of areas related to the graphic arts sector, packaging of different types of materials, clothing and footwear, who were interested in the assurance of their environmental responsibility. They had more than 10 years of experience in management positions and some had postgraduate degrees; ii) the construction of the SWOT matrix, based on internal and external analysis so the organization can focus on what really matters and prevent unfavorable situations for growth, development, and maintenance (Table 1). iii) to recognize key success factors, defined by managers through an in-depth study of the organization objectives, and validating that they contribute to the creation of added value for customers (Table 2). iv) to identify generic and corporate strategies, which are the alternatives to be evaluated (Tables 3 and 4). In this context, among the two possible alternatives of competitive advantage, there are low cost or differentiation, which combined with the scope of activities lead to three generic strategies to achieve above-average performance in an industry, namely: cost leadership, differentiation, and focus (Porter, 1997). Likewise, to select strategies to be completed, the proposed model suggests exploring all the alternatives of corporate strategies formulated by Porter, so that the experts evaluate the two types (generic and corporate) against all the opportunities, threats, strengths, and weaknesses identified, and key success factors.

The information was obtained through workshops with managers and staff of the strategic committee.

Table 1. SWOT Matrix.

	Negative aspects	Positive aspects
Internal factors	**Weaknesses** (D1) High management costs. (D2) Production system not adaptable to different raw materials. (D3) High sales costs.	**Strengths** (F1) Brand positioning at national scale and international scale. (F2) Processes and products that are environmentally responsible. (F3) High R&D capacity.
External factors	**Threats** (A1) Few entry barriers to the domestic market. (A2) Low-cost imported product supply from other countries increase competition in the sector. (A3) Scarcity and price increase raw materials (A4) Revaluation of dollar.	**Opportunities** (O1) Growth in demand for ecological products in the other countries. (O2) Increased demand for products for other applications.

Source: own elaboration.

Table 2. Key success factors.

(KSF1) Low prices: This factor allows the company to achieve growth in sales and profit margin.
(KSF2) High quality: The objective is to offer good quality products at competitive prices.
(KSF3) Sustainability: This factor refers to the sustainability of production over time, given the threats of technological change in the environment.
(KSF4) Fast delivery: This factor is considered a highly expected value by customers.

Source: own elaboration.

Table 3. Generic strategies cluster.

- (GS1) Differentiation strategy
- (GS 2) Focus strategy
- (GS 3) Cost leadership strategy

Source: own elaboration.

Table 4. Corporate strategy cluster.

-(CS1) Horizontal integration strategy
-(CS2) Backward integration strategy
-(CS3) Direct integration strategy
-(CS4) Market development strategy
-(CS5) Product development strategy
-(CS6) Market penetration strategy
-(CS7) Related diversification strategy
-(CSD8) Unrelated diversification strategy
-(CS9) Divestment strategy
-(CS10) Liquidation strategy
-(CS11) Downsizing strategy

Source: own elaboration.

4.2 Stage 2. Construction of the decision-making model

As planned, in the Modeling procedure, the identified decision elements were grouped according to their affinity to establish clusters. Two clusters contain the generic and corporate strategies, respectively. The other two clusters represent the decision criteria and sub-criteria: key success factors and SWOT elements. At this stage, as established by the method, the experts involved, acting as evaluators, determined what influence each element has and receives in relation to the other and even on itself. In this part of the process, the information is captured and processed in the SuperDecisions® support software to build the systemic network model. The software for decision making with dependence and feedback was developed by William Adams in 1999-2003. He and his team have developed SuperDecisions® (Creative Decisions Foundation, Pittsburgh, USA).

The described clusters were entered into the software configuring the network shown in Figure 6.

So far, the methodological steps a and b exposed in the "Materials and Methods" section have been covered. Once the elements were grouped by clusters, the influences between elements of the same cluster and towards elements of the other clusters were determined. These interdependencies are supported by primary and secondary sources. Then, the correlated elements were evaluated by means of paired comparisons and the experts defined above, using Saaty's scale (2012), determined the greater importance or influence of one element with respect to another and for each matrix, the consistency coefficient CR was calculated. It resulted in a value equal to 0.01548, below the maximum permitted limit (=1), and validates the level of precision of the responses of the consulted experts. For all matrices, we followed including the comparison between clusters, the procedure proposed by Saaty (1980) for the AHP method. This step was completed by multiplying the vector of weighted clusters by the original matrix containing all the priority vectors of the items compared with each other.

4.3 Stage 3. Decision -Strategy selection

Paired comparison: Once the multi-criteria analytical model was built in step 2, according to the ANP application algorithm, a paired comparison is carried out subsequently between the related elements by determining the influences determined in section b of the methodology.

Original supermatrix: it is built with all the priority vectors product of the analysis of influences among all the elements identified for the model (step d of the methodology).

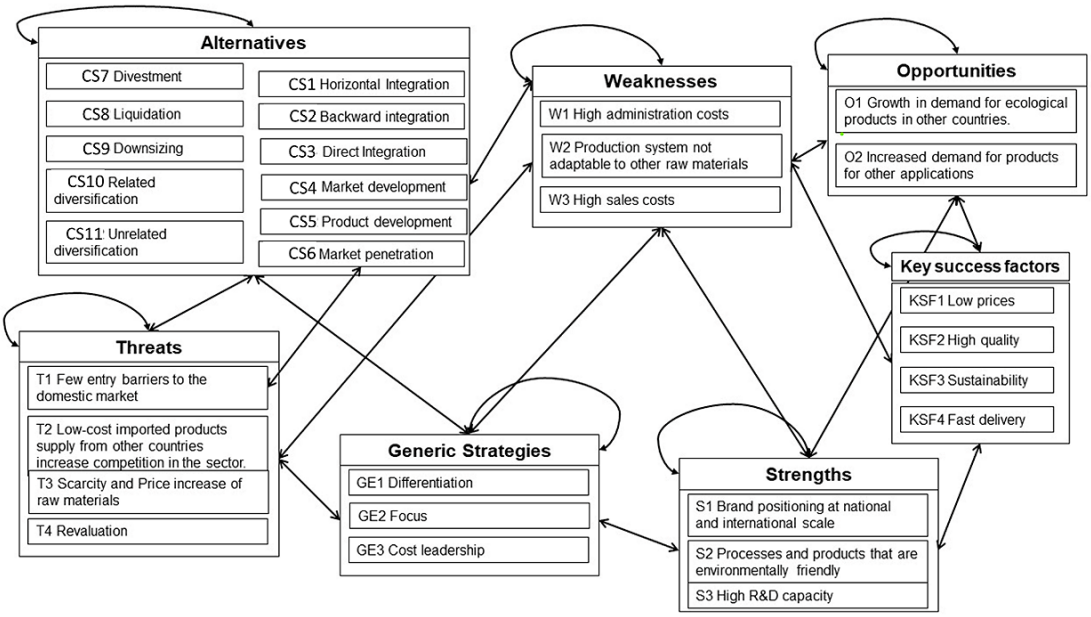

Figure 6. ANP model for selecting the best strategies for the case study. Source: Authors supported by SuperDecisions® software. Source: own elaboration.

Weighted supermatrix: When the original supermatrix is weighted with the values of the importance ranking of the identified clusters, the weighted matrix corresponding to step e of the explained methodology is obtained.

Boundary supermatrix: the weighted matrix is raised to the n-th power until all the results are stabilized to interpret the priorities of all the decision elements (stra-tegies, success factors, stakeholders, among others). The prioritization was not only applied to the generic and competitive strategies, but also for the other elements related to the decision-making process.

Prioritization of alternatives: it is the matrix whose values are stable, having been raised to the n-th power and which allows us to read which of the alternatives has the highest value in the globally calculated ranking. That is, the alternative to choose is the one with the greatest importance among its set of alternatives and among all the elements of the decision model.

5. Interpretation of results and discussion

According to the normalized values of the "Generic Strategies" cluster in the limit matrix provided by the software, their prioritization was obtained, as shown in Figure 7. The cost leadership strategy obtained the highest value (0.539734), followed by the differentiation strategy (0.268087), and the focus strategy (0.192179).

The competitive strategy currently pursued by the production unit is differentiation and aims at developing products that leave a higher profit margin; however, the results of this study suggest that the pursued strategy is cost leadership. This strategy is strongly influenced by the threats defined in the SWOT (Figure 8) and is largely related to the KSF "Low prices" (Figure 9).

Another result was the prioritization of corporate strategies by families or types presented in Figure 10. It indicates that the organization's situation forces it to formulate intensive strategies with the intention of gaining market share.

Within the intensive strategies, the market penetration strategy is the highest priority (0.162361) within the comprehensive analysis, followed by the product development strategy (0.1452), as shown in Table 5.

The integration strategies ranked second (0.283975), and the backward integration strategy ranked third with respect to the total number of alternatives (0.144910), as shown in Table 5.

Moreover, the results provided by the software allowed us to include an analysis of key influences related to corporate strategies. The influences between the SWOT matrix and the corporate strategies are of special interest because they are a key aspect in the formulation of the strategies. For instance, according to the weighted matrix, the market penetration strategy is strongly influenced by the opportunity (O1) Growth in demand for ecological products in other countries, and by the threat (T2) Low-cost imported product supply from other countries increase competition in the sector. Therefore, the penetration strategy that takes advantage of the opportunity (O1) and reduces the impact of the threat (T2) should be selected. The suggested generic strategy for this corporate strategy is obtained from the original matrix, as shown in Figure 11. It is cost leadership, which had the highest value (0.4579), followed by differentiation (0.4161). Likewise, with respect to the product development strategy, there is a strong influence from (S3) High R&D capacity and (O2) Increased demand for products for other applications. The corresponding generic strategy is cost leadership (0.5213).

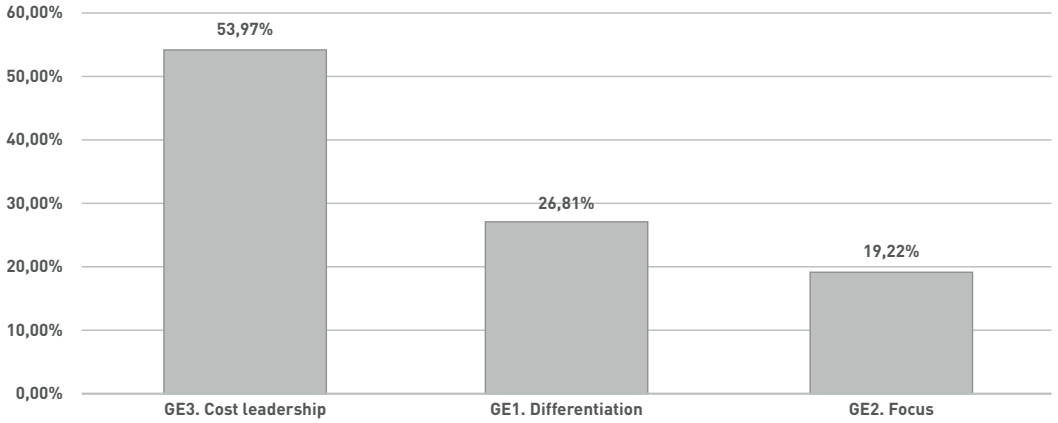

Figure 7. Prioritization of generic strategies.
Source: own elaboration.

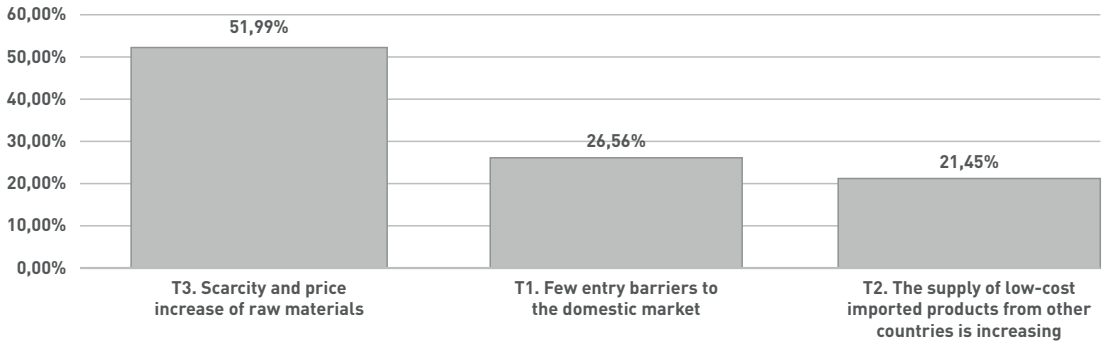

Figure 8. Influence of threats cluster on cost leadership strategy.
Source: own elaboration.

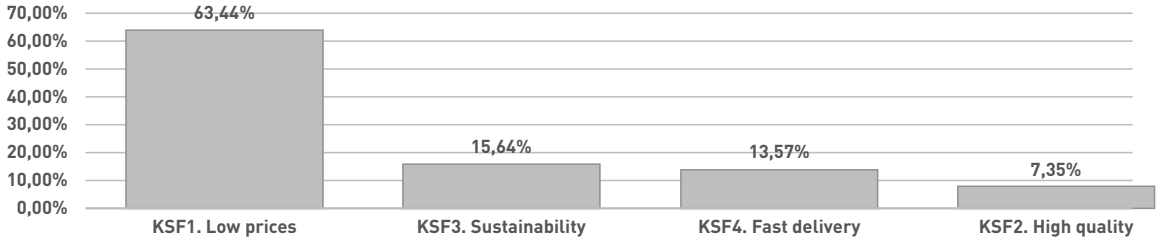

Figure 9. Influence of the KSF cluster on cost leadership strategy.
Source: own elaboration.

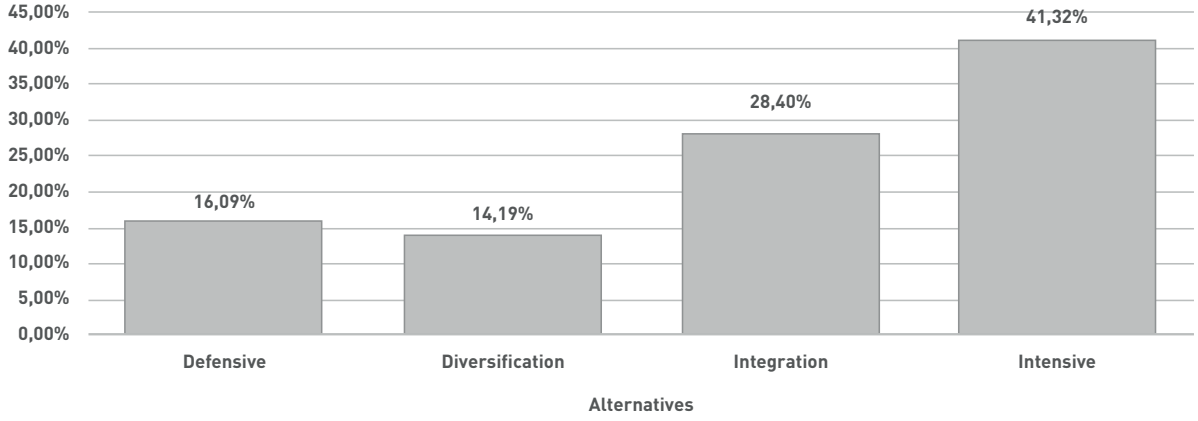

Figure 10. Prioritization of corporate strategies by family or type.
Source: own elaboration.

Table 5. Prioritization of corporate strategies

Family of strategies	Corporate strategies	Weighting (Normalized)	Weighting by Family
Defensive	Disinvestment	4.05%	16.09%
	Liquidation	2.00%	
	Downsizing	10.03%	
Diversification	Related	7.04%	14.19%
	Unrelated	7.15%	
Integration	Horizontal	9.17%	28.40%
	Backward	14.49%	
	Direct	4.73%	
Intensive	Market development	10.57%	41.32%
	Product development	14.52%	
	Market penetration	16.24%	

Source: own elaboration.

Based on these results, the case study organization chose to intensify its participation in the international market through market penetration strategies, product development, and diversification related to the organic product line.

Figure 12 shows the resulting prioritization of the key success factors.

Although all the KSFs are of great relevance to achieve success in the industry, organizations define the priorities of the KSFs with respect to the focus in which they want to stand out. In this case, the factors "Low prices" and "sustainability" obtained the highest weights; therefore, the competitive and corporate strategies should be selected and formulated without affecting the priority with respect to them.

When analyzing the influences of the KSFs and using as a source the Weighted Matrix (the intermediate result of the model), it is evident that both the KSF "Low prices" in Figure 13, and "Sustainability" in Figure 14 are strongly influenced by the generic strategy of cost leadership, this validates that the production unit should follow this competitive strategy to support the intensive strategies. Furthermore, in this type of industry, the demand has been elastic with the consumption of the products, not because of the availability of substitutes—in fact, they were not identified—but because of the large market supply, the variety of presentations, quality, and prices.

MANAGEMENT STRATEGIES											
		CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11
ALTERNATIVES	CS1	0	0,5857	0	0	0	0,25	0	0	0	0	0
	CS2	0	0	0	0	0	0	0	0	0	0	0
	CS3	1	0,4142	0	0	0	0,75	0	0	0	0	0
	CS4	0	0	0	0	0	0	0,71	0,179	0	0,75	0
	CS5	0	0	0	0	0	0	0,289	0	0	0,25	0
	CS6	0	0	0	1	0	0	0	0	1	0	1
	CS7	0	0	0	0	0	0	0	0	0	0	0
	CS8	0	0	0	0	0	0	0	0	0	0	0
	CS9	0	0	0	0	0	0	0	0	0	0	0
	CS10	0	0	0	0	0	0	0	0	0	0	0
	CS11	0	0	0	0	0	0	0	0,820	0	0	0
THREATS	T1	0	0	0	0,71	0,477	0,775	0,261	1	0,759	0,248	0,205
	T2	0	0	0	0,289	0	0,224	0	0	0,24	0,243	0,794
	T3	0,84	1	1	0	0,522	0	0,738	0	0	0,507	0
	T4	0,15	0	0	0	0	0	0	0	0	0	0
WEAKNESSES	W1	0,31	0,1095	0,4537	0,289	0	0,423	0	1	0	0	0,25
	W2	0,31	0,5328	0,1499	0	0,833	0,387	0,817	0	1	0,414	0
	W3	0,37	0,3576	0,3963	0,710	0,166	0,189	0,182	0	0	0,585	0,75
GENERIC STRATEGIES	GE1	0	0	0	0,502	0,500	0,369	0,140	0,407	0,443	0,293	0,416
	GE2	0	0	0	0,201	0,170	0,128	0,111	0,169	0,190	0,185	0,126
	GE3	1	0	1	0,296	0,328	0,501	0,748	0,422	0,365	0,521	0,457
KSF	KSF1	1	0	0,7387	0,320	0	0,285	0,368	0,324	0,238	0,287	0,404
	KSF2	0	0	0	0,224	0	0,120	0,116	0,102	0,268	0,338	0,136

Figure 11. Original matrix.
Source: own elaboration.

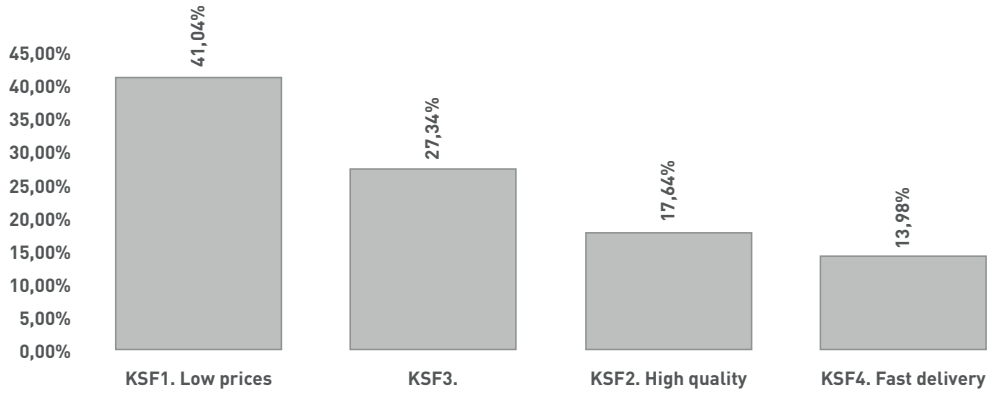

Figure 12. Prioritization of key success factors.
Source: own elaboration.

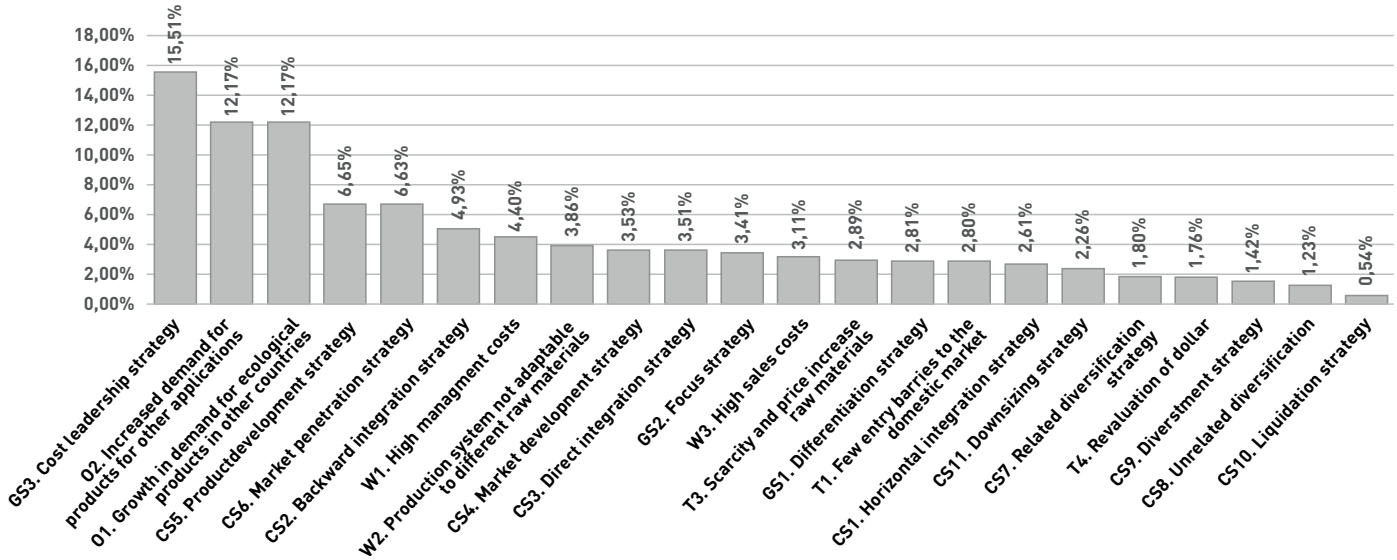

Figure 13. Influence on KSF low prices.
Source: own elaboration.

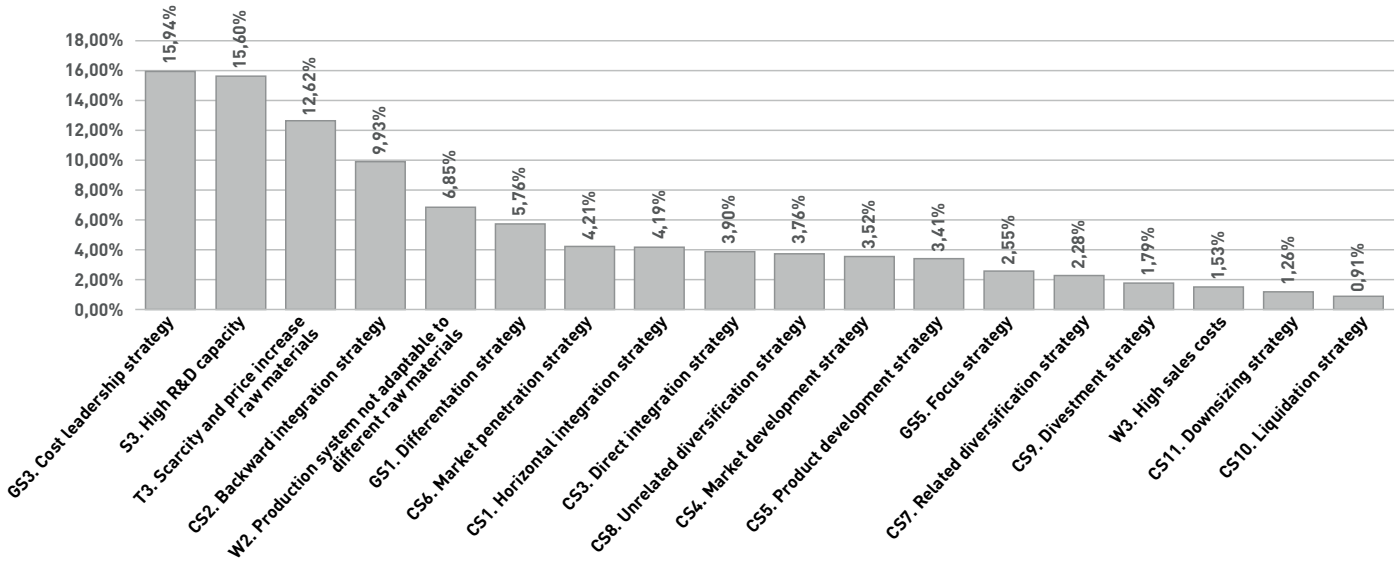

Figure 14. Influence on KSF sustainability.
Source: own elaboration.

6. Conclusions

The proposed methodology makes it possible to delimit the universe of strategic alternatives and, therefore, to focus the analyses and facilitate strategic decision-making for any type of organization.

The implementation of the analytical network process enabled a better use of the SWOT matrix by considering the interrelationships between strategic factors, expanding the decision framework, and ensuring the evaluation of all possible alternatives.

Integrating the two levels of strategies dealt with in strategic planning, corporate and competitive, allows the case study organization to focus on the strategic direction, i.e., how to compete, where to compete, and with what competitive advantage it is going to achieve the key success factors of the industry in which it competes.

The multi-criteria decision tool made it possible to prioritize alternatives from a systemic approach by considering the relationships between all the elements integrated into the methodological proposal. The most important contribution of this work is the study of the interrelationships between the two major types of strategies, generic and corporate, with the key success factors and the SWOT.

The field of study in which this work was developed gets wider research opportunities as markets become more complex. Considering the creation of more robust tools, easy to interpret by managers, is one of the aspects that still need to be analyzed and deepened. The methodology proposed here has an integral condition for the exercise of decision-making, where the strategy, key success factors, and business decisions were analyzed jointly.

Integrating simulation techniques and scenario analysis in highly competitive systems or industries is also an aspect of research because the SWOT analysis is a static evaluation in time, even if it is visualized in the future. When circumstances, capabilities, threats, and strategies change, it is possible that the dynamics of a competitive environment may not be evident in a single matrix.

Conflict of interest

The authors declare no conflict of interest.

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