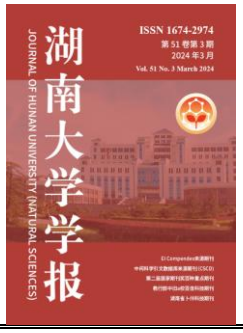

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Decision Framework for Strategic Deployment of a Supply Chain

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Abstract: A supply chain strategic decision-making framework is developed by characterizing this particular type of decision, determining its constraints and criteria, and establishing the relationship it holds with them. To develop the SC strategic decision framework, a literature review was conducted on existing characterization methodologies that had been identified. The decision-making framework outlined in this study consists of the following key components: strategic decision-making, identification of influencing factors, establishment of criteria, and the interplay between strategic decisions, criteria, and determining factors. This study establishes a context that facilitates obtaining inputs for multi-criteria decision techniques, which significantly facilitates the work of strategic decision-makers. The novelty of this work is that it develops a strategic decision structure that links the criteria, variables, and theoretical and methodological frameworks in which the decision is epistemologically supported.

Keywords: decision framework, strategic decisions, supply chain.

供应链战略部署的决策框架

摘要：供应链战略决策框架是通过描述这种特定类型的决策、确定其约束和标准并建立其与它们之间的关系来开发的。为了制定SC战略决策框架，对已确定的现有表征方法进行了文献综述。本研究概述的决策框架由以下关键组成部分组成：战略决策、影响因素的识别、标准的建立以及战略决策、标准和决定因素之间的相互作用。这项研究建立了一个有助于获取多标准决策技术输入的背景，这极大地促进了战略决策者的工作。这项工作的新颖之处在于它开发了一种战略决策结构，该结构将标准、变量以及理论和方法论框架联系起来，在该结构中决策得到了认识论的支持。

关键词：决策框架、战略决策、供应链。

1. Introduction

Mentzer et al. [1] define supply chain (SC) management as the systematic and strategic coordination of traditional business functions that allow the operation of the tactical functions of a company. This is performed in collaboration with other organizations participating in the chain, always aiming to improve the performance of individual businesses and the SC as a whole in the long term. SC comprises activities associated with information flow and the transformation of goods, from raw material extraction to provision to the final user [2]. SC operations require administrative processes that cover the functional areas of individual organizations and link their customers and commercial allies through the limits of the organization [3].

The management of these systems implies collaboration among organizations that look forward to a common strategic positioning, in such a way that each represents a particular strategic decision. The latter is the decision level of the chain that conveys the most impact and economic risk [4] and the strongest influence on its decision tree [5].

In this respect, [5] developed a taxonomy of SC decisions and relationships, both at the strategic and tactical-operational levels. They identified five strategic decisions framed in a two-level hierarchical structure. Decision-makers (DMs) must face the challenge of correctly managing the organization, for which they must gain a full understanding of the local, national, and global contexts in which it operates. Superior business performance requires a superior SC that results from comprehensive management supported by an integral and articulated vision.

SC characterization is a basic step in the decision-making process because it provides the necessary general context, not only for the market but also for the logistic links and stages involved. The current literature review has shown a tacit deficiency of research works addressing a direct relationship between SC characterization and decision-making. Despite the existence of studies that partially deal with strategic decisions, they differ in the way they approach strategic planning. In sum, it is necessary to develop a comprehensive approach to this topic that covers the strategic decisions of the SC. In response to this need, the present work developed a SC decision framework that can be applied to any SC.

According to [6], characterizing an object means providing an organized description. This task, which may correspond to the first stage of a process intended for the systematization of experiences, departs from a documented investigation of the past and present of a phenomenon. Because of its descriptive nature, it should be free of any interpretation as far as possible.

To develop the SC strategic decision framework, a literature review was conducted on existing characterization methodologies that had been identified and embedded in the decision structure developed by [5]. The decision framework identifies the criteria and alternatives for each decision so that DMs have an organized and sufficient context to fulfill their task.

2. State of the Art

The literature review identifies and describes different existing SC characterization methodologies, which provide the basis for the development of the current decision framework.

Table 1 Summary of SC characterization (The authors)

References	Description
[7-12]	*Research objective:* These works introduce variations on a basic methodology priorly developed by [7]. Their objective consists of describing and characterizing the functionality, connections, and synergy of the agents involved in the value and supply chains, both at the local and international levels. It corresponds to a network strategy characterization approach. *Decision framework characteristics:* usage of the basic function analysis decision framework. Used as a special theoretical reference, the decision framework of [13] and [14] comprises four steps: Step 1 – describing the global agribusiness; Step 2 – identifying the role, impact, and relevance of SC actors; Step 3 – describing the SC management processes; Step 4 – defining the management components that make up the SC. *Study objects:* coffee SC; health sector; oil palm; cocoa; potato; beef
[8]	*Research objective:* introducing a reference framework that allows characterizing the governance forms under which SCs are structured. This is done from diverse disciplines such as economics, strategy, organizational theory, and marketing. It corresponds to a strategic, organizational, and governance approach. *Decision framework characteristics:* design of a four-dimensional analysis model to characterize exchanges along the SC: forms of interaction and coordination, legal contracts, and economic incentive type. *Study object:* pharmaceutical sector
[15]	*Decision framework characteristics:* design of a four-dimensional analysis model to characterize exchanges along the SC: forms of interaction and coordination, legal contracts, and type of economic incentive. Regarding strategic characterization, it focuses on network spatial deployment design. Its configuration comprises: - The levels of planning of the aggregate demand and its sources of information; - The location of the supply sources of products and raw materials; - The location of production plants and their production methods; - The distribution channels and the deployment of inventories and products; - The location and return methods. *Study object:* not applicable. It is a theoretical study that can be applied to any sector.
[16-18]	*Research objective:* A SCM conceptual structure is introduced, holistically covering strategic and tactical aspects

	(especially the latter) and paying special attention to SC network functions. It does not specifically address characterization issues, except for those related to the SC network. *Decision framework characteristics:* Regarding characterization specifics, this work focuses on a description of methods for mapping the supply chain network structure and identifying the supply chain agents with whom key business processes should be linked. *Study object:* not applicable. It is a theoretical study that can be applied to any sector.
[19]	*Research objective:* describing and characterizing the functionality, connections, and synergy of the agents involved in the value and supply chains, both at the local and international levels. It is a network strategy characterization approach. The decision framework proposed by [10] for strategy and value description is applied. Parts of the decision framework of [17, 18, 20] are incorporated to characterize distribution channels. *Study object:* Ruta de la Carne Association ("meat route" association, which is a meat producer's organization to promote the consumption of their product).

The decision framework developed by [7] has a strategic focus, especially on network decisions. It seeks to contextualize SC within global and domestic markets, physical network structure, and the identification of agents and their roles and system of relationships. The work of [8] focuses on the organization of the SC to determine its governance and degree of vertical integration and outsourcing. This type of development can be applied to case studies ranging from the national to regional levels. Stephens [21] focuses on the characterization of SC processes, and [17], [18], [20] characterize the physical network of the SC. In summary, the literature review shows that none of the consulted methodological structures is directly focused on decision-making, nor does it address all strategic decisions identified by [5]. This study proposes a decision framework to support SC strategic decisions.

3. Methodology

The methodology for the development of the current decision framework consisted of identifying, through a rigorous review, existing characterization methodologies in the literature, among which [5] certainly stands out.

The SC decision framework comprises all relevant aspects supporting strategic decisions.

The decision structure proposed in this study comprises the following steps:

The developed decision framework significantly facilitates the application of a decision-making technique, the input of which would be identified alternatives, criteria, and associated information.

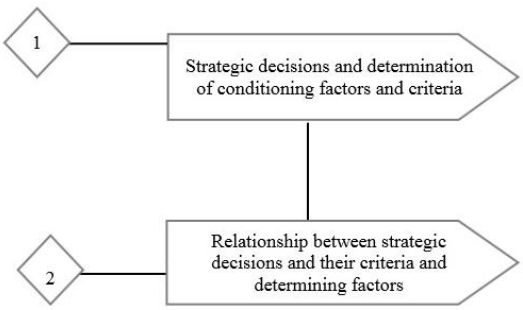

Fig. 1 Decision framework (The authors)

4. Decision Framework

4.1. Identification of SC Strategic Decisions and Their Conditioning Factors and Criteria

Strategic decisions are the most important ones in terms of economic and operational impact over time and concern the highest levels of organizational hierarchy. The decision framework developed in this work facilitates strategic decision-making [5]. The decision structure proposed in this study comprises the following steps:

1. *Strategic decisions and determination of their conditioning factors and criteria:* The criteria and conditions that must be considered to make a particular decision are determined. For this purpose, a review of the literature is conducted. In addition, the conceptual frameworks that support the relevance of the criteria for the decision in question are identified.

2. *Relationship between strategic decisions and their criteria and determining factors:* The conceptual frameworks, if any, are used to identify the relationship between the decision alternatives and criteria. This stage corresponds to the actual development of the decision framework of the SC and constitutes the central value of the paper, which seeks to facilitate the strategic decision-making process of the SC.

The ways in which they have been studied are quite dissimilar, ranging from solid economic theories widely supported by facts to references that show factual evidence but lack rigorous theoretical frameworks. Table 2 presents a thorough literature review that identifies strategic alternatives and corresponding criteria.

Table 2 Strategic decisions and determination of the associated criteria and conditioning factors (The authors)

Decision Category	Decision	Criteria
1. Strategic planning level	1.1. Performance	Riopel et al. [5] suggest that the decision-making conditioning factors are:

	objectives	- Organizational mission and strategies; - Customer expectations; - Competitive environment; - Financial resource availability; - Logistic system (both physical and information and communications systems).
	1.2. Degree of vertical integration and outsourcing	Coase [22] and Williamson [23], [24] suggest that the transaction cost theory explains this determination, whose decision criteria or conditioning factors include the following: - Specificity of the key human or material assets dominating the commercial relationship; - Agent performance measuring difficulties among SC actors; - Uncertainty in the relationship between agents.
	1.3. Outsourcing	According to [25-32], the most relevant criteria regarding outsourcing, onshore, nearshore, and offshore decisions are as follows: - Intellectual property rights; - Political stability; - Economic stability; - Cultural affinity; - Geopolitical reasons; - Domestic or regional demand in the area of influence of the organization; - Logistics, communications, and power infrastructure; - Labor availability, quality, and cost.
2. Strategic network level	2.1. Physical facility (PF)	Regarding the logistics network, once the decision to outsource has been determined, [4] and [33] suggest that the conditions are determined by its geographic scope (regional, national, multinational, or global), with the decision-making criteria being as follows: - Production costs related to scale economies; - Location costs, which depend on the specific area or sector where the facility has been built; - Assignation costs, which are related to supply provisioning and distribution costs as they are needed for customer demand satisfaction and facility building processes.
	2.2. Communication and information (C&I) network	The communication and information network and the decisions that affect it are expected to generate and maintain an information-sharing system in all the SC [34-41, 43, 56]. Its design depends upon a network strategy that is capable of addressing its structure and organization. In this regard, the most important decisions are as follows: - Information management and processing centralization degree. An example of the latter is the contrast between centralized and distributed data. - Development of an adequate locus for applications, which may correspond to rental, purchase, or the "centralized in-house" and "distributed in-house" modes, among others). - Level of integration of the different systems of an organization. In this regard, it is important to consider both ERP (Enterprise Resource Planning) systems and e-commerce. - Development environment, hardware, software, operative system, and vendor standardization.

Decisions 1.1-2.2, which certainly impact tactical decisions [5], are hierarchically nested in decreasing order according to the list. On the other hand, the only theory-based strategic planning processes found in the literature are those supported by the theory of transaction costs, which comes from economics. All other decision-making processes were based on SCM.

4.2. Strategic Decision-Making Framework for the SC

To deepen the decision framework proposed in this work, the relationship between the alternatives and the criteria of the five strategic decisions introduced in Frame 2 is presented. This methodological step identifies the decision alternatives and determines how the facts described by the criteria influence the choice of a specific alternative. In this way, a decision-maker can easily identify the framework's recommendations in a specific decision context. The decision framework developed here is presented in Table 3.

Table 3 Decision framework (The authors)

Decision 1.1. Performance objectives	
Criterion	**Alternative decisions**
Organizational mission and strategies	The mission of an organization is closely related to its business name. In theory, it can address infinite possibilities of business action that are restricted only by the physical, technological, and financial capacities of the institutions, leaving aside legal viability. Dermol and Širca [44] state that the corporate mission provides the fundamental

	strategic market positioning guidelines.
Customer expectations	The fundamental objectives of the SC are: - Assessing both customer service performance and the metrics employed for such purpose. Regarding the latter, it is important to stress how they should be used, to weigh and give traceability to their performance. - Determining the customer service level: Once a company's customer service policy has been defined, the key question is to determine its most important supply chain management (SCM) components. Therefore, it is essential to determine the level of customer service, which is assessed as a percentage of compliance. In this regard, the parameter is usually set by competitor benchmarking [45]. - SC metrics: The metrics established for the SC seek to determine central aspects of its performance [46] effectively. Some of the most important ones are as follows: - Cash cycle time; - Customer order cycle time; - SC cycle time; - Average payment time for manufacturing materials; - Percentage of lost sales; - Timely delivery rate. These indicators are susceptible to factors such as economic objectives, level of customer service, type of products and services, and geographical scope of production and distribution. Some of these are detailed below: *Economic objectives:* Being the main goals of an organization, they depend on its capacity to gain customers and develop periodic innovations, and on the efficient use of available resources (income growth and cost reduction) [47]. *Type of products or services:* An organization's mission may focus on either flexibility or cost. If flexibility is prioritized, the productive capacity should be greater than the demand so that the good or service is available at any time the client requests it. On the other hand, if cost is prioritized, the productive capacity will be equal to or less than the demand, focusing on the benefit of economies of scale (i.e., it will seek to be efficient to make the unit cost as low as possible [48]. The fact that one or the other is adopted is due to the product type: Those with low-profit margins require an efficient SC; otherwise, they will require a robust or redundant SC (both in logistical and contractual terms) that can contract or expand its operation quickly enough to take advantage of the success or mitigate the commercial failure of the product. *The geographic scope of production and distribution:* This has to do with the outsourcing strategy, which will be presented below in this same frame.
Competitive environment	The more competitive the market, the greater the risk incurred by the business, which implies better SC performance and more innovation to effectively satisfy the customer. In summary, competition makes it necessary to add value to the product or service in all aspects: form, time, place, and possession [2], framed in a business sustainability context and based on the development of competencies that confer corporate competitive advantages over time.
Financial resource availability	The greater the availability of financial resources, the greater the possibility of leveraging investments, developing innovation, and using new technologies that make it possible to achieve the objectives of the organization [49]. Likewise, the greater the availability of resources from banking and development entities, the lower the financial cost.
Logistics system (both physical and information and communications systems)	Provided that logistics affects both mode and place values, logistics becomes a key customer satisfaction factor. The logistics and communication networks cooperate to reach the final client in the right place and in the shortest time. An important contemporary aspect is last-mile logistics, which is in the full innovation phase due to the high costs generated by satisfying the customer at this step. Coordination obtained from an adequate SCM can become a key competitive advantage. Therefore, the better the performance and efficiency of the SCM, the higher its added value and effectiveness in achieving the logistic objectives of the organization. Logistics is measured through established and permanently renewed indicators for each sector in which the firm is competing in the market [50].
Decision 1.2. Degree in vertical integration and outsourcing	
Specificity of the key material or human assets that dominate the commercial relationship; agent performance measurement difficulties; uncertainty in the relationship among agents	The higher the values of the transaction cost criteria (shown on the left of this frame), the higher the transaction costs and, therefore, the greater the need to adopt hierarchical government forms, which are closer to vertical integration. At lower criterion values, closer relations with the market can be chosen, corresponding to a less integrated governance alternative. At intermediate levels, there is a tendency to make decisions related to alliances (networks) such as joint ventures or strategic alliances [22-24].
Scale economies	The lower the operational cost, the larger scale economies can be reached and the more hierarchical governance modes will be chosen [22-24].
Decision 1.3. Outsourcing	
Criterion	**Outsourcing decision alternatives**

Continuation of Table 3

	Offshore	**Nearshore and Onshore**
Factory location distance	Longer distance to the country of origin	Shorter distance to the destination country
Respect for intellectual property rights	High to medium, implying greater espionage risk	Low, implying lesser espionage risk
Governmental policy	Political stability varies from high in developed countries to low in developing countries.	
Cultural affinity	Typically, there is less cultural affinity with the country of origin.	Typically, there is more cultural affinity.
Language ability	Less affinity can be typically observed with the country of origin.	The same language of the headquarters is typically used.
Note: The typical use of the English language for commerce is taken as a reference. However, this varies according to each pair of countries across which economic exchange is established.		
Logistics, communications, and energy infrastructure	Elevated power and communications are common.	Power and communication costs are usually lower.
Note: This is changeable depending on each pair of countries involved in economic exchange. These factors, which are susceptible to natural phenomena and infrastructure availability, are also dependent on external fossil fuels.		
Labor availability, quality, and cost	Usually cheaper. This outsourcing alternative is generally implemented in countries with high labor availability.	Usually more expensive
Operative control	Operative control intensity reaches medium levels.	Managerial and operative control intensity reaches high levels.
Production costs	Low production costs and high logistic costs	Intermediate production costs and low logistic costs
Timely delivery rates	Medium to high. Due to the distance, lead times and inventory cycles are longer and, therefore, more susceptible to logistic breakage.	It was low, resulting from proximity between countries.
Physical Facility (PF)		
Production, location, and assignation costs	The design of the logistic network depends on the selected logistic strategy: Flexibility or cost efficiency. If flexibility is sought, production centers need to be located close to customers and suppliers. If cost efficiency is sought, facilities should be fewer in number but have greater capacity [51]. In summary, greater flexibility means higher location and allocation costs, but lower opportunity costs, greater profit opportunities, and lower operational risks [52, 53].	
Communication and Information (C&I) Network		
The extent to which information management and processing is centralized, as opposed to being distributed; application development locus, which can be rental, purchase, centralized in-house, or distributed in-house; level of integration of different systems of an organization. In this regard, it is important to consider both ERP (enterprise resource planning) systems and e-commerce.	The current physical facility (PF) network design proposal determines the general organization and structure of the network (hierarchical level, number of steps, and degree of centralization/decentralization, among other aspects). The design is subordinated to previous decisions: customer service objectives, degree of vertical integration and outsourcing (at the strategic planning level), and market information: suppliers, customers, and potential markets [52]. Once the strategy of the physical facility network is determined, the design must be carried out. Several key decisions concerning facilities are as follows: the type and number of facilities (e.g., warehouses, terminals, and distribution centers); the capacity, specialization, and location of each facility; the activities and services provided by each facility, the use of new or existing facilities, and the logistic connections between facilities [54]. They are interdependent decisions that cannot be made in isolation. A variety of information such as the existing logistics system, the competitive environment, resource availability and limitations, available capacities of production and logistics machinery, availability of labor and support services, availability of sites and transportation, government incentives, community attitudes, environmental and zoning regulations, and public services and taxes supports them.	
Development environment, hardware, software, operative system, and vendor standardization	Centralization allows more control of information, whereas decentralization facilitates the distribution of tasks and multiplies the effectiveness of management functions [55]. In this regard, companies with global reach require strategic alliances to develop information and communication systems, establish the necessary data segregation and aggregation deployment for SCM, and effectively manage data preparation, collection, preservation, and privacy, decision analysis	

support, and information security.
C&I networks depend on several factors and associated decisions, among which are network architecture and capacities, IT coverage, vendor selection, software, and hardware [5]. According to [5], network architecture is related to data management and information flow between nodes and functional groups. Its coverage affects manual paperwork, digital file management, relational databases, and blockchain technology. These decisions are influenced by the previous C&I network structure, among other factors.
The technological tool that has been gaining momentum is blockchain, which seeks not only to integrate key product information and financial flow management data but also to address the client more effectively and assure the traceability of transactions, all of which depend on organization size [42]. A typical case is that of BMW and DHL, which is a key partnership due to the high costs of technology that firms must afford.
In summary, the larger the size, complexity, and scope of the operation of an organization, the more integrated, secure, and complex systems will need to be chosen, ranging from the most complex blockchain type to simpler ERP levels or lighter tailor-made systems. In addition, highly complex operations lead to strategic alliances with higher-level logistic operators (from 5PL to 1PL).

SC corporate management is in charge of strategic decisions that focus on the achievement of high institutional goals and are the guidelines of the organization. The decision framework presented in Frame 3 is intended to facilitate the work of the DMs. As can be observed, SC strategic management continues to move toward its paradigmatic support, which is integration and coordination between agents and customer satisfaction. These guidelines are being currently framed in the new technological leap of Industries 4.0 and 5.0, which have focused on AI.

5. Conclusions

This article presents a decision framework for the strategic deployment of a supply chain. It provides three important results that embody a quick guide of use: 1. strategic decisions and determination of their criteria and conditioning factors; 2. relationship between strategic decisions and their criteria and conditioning factors; 3. an SC strategic decision framework. The usefulness of the framework consists in offering the DMs a holistic vision of the SC, which is important to support SCM.

The research perspectives focus on including tactical and operational decisions on the SC in the decision framework.

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