

## **SUPPLIER SELECTION USING AHP AND TOPSIS IN FOOD COMPANIES CONSIDERING OPERATIONAL RISK**

### **ABSTRACT**

Supplier selection is one of the essential activities in the current supply chain management. Due to the supplier has a fundamental role in the chain, we notice the importance of a suitable selection process. It is clear that provider selection is a multi-criteria decision-making problem, and therefore appropriate tools are required to perform this process. Additionally, suppliers tend to influence the supply chain risks, so the requirement to include potential risks in the selection criteria of these suppliers becomes apparent. This work proposes using the Analytic Hierarchy Process (AHP) combining with Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) for supplier selection of a Colombian company in the food sector. In addition to the traditional criteria considered in a supplier selection process, this proposal includes some operational risks among these criteria. We use AHP to define the weight of the criteria and TOPSIS to select the supplier. Keywords: supplier selection, operational risk, AHP, TOPSIS, multicriteria decision making.

### **1. Introduction**

The problem of supplier selection within supply chain management is one of the most difficult decisions faced by organizations seeking to be successful and competitive in the market. That is why have the right suppliers guarantees high-quality goods and services, products with high harmlessness standards, a higher speed of response to variations in demand, proper time management, cost reduction, higher productivity, among others. In organizations, supplier selection today is a challenge for the purchasing area by having a wide variety of alternatives, criteria and risk factors to consider in the decision-making process according to the needs of the organization.

The key to supplier selection lies in knowing the criteria to use to select them; that is why various mathematical tools have been developed that evaluate both quantitative and qualitative criteria guaranteeing the best selection of them. Among these criteria are the three most common and traditional factors used by organizations: price, quality, and delivery time. However, it should be noted that it is ideal not to set aside essential factors such as legal, economic, and political conditions. We also claim that public relations, reputation, company infrastructure, inventory management, customer service, after-sales service, technical assistance, and administration must be taken into account.

The problem of supplier selection should consider the criteria mentioned above and the different risk factors that may arise in the supply chain. Risk is defined as the probability or frequency of an event that negatively impacts normal supply chain performance. These could be due to human-made actions or natural events (Ravindran, 2010). There are multiple factors to consider in the supplier's selection problem. In addition to the criteria, it is also important to remember that several risks can unbalance the acquisition process. Some are uncontrollable, such as so-called disruption risks that occur due to external factors such as natural disasters, social manifestations, terrorist attacks, among others. Other risks such as operational risks are prone to be controlled, and it is necessary to have

an action plan that allows them to be mitigated. Operational risks are the most likely to occur, and that is why they should be taken into account when performing the supplier selection process.

Within the supplier selection process, the operational risks associated with the different alternatives should be considered, since their impact on the supply chain. These risks generate direct and indirect costs, quality problems, delivery time problems, and other potential situations that deteriorate the organization's status and contribute to the loss of its customers and even the bankruptcy of it (Escandón, Parra and Osorio, 2019).

The objective is to establish a multi-criteria proposal to select suppliers considering the operational risk among the selection criteria. In addition, provide the organization with a tool that allows it to apply this process at any time, so that supply chain management is improved from a good selection of its raw material suppliers.

## **2. Literature Review**

There are a large number of papers use multicriteria techniques for supplier selection, and recently some have appeared that consider risk within the selection criteria. In the literature review process, we considered the following works: (Nekooie, Sheikhalishahi, & Hosnavi, 2015), (Patra & Mondal, 2015), (Hosseininasab & Ahmadi, 2015), (Osorio, Garcia, Manotas, 2018) y (Alikhani et al., 2019).

## **3. Research Design/Methodology**

The proposed methodology presents a combination of AHP and TOPSIS. The AHP defines the weight of the criteria that will be considered for the decision-making process. To make the final selection, we use TOPSIS by designing evaluation scales for each of the criteria. There are two moments in this methodology. At the first moment, we applied the AHP. The results obtained have a medium and long-term horizon since the criteria and weights are defined for any selection process and are maintained as long as there are no structural changes in the company.

Secondly, by defining evaluation scales for each of the criteria, including the operational risks to be considered, TOPSIS applies each time selecting a supplier must be addressed. In this way, we have a strategic activity applying the AHP, and a tactical-operational one applying TOPSIS to finally select the best possible provider from a list of potential suppliers, considering the criteria and risks that the organization defines as essential to its process.

## **4. Data/Model Analysis**

The supplier selection model was implemented in a Colombian origin multinational company where food supplies are produced and marketed for the bakery, gastronomy, agribusiness, and home food sectors. There was then the participation of a group of people linked to the purchasing process. By implementing the proposed methodology, it was possible to establish the best supplier for a fundamental product in the company's manufacturing process.

Additionally, a sensitivity analysis was performed against the criteria' weights to see whether or not the solution obtained could be trusted. We tackled five scenarios, and in all of them, the selected alternative was retained. However, it is important to mention that the other alternatives' order is modified with the change in the weights of the criteria according to the above analysis.

## 5. Limitations

This proposal has two fundamental limitations: firstly, the selection of the criteria and the inclusion of risks, and the weights thereof are based on the expertise of the group members. If they are not experts, the results will be less significant to the company.

The second limitation relates to the valuation scales designed for each of the criteria. These scales are associated with the knowledge and judgments of those involved. The final result of the selection depends directly on those valuations.

## 6. Conclusions

Although the proposed methodology was designed for a particular organization, the methodological scheme can be easily replicated for any other type of organization. According to the company's objective, the new criteria must be defined, and other risks considered.

It is essential to involve people with high knowledge and experience so that the methodology's results are reliable and important to the organization.

## 7. Key References

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