

# Proposal for a Management Model for SME Providers using a Multi-Criteria Model with a Fuzzy Analytical Hierarchy Process – FAHP

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## Abstract:

It is proposed through a multicriteria model with FAHP, the appropriate management of suppliers for SME companies in Colombia, in order to find the best and most appropriate, according to the needs of each particular company. The model that is sought within the ongoing investigation will serve as support in decision making when selecting methodologies that facilitate the selection of the best provider. The methodology used is descriptive, and its approach will be mixed (quantitative and qualitative), which begins with sufficient literature review, through the collection of information with a technical research instrument (survey) to identify the selection criteria that companies have SMEs and finally designing a multicriteria model proposal. The preliminary results are based on the contributions that provide an adequate bibliographic review and the validation of the criteria to be surveyed by suitable personnel, concluding with what the investigation leads that is a clear sample that the selection of any type of criterion every time it takes more strength to be at the forefront of global technology.

**Keywords:** Supplier Management; Selection; Model; Multicriteria; FAHP.

## 1. INTRODUCTION.

Supplier management is a main source in the administration of any company at a global level, being a fundamental part of the supply chain, considering that it will depend on the quality of inputs vs. the quality of outputs, as a result, it is done it is necessary that those in charge of the selection of suppliers and those who manage them have tools that facilitate this work, which have a high degree of objectivity, efficiency and useful in their use.

The ISO 9001 standard establishes with respect to the management of suppliers that: The organization must evaluate and select suppliers based on their ability to supply products and / or services in accordance with the requirements of the organization. Criteria for selection, evaluation and reevaluation must be established [1].

For this reason, in the investigation that is ongoing, in its second phase of information gathering, it is planned to design a model that allows the management of suppliers in a SME company, understanding management as the correct way to manage suppliers. This model is based on the process of diffuse hierarchical analysis (FAHP), which has proven to be very effective in multi-criteria decision-making processes in other studies.

## 2. SCIENTIFIC REVIEW.

The authors [2], who in their article expose a wide and varied state of the art in terms of supplier selection, with greater orientation towards quantitative approaches: "The first link and basis of all management, It is the provisioning function, which until the 1980s, was relegated to the purchase and inventory management operations. However, the demands of the current competitive environment have led to recognizing its importance in business strategy and it is largely accepted that the good performance of the company depends on the performance of its suppliers".

Currently, provisioning is responsible for supplier-customer relationships and ensures that the necessary equipment and resources are available for the implementation of services, within this the selection of suppliers is immersed as a process that guarantees the company to have good equipment and supplies at the right time and according to the specific needs that are required [3]; In order to make these decisions, two types of criteria must be taken into account: qualitative and quantitative, which cover all the essential aspects to consider when making the decision of who will be the most appropriate and indicated provider as expressed by the authors [4]. The tools used for the selection of suppliers that involve multicriteria decisions are different, researchers in this field have developed a varied number of case studies applying these methods both for producing companies and for service providers in different economic sectors.

In relation to the above, [5] conclude in the study that they made that of 78 articles published between 2000 and 2008, the own approaches are more used than the integrated approaches, being the Data Envelopment Analysis (DEA) the most used,

followed by mathematical programming and the AHP model. The AHP model is the hierarchical analysis process for multicriteria decision making most used as indicated in its article [6]. It is in this way that it is possible to appreciate that the AHP process is a useful, practical and systematic method for the selection of suppliers [7]. However, in practice, clear data are sometimes inadequate to design a real-life situation [8], since human judgments are vague and cannot be represented with exact numbers [9]; This is why the AHP methodology with diffuse triangular numbers is used to represent the comparison of judgments in decision making as expressed by the authors focused on a washing machine company [10]. The theory of fuzzy sets is similar to human reasoning in the use of approximate information and the uncertainty generated by decisions and offers the advantage of representing mathematically such uncertainty and vagueness, providing formalized tools to deal with the intrinsic imprecision of many problems [11].

According to the authors [12], where they expose us that “the axes of the research are related to the application of the AHP and FAHP theory, which are widely applied for the selection of the best alternative of the existing ones, depending on the selection of multiple criteria, for which linguistic labels are used, which allow ambiguities to be avoided in the experts' responses. The proposed model will serve as support in decision making when selecting methodologies.”

One of the studies that attracts attention is that which makes a proposal for a method of analysis and decision making for the implementation of barcode or RFID in the supply chain of SMEs, in this the author [13], expresses the feasibility and feasibility generated by the multicriteria process, because, in SMEs, bar codes are widely used. By reason, at their price, popularity and standardization, they are available to everyone. Its implementation allows to better manage inventories, logistics in general and points of sale wholesale and retail. The introduction of RFID (Radio Frequency Identification) technology improves the effectiveness of the operation in the supply chain in general. Therefore, a decision-making tool is required for companies to consider adopting RFID or the Bar Code in their work environments. There are many criteria to consider before making the decision to implement a tool that uses a certain technology to manage the supply chain within an SME. The document analyzes the technologies, comparing them in their advantages and disadvantages, to determine which one to adopt as a work tool, to carry out operations in the business supply chain. After that analysis, three existing statistical methods for decision making are compiled and subsequently a method, based on the Analytical Hierarchical Process (AHP), is proposed to compare and make appropriate decisions regarding the adoption of one or another technology.

Another investigation that allows us to observe the viable management provided by the tool, in relation to inventories within companies, is that of the author [14], which talks about the consensus classification derived from multicriteria methods applied to the ABC inventory analysis.

In general, these identified works show a current trend towards the consolidation of supplier management processes, it should be noted that for medium and small-sized companies providing

telecommunication services, it was void what was found evidencing in this way the relevance of this investigation. Being these, the findings closest to the need for this research in companies in the telecommunications sector, those multicriteria tools that have been studied for the selection of high impact projects and those that seek to find the utility of multicriteria decision methods (such as AHP) in an environment of increasing competitiveness in companies related to Information Technology and Communication

### 3. MODEL MAP FOR SUPPLIER MANAGEMENT IN SMEs.

Using the multicriteria decision making tool diffuse hierarchical analysis process (FAHP), it is proposed for the model to involve the four (4) stages for continuous improvement in the processes, framed in the PHVA cycle: Plan, Do, Verify and Act (Figure 1), in order to mitigate the margin of error in the appropriate and suitable selection of suppliers.

#### To plan:

The selection of suppliers.

The definition of the criteria to evaluate.

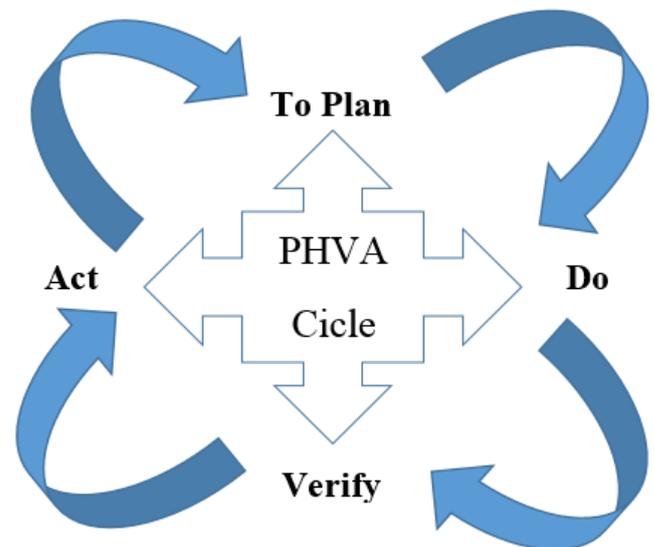


Figure 1. PHVA cycle for the selection of suppliers.

#### Do:

The evaluation of the criteria and variables of the management of the suppliers, from their selection to their consolidation as a SME supplier.

#### Check:

Monitoring compliance with the criteria and variables of the management of the suppliers.

**Act:**

Information management and provider decision making.

The PHVA cycle stages have been defined with the objective of achieving the proposed goals for the development of the management model, in terms of the selection of suppliers:

- Select the best provider when you have different alternatives.
- Have clearly defined criteria and characteristics at the time of selection.
- A diagnosis of the management system to monitor compliance with suppliers.
- Evaluate the compliance agreed upon from the beginning of the provider.
- Decide to certify a supplier or terminate negotiations depending on performance verified by the SME.

In search of analyzing the way in which SMEs carry out the selection of suppliers and based on the execution of a research project, the surveys carried out on 5 companies in the mobile cellular telecommunications sector in Bogotá are observed, quickly obtaining response on the criteria and variables taken into account when selecting suppliers.

In the surveys, the criteria are taken into account: By quality, by price of the product / service, compliance with delivery date and quantity, after-sales service and the company's own criteria, there were 12 questions of the survey that allow analyzing the results and then weighing them and to be able to systematize them to create the appropriate model for the selection of suppliers within SME companies, thus obtaining a corresponding management along the trajectory and compliance derived from the previous study that is carried out from the selection to the end of negotiation, with which the design of the model seeks to facilitate the own management that is done to the supplier.

As mentioned above, a fundamental part of the management that a supplier should receive is born from a good selection of it, and it is for this reason that the criteria that must be present when looking for them must be identified, the objective is always to seek the best or most appropriate to meet the needs of the SME with its final customers who will be those who at the end of the process will want or not to continue contributing to the business growth to whom they will finally evaluate, indicating the degree of satisfaction that exists or not for the duty fulfilled to its final clients. To prevent this situation from the negative point of view, the selection of suppliers becomes a multi-criteria decision making, where a variety of criteria should be evaluated.

**3.1. Selection criteria.**

The application of the Fuzzy Analytical Hierarchical Process (FAHP) must be based on a standard of criteria that allows the staff who decides to make the necessary comparisons by the model; As mentioned previously, a proposal for the evaluation of the criteria is presented:

- Quality criteria.

- Criteria for price of the product / service.
- Compliance criteria delivery date and quantity.
- After-sales service criteria.
- Own company criteria.

As can be seen, the model is very ductile and allows us to refer to as many criteria as deemed necessary to guarantee the decision. Likewise, the criteria can be divided into different variables or elements that help the analysis.

For the quality criterion, it is sought to evaluate if the supplier has defined the fulfillment of the characteristics of durability and / or proper functioning of the acquired good or service, it is intended to measure:

- If this criterion is taken into account within what is requested from suppliers.
- If you have a lot of equipment.
- If you have procedures to measure quality.

For the criteria for the price of the product / service, it is sought to assess whether the supplier has fair, competitive prices and according to the quality of the product and / or service, it is intended to measure:

- If the supplier has discounts, occasional expenses, among others.
- If you have deadlines, payment methods, financing, among others.

It is intended to identify how important it is for SMEs that comfortable prices are those that contain more quality in the product and / or service, if only one supplier depends on this criterion, it is sought to contemplate that it is not the most relevant when selecting a provider.

For the compliance criteria delivery date and quantity, it is sought to evaluate if the supplier has defined the manufacturing times, punctuality with the time agreed between the parties, quantity of equipment, equipment certifications, where it is intended to measure:

- If they have a database where the criteria of why they are or were suppliers are stipulated.
- If you have a method of measuring this criterion.
- If the suppliers comply with the agreement or not.

It is essential for SMEs to be clear that this criterion, like the others, is of the utmost importance and is a fundamental part of achieving successful business, satisfied customers and convinced that what is written in the contracts is met with quality and efficiency.

For the criterion of after-sales service, it is sought to identify if the response is timely by the supplier after a product and / or service has been delivered, where it is intended to measure:

- Timely response.
- Guarantee.
- After-sales compliance clauses.

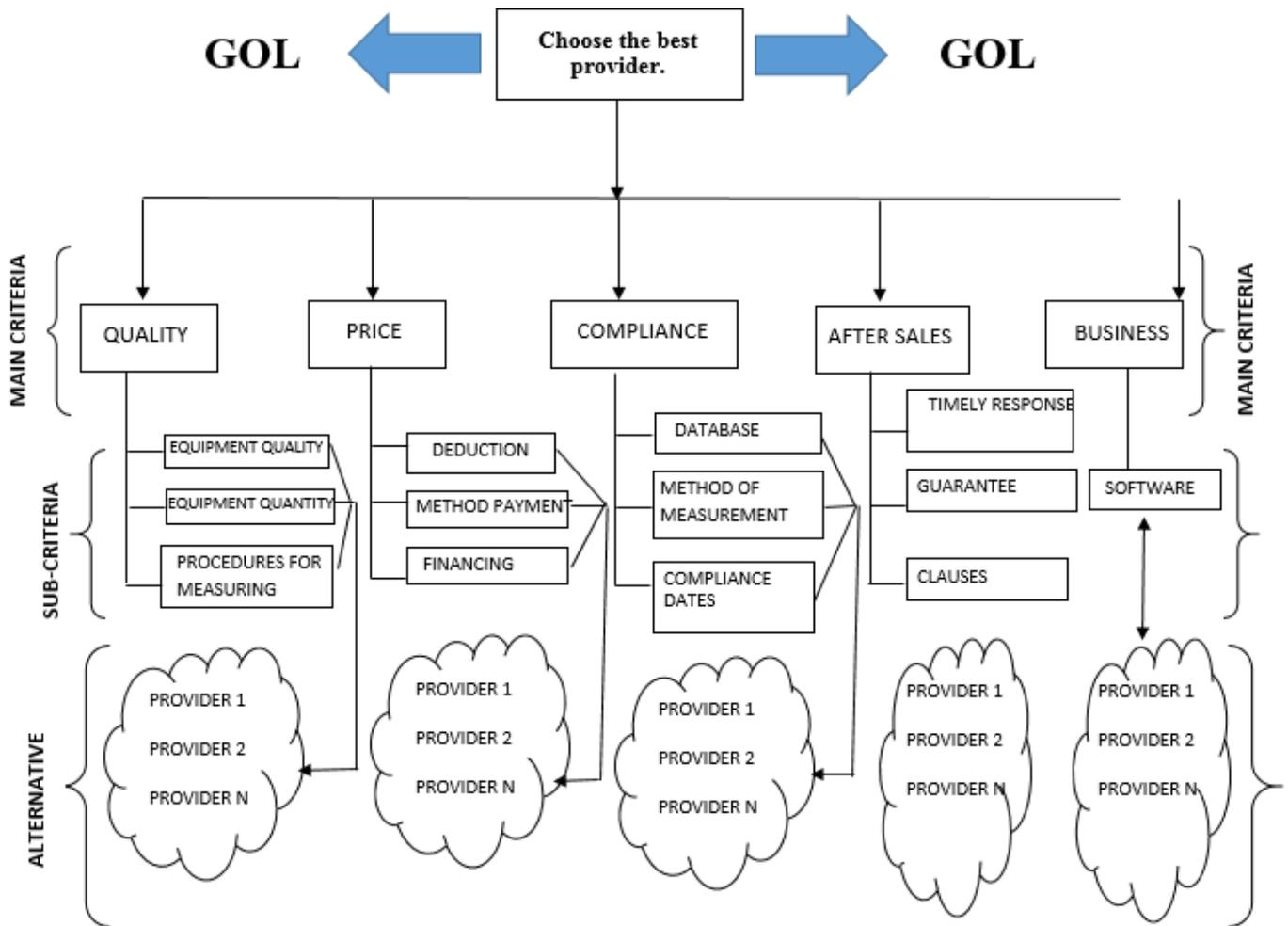


Figure 2. Model map of management in the selection of suppliers.

For the company's own criteria, it is sought to identify criteria not taken into account that perhaps the company does keep in mind and are important, where it was possible to establish that: It did not take into account the tenders that some companies consider are a fundamental wild card to mitigate failures when selecting suppliers, in addition to recognizing that most companies do not have tools that facilitate the selection and management of suppliers.

### 3.2 Process: Hierarchy - Prioritization – Selection.

After defining the criteria, the elements that make up each criterion, the next step is to be able to structurally rank a purpose, criteria and sub-criteria for selection and alternatives by which the selection map is constructed. Figure 2, identifies the map of the management model in the selection of suppliers, where there is a goal, criteria and alternatives to achieve successfully meet the proposed goal.

Starting from there, we must continue with the construction of the comparison matrices for each level of ranking, prioritization and selection that are part of the process to reach the end, to the proposed goal within the management of the suppliers, the appropriate selection and the Best of suppliers.

### 4. CONCLUSIONS.

As mentioned in the course of the article, research is still under development, so it can be evidenced in the literature that, although there are models that use the diffuse hierarchical analytical process in some sectors of the industry, this is not It has been worked from the point of view of the telecommunications sector in terms of the suppliers of cellular mobile telecommunications equipment.

In addition, it can be concluded that any activity involves, in one way or another, the evaluation of a set of alternatives in terms of a set of decision criteria, where very often these criteria are in conflict with each other. It is clear that he is influenced by his mental patterns or models, by the influence of those who are in a higher hierarchical position, also including mood and family and social relationships, which determines inconsistencies when addressing the problem. , and of course add more elements of complexity as indicated. Therefore, it is necessary to have tools to discern about the alternatives, so that the effect of the multiple criteria is considered, and the solution responds to all of them in a consolidated and not individual way. These tools include preference models, that is, tools that allow addressing the multicriteria decision problem in a systematic and scientific way, seeking to favor the process and

help the decision maker, [15] and within of these models, specific reference will be made to the Hierarchical Analysis Process and Diffuse Hierarchical Analysis Process, which is intended to propose at the end of all its phases this investigation.

Each of these results will be taken to a “Matlab” software or program where the multicriteria model will be executed using the tools of Hierarchical Analysis Process and Diffuse Hierarchical Analysis Process, where all the criteria will be taken into account and thus perform an appropriate management of the suppliers within the SME companies.

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