Supplier Evaluation and Selection: A Review of the literature since 2007

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Abstract Supplier selection is currently a subject of great importance to companies. Numerous articles have been published recently, recommending different methods and/or procedures for evaluating and selecting the suppliers with whom the purchasing company will work. The present article reviews a total of 39 articles dealing with this subject, published between 2007 and the present day, in magazines indexed by Journal Citation Reports (in ISI Web of Knowledge). They will be analyzed in order to determine: (i) procedures used in determining criteria, (ii) identification and structure of the criteria under consideration, (iii) methods used to evaluate and select the suppliers and (iv) aims in the selection of suppliers.

Keywords Supplier selection · Supplier criteria

1 Introduction

Supplier selection is one of the strategic elements in managing purchases, as the ability of a company to satisfy its clients, as well as its own continuity, depends to a large extent on its suppliers.

Purchases have a direct and important impact on profits, as the acquired products and services (purchases), have a significant influence on the cost structure of manufacturing companies, ranging from 42 to 79 %. On the other hand, there is a larger framework which defines the general policies of organizations with respect to their relationships with suppliers, some examples being the establishment of partnership deals or global supply chain management.

Supplier selection is basically determined by four decisions, which are: (1) Having the appropriate procedure for determining the criteria and establishing their structure and ranking. (2) Identifying the criteria with which the suppliers will be evaluated. (3) Selecting the most suitable suppliers from those available. (4) Obtaining a list of suppliers, the Suppliers Panel, with whom orders will be placed.

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This process involves different types of criteria (strategic, tactical, and operational) which are cohesive, as they originated in corporate strategy and are in consonance with it.

The described situation has motivated the present article, which reviews a total of 39 articles dealing with this subject, published between 2007 and the present day, in magazines indexed by Journal Citation Reports (in ISI Web of Knowledge). They all deal with the subject of supplier evaluation and selection.

This article is organized in such a way that the following section includes an analysis of the principal aspects and, finally, Sect. 3 shows the conclusions which can be drawn from this review of the latest developments.

2 Analysis of the Latest Developments (Since 2007)

The most recent theories on supplier selection are organized according to the 4 decisions mentioned in the introduction, in a way that Sect. (2.1) analyzes the procedures for determining the criteria, and Sect. (2.2) studies the criteria used for supplier selection. Sect. (2.3) describes the methods used to evaluate and select the suppliers, while Sect. (2.4) analyzes the aims of the different works on the subject of supplier selection.

2.1 Procedures for Determining Criteria

The criteria used for evaluating and selecting suppliers depend on the procedures used for determining them. In this context it can be seen that the most frequently used source is consultation with experts (19 articles, 57.5 %), either as a unique source (15 articles, 45.4 %) or reinforced by a review of the available literature (4 articles, 12.1 %). A detailed analysis shows that some articles described the methodology used, whereas others do not specify how the information was obtained. The experts may either be employees of the purchasing company or others who are familiar with the industry.

The second most used source is the review of literature; 6 (18.2 %) articles are used as a unique source as well as the previously mentioned case of 4 (12.1 %) in conjunction with the experts. Not one article describes how the review was carried out.

There is just one article [12] which describes a specific method, the QFD (Quality Function Deployment) which translates shareholders' needs into criteria for supplier selection. There are seven articles (21.21 %) that do not specify the procedure used.

2.2 Identifying the Criteria for Obtaining the Panel

The panel of suppliers is made up of those suppliers who have best satisfied the criteria of the purchasing company. These criteria can be grouped and ranked according

Table 1 Classification Family vs. Typology using distinct criteria

		Typology				
		Strategic	Operational	Tactical	Total general	
Family	Assets and infrastructure	78	10	18	106	56.4%
	Cost	7	20	4	31	16.5%
	Logistics	1	9	7	17	9.0%
	Quality	12	19	3	34	18.1%
	Total general	98	58	32	188	100%

Table 2 Classification Family vs. Typology counting all repetitions

		Typology				
		Strategic	Operational	Tactical	Total general	
Family	Assets and infrastructure	124	12	50	186	48.9%
	Cost	12	37	23	72	18.9%
	Logistics	1	13	35	49	12.9%
	Quality	21	28	24	73	19.2%
	Total general	158	90	132	380	100%

to families. Analysis of the articles shows how each author opts for different ways of structuring them, only coinciding in one case. The present study uses the families proposed by Erdem and Göçen [7], "Assets and Infrastructure, Costs, Logistics and Quality"; these authors propose an exhaustive classification obtained from reviewing the literature and interviewing experts. The criteria can also be grouped according to their typology: strategic, tactical and operational.

Table 1 classifies the criteria of the articles according to their family and typology, taking each criterion as distinct (not counting the number of times it is repeated in different articles). Table 2 includes the repeats of each criterion, the number of times it is cited in the different articles.

Tables 1 and 2 show that a total of 380 criteria were mentioned, of which 188 are distinct. Detailed analysis of the distinct criteria shows a very disparate level of detail, some criteria being very generic (e.g. technique) and others which are more specific (e.g. the number of Rejected items at entry quality level).

Regarding Typology, the most common are strategic criteria (98 criteria, 52.13%), although if the total number of articles citing them is taken into account the number drops (158 criteria, 41.58%). There are 32 criteria (17%) of a tactical nature, representing 34.74% of citations. Finally, there are 58 operational criteria (30.85%) which make up 23.68% of all citations.

To determine the level of criteria standardization, the ratio between the number of citations and the number of distinct criteria is determined, resulting in: "Assets and Infrastructure" (1.75), "Cost" (2.32), "Logistics" (2.88) and Quality (2.15). The family with the highest number of criteria is "Assets and Infrastructure" with 1.75 citations per criterion. This is due to the fact that 75 of the criteria have only one citation; this family reflects the specific cases of the company concerned, leading

Table 3 Relation of criteria with most citations

Criteria	Total	Family
Delivery performance	21	Logistics
Price	20	Cost
Quality performance	19	Quality
Production capacity	16	Assets and infrastructure
General demand	10	Assets and infrastructure
Financial stability	8	Assets and infrastructure
Communication openness	7	Assets and infrastructure
Location	7	Assets and infrastructure
Transportation	5	Cost
design capability	5	Assets and infrastructure
Quality management practices and systems	5	Quality

to fewer repeated criteria. The other three families have fewer distinct criteria and higher levels of repetition, which indicates that their criteria are used by different authors; there is more consensus and a certain standardization.

Table 3 shows the most mentioned criteria, a total of 11, which have five or more repeats, and which show a high degree of concentration, as the 11 criteria (5.85%) have a total of 123 citations (32.36%).

There are 156 criteria (82.97% of the total) that have two or more citations, representing 49.47% of the criteria of all the articles.

2.3 Methods of Evaluating and Selecting Suppliers

The methods used to evaluate and select suppliers are very diverse, and Table 4 includes a correlation of all those found in the analyzed articles and the total number of times each one has been used.

Analysis of Table 4 shows that there is a great variety of methods, finding 25 different methods in a total of 35 articles. The principal ones are: Analytic Hierarchy Process (AHP) + mathematical programming (four articles) and those based solely on mathematical programming (five articles). A detailed study of those that include mathematical programming shows how the authors opted for different procedures and so, as each one is practically unique; there are 34 different methods and only one repetition. It can also be seen that 17 of the articles (48.6%) use the AHP or its variations (ANP, Fuzzy AHP, Fuzzy ANP).

2.4 Objectives in Selecting Suppliers

The selection of suppliers, in general, has the aim of determining a number N of suppliers and forming a panel of suppliers. An analysis of the current situation shows that the articles suggest different methods:

Table 4 Methods/procedures used to evaluate and select suppliers

Methods/procedures	Total	References
AHP (Analytic Hierarchy Process)	1	[12]
AHP + Mathematical Programming	4	[7];[15];[21];[32]
AHP + CFPR(Consistent Fuzzy Preference Relations)	1	[6]
ANP (Analytic Network Process)	1	[10]
ANP + Mathematical Programming	3	[14];[27];[31]
ANP + TOPSIS+ Mathematical Programming	1	[20]
FAHP	2	[13];[16]
FAHP + Mathematical Programming	1	[25]
Fuzzy AHP + Fuzzy TOPSIS + DEA	1	[34]
FANP	1	[29]
FANP + Mathematical Programming	1	[19]
DEA (Data Envelopment Analysis)	1	[26]
DEA + Decision Trees (DT) + Neural Network (NN)	1	[31]
Discret Choice Analysis (DCA)	1	[28]
Fuzzy logic	1	[2]
Grey ralational analysis (GRA)	1	[11]
Influence diagram + Fuzzy logic	1	[9]
MultiAlternative proposal	1	[4]
NN	1	[1]
Mathematical Programming	5	[5];[8];[22];[23];[24]
Stochastic Dynamic Programming (SDP)	1	[18]
Stochastic programming model (SP)	1	[17]
Weighted additive fuzzy programming	1	[33]
Supplier evaluation system (utilitza PROMETHEE)	1	[3]
Vague sets theory	1	[35]

1. Articles which recommend a ranking of suppliers (23 articles), normally in descending order according to their weight. In general the values of their weight show the degree to which each supplier satisfies the client's needs. Their value is composed of the relative weight of the criteria for the client and the degree to which each supplier satisfies each criterion.
2. Articles that classify the suppliers in binary fashion (3 articles), only including those who are suitable in the panel. The result of the selection is as follows: supplier selected/not selected [1], supplier efficient/inefficient [34].
3. Articles that propose different solutions to the anterior:

   3.1 Articles that select suppliers without creating a panel (8 articles); directly assigning orders to the cloud of suppliers [23], or obtaining a ranking which is not based on weight or binary classification; one example is the classification of suppliers according to their partnership consideration [3].

   3.2 Two articles that analyze other aspects arising from the selection process: a comparison of the weight of criteria in different countries [28] and the analysis to determine whether the relationship with suppliers should be long or short term [18].

3   Conclusions

Purchasing management is strategic and supplier selection one of the most decisive processes. In this paper, a review of current thinking in selecting suppliers demonstrates the inexistence of a general model for determining the panel of suppliers, while showing a great diversity in the methods used for creating the panel. Each proposal is almost unique, with those articles that use the AHP or its variations standing out.

There is no standardization in the criteria themselves nor in the ways of classifying or ranking them. In general, the criteria are determined in two ways: consultation with experts and reviewing the literature, and a detailed analysis shows the wide variety of procedures used. Therefore it can be stated that there is a lack of standards for determining and classifying criteria, which currently depends on the decision-maker's experience.

Almost all the articles deal with different industrial sectors (automobiles, electronics, …), and only one was found which dealt with the service sector [8], presenting a method of decision making, in the case of an airline company, to solve the problem of supplier selection in subcontracting services.

Future research works may include: (i) expand the scope of the review focusing on criteria and validate the lack of standards detected: (ii) implement the stages of supplier selection in the area of services.

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