

Multiple case study of the supplier selection decision process

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Abstract. The complex and important problem of the supplier selection has been modelled with the involvement and integration of different multiple criteria decision techniques. Nevertheless, there is little empirical evidence of the relevance of such approaches to the procurement practice. In order to overcome the relevance gap it is imperative to analyze the practical decision process in the procurement function. With this aim an exploratory multiple case study was undertaken, based on semi-structured interviews with senior procurement managers of eight Portuguese enterprises, and triangulation with previous research. The results suggest that supplier selection decisions tend to be based on the non-compensatory decision strategy (conjunctive decision rule) in the pre-selection stage, followed by the price bidding and qualitative analysis in the stage of final choice.

Keywords: Supplier evaluation, supplier selection problem, non-compensatory decision rule, multiple criteria decision analysis, multiple case study.

1 Introduction

In the last decades the complex decision problem of supplier selection has been an object of growing theoretical research, which employs multiple criteria decision analysis (MCDA) approaches such as Analytic Hierarchy Process, Analytic Network Process, Goal and Mixed Integer Programming, Data Envelopment Analysis among others. Systematic literature reviews show that modern research tends to combine different techniques in integrated approaches, with increasing use of the Fuzzy Set Theory [1][2].

Meanwhile, there is the problem of relevance, to the procurement practice, of the modelling of the supplier selection as a MCDA problem. Most papers on the topic are based on numerical examples, or real data with illustrative purposes. However, few information is given about practitioners feedback and implementation process of such approaches[3][4]. Also, “the relevance gap” is a known issue in the field of the decision support systems [5].

Additionally, above mentioned MCDA approaches to the supplier selection problem are based on the compensatory decision rule, i.e. the poor performance of an

alternative on one criterion might be compensated, to some extent, with good performance on other criteria. However, there is research reflecting the use of the non-compensatory decision rule in the procurement practice [6][7]. For instance, such practical approach, based on a non-compensatory pre-selection procedure, followed by price bidding, was denominated as *bespoke approach* by Holt [8].

In order to understand the relevance of theoretical research of the supplier selection problem and to overcome eventual bottlenecks of implementation, it is imperative to analyze the real decision process in the context of the purchasing function. The present research is based on a multiple case study design and it was aimed to analyze the decision-making process of procurement professionals, applied to supplier selection. The unique assumption made prior to the field involvement stage of the research was that the real supplier selection process is expected to be based on the multiple criteria evaluation. The way how criteria information is aggregated and what decision strategy is used are to be explored, aiming to confirm the relevance problem of the MCDA-based approaches and to discover the possible explanations of it.

Next section (section 2) presents the methodology and context issues of the research. In section 3 the main research topics are discussed. Section 4 summarizes overall findings of the study and is followed by section 5 that presents the final conclusions.

2 Methodology and context description

Taken into account the complexity of the topic, lack of empirical research and necessity to enhance generalization potential of the findings, a multiple case study qualitative research was adopted. It was reasonable to expect purchasing managers not to be familiar with decision theory and multiple criteria decision analyses terminology; the point was to understand how purchasing managers perceive the supplier selection process and how they describe it. In order to address this issue, the semi-structured interview model with open-ended questions was chosen, as advised by Yin [9]. The main topics covered by the interviews are presented in the Table 1.

Table 1. Topics covered by the semi-structured interviews

T01	Description of the company from the purchasing perspective
T02	Organization and internal regulation of the purchasing function in the company
T03	Initial sourcing decisions
T04	Contracts and legal tools applied to the purchasing
T05	Criteria of evaluation of the potential suppliers
T06	Supplier selection as a formalized process: internal regulation and procedures
T07	Underlying principles of the supplier selection
T08	MCDA techniques and decision support software applied in the supplier selection
T09	Post-contract sourcing analyses and supplier performance evaluation

To enhance reliability of the research, the following auxiliary documents and forms were elaborated: the case study protocol (with background, purpose and design of the research), the bulletin of the participant and the guide for the semi-structured interviews.

The bulletin of the participant was a part of a formal invitation to participate in the multiple case study, presenting the objectives of the research, the research team and the commitment to conduct an ethical research process. Being the procurement function a sensitive issue for many companies, it was decided not to record interviews. The guide of topics to cover was used to make notes during interviews and to structure transcriptions immediately after them.

Eight cross-industry enterprises, operating in Portugal, participated in the research. They were represented by senior purchasing officials as interlocutors of the semi-structured interviews. Brief description of the participants is given in Table 2, providing some contextual details.

Table 2. Description of the multiple case study participants

C01	Company	Electrical equipment manufacturer, infrastructures and engineering solutions; export-oriented, gross sales of about €800 millions
	Interlocutor	Director-coordinator responsible for purchasing and logistic
C02	Company	Multinational technological holding - industry, mobility, consumer goods; 4 plants in Portugal with annual operations of €750 millions
	Interlocutor	Coordinator of <i>indirect</i> purchasing (i.e., out of the bills of materials)
C03	Company	Multinational automotive OEM company, with one plant in Portugal, gross sales up to €100 millions
	Interlocutor	Head of purchasing and logistic
C04	Company	Cutlery manufacturer, exporting about 90% of production, with gross sales of €5 millions
	Interlocutor	Financial director
C05	Company	Textile manufacturing group, with its own trademark, also working for world-known labels; gross sales of about €40 millions
	Interlocutor	Head of purchasing department
C06	Company	National paints and coatings manufacturer, with 5 production facilities around the world and gross sales of €180 millions
	Interlocutor	Vice-director of purchasing department
C07	Company	Portugal-based international group in food distribution and manufacturing, with annual sales above €12 billions
	Interlocutor	Commercial director of retail division
C08	Company	Portuguese production facility of one of the world's leading automobile manufacturers, exporting up to 99% of cars produced
	Interlocutor	Factory's general purchasing coordinator

Low generalization capacity is an implicit limitation of the qualitative case study researches [10], but some valuable insights were obtained and discussed. Cross case analyses with the main topics examined through the set of the cases, and comparisons with previous research papers approaching the similar issues, were used to enhance the validity of the research and to provide a basis for the analytical generalization.

3 Analyses of main topics covered by the research

In this section the importance and organization of the purchasing function will be analysed, as well as the observed evaluation criteria used for the supplier selection. Finally the supplier selection decision process and supplier performance evaluation will be addressed.

3.1 Importance and organization of the purchasing function

Undoubtedly, purchasing represents a significant parcel of the product costs. Its percentage weight varies from industry to industry, and is also sensitive to the technology and external markets' conditions. Some rough estimations made by the participants were 60% for C03, 30-35% for C04, 40% for C05. In the C02 case the weight of *indirect purchasing* in the product costs (i.e., components out of bills of materials, equipment and services) was estimated as 5%. An example of the exposure to market's conditions would be, for the C06 case, the dynamic market of titanium dioxide TiO_2 , which is the most widely used industrial white pigment.

In all cases studied there were difficulties to perform ABC analysis of suppliers' portfolio. Three main reasons to consider a supplier as a *key* ("A") *supplier* were identified: financial importance (e.g. a supplier with turn-over of more than 1 million €/year for C01), criticality to the quality or to the production (e.g. products considered as potential *job stoppers*, a typical situation for the lean-oriented supply chains of the automotive industry), and a dominating position of a supplier on the respective market (e.g. assembly line robotics).

There was a clear distinction between *active* and *non-active* suppliers, the last ones being casual and back-up suppliers. In the C01 case, for instance, active suppliers represent about 37% of the total. The weight of key suppliers in active suppliers' base was estimated as about 1.8% for C01 and 4.2% for C08. From 250 active suppliers in C06, there were from 3 to 5 key suppliers for each of five main purchasing areas.

In all cases the policy of long-term relationship with key suppliers was chased. Portfolio-based approaches to the supply management were identified in the first three cases but, to some extent, the same underlying principals were common to all cases.

Such areas as R&D (research and design), quality and production were seen as responsible for the formulation of a new or modified buying need, including corresponding specifications. It is up to a purchasing department to decide whether to use the current supply sources or to look for new alternatives. Straight re-buy situations are commonly under responsibility of a company's operational units.

The complex structures of the purchasing function of large enterprises are of the main focus for this research. It is common for international companies to have central

and also local purchasing departments, i.e. a decentralized organization of the purchasing function. Central purchasing departments were commented as responsible for key suppliers and methodological support, with local departments being responsible for back-up, equipment and services suppliers.

In C03 case, for instance, the central purchasing department is directly responsible for a share of 6-7% of the plant's total acquisitions. Meanwhile, up to 70% of the plant's purchases are electrical components, for which the respective suppliers are chosen, over again, by the central department. In C02 case, the central, regionals and locals purchasing offices are vertically integrated, being autonomous from the local plants.

Other common features were strict individual specialization of purchasing managers on one family of products or services acquired, and the practice to evaluate their performance accordingly to the cost-reduction criterion (as a part of the supply chain cost management). Such organizational decisions and managerial practices have strong reasons to be implemented, but some interesting conclusions were drawn.

Firstly, a large enterprise might create some internal barriers between purchasing managers and R&D, production, quality areas and operational units. Such barriers are the consequence of the organizational and geographical distance between the central purchasing department (responsible for the key suppliers) and respective plants. As purchasing managers are specialized and assigned to some strict type of product (component, raw material, services) acquired, those factors are not favorable for an overall multi-disciplinary analysis of some buying situations.

Secondly, being cost-reduction programs an important performance indicator to evaluate procurement officials, it is reasonable to expect that purchasing managers by themselves will tend to choose an alternative with a lower cost of acquisition as soon as minimal requirements are fulfilled.

3.2 Evaluation criteria of the supplier selection

No ready-to-use list of applicable criteria was suggested to the participants of the research. Notwithstanding, and as expected from literature [11][7], supplier selection was treated by the purchasing officials as multiple criteria evaluation. The summary description of the supplier evaluation criteria mentioned by case studies participants is given in the Table 3. The three most cited criteria were placed separately: price (*P*), quality (*Q*) and logistic performance (*L*); if some criterion was mentioned as the most important one, it was signaled with capital "X". The quality and price criteria were stated as the most important ones in four cases each.

Price criterion was not seen as simple unit price, but more in the sense of the total cost of acquisition (or formal total cost of ownership (TCO) model in the case C02). With many commercial conditions and long-run costs taken into account, such observations were consistent with the exploratory study of Plank and Ferrin [12].

The relative importance of the quality criterion, one of the always mentioned top priorities, tended to decrease drastically as soon as minimal quality requirements were fulfilled. The same controversy was mentioned in the experimental study of Verma and Pullman [11]. On time in full (OTIF) delivery performance was implicitly expected to be high, as a kind of benchmarking standard.

Table 3. Summary of the supplier evaluation criteria

Case	<i>P</i>	<i>Q</i>	<i>L</i>	Comments
C01	X	x	x	As soon as potential suppliers are approved on minimum requirement levels, the price is an unblocking criterion
C02	X	x	x	Evaluation of <i>essential/preferred</i> suppliers is based on the total cost of ownership model with prior analysis of minimum requirements and qualitative criteria (ex.: technological competencies); minimum requirements and price for <i>commodity</i> suppliers
C03	x	X	x	Criteria seen as <i>general</i> are commercial conditions (price included), quality (minimum level, certificates), flexibility and delivery, switch costs, tools dependency; <i>additional</i> criteria are qualitative, such as technical and innovative capacity
C04	X	x	-	The purpose is to obtain the same quality for the lower price or a better quality for the same price; technical support and flexibility
C05	x	X	x	Quality, as a set of technical parameters, and price; trade-off between foreign suppliers (lower price, longer lead-times) and national suppliers (more flexible and stockless supply)
C06	x	X	x	Quality, seen as consonance with the specifications, is the main criterion, followed by the price; capacity, flexibility and collaboration are relevant criteria as supply markets are turbulent
C07	x	X	x	Quality (food safety and specifications) is the main criterion; with quality requirements fulfilled and panel customers tests performed, a new product will be launched only if it is competitive (therefrom quality and cost criteria for potential suppliers)
C08	X	x	x	As soon as specifications and minimum requirements are fulfilled, the lowest bid will be chosen (grounded exceptions are possible)

Qualitative criteria were seen as pre-requisites or/and as post-bidding adjustment criteria. Qualitative analysis was commented as based on expert opinions, with documental analyses and site visits. Some kind of Likert scale might be employed to express qualitative criteria numerically.

Standards and certifications, varying from industry to industry, were seen as qualifying requisites. Among them there were ISO9000, 14000, 22000 and 26000 families, SA8000 Standard, VDA6 Quality Management System and Good Manufacturing Practices (GMP). In the *C05* case, for instance, the company had to implement SA8000 Standard and to guarantee socially acceptable practices in its supply chain to work for North-American market.

Formal or informal use of the concept of a base of approved suppliers was common to all the cases, which is consistent with the results of Plank and Ferrin [12]. In such cases, once approved by a purchasing department as matching all legal and minimum requisites and requirements, a supplier enters some list of approved suppliers. Consequently, it might be requested for quotation either by the purchasing department or by an operational unit when the respective buying need arises.

3.3 Supplier selection decision process and *a posteriori* supplier performance evaluation

Nowadays there is a growing trend for implementing cost management, total quality management, lean logistics, of enterprise resource planning systems and web-based companies' supply portals. Meanwhile, in the context of this multiple case study, the observed *ad hoc* algorithms of the supplier selection process had much in common with *bespoke approach* described by Holt in 1998 [8]. With some contextual differences, the supplier selection decision process was the following.

Firstly, a set of potential suppliers is evaluated against minimal requirements on non-financial quantitative criteria (ex.: quality and logistic requirements). Qualitative "capacities" (such as technical competence or R&D potential) and conformity with legal or sectorial standards required are also evaluated in this stage. This pre-selection stage of qualification of the potential suppliers as acceptable alternatives is based on the conjunctive non-compensatory decision rule.

Secondly, suppliers qualified as acceptable ones are requested for quotation and the best bid wins (alternatively, qualified suppliers are included to a list of approved suppliers).

Thirdly, the final choice decision might be adjusted by experience-based qualitative analyses, if grounded.

The same decision algorithm of the supplier selection process might be recognized in the empirical research of the buying process for new components of Matthyssens and Faes [13] and in the case of Toyota Industrial Equipment Manufacturing [14]. The case of supplier selection described by Naudé [15] was partially compensatory. Potential suppliers were screened by a set of excluding criteria, followed by a scoring model with eight attributes. But the output of the scoring model was used only to qualify alternatives for the bidding stage. No decision technique to trade-off scores and cost criterion in the stage of the final choice was commented.

Albeit criticized for the non-compensatory nature and subjectivity, the *bespoke approach* was seen by Holt [8] as a commonplace practice (for construction contractor selection). The term of *bespoke approach* was adopted to describe the observed *ad hoc* decision algorithms within the scope of this research.

The non-compensatory conjunctive decision rule, applied in the qualifying stage, is important to define a set of feasible alternatives. But, within the scope of this research, there were not identified compensatory MCDA-based approaches to trade-off conflicting criteria of different nature in the stage of the final choice decision. Consequently, the described *bespoke approach* to the supplier selection cannot be considered as based on the semi-compensatory decision strategy.

The C02 case is slightly different because of the formal total cost of ownership model implemented to evaluate potential supply sources. But, as it is common for cost-based approaches, qualitative and non-financial criteria are expected to be analyzed separately from the financially quantifiable attributes. Without compensatory decision strategy to trade-off this two groups of criteria, such TCO-based approach is only a rough approximation to the multiple criteria supplier selection decision analyses [16].

The importance of the supplier performance evaluation for the purposes of this research is twofold. To start, data on actual performance of the suppliers chosen is

used to rectify supplier selection decisions. Also, simple weighted score models were identified as a common tool of the suppliers performance evaluation.

An actual supplier might be dropped if it was proven as non-competitive, face to changed market conditions (e.g. as stated in general Purchase and Supply Agreement of Yazaki Europe Limited [17]), or if it is not able to maintain agreed levels of performance (the quality level agreement, for example). It was common for the participants to monitor permanently supplier performance (conformity with specifications, the quality and logistic dimensions), being a responsibility of the internal clients, but oriented by the purchasing and quality areas.

If some supplier does not meet the agreed levels of performance, there were some different immediate or sequential scenarios: negotiations and elaboration of a plan of corrective actions, suspension of a supplier in the list of approved suppliers (for future buying needs), or contract cancelation.

Scoring systems for the evaluation of supplier performance were directly mentioned in six cases, sometimes jointly with the internal questionnaires. In the C07 case a project of Supplier Performance Scorecard was under implementation. Such scoring evaluations are done with weighted scoring models, based on the semi-compensatory decision rule. A detailed real-life example of Supplier Scorecards might be consulted from Yazaki Europe Limited [17].

Albeit the relative weights of criteria are subjective (or based on the sectorial standards), such scoring models might be useful as a starting point for the practical implementation of MCDA-based approaches to the supplier selection. Also it is worth to mention that such weighted scoring models are commonly advised by supply chain and procurement manuals [14][18].

4 Overall analyses of the findings

The overall findings of the present study are to be treated carefully, with concern to the qualitative nature of the research. Nevertheless, cross-case analyses and comparisons with previous research allowed to draw some relevant conclusions to the field of the supplier selection problem.

The problem of the relevance of the MCDA-based approaches to the supplier selection for the procurement practice was present in all the cases. In all the cases, senior procurement managers were not familiar with multiple criteria decision analyses techniques. The actually implemented formal models of supplier selection were based on the conjunctive non-compensatory decision rule (with a set of exclusion criteria), followed by price bidding and qualitative analyses. Following the description of Holt [8], such models might be denominated as *bespoke approach* to the supplier selection problem.

Albeit the MCDA techniques were seen as interesting and, to some extent, promising, the actually implemented *ad hoc* models of supplier selection were considered by the purchasing managers as effective and efficient (with the exception of the C05 case, in which the head of the purchasing department was interested to implement MCDA approaches to tackle yarn quality specifications). Thus, the proposition of the relevance gap problem, as mentioned in [3][4], cannot be discarded.

In designing empirical research of perceived value of supplier selection criteria (e.g. questionnaires), it will be necessary to take into account such possible features as: presence of organizational barriers complicating interaction of multiple points of view; evaluation of procurement managers' performance based on the cost-reduction goals; and importance of the exclusion criteria and of the minimum level requirements. No closed list of applicable criteria might be elaborated, and their relative weights are quite situational.

Taken into account the results of this research, the supplier selection problem modelling based on the semi-compensatory decision rules was seen as the appropriate way to implement MCDA-based approaches.

At the same time, the experience of procurement professionals cannot be ignored. In other words, the observed *bespoke approach* to the supplier selection should be further studied in the following sense: is it capable, in certain conditions, to represent the complex multiple criteria supplier selection problem objectively and comprehensively?

The use of simple weighted score models was identified as a common tool for the post-contract supplier performance evaluation. With necessary modifications, such models would be a natural *initial* approach to start the implementation of multiple criteria decision analyses tools for the supplier selection.

5 Conclusions

With the purpose to find the relevance of the MCDA-based approaches to the supplier selection, a multiple case study research was performed. Eight enterprises, operating in Portugal, participated in the research through semi-structured interviews with the senior procurement managers.

The multiple criteria nature of the evaluation of potential suppliers was confirmed. The observed *ad hoc* decision approaches for supplier selection were clearly based on the conjunctive non-compensatory decision rule, defining the set of feasible alternatives, and followed by the price bidding. For the qualified suppliers (as feasible alternatives) the application of multiple criteria decision techniques capable to trade-off multiple evaluation criteria in the stage of the final choice decision was not identified.

The capacities and limitations of the observed decision method, denominated as *bespoke approach*, need to be further studied. MCDA-based approaches to the supplier selection, to be successfully implemented, should be seen as a part of a complex decision process with underlying semi-compensatory decision rule and adapted to the context of a buying organization.

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