A Model for Vendor Selection and Dynamic Evaluation

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Abstract. The present paper proposes an evaluation model able to integrate the selection phase with the monitoring and the continuous analysis of the vendor performances. The vendor evaluation process is realised through an opportune methodology which puts beside qualitative judgements (i.e. the adequacy of the organisation or the maintenance management policies) and performance data (i.e. delivery delays, number of non conformities, discrepancies in the delivered quantities, etc.) and builds the database which will support the daily decisions of the buyers. Thanks to its generality and customisability, together with the use of basic managerial tools, the system represents an appropriate trade-off between implementation costs and obtainable benefits.

Keywords: Vendor Evaluation, Vendor Selection, AHP, Supply Management.

1 Introduction and Literature Review

The success of an enterprise into the global market is even more strictly conditioned by the competitiveness of the supply chain in which it is positioned: however effective and efficient in pursuing its targets a company is, it can be in serious troubles if has to interact, along the chain, with ineffective actors, which operate far to the real needs of the market, because this will have severe repercussions on the output offered to the final customer.

The global trend, as largely confirmed in literature and by the practice, advises the enterprises to focus on their own core activities, with consequent aiming to the outsourcing, which represents the tool able to reduce the enterprise overall dimensions. The higher flexibility, obtained by the transposition of the fixed costs in variable costs, is accompanied by the transferring to external actors of all the activities not directly related to the core business. Obviously, these actors must be able to sustain the quality levels which before were a peculiarity of the enterprise.

The purchasing function, therefore, assumes a fundamental role, in terms of both incidence on the total costs and strategic relevance [1]. For these reasons, its positioning into the organisational macrostructure has been progressively redefined, up to the creation of interfunctional teams able to guarantee a systemic vision of the process and more decisional power. This has been targeted to satisfy a series of new necessities: to monitor the suppliers performances, in order to verify their ability to

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assure the required levels of excellence; to optimise the even more complex purchasing process, through careful comparisons and by reducing the set of available suppliers to the most virtuous ones; to understand the real potentialities of the suppliers in order to establish with them strict and durable relationships [2].

The process of Vendor Evaluation (VE) is characterised by:

- *Vendor selection*: vendor knowledge and evaluation of its potentialities in order to elaborate a list of qualified vendors;
- *Performance evaluation*: rectified measurement during the supplying. Together with the selection phase it constitutes the *vendor rating*, which ratifies or denies the final approval of a vendor;
- *Vendor ranking*: comparison of the results of all the vendors;
- *Periodic review* of the potentialities evaluation.

To support the new strategic role of the purchasing function, during the last decades numerous methods of vendor evaluation have been proposed. In literature the Multiple Criteria Decision Making nature [3,4] of the VE is commonly accepted, as well as the extremely diversified data the models have to manage, reflecting the logic of the specific decision maker. As concerns the analysis criteria, different studies have been carried out [5,6], but most of them have demonstrated their applicability under specific constraints only and, then, scarce practical interest.

The experience matured on the field leads the authors to affirm that these models have been scarcely appreciated and utilised in the industrial practice (especially in small and medium enterprises). This can be principally explained with the traditional reticence towards complex mathematical models for choices that can be left to the intuition of the buyer. In the rare cases in which such reticence has been surmounted, these methods have been seen as not very reliable black boxes, due to the reduced number of considered variables.

This paper proposes a model able to guarantee **completeness**, by taking into consideration a wide range of aspects, and **easiness**, by avoiding the adoption of a high number of mathematical modellings, contrarily to what found in literature [7].

2 The Proposed Vendor Evaluation Method

In this section a VE model, based on the Linear Weighting Method (LWM), is presented. Starting from a hierarchical structuring of all the evaluation criteria, the model provides for a procedure which aims to contextualize the general structure to the specific cases. This is obtained through a calculation method based on the AHP logic which assigns opportune weights to the criteria, basing on experts judgment. The general scheme of the model is shown in Fig.1. Objectives and details of the steps will be described in the next paragraphs.

The batching in homogeneous classes. The classification of the provisions in clusters for which the same rules are valid enables to contextualize the evaluation structure for a limited number of categories. This can be performed by means of the material merchandise data.

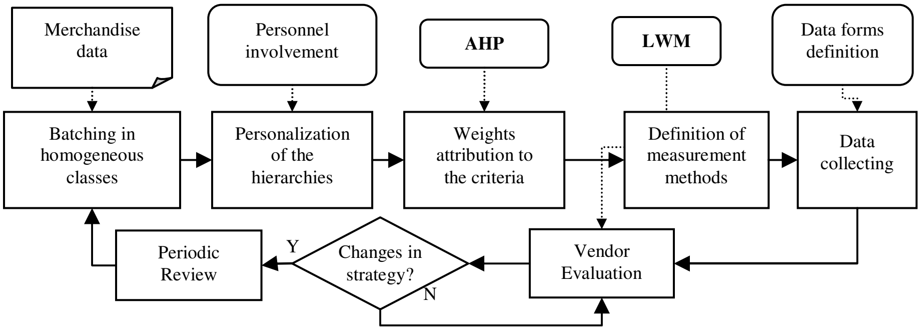

Fig. 1. Logical scheme for the implementation of the model

The hierarchy of the evaluation criteria. In order to permit a complete evaluation of the vendors, a wide set of analysis aspects, subdivided in criteria, sub-criteria and indicators has been defined (Fig.2). This structure represents the hierarchy of the evaluation criteria. The passing from a level to the lower implies a detail increase of the analyzed information. In Table 1 the detail of the evaluation criteria is proposed. It is important to underline that the evaluation has subjective nature, whether it is based on quantitative data or it arises from qualitative judgments.

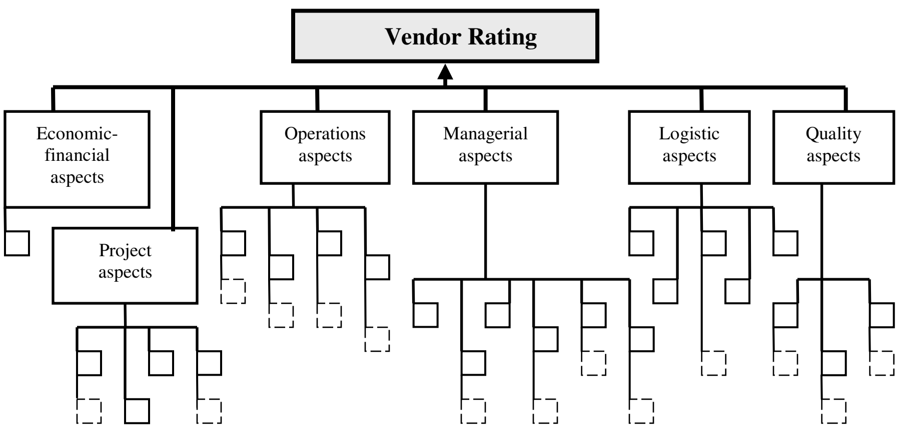

Fig. 2. The criteria hierarchical structuring

The personalization of the hierarchy. The hierarchy of criteria is extremely generic: to guarantee the right trade-off between implementation efforts and benefits of the model, it has to be contextualized according to the company strategy and to the cluster of the considered materials. The method proposes to selecting the criteria by submitting the maxi-hierarchy to at least two figures with specific competences on the provisioned products/services. In particular one member of the Engineering Department and one of the Quality Assurance Department should be involved. They are called to cut/supplement the list of criteria, realising in this way a specific hierarchy for each cluster of materials. The cutting is performed by defining a lower

Table 1. The proposed hierarchy of criteria

Aspects	Level 1 – Criteria	Level 2 – Sub-criteria
C_1 Economic-financial	C_{11} Country Risk C_{12} Stability C_{13} Credit Capacity C_{14} Price	
C_2 Project	C_{21} Innovation Capacity	C_{211} project innovativeness C_{212} R&D investment and patents C_{213} adaptability to technological development
	C_{22} Support tools and technologies	
	C_{23} Qualified manpower	
	C_{24} Technical –planning collaboration	C_{241} participation in project development C_{242} adapting to project requirements C_{243} one-pieces or prototypes realization
C_3 Operations	C_{31} Manpower	C_{311} available C_{312} overtime capacity C_{313} skill C_{314} independence on the job C_{315} technical/social integration
	C_{32} Machinery and equipment	C_{321} adequacy C_{322} maintenance policies
	C_{33} Structures	C_{331} plants C_{332} warehouses C_{333} service equipment
	C_{34} Flexibility	C_{341} ability to reduce lot dimensions C_{342} flexibility to mix and selling volume
	C_{35} Punctuality	
C4 Managerial	C_{41} Type of organization structure	
	C_{42} after--sales service	C_{421} supply problems management C_{422} faulty products substitution
	C_{43} Documental management	
	C_{44} Procedures management	C_{441} scheduling C_{442} activity advancement C_{443} reception C_{444} final inspection C_{445} non conformities C_{446} supplying problems C_{447} security C_{448} process reviews
	C_{45} Administrative – commercial collaboration	C_{451} offer formulation process C_{452} availability, professionalism and timeliness in question answering C_{453} time for order confirmation
	C_{46} Purchase management	C_{461} entry inspections C_{462} vendor selection and evaluation
C_5 Logistic	C_{51} Coherence in packaging modalities	
	C_{52} Flexibility	
	C_{53} Punctuality	C_{531} unproductive working hours C_{532} increase of interest charges on capital invested in WIP C_{533} delivery delay on estimated times C_{534} reminders for shipments
	C_{54} Respect of ordered quantities	
	C_{55} Geographical localization	
C_6 Quality	C_{61} Quality certification	C_{611} application of the quality management system C_{612} skill of quality control operators
	C_{62} Quality costs	C_{621} checks in acceptance C_{622} cost of audits C_{623} cost of reworking
	C_{63} Quality problems	C_{631} non conformities C_{632} damaged products C_{633} claims

limit for the judgments of preference obtained by each criterion. The criteria whose mean judgment is below that limit will be excluded by the hierarchy. A further reduction can be effected by other company figures directly involved in the vendor evaluation process [8].

Weights attribution to the criteria. Not all the evaluation methods require the definition of the weights for the criteria – see DEA [9], OR methods [10,11], total cost of ownership methods [12]. Given the numerousness of the considered criteria and the easiness aim, the model is based on the LWM which receives as input weights and scores of the evaluation parameters. In order to convert in numbers the decision maker perceptions about the relative importance of the criteria, the AHP method, already adopted by Narasimhan [13], is utilized. This differs from the traditional application of the AHP, which is generally used to choose among different alternatives [14]. According to this method, the comparison matrices will be compiled. They are not necessarily consistent (unit rank): forcing the compilers to be perfectly coherent in their judgments, inappropriately obliges them to respect the principles of preference and indifference transitivity. The error will be therefore reduced through the Power Method and subsequently by verifying the consistence through the calculation of the relative index (see [15] for the explanation of the steps to follow). The procedure will be executed at the first implementation of the model as well as at each change of the company strategy [16].

The evaluation model. The relative weight vectors obtained through the AHP are disposed beside the indicators into a worksheet, so as to constitute the global evaluation form for each cluster of materials. The decision makers will be able to complete the form for each vendor by assigning their score to each criteria or sub-criteria of the hierarchy. Through the LWM, the global rating A_i of the ith vendor for a specific cluster of material will be calculated by the following formula:

$$A_i = \sum_{j=1}^{n} w_j a_{ij} \cdot \tag{1}$$

where: w_i = weight relative to the jth aspect; a_{ij} = score obtained by the ith vendor on the jth aspect; n = number of considered aspects.

In (1) the score a_{ij} is in its turn given by:

$$a_{ij} = \sum_{k=1}^{m_j} w_{jk} a_{ijk} \cdot \tag{2}$$

where: w_{jk} = weight relative to the kth criterion of jth aspect; a_{ijk} = score obtained by the ith vendor on the kth criterion of the jth aspect; m_j = number of considered criteria of the jth aspect.

The same relation of (2) is valid for the score a_{ijk} as a function of its sub-criteria. At each level the weight vectors are defined according to the following conditions:

$$\sum_{j=1}^{n} w_j = 1 \text{ and } \sum_{k=1}^{m_j} w_{jk} = 1 \ \forall j \cdot \tag{3}$$

As concerning the score attribution, for qualitative judgments a 1-10 range (10 is the optimum) will be adopted; for quantitative data specific formulas have been created. Starting from them, opportune membership functions can be defined, in such a way as it is possible to convert the performance measured through the formula in a score included in the 1-10 range.

This method avoids the problem of the uncertainty in the weights attribution, typical of the pure LWM. The other controversial issue, the possible offsetting among the criteria, has been solved by fixing a score which represents the lower limit for the approval: if a score goes under this limit (i.e. 6/10) the vendor cannot be considered qualified, independently to its final score.

Data Collection. In order to implement the method, data have to be procured in different ways and moments of the supply process. For the evaluation of the potentialities in the Selection Phase, the *Auto Evaluation Form* (an opportunely developed questionnaire to be sent to each vendor) and the predisposition of test samplings have to be used. After the first selection, the proper qualification consists of the analysis of all the data, through the compilation of the *Preventive Evaluation Form*. The supplies evaluation is performed through the *Rectified Evaluation Form*. The two evaluations, preventive and rectified, constitute the global rating of the vendor, whose total score determines the eventual approval. The preventive evaluation has to be updated at each change in strategy (**Periodic Review**) and, in any case, at least every 3-5 years; the rectified evaluation, on the contrary, has a time-limited validity which strongly depends on the kind of supply.

3 The Case Study

A first validation of the model has been carried out on a company leader in the engineering industry. The high number of vendors and the relative importance of the purchases on the total expenses (70%) have offered a valid test field for the validity of the proposed model. After unstructured interviews and the analysis of the data resident into the ERP of the company, all the steps of the model have been implemented. Subsequently, a comparison between the obtained results and the actions undertaken by the buyers, basing on their experience, in a period of six months has been done. As instance, the comparison for a particularly critical mechanical component, present in all the products, is reported. The characteristics analyzed for a vendor of this component are resumed in the ad hoc hierarchy shown in Fig.3. According to the model, the hierarchy has been adapted to the specific case with the elimination of some criteria and the addition of others.

The purchase department, in the analyzed six months, has confirmed orders for 80 pieces, distributing them on 5 accredited vendors. The diagram of Fig.4 shows such distribution together with the global rating obtained by each vendor through the application of the proposed model. The coherence between obtained results and buyers choices appears evident. The same coherence has been confirmed for all the main clusters of the materials provisioned by the company.

The buyers are surely facilitated in their choices by the implementation of the proposed VE system: by reading on the database the scores obtained by the vendors for the specific aspects of evaluation and the relative global ratings, they can

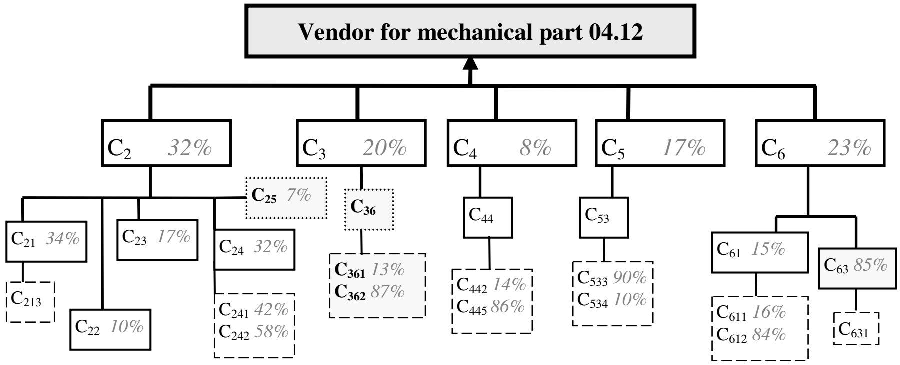

Fig. 3. Hierarchy of criteria for the analyzed mechanical component

immediately take their decisions. In this way they avoid the long and laborious process of data acquisition, which often requires numerous consultations with different company figures, without losing effectiveness in their final choices.

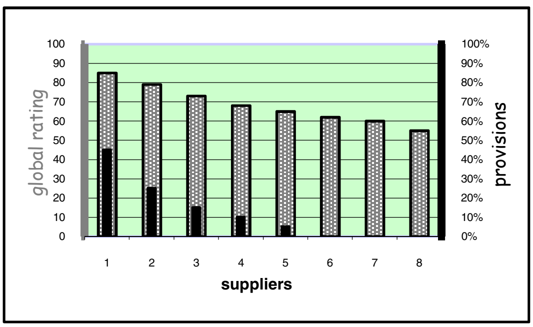

Fig. 4. Comparison between global ratings of the model and buyers choices

4 Conclusions

The paper presents an easy and versatile VE model which can be utilized by every kind of company. Its information power can be a basic tool for the management in supporting the company strategies in the medium period, because it assures a complete outline of the vendors and facilitates considerations about the instauration of more evolved contractual relationships. In addition it allows the buyers to make studies on historical series, sensitivity analyses and also make the evaluation parameters known to the vendors (which can in this way steer better their efforts).

The implementation and the continuous use of a VE system requires great care of the decision makers: retrieving the necessary data and taking coherent evaluations from time to time are not banal problems. For these reasons, the system, even if well conceived, can result in some cases limited or lacking. Other problems can be the underutilization or the crystallization of the system. Therefore, the choice of implementing a VE system should be well pondered and should come from the perception of a real necessity.

Finally, the extensive implementation of the system, opportunely tuned, makes the company abler to defend its competitive advantage position, because it results as a merit mark and a certification of the attention to the customer satisfaction, key factor in the global market.

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