

# A method for the evaluation of suppliers' co-design effort

Alberto De Toni, Guido Nassimbeni\*

*Dipartimento di Ingegneria Elettrica, Gestionale e Meccanica, Università degli studi di Udine, Via delle Scienze 208, 33100 Udine, Italy*

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## Abstract

A framework for the analysis and measurement of the support given by the supplier to the buyer's new product development activities is described. Having consulted the literature on best practices in product development, 14 criteria were individuated. This assessment framework was implemented and tested in a major company in the Northwest of Italy, which operates in the sector of Industrial Automation. The case study points out advantages and limitations of the proposed instrument. © 2001 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

Several studies and empirical observations have demonstrated the benefits of collaborating with the suppliers at the product/process design and development stages [1–4]. The contribution of the supplier in new product development (NPD) can, in fact, enable the buyer to:

1. Take advantage of the technological competence of the supplier.
2. Shorten the time to market.
3. Improve the quality and lower the global cost.
4. Increase the level of motivation of suppliers, because the suppliers become responsible for the whole product design and not just “pieces” of it.

Various investigations have shown that one of the principal reasons for the competitive advantage

of the Japanese automotive industry, is their supply system [5–9]. The assemblers actively involve suppliers in NPD activities by asking for technological input in the product. The sharing of designing responsibility and the exchange of information concerning the product has enabled the assemblers to improve time, cost, and quality performances [1]. Following the example of their Japanese competitors, almost all European automobile makers have adopted the co-design approach. According to Lamm [10] and Turnbull et al. [11], the involvement of the supplier in NPD has become a widespread practice in the European automotive industry.

Even though there have been several studies on co-design, there are few contributions specifically dedicated to the measurement of the suppliers' co-design effort. In this research we propose an instrument for the evaluation of this critical performance. The questions proposed concern the principal stages in NPD: product concept and functional design, product structural design and engineering, and process design and engineering [1].

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\*Corresponding author. Tel.: +39-432-558333; fax: +39-432-558251.

E-mail address: [nassimbeni@uniud.it](mailto:nassimbeni@uniud.it) (G. Nassimbeni).

The paper is structured as follows. The first section is dedicated to the evolution of the supplier rating system and in particular of supplier evaluation criteria. The literature concerning assessment of the suppliers' "technical capability" is briefly presented. Section 3 summarises the objectives and the methodology used in this work. Section 4 develops the suggested measurement instrument and the modes of processing the partial scores associated with each of the evaluation criteria proposed. Finally, Section 5 describes the implementation of the instrument and its testing in a case-study company.

## **2. Literature review**

The choice of the right supplier is perhaps the most important responsibility of the purchasing function. The vendor rating system identifies the suppliers best equipped to meet the customer's expected level of performance, and checks them periodically and systematically [12]. Thus the branch of studies concerning "vendor rating" is particularly rich and different conceptual models for supplier rating have been worked out, depending on the firm's situation, priorities, activities and competencies. Analysing the papers on vendor rating, starting from the seminal work of Dickson [13] right up to the most recent ones, we can see that the approach has greatly changed [14].

Firstly, this evolution regards the mathematical tools used for supplier selection and rating. In the past the "weighted sum algorithm" was foremost in the literature, then gradually researchers started focusing their attention on more sophisticated methods such as fuzzy logic and neural network applications [15]. Weber et al. [16], reviewing 74 articles about the supplier selection problem published since 1996, stated that only 10 articles applied mathematical programming to vendor rating. More recently, Ghodsypour and O'Brien [17] mentioned seven other articles that describe this technique: four are about linear programming, six propose a mixed integer programming approach, two use goal programming techniques and one discusses multiple objective programming. Nevertheless, De Boer et al. [18] observe that purchasing

managers have only just begun to explore the potential of operations research (OR) for dealing with the supplier selection decision. They also review the different models and tools offered by OR for making this decision. These range from brainstorming methods to multi-criteria optimisation techniques.

Secondly, the evolution of vendor rating regards the number and variety of criteria used. Based on empirical data collected from 170 purchasing managers, Dickson [13] identified quality, cost and delivery performance history as the three most important criteria in supplier selection. The review of supplier selection criteria carried out by Weber et al. [16] shows that quality, cost and delivery are still basic. However, the need to consider current purchasing environments, including just-in-time supplies and partnership agreements, has caused present vendor rating systems to pay greater attention to other performance dimensions or else organise the "traditional" criteria in a more detailed way. Performance dimensions found in the current literature regard, for example, the total cost of supply [19], just-in-time delivery capabilities [20], co-operation in partnership agreements [21], environmental issues [22], and supply chain aspects [23]. Lamming et al. [24] focused on "relationship assessment", that is, the assessment of the overall partnership dimensions, underlying the necessity for a joint customer-supplier evaluation approach.

In spite of the fact that the collaborative product development approach is one of the most important aspects of present supply relationships, few articles exist that propose a structured measurement instrument. The "technical capability" of sources was numbered among the vendor selection criteria by Dickson [13] but in a secondary role. However in his work, as well as in a series of other papers [25–27], "technical capability" was not developed in detail. Others later tried to define the technological and R&D capabilities of sources in more detail, but without proposing a structured list of criteria and indicators. Mandal and Deshmukh [28], for example, affirm that the technical capability" refers to the availability of technical manpower, state of production technology, R&D facilities". Bhote [29] suggests measuring the

technological and design profile of the supplier using the level of investment in R&D, the presence of computer aided design/engineering/manufacturing systems, the level of collaboration in the determination of product specifications and time reduction in product development. Cole [30] underlines the importance of measuring the supplier's capabilities for "product design and testing, R&D, prototyping, manufacturing engineering and the overall technology and innovativeness". Ellram [31] suggests considering the technological level of current and future manufacturing facilities and the supplier's speed in development. So, in general, the literature on vendor rating places the supplier's design skills within the generic "supplier technical capability" criteria, however a detailed measurement framework has not been adequately investigated.

### 3. Objectives and methodology

The objectives of this work can be summarised as follows:

- To develop a framework for the analysis and measurement of the support given by the supplier to the buyer's new product development activities. This basic framework is intentionally generic. Being independent of firm or industry-specific factors it can be adapted to any single buyer-supplier relationship.
- To implement and test this framework in a case study company, noting advantages and weaknesses.

The work was developed along the following steps:

- Review of relevant literature. The most promising trend in research seemed to us to be in the concurrent engineering field, where best practices in co-development are noted and discussed.
- Theoretical development of the measurement framework. During this step, 14 criteria of a perceptive nature were selected in order to grasp and measure the support given by suppliers to the customer's product development activities.

- Implementation of this framework in a case study company. We individuated a company where the supplier involvement in NPD is a critical factor for success. Together with a team of experts (composed of purchasers, designers, process engineering and assemblers and co-ordinated by the procurement manager) from this company we conducted a detailed analysis of co-design activities. Then a sample of 16 suppliers was selected. All these belong to the same "design family", that is, they manufacture parts that are similar in terms of design complexity. The type of intervention as well as the intensity and nature of collaboration required are comparable. The team chose 11 of 14 previously identified criteria and evaluated the sampled suppliers on these.

### 4. The assessment framework

In this section we present the theoretical measurement framework developed along the lines suggested by the review of the literature.

To decide which evaluation criteria to use we asked ourselves: which practices and methods make firms good product innovators? We then analysed the literature on best practices in product development (see [32, 33]), noting that most of these practices are ascribable to concurrent engineering tools and techniques. Concurrent engineering (CE) suggests an 'integrated' design approach, that is, a co-ordinated effort of the various competencies and organisational functions involved in the development of new products. The main idea of concurrent engineering (known also as "simultaneous engineering", "concurrent product and process design", "total industrial engineering") is to integrate all the functions involved in the project, including external ones, that is, suppliers and customers. The most widespread CE tools and techniques – grouped according to their goals – are: 1. Reduction of the number of parts, by product *Modularization*, *Standardisation* of parts and project *Simplification*; 2. Manufacturability and assemblability, achieved using techniques such as *design for manufacturing (DFM)* and *design for assembly (DFA)*; 3. Project schedule and development

Table 1  
The measurement of the suppliers's co-design effort<sup>a</sup>

	min↔max	Weight	Score
Product concept and functional design			
(a) Technological expertise	1 2 3 4 5	—	—
(b) New technologies identification	1 2 3 4 5	—	—
(c) Support in the development of product specificat.	1 2 3 4 5	—	—
(d) Support in value analysis/engineering activity	1 2 3 4 5	—	—
Product structural design and engineering			
(e) Support in product simplification	1 2 3 4 5	—	—
(f) Support in modularization activities	1 2 3 4 5	—	—
(g) Support in component selection	1 2 3 4 5	—	—
(h) Support in standardisation choices	1 2 3 4 5	—	—
(i) Efforts to make product and process compatible	1 2 3 4 5	—	—
(l) Promptness and reliability in prototyping	1 2 3 4 5	—	—
(m) Prompt communications of engineering changes	1 2 3 4 5	—	—
(n) Support in FMEA activities	1 2 3 4 5	—	—
Process design and engineering			
(o) Support in DFM/DFA activities	1 2 3 4 5	—	—
(p) Support in process engineering equipment	1 2 3 4 5	—	—
			Total

<sup>a</sup>Legend: 1. The supplier's support has been negligible. 2. The supplier's support has been limited and irregular. 3. The supplier's support has been sufficient. 4. The supplier's support has been important. 5. The supplier's support has been decisive.

time reduction, where tools such as *work breakdown structure (WBS)* and *overlapping (OL)* can be helpful; 4. Product assessment, using *failure mode effect analysis (FMEA)* for example; 5. Customer satisfaction, evaluated by *value analysis and engineering (VA/VE)* tools [34]. Many articles have been published showing the advantages of these “concurrent” methods and tools, used in isolation or – preferably – in groups [35–37].

Some of these techniques and methodologies can be carried out together with the supplier and so have suggested most of the items of our measurement framework (items “c”, “d”, “e”, “f”, “g”, “h”, “i”, “n”, “o”, “p” in Table 1). Others do not refer to specific techniques but to how fully the supplier co-operates in: making technological expertise available to the customer (item “a”), identifying new technologies (“b”), promptly informing the customers about part prototypes (“l”) and engineering changes (“m”).

The design team activity evaluates them at the end of the development process. Each of the following questions, grouped according to the principal

phases of product development, corresponds to each of the proposed criteria.

#### 4.1. Product concept and functional design

- Has the supplier provided complete and true information regarding the technological expertise?*
- Has the supplier contributed to the identification of new materials and new product and process technologies?*

The concept of a new product should take into account the materials and technologies available in the buyer's firm or the suppliers collaborating in the project or, more generally, the technological supplies market. Knowing which technologies are available can influence the designer's and the product manager's choice in the development of a new product [38]. The present competitive environment forces the buyer firms to thoroughly check the technological markets and acquire innovations wherever they are available. From this point of view the suppliers assume the role of direct source

of innovation or “gatekeepers” oriented towards the sources of innovation in their own or related sectors. Using the suppliers as “gatekeepers”, the buyer firm has a greater possibility of coming into contact with innovative ideas and choosing the most promising ones [3,38].

(c) *Has the supplier made a significant contribution to the customer's product specifications?*

The product specifications are the translation of functional requirements that the designer seeks to incorporate into a product. These specifications, in turn, are the basis for procurement and process planning activities [39]. In what way can the supplier help the buying firm to define the product specifications? First of all by identifying and calculating the importance and technological impact of each specification, estimating the cost linked to it and helping to modify those that contribute to additional costs. Moreover, the supplier can help formulate the specifications so that they:

- are expressed clearly and comprehensively;
- are sufficiently precise and rigorous;
- provide enough information for inspection and quality test purposes; and
- do not include unnecessary and nonessential features.

The determination of specifications with these characteristics is then reflected on competitiveness of the product on the market [40].

(d) *Has the supplier contributed significantly to the activity of VA/VE?*

Value analysis and engineering provides a systematic approach to evaluating the design and manufacturing alternatives that are essential for the achievement of product specifications. In assessing the value of an alternative, both functional value and esteem value are considered. Functional value is the perceived value of the intended use. Esteem value refers to the aesthetic features of the product that are appreciated by the customer. To achieve maximum functional or esteem value is to achieve the lowest possible cost of providing the performance function or the aesthetic features [41].

In reference to all the primary and secondary purposes, VA measures the degree of usefulness and

the appreciation of the product by customers. The aim of VA is to manufacture a product at the lowest cost, but with the highest degree of all the functions appreciated by the customer and without those functions whose utility is not perceived. Cost evaluation is the object of value engineering (VE). It considers the materials to be used and the work to be done Function by function and component by component. Regarding the quantification of the costs associated with each performance the contribution of the suppliers can be the determinant [42].

#### 4.2. Product structural design and engineering

(e) *Has the supplier contributed significantly towards simplifying product design?*

The current competitive need for a faster introduction of new products or new versions renders the ability to effectively and efficiently manage the design critical, especially when the number of product components is high. It is essential to simplify the structure of the product and the process, limiting the number of components and production or assembly operations. Simplifying product design, provides numerous benefits such as reduced costs, improved quality, and shorter development lead times. The contribution of the supplier could be valuable for achieving these results.

(f) *Has the supplier contributed significantly to product modularization?*

Modularization permits differentiated products to be obtained in unison with cost reductions in the design activity, production and management of logistic flows, thanks to a repetitive use of standard elements in the definition of the product [39,43]. The suppliers' contribution can be valuable where the product modular composition requires modifications in the designing of the single components.

(g) *Has the supplier provided useful information for making decisions regarding the choice of product components?*

The main choices regarding component production (Use of new or existing parts? Internal or external development? Which technologies to adopt for the basic components?) greatly influence the

competitiveness of the product. The use of existing parts (common to other models or taken from former models) reduces the cost of designing and manufacturing new equipment and the risk of unreliability. However, this solution is not always practicable.

Similarly, the involvement of external resources can improve the quality of the components and reduce the internal work of planning and co-ordination, but could also result in a deterioration of the internal know-how. Neglecting the basic technologies concerning components could weaken the negotiating position of the customer in regard to the supplier [1]. Recourse to external sources for product development must be carefully calculated. When making this choice the designers must take into account not only the technological characteristics of the components to be developed but also the suppliers profile and potential. Therefore, an element to be evaluated is their willingness and timeliness in providing information of this type [44].

- (h) *Has the supplier made a significant contribution to the design/use of standard components? Has the supplier resorted to standard components?*

The use of standard components means that parts become more readily available and the choice of sources wider, so inturn inreducing the production lead-time and both product and inventory costs. The designing of standard components can be aided by automated design systems (for example computer-aided design) which include archives of elements available from suppliers and are automatically included in the design [43]. The supplier can suggest standardised solutions thus avoiding “reinventing the wheel” which may occur when the buyer designer, especially if idiosyncratically preferring pre-established technical solutions, neglects the offer [45]. Similarly, the use of standard components can enable the supplier to work faster and make the offer more economical.

- (i) *Has the supplier tried to make the designing of the product compatible with his own processes?*

The attempt on the part of the supplier to make the characteristics of the product and the characteristics and potentials of his own productive

processes compatible can lead to shorter lead times and cost containment [46]. The benefits for the buyer are the availability of the components in advance and possibly also a reduction in the cost of acquiring the supplier's components [39].

- (l) *Is the supplier timely and reliable in making the prototypes?*

The speed and quality of constructing prototypes have a significant influence on the speed and quality of the entire activity of NPD. The prompt availability of externally made component prototypes provides the designers with rapid feedback, quicker execution times and an early diagnosis of problems, reducing the time needed to modify tools and dyes. In addition, a greater number of prototypes can be made so increasing the frequency of the design – prototype – test cycle, which is carried out repeatedly until the final result is obtained [45].

- (m) *Has the supplier promptly provided information relating to any modifications carried out during the prototyping stages?*

Engineering changes made by the supplier during the prototyping stages can occur frequently. The cost when these are made after the design stage tends to increase exponentially along the NPD process. If the buyer's NPD team is informed at once the work of re-designing is easier and the testing operation speeded up. There are notable savings in cost and time, especially when the changes to be made are not subject to formal approval (as often happens) before being passed on to the prototype workshop [45].

- (n) *Has the supplier made a significant contribution to FMEA?*

Failure mode effect analysis (FMEA) techniques help the design team to study the causes and effects of product failures. FMEA specifies the various conditions the product will endure, and tests, how it reacts under those conditions, allowing designers to plan a product that will withstand a broader range. Designers can decide which materials and components to use depending on their performance and cost. Suppliers with their more detailed knowledge of the components can suggest lower cost

solutions to problems revealed under various conditions.

#### 4.3. *Process design and engineering*

- (o) *Has the supplier contributed to the application of DFM/DFA techniques? Has the supplier resorted to these techniques in his own factory?*

Design For manufacture (DFM) considers the effects of product structure on manufacturing costs and “producibility”. A collaborative approach between the design and production functions enables DFM to simplify the productive processes, provided that characteristics and performances of the product are equal [3].

Similarly, the design for assembly (DFA) could limit costs while maintaining the high quality of the assembly activities by choosing appropriate assembly methods [1]. If the supplier uses techniques of integrated product/process design the buyer will receive the supplies in a shorter time, as well as (possibly) at a more competitive price. The supplier's experience and suggestions could, in addition, aid the buyer's DFM/DFA activities.

- (p) *What was the supplier's level of involvement in the executive designing of tools and machinery used in the productive process?*

The pilot tests, which usually conclude the activity of process engineering, show up any design problems that have accumulated during the preceding phases. In fact, their principal scope, is to discover and solve difficulties that had not emerged during building and testing phases of the prototype. Also here the supplier's experience could be invaluable [47].

#### 4.4. *The weights*

The framework presented above pinpoints a series of criteria that can evaluate the supplier's co-design capabilities. Obviously, the relevance of each of them depends on the context, industry and kind of firm. The weight to be attributed to each criteria depends on a series of variables:

- The stage at which the supplier is involved in the NPD activity. Clearly, evaluation of the supplier

only concerns those stages in which part is taken. Indeed, the earlier (nearer to product concept) the suppliers becomes involved the greater their knowledge of the entire project and the needs of the customer, so they can contribute more to the co-design activity.

- The nature and importance of the component supplied. The technological content, possibility of standardising and simplifying the product/process, complexity of the prototyping activity and the impact on the characteristics of the finished product vary according to the component supplied.
- The capabilities within the buyer firm. In general, the capabilities that are most appreciated are “complementary” to the buyer's as they better complete NPD activity.
- The competitive priorities of the buyer firm. For example, to shorten the time to market prototype construction and set up processes must be speeded up, while the need to reduce costs emphasises the supplier's contribution to the activity of standardisation or simplification of the product/process.

### 5. *Implementation and testing of the instrument*

The proposed instrument was implemented and tested on a large firm which operates in the Industrial Automation sector, in the Northwest of Italy. The purchasing manager and other personnel of the purchasing function were interviewed over a period of four months. In addition documents relating to the evaluation of 16 suppliers involved in co-development activities were carefully examined.

#### 5.1. *The firm*

The firm is part of a multinational Group (food sector) and makes machinery and plants. The turnover amounts to about US\$ 20 million: the purchases account for about 70%. It is a make-to-order firm, offering single products or small lots. Each customer order is assigned to a project-leader that manages the development activities from preliminary analysis to product completion. The project-leader co-ordinates a cross-functional team

involving purchasers, technical specialists in automation and electronic equipment as well as the suppliers' engineers. Collaboration with the suppliers has become a critical factor for success since they determine the manufacturer's product quality, innovation and time to market (TTM). For this reason the firm wished to have an instrument to assess and monitor the supplier's co-design contribution.

## 5.2. *The selected criteria*

The company has adopted several of the CE practices pointed out in Section 4: Reduction of the numbers of parts (product Standardisation and Simplification); Product manufacturability and assemblability (*DFM* and *DFA*); Product assessment (*FMEA*). In addition, the company requires the unwavering support of the suppliers in technological choices and prototype development. Prompt and continuous interaction between internal and external designers is expected. The team of experts chose 11 of the 14 criteria proposed. The reasons are summarised below.

### 5.2.1. *Product concept and functional design*

The level of technological expertise and reliability (a) of the supplier are of prime importance. The firm seeks out suppliers that are leaders in their field and relies on them for the identification of new technological opportunities on the supply market. Innovation of materials (b) is appreciated particularly if it reduces costs. In fact the materials account for about 70% of the entire cost of the finished product. Similarly, new process technologies (b) able to speed up flow and better control its characteristics are in great demand. New technologies that have been incorporated into the product thanks to co-design regard the multi-axis approach, use of composite materials, optical fibres and new software protocols. Research on hardware and software compatibility between components and products (for example programmable control machines) made by different companies was then carried out by some suppliers together with the firm's informatics experts.

### 5.2.2. *Product structural design and engineering*

Development projects managed by the firm can require thousands of components, though their number varies considerably from order to order. The importance of a reduction in the number of components (e) and recourse to standard components (h) is evident. For example, suggestions made by some suppliers enabled the firm to considerably reduce the number of components used in the pneumatic part of the product.

The support of the supplier in the choice of components (g) is carefully evaluated. This directly influences the TTM, which is one of the competitive priorities of the firm. Components that are readily available on the market and have a low delivery lead-time are favoured. The firm expects the supplier to indicate the availability on the market of parts with these characteristics (or known parts with other possibility applications). The active involvement of suppliers has reduced the TTM of some machinery to one month and the TTM of installation to 4–6 months.

The supplier's search for compatibility between the product and the internal processes (i) is another of the parameters analysed at this stage. It is important for two reasons: (1) with product–process compatibility the manufacturing lead times are reduced and consequently the whole TTM; (2) product–process compatibility is a prerequisite for respecting design specifications. Compatibility is required both in relation to materials and single processes, including the simplest ones (for example: surface finishing). Almost all the products pass through the prototype phase, to verify if they work and check whether the specifications were respected and identify the phases and complexity of production. For example, the construction of a robot needs the principal building elements to be prototyped: the motion system, control system software, the support component construction, frame and crank-case. The speed and reliability of prototyping (l) guaranteed by the suppliers has a direct effect on the quality of the product and the TTM. Similarly the firm expects the suppliers to immediately pass on all information relative to modifications carried out during the prototyping phase (m).

The firm carefully analyses the tests for defects carried out by suppliers. In the past the finished



product often showed problems regarding resistance to wear precisely because some components had not been sufficiently tested. Analogous problems have arisen in the parts most liable to stress, such as jaws and sliding elements. Insufficiently tested components have even generated dust, a very serious factor in the market where this machinery is used. Support in the FMEA activity (n) is thus an integral part of the supplier measurement system.

### 5.2.3. Process design and engineering

Particular importance is given to the supplier's support in the simplification of assembly, maintenance and disassembly of the products (o). Maintenance is essential as the buyer firm can use internal personnel instead of outside specialists. In addition this market demands stringent norms of cleanliness. So the machinery must be easily disassembled to allow frequent washing. Finally, this type of machinery is subject to a high amount of wear and components must be changed frequently.

The supplier's support in process engineering and equipment (p) is also appreciated: the experience of suppliers in the designing of production tools has often proved invaluable.

### 5.3. The un-selected criteria

Three of the 14 criteria proposed were excluded by the team of experts, as the corresponding CE practices are not significant in this context. These criteria are the following:

- the support of the supplier in the development of the product specifications (c). The specifications are provided by the end customer, then discussed and agreed upon with the firm. Besides, the supplier rarely holds such a position in the whole process that he can make a significant contribution to the formulation of the design macro-specifications;
- the support of the supplier in VA and VE activities (d). The firm does not carry out structured VA and VE activities: these are significant mainly for production in series and are so aimed at a large number of customers. In this case, the detailed study of the use-cost functional relations helps the designers to eliminate functions which

are very expensive and not appreciated by the average customer;

- the support of the supplier in product modularization activities (f). Given the great variety and complexity of the products, modularization is difficult. In addition, it is believed that a modular product can be easily copied by competitors. For this reason only specific component systems are acquired from external sources: "we wish to avoid putting a supplier in the position of being able to replicate an entire process, or a strategic part of it *in toto*".

### 5.4. Implementation

The evaluation scale could be understood by all. However some difficulties were encountered in interpreting the score (from 1 to 5). The purchasing function therefore showed the others the significance linked to the various scores (Table 1). Only two suppliers had comments to make, not about the content of the proposed criteria but the "vagueness" of some. They suggested making a more detailed measurement of the process engineering step, taking into account the different technological characteristics of supply parts. In future, the purchasing function will improve the measurement instrument adding some other criteria and introducing weights.

As already mentioned the instrument was tested on 16 suppliers. Each was evaluated by a team consisting (a) the purchasing manager; (b) the buyer in charge of the appropriate parts category (electronics, plant engineering or mechanics); (c) the project manager (at times aided by designers); (d) the process engineer; and (e) the assembly manager. The contribution made by the latter two was particularly helpful: the evaluation enabled them to communicate the internal designers and suppliers and suggest ways to simplify production and assembly. Fig. 1 gives a graphic example of the application of the proposed instrument.

## 6. Results

What is the final judgement of this instrument? In brief, the advantages are the following:

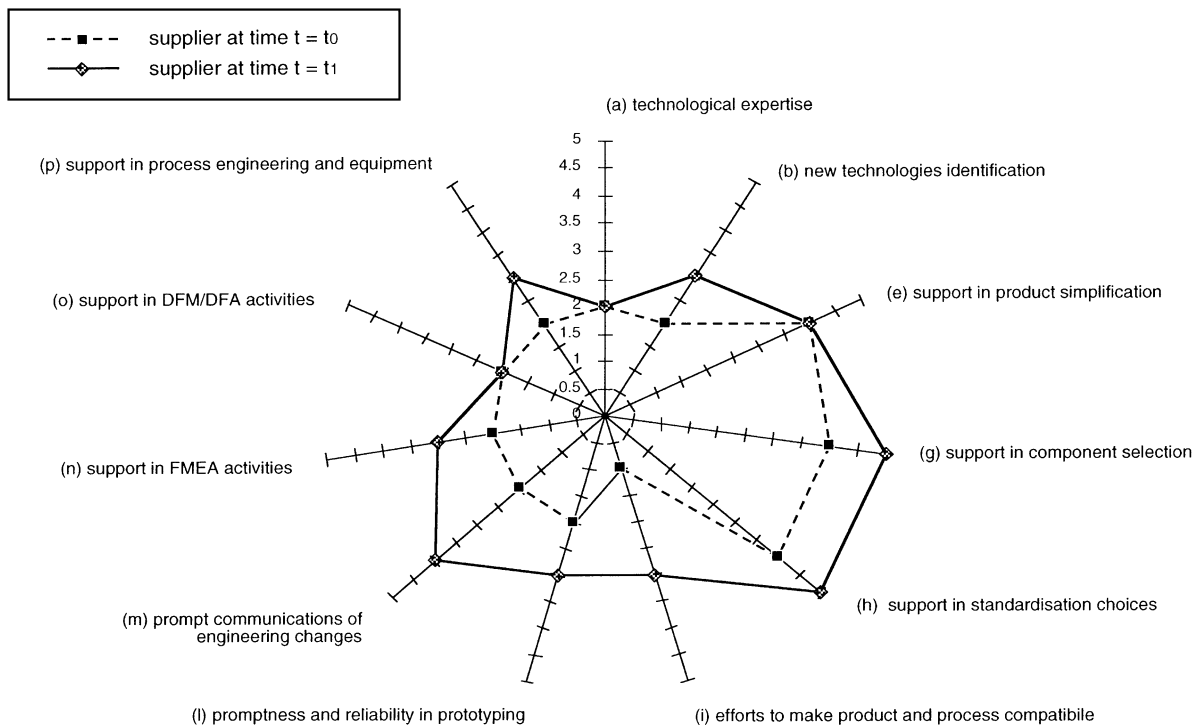


Fig. 1. Example of monitoring at  $t = t_0$  and  $t = t_1$  a supplier involved in NPD.

- The instrument provides a more precise and objective evaluation of the suppliers. “Some credence have been re-evaluated”, the purchasing manager notes. These objective evaluations together with the history of the supplier’s performance make the choice of the supplier more rational “Unfortunately we always make the mistake of only remembering the supplier’s last performance as well as the most brilliant and worst results. Now we can reconstruct the contribution made over time and so make a more informed decision”.
- The suppliers have become aware that they are systematically evaluated on certain parameters and have consequently made improvements.
- The instrument provides a method of control also for designers. It presupposes the use of advanced management practices for product development and involvement of the supplier. For example, it assumes that DFM / DFA practices are used by the customer and that the supplier

will give support for these practices. The manufacturability of a process consequently depends both on the ability of the supplier and the ability of the customer’s designer to implement this technique and solicit an adequate contribution from the suppliers.

As far as the limitations are concerned, this instrument is oriented towards supplier monitoring rather than selection. However this is one of the innate limitations of the evaluation ambit we are considering: the evaluation of supplier’s co-design effort is an ex-post supplier assessment, since it can be applied only downstream from the NPD activity carried out jointly with the supplier. Moreover it should be remembered that, in general, co-design outlines a stable long-term buyer–supplier relationship. The scope of this rating is therefore not the exclusion of the supplier who has “blotted his copy-book”, but the identification of the factors and NPD stages that must be improved. Another

limitation is the time and cost of the development and implementation of the instrument. It requires the involvement of experts in various functions, the identification of an appropriate set of evaluation criteria and weights for each part category, the development and maintenance of a detailed Data Base. In addition, the effectiveness of the instrument depends on the organisational context. If the internal team (basically the purchasing staff) is not truly motivated and convinced of its effectiveness it risks becoming a ritual rather than a useful guide for supplier improvement.

## 7. Summary

In the context characterised by increasingly aggressive global competition, higher costs for research and development of new products, technologies in rapid evolution, the need to speed up product development in order to reduce the “time to market”, competitive success depends more and more on product development [2]. Many firms have felt the need to review the traditional antagonistic procurement logic, by involving suppliers right from the initial stages of product development. How to manage the pool of suppliers and in particular vendor rating systems, have assumed a central relevance [48].

The objective of this work was to develop a tool to measure the support given by suppliers in NPD activities. In spite of its increasing popularity, co-designing is often neglected in the literature on vendor rating. The studies are mainly focused on the material flow, that is on the “tangible” output of suppliers. The design skills are generally located within the generic “supplier technical capability” criteria, but a detailed measurement framework has not been adequately investigated.

Analysing the literature on best practices in product development, we observed that most are ascribable to concurrent engineering tools and techniques. The latter can be grouped according to their goals: 1. Reduction of the number of product parts; 2. Product manufacturability and assemblability; 3. Project schedule and development time reduction; 4. Product assessment; 5. Customer satisfaction. Some of these techniques and methodolo-

gies can be carried out together with the supplier and so have intimated most of the items used in our measurement framework. The set of 14 evaluation criteria we have identified was tested in a firm operating in the Industrial Automation sector. The instrument has certain limitations, i.e. it can be used only for an ex-post evaluation, that is, for supplier monitoring rather than selection. In addition time and resources are required for its implementation, and to some extent it depends on the organisational context. However, the case study demonstrates its usefulness, since it can offer an analytical assessment of supplier co-design effort and show where improvements could be made.

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