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DEALING WITH THE NON-ACCOMPLISHMENTS OF FUNCTIONAL SPECIFICATIONS IN THE CONTEXT OF BUYER-SUPPLIER RELATIONSHIPS: A CASE STUDY IN THE AUTOMOTIVE INDUSTRY

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Abstract

The access to technological resources and capabilities by a company may involve the establishment and development of business relationships with specific suppliers. These relationships may reflect both general, prescribed or formal purchasing orientations (i.e. adversarial vs cooperative approaches) and more specific evaluation criteria of suppliers. This paper aims to analyse the relevance of inconsistencies between the two levels for the emergence and search for solutions to failures in the accomplishment of functional specifications in the stage of series production, i.e. when both parties are interdependent. The starting point for the empirical study was non-accomplishments of functional specifications involving an auto manufacturer and some of its suppliers, followed by an exposition of the searching processes for solutions, often by trial and error, involving several departments and firms. The results of the study suggests that these processes may reflect the tensions between transactional and cooperative orientations regarding business relationships with suppliers, a fragmented view of NPD and series production activities and targets, and the lack of integration of the criteria used for the evaluation of suppliers within the customer company. In face of inconsistencies between the formal purchasing orientation and the specific frameworks used to evaluate suppliers during series production, local solutions may emerge at operational level, which may be contrasted with existing formal orientations.

Key words: Business Relationships, Supplier Evaluation, Functional Specifications.

Introduction

An increasing part of the technological resources used by a company is mobilised through external sources. In many industries, more than a half of the total costs of the final products result from purchased parts and services (Ford et al, 2011; Gadde et al, 2010; Van Weele, 2005).

Traditionally, companies have avoided losing valuable intellectual property to competitors. Assemblers used to produce most of the components for their products "in-house", in order to retain control over their value chains. However, globalisation and rapid technology changes impelled "original equipment manufacturers" (OEM) to recognise the importance of inter-company relationships, in order to access new resources (Handfield et al., 1999). Nowadays, the complexity of technology products, such as cars has increased to such an extent that no single company possesses 'in house' all the resources needed to develop and produce each and every part (Ford et al, 2011). Furthermore, knowledge can be developed and transferred between industries because suppliers often bridge different markets. OEMs' efficiency and effectiveness came to depend crucially on the performance of their networks of suppliers. Furthermore, their suppliers can contribute to innovation, and thus become sources of competitive advantage.

During not only the stage of new product development (NPD), but also during series production, one activity that is carried out by customer firms is the evaluation of the degree of fulfilment of the required specifications. Different configurations regarding supplier evaluation dimensions and techniques have been established, together with diverse approaches and philosophies for purchasing. In the automotive industry, several practices have become explicit over the decades. The western car assemblers, with their main focus on the price of purchased inputs, used to maintain an "arms-length" relationships with an extensive portfolio of suppliers. However, since the 1980s, when the Japanese car manufacturers challenged the western OEMs, based on their comparative shorter lead times, better quality and lower production costs (Clark, 1989; Cusumano and Takeshi, 1991; Dyer and Hatch, 2006; Kamath and Liker, 1994), there has been a growing interest in developing co-operative inter-firm relationships with specific suppliers (Dyer, 2000; Phillips et al., 2012). The emergence of structures of counterpart-specific relationships has led to the notion of business networks (Håkasson and Snehota, 1995).

What a supplier is willing to do for and with its customers depends, to a large extent, on the relationship between both firms (Fredrikson and Araujo, 2003). Buyer-supplier relationships may reflect both general purchasing orientations (Anderson et al, 2009) and the more specific evaluation criteria of suppliers (Fredrikson and Araujo, 2003; Van Weele, 2005). While some authors argue for the need to ensure the consistency between these two levels (e.g. Anderson et al, 2009), others recognise that a customer cannot present a common approach to its interactions with all its suppliers (e.g. Fredrikson and Araujo, 2003).

In line with this perspective, this study aims to analyse the emergence and the resolution of the non-accomplishment of functional specifications, both in the broader context of the business relationship between the parties, and also in the more specific framework of the criteria for evaluating suppliers. The next section reviews the literature regarding business relationships, supplier involvement in product development and supplier evaluation. The third section justifies the choice of methodology and the methods used to conduct the empirical study. The cases are described in the fourth section and in the fifth section we present a concluding analysis.

Literature Review

In recent years it has been recommended that firms should outsource ancillary activities and concentrate on those core competences that add value to their customers (Quinn, 1999; Quinn and Hilmer, 1994). As they should also construct accesses to competences that complement their own (Phillips et al., 2012), suppliers became ever more important for the performance of their customers. Collaboration with suppliers is crucial for firms that purchase, not only in financial terms, but also for accessing technological resources and benefits (Ford et al., 2008). In particular, inter-organisational networks of suppliers are determinant for the speed of development and for launching new products (Corswat and Tunälf, 2002). In this context, suppliers came to carry out ever more activities than those formerly carried out by their customer companies. This led both to an increase in customers' expenses and also to a greater focus and concern for supplier selection. When companies work together, a successful partnership depends fundamentally on process adaptations and key behavioural aspects, such as trust, commitment and conflict resolution (Anderson, Narus and Narayandas, 2009). These aspects are discussed in the following section.

Business Relationships: trust, commitment and conflict resolution mechanisms

The development of business relationships usually requires mutual orientation and adaptations of those companies involved (Håkansson and Senhota, 1995). Adaptations are necessary to facilitate the coordination of activities, the combination of resources and to create a common view of important targets. These adaptations may concern technical issues (changing production processes or modifying products), or administrative and logistical company rules and routines (Hallén et al., 1991; Håkansson and Senhota, 1995). Walter (2003, p. 724), in a study about supplier involvement, defined adaptations as being "the investment of a customer in the supplier's knowledge, structures, and processes, in order to make use of its resources". Thus, by definition, adaptations imply dedicated or counterpart-specific investments by one or both companies involved (Hallén et al., 1991).

The resulting interdependency gives access, over a period of time, to resources and skills that a company could not develop alone (Ford et al, 2011). However, dedicated investments create interdependencies between the companies, exposing them to the possibility of opportunistic behaviour by the other party. For example, a supplier may fear being forced to lower the price if it became dependent on a customer. Likewise, a dependent customer may be worried about the supplier becoming negligent in terms of quality and other factors.

In this context, trust, commitment and conflict resolution mechanisms are essential to establish, develop and maintain a business relationship (Mohr and Speckman, 1994; Morgan and Hunt, 1994). Trust in a business relationship can be defined as being the firm's belief that actions by the other company will result in positive outcomes for the firm (Anderson et al, 2009). If companies do not trust each other, then they will hesitate to share knowledge and information and will decline any form of influence or control from the other party, which can disturb joint goal-settings and problem solving (Zand, 1972).

Through commitments, companies promote investments between themselves that are dedicated to assets which develop stable relationships (Dyer, 2000). Commitments involve the willingness to make short-term sacrifices and actions, in order to sustain a relationship (Anderson et al, 2009). This can be achieved by guaranteeing a supply contract for the lifetime of a model (Dyer, 2000). In this context, a supplier is much more likely to make dedicated investments or adaptations and to share valuable knowledge with the customer (Dyer, 2000). Relationships with high degrees of commitment are more likely to succeed, without companies running the risk of opportunism from either side (Mohr and Speckman, 1994).

Some sort of conflict is likely to arise, sooner or later, in every business relationship. Conflicts may arise from misunderstood communications, divergent or incompatible goals in the organisational structure or between the companies, insufficient definitions of domain, and differences in perception of specifications (Rosenberg and Stern, 1970). The absence of conflict in a relationship may encourage companies to become passive and non-innovative (Stern and EL-Ansary, 1992). Conversely, conflicts may involve mutual behaviours which are capable of greatly disturbing relationships.

Pathological conflicts may harm or even destroy a relationship (Anderson et al, 2009; Morgan and Hunt, 1994). Functional conflicts, in turn, are productive discussions held to settle tensions, and they result in policy or procedure changes that add value to the relationship (Anderson et al, 2009). Morgan and Hunt (1994) claim that the ability to make conflicts functional is a result of trust between the companies. Anticipation of conflicts can be achieved by both sides exploring inputs from each other on how modifications can be made to adapt processes or technology to common interests (Håkansson and Senhota, 1995), by joint goal setting and information sharing[1]. This leads to mutual expectations and specification of cooperative efforts (Mohr and Speckmann, 1994). Stern and El-Ansaryn (1992) suggested bilateral exchange programmes of employees, so that they be able to represent the viewpoints of partners of major projects that have a high potential for conflict, to be an effective way of preventing problems. Anderson et al (2009) advocated the introduction of boundary-spanning personnel, i.e. employees who are in close contact with partner companies and who are sensitive to problem detection. These individuals are expected to informally pre-empt or solve problems before conflicts arise.

Supplier involvement in product and process development

A firm's strategy in managing supplier relationships is contingent on the supplier's level of integration in the product and process development, which, in turn, is related to the specification-generating process. The degree of supplier involvement in product development reflects the division of work between the supplier and the customer in the product creation process. Kamath and Liker (1994) have categorised suppliers into four groups: Partner, Mature, Child and Contractual. A partner supplier has autonomous engineering and development capacities and the relationship is defined as "between equals". During the product development process, a partner collaborates with the OEM from the pre-concept stage onward, and is responsible for entire subsystems. A mature supplier is defined as "customer has superior position", whereby the supplier only needs basic specifications from the OEM to develop a product, e.g.

[1] Information sharing, in the sense of communication of critical and often proprietary information between the companies involved (Mohr & Spekman, 1994).

interfaces with adjacent parts and aesthetic requirements. A child supplier is defined as "customer calls the shots", needs complete specifications, e.g. dimensions, functional and technical requirements and materials to be used, in order to produce the component exactly as the customer stipulates. Lastly, contractual suppliers are defined as "an extension of a customer's manufacturing capabilities" and provide off-the-shelf parts, which an OEM purchases through catalogues.

In studies of the automobile industry, Clark (1989) concluded from empirical evidence that the supplier's role in product development can be divided into three groups of components. In Black-Box Parts, the OEM specifies the general product requirements, such as performance, cost targets, lead time, etc., and the supplier then carries out the development. In Detail Controlled Parts, components are developed entirely by the OEM, while the supplier is responsible for the production processes. In the Supplier Proprietary Parts, the supplier produces standard parts (off-the-shelf parts) completely on their own.

As mentioned, in the case of Black Box Parts, the OEM takes advantage of the supplier's development capacity. This implies close relationships with the supplier as well as an intensive involvement which results in more efficient product development (Clark, 1989). However, as the product development in certain cases is an interactive process between the OEM and the supplier, Lamming (1993) argued that there should be a distinction between Black Box Parts and Grey Box Parts, the latter involving more OEM influence in the supplier development process.

Some researchers have linked the specification generation process to supplier performance. Karlson et al. (1998) noted that disregard of specifications affects the party's assessment of product development, in terms of quality, costs and lead time. Incomplete specifications can cause delays in product design and an increase in costs. Furthermore, over-specification can hinder the supplier's ability to produce the component within the current budget and technologies (Karlson et al., 1998). However, as noted by Quinn (1999, p. 18), "If the buyer specifies how to do the job in detail, it will kill innovation and vitiate the supplier's real advantage". Araujo et al. (1999) argue that the resources of buyer and supplier and the way that they are developed and brought together, determine the static and dynamic efficiency of a company. More generally, the use and value of a particular resource results from the combination and interaction with other resources in a business relationship (Mouzas and Ford, 2012).

All this suggests that the specification process can be seen as a mechanism for combining the resources and capabilities of the firms involved in business exchanges. Araujo et al, (1999) presented four types of resource interfaces, based on how a customer can access its suppliers' resources. In the case of standardised interfaces, "… the supplier does not need to know about the user context, nor do they need to understand the producer context", and the products exchanged are standardised (Araujo et al, p. 499). If the customer firm prefers a customised product, then the supplier needs to receive certain instructions from the customer. In a specified interface, the supplier requires detailed specifications about the characteristics of the product and/or how it is to be manufactured. In a translation interfaces, the supplier translates the functional description given by the customer into a product. Thus, the buyer allows the supplier to take important decisions on how to best meet the user requisites. Finally, in an interactive interface, both the buyer and supplier develop the specifications together, based on their knowledge of user and producer contexts. This is a joint learning process that may result in adaptations from the parties involved (Araujo et al, 1999; Gadde et al, 2010). Thus, in a strong sense, what a supplier can do for (or with) a customer depends on how both parties combine their resources and capabilities.

Supplier evaluation criteria and purchasing orientations

Several techniques have been established over time to evaluate the performance of suppliers (Fredriksson and Araujo, 2003). These techniques reflect the customer's expectations of the supplier, and whether emphasis is given to short-term performance, or long-term relationships (Fredriksson and Araujo, 2003). In the traditional purchasing model, the customer evaluates tenders from competing suppliers, in order to purchase the cheapest product, based on the buyer's specification (Gadde et al, 2010). In relational models, the target of business customers is not to purchase the cheapest pre-specified product, but to look for solutions by using resources from specific suppliers (Ford et al, 2011).

Anderson et al (2009) argued that the scope of evaluation criteria is associated with different types of purchasing orientations. The buying orientation, or the traditional model of purchasing (Gadde et al, 2010), is a purchasing activity that focusses on transactional and short term relationships with suppliers (Anderson et al, 2009). Every purchasing decision is an isolated event (Gadde et al, 2010), in which usually a different functional department of a customer company issues a purchasing release to the purchasing department. Quality and availability are basic conditions that the customer has to recognise in the supplier, and, as such, price tends to be the main criterion for selecting a supplier (Anderson et al, 2009; Gadde et al, 2010). Through multi-sourcing and global sourcing, the customer maximises their power over suppliers and lowers prices, as it is able to obtain quotes for tenders from large numbers of suppliers around the world (Anderson et al, 2009). Even if a supplier wins the business with its offer, frequently the bidding does not stop. Deflective behaviour and information-withholding occur from both sides as a means of gaining business or lower prices (Lamming, 1993). In the buying orientation, the customer sets the target, and the supplier will hardly ever provide benefits through best performance, as the emphasis is on price (Lamming, 1993; Nellore et al., 2001). The products delivered seek just to fulfil the customers' specifications (Gadde et al, 2010).

In contrast to the buying (or transactional) orientation, both the procurement and the supply management orientations are relational, in the sense that they require collaborative relationships with suppliers (Anderson et al., 2009). Quality and logistic issues may require integrating other departments of production and logistics in the purchasing process (Axelsson et al., 2005). The purchasing department may also work closely with engineers so that the suppliers of critical parts can be involved in the early stages of product design and development. The customer firm may act deliberately to develop its suppliers' capabilities (Axelsson et al., 2005). In these types of orientations, the combination of internal with external resources and capabilities occurs in the context of long-term relationships. It requires other functional groups within the company to be integrated in the purchasing decision and the suppliers' evaluation (Anderson et al., 2009; Axelsson et al., 2005; Gadde et al, 2010). As noted by Teece et al. (1997), purchasing decisions need to consider the value of the resources that are integrated and reconfigured by other functional departments, as these resources define the dynamic capabilities of the organisation.

Different purchasing orientations may co-exist within a particular industry and may change in the same firm over time. For example, in a study about the American auto industry, Dyer (2000, p. 111) pointed out that "In the spring of 1992, General Motors' purchasing czar, Jose Ignacio Lopes, instructed his troops that cozy supplier relationships were a thing of the past. Every supplier would have to re-win its business in a new round of bidding." In the opinion of General Motors' executives, partnerships with suppliers were obstructive (Dyer, 2000). In the same study, Dyer (2000) contrasted General Motors with the example of Chrysler's Extended Enterprise. During the 80's and 90's the American auto OEMs were far behind their Japanese competitors in terms of delivery, costs and product quality (Dyer, 2000). Many companies tried to imitate the Japanese supply management system by cutting costs through reduction of supplier bases, bestowing suppliers with quality responsibility, and implementing just in time (JIT) delivery. As Dyer (2000) contended, these measures merely helped these companies to survive.

According to Dyer, in order to become truly competitive, adversarial relationships with suppliers would have to give way to partnerships. Initially, Chrysler's engineers developed components and then its buyers selected a supplier capable of producing it at the lowest price (Dyer, 2000). After the change, the automaker eliminated competitive bidding in order to create a mutual vision of how to create value. Cross-functional teams of engineering, quality and purchasing professionals were by then choosing the most appropriate suppliers, and giving them significant or total responsibility for developing prototypes and series production, which resulted in a common view of design, quality and cost (Dyer, 2000). In addition, suppliers were asked to assist the OEM in matters relating to improvements in weight, warranty and complexity. The former president of Chrysler, Robert Lutz, explained the new programme to his largest suppliers in the following words: "All I want is your brainpower, not your margins" (Dyer, 2000, p. 124). By doing so, Chrysler managed to become the company with the highest profit per car in the world (Liker, 2004), but only until Daimler took it over in 1998 (Liker and Choi, 2004).

Therefore, several techniques and emphases have been adopted over time to evaluate the performance of suppliers, which all seem to be associated with different purchasing orientations of customer firms. Nevertheless, each functional department in a company may have its own evaluation criteria, since their interests and expectations regarding the counterpart can differ. Consequently, a customer cannot present a strictly common approach in its interaction with suppliers. Fredriksson and Araujo (2003) pointed out that instead of placing too much emphasis on one single dimension, i.e. cost, delivery and quality, the use of multi-criteria models in supplier evaluation provides advantages through the complementing and overlapping of perspectives.

Research purpose

The development of business relationships usually requires mutual orientation and adaptations of the companies involved. In the context of a structure of counterpart-specific investments, trust, commitment and conflict resolution mechanisms are essential to maintain a working relationship. These relationships may reflect general, prescribed, or formal purchasing orientations (i.e. adversarial vs cooperative approaches), and more specific evaluation criteria of suppliers. In line with this perspective, the paper aims to analyse the relevance of the inconsistency between the two levels for the emergence and search for solutions to failures in the accomplishment of functional specifications during the series production stage, i.e. when both parties are interdependent.

By considering the broader context of the business, the relationship between the parties and specific frameworks or criteria for evaluating suppliers, it is herein suggested that the non-accomplishment of functional specifications, and the search for solutions in the stage of series production, may be linked to:

a) The relationship between the firms, namely the customers' transactional or collaborative orientations;

b) The relevance of the division of work in the specification generating process;

c) A fragmented evaluation of suppliers by different functional departments.

Methodology

Case studies are an adequate research strategy to answer "how" questions about a contemporary set of events over which the researcher has little or no control (Dubois and Gadde, 2002; Yin, 2003; Easton, 2010). This kind of question is also associated with process analysis, which is defined as being a sequence of individual and collective events, actions, and activities unfolding over time in context (Pettigrew, 1997:338). This takes into account that business relationships are not steady states, but rather dynamic states with indirect and often delayed effects, which require research over a period time (Dubois and Araujo, 2004; Pettigrew, 1997). Besides, according to Van der Valk (2008), ongoing interactions that take place both within organisations and across organisational borders need researching in real life situations.

Since our objective focusses on questions of "how", in a contemporary context, which involve interactions both within an organisation and across its borders, our case study research strategy seems adequate here. The research site chosen was the Quality Assurance Buy-Parts Department (QA) of a car assembly plant, during August 2012 through to June 2013. This site is particularly interesting, as the diverse capabilities and resources of both the supplier's and customer's functional departments are combined, through an intra and inter-organisational network, in order to resolve together, on the shop floor, any non-conformance that results from earlier activities.

The case study focal actor is one single organisation, and the larger unit of analysis includes two sub units of analysis, which results in an embedded case study design (Yin, 2003). Each sub unit involves the car assembly plant and its suppliers in different technological fields, and in current activity stages. Both stages address new product development and the ongoing process of buy-parts supply. The idea that was underlying this design was not to compare the sub units, but rather to observe the variations among them, and also the individual contributions or relevance to the larger unit (Dubois and Gadde, 2002). As Langley et al. (2013, p. 9) noted, "…ongoing interactions among different individuals, between individuals and organizations, and between multiple levels across organizations and contexts permeate and orient change processes".

In our study, evidence was systematically collected through multiple sources, to triangulate lines of research (Yin, 2003). The evidence collected included company records, statistics, meeting minutes and internal company guidelines from the OEM, as well as direct observations, participant observation, and informal conversation with quality engineers of the OEM and representatives of the suppliers.

Direct observations were conducted in four meetings, at management level and between the OEM and the suppliers used in the study. Every meeting lasted, on average, three hours. In addition, the researcher attended weekly video conferences between the Purchasing, Quality, Logistics, Development and Production departments of the OEM, regarding the management of changes of the current models and delivery dates of first samples of pre-line models. Participant observations were possible, as one of the researchers performed diverse functions relating to quality concerns and the preparation of line processes of buy-parts, and also direct interaction with suppliers. Every week, for nine months, the researcher assumed the position of a neutral organiser of round table meetings between the OEM and several suppliers. These round table meetings were aimed to solve quality concerns and to follow up on new projects of buy-parts.

The case studies

This section starts with a cursory presentation of the OEM, the formal procedures that regulate new product development processes, especially the generation of specifications, the selection of suppliers, the description of their roles, the procedures for quality control and, finally, the procedures for implementing changes in the components acquired by the OEM. Next, we present a description of the technical problems that happened relative to two specific components, and how the parts sought to find out the immediate and remote causes for these problems, in the context of several episodes of interaction between the representatives of the various firms involved.

The OEM: NPD and formal Purchasing processes

The focal firm is an OEM which operates in the automotive industry. Its formal product development process consists of four different stages: the project definition stage, the concept and product development stage, the preparation for series production, and series production itself (see Fig. 1).

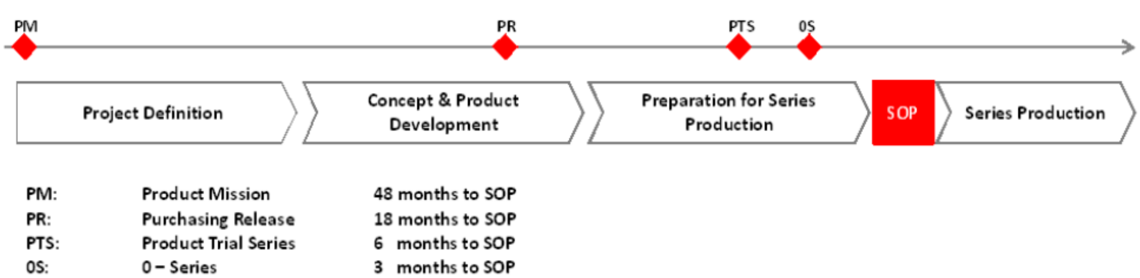


Figure 1: Simplified Product Development Process

Research and Development

The Research and Development department of the OEM (R&D) is responsible for the development of new parts and the vehicle itself and also detailed construction and try-outs. In general, future line suppliers are not part of the concept development phase. Integration usually only happens as a consulting function where the supplier (or engineering service provider) is compensated directly from the product development budget.

The R&D consists of five main sub-divisions: Group Research; Design; Technical Project Management; Group Development Management; Aggregate: Electric/ Electronic, Body/ Interior, Chassis, Complete Vehicle/ Assembly, Concept and Commercial Vehicle Development.

After the technical and feasibility approval of a component, R&D generates the "purchasing release" (PR) (Fig. 1). With the PR, the Purchasing Department, which is centralised in the OEM's head office, receives the order to start sourcing relevant suppliers. The work of Simultaneous Engineering Teams (SET) seeks to reduce the product development time[2]. SETs are composed of employees from the divisions involved in the product development process (e.g. including Production, Logistics, Purchasing and Quality Assurance). SET members represent the project needs of their divisions, and ensure that their divisions' specific requirements be incorporated in the project development.

SETs do not include representatives from suppliers. However, the suppliers of more complex components, such as heating or seat systems, are in close contact, on an informal basis, with the responsible engineer for the respective part, and also from the Quality Assurance (QA) and R&D departments of the OEM.

The setting of specifications

General Management, together with the R&D and Production departments, generate the Product Requirement Letter (PRL) with product and market targets. The PRL, along with the Product Concept (Market Segment and Project Timings), give the input for the Technical Concept Description (TCD) which is generated by the R&D department. The TCD is the main specification in the early stage of the product development process, and it includes rough estimations of Target Markets and is used to evaluate the concepts.

The Technical Project Management of the R&D generates the Technical Product Description (TPD). The TPD is a complete and structured description of the technical requests and specifications for the NPD in the early stage of the Product Development Process. Based on the TPD, the R&D sub-divisions evaluate the financial and time expenses, which occur during the development process. The TPD also provides the Finance, Purchasing, Production, Marketing and QA departments with an overview and evaluation of the project.

For every component, the sub-divisions of R&D generate detailed specifications. These specifications are partly-delineated technical descriptions at sub system and component levels, and drawings and project-specific functional dimension catalogues. Suppliers only influence the specification-generating process if they are contracted as engineering service providers. All specifications are binding for the supplier. Suppliers sometimes claim that the OEM should be more open to suppliers' suggestions (observations by a participant).

[2] SET – Simultaneous Engineering Teams, as opposed to the traditional sequential approach to product development activities.

The sourcing process

When choosing between different suppliers, the OEM separates the sourcing process into two phases: the development phase, where new components for new projects are first developed and then sourced out (forward sourcing), and the line phase (global sourcing) (see Fig. 2). Each decision is made by the Central Sourcing Committee (CSC), through nomination of the most adequate supplier sourced by the purchasing department. Despite the standardised product development process (PDP) which indicates that the sourcing process starts with the PR, depending on the complexity of the components, i.e. time to completion for line tooling, the purchasing department starts sourcing the suppliers at the same time as the development of the respective component.

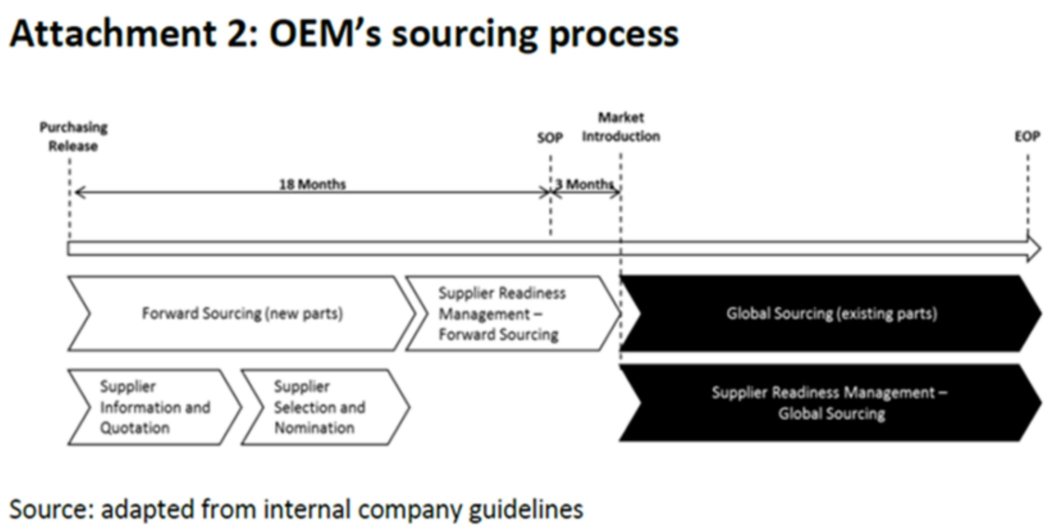


Figure 2: The OEM's sourcing process

Forward sourcing process - potential suppliers are identified using the information provided to the OEM in a B2B platform. After a pre-selection, the supplier receives a request for quotation based on the technical, financial, organisational and quality requirements of the OEM. The supplier then provides a quotation to the OEM and the Purchasing department ensures that this quotation does not neglect any important, possibly price relevant, aspect of the component. During this phase, suppliers are also asked to meet the R&D representatives, and to present their engineering capabilities and available technologies, preferably adding up reference sample parts.

To be admitted as a potential supplier, a firm has to fulfil the standards of the OEM (e.g. regarding quality, process and production). Then the Purchasing department initiates the bidding process, usually oriented at the A-price[3] . Thereafter, a selection of the most attractive suppliers is presented to the Central Sourcing Committee, which nominates the supplier, based on strategic considerations and the competitiveness of its quotations. After the nomination, the supplier starts manufacturing the line tooling. The supplier produces their Production budget, and is reimbursed by the Purchasing

[3] A-price is the price of the product, excluding transport costs.

department, provided that the parts are assessed with grade 1 by the QA[4]. The Purchasing department constantly monitors the project performance of the new components, i.e. Supplier Readiness Management, in order to guarantee the supply of samples for specific project milestones.

Global sourcing process - The aim of the global sourcing process is to optimise the resources of build-to-print parts. At certain time intervals along the line process, the supplier base is reviewed, in terms of cost and performance[5]. The OEM seeks price optimisation by benchmarking, procurement of advantage of price potential, creation of competition, money exchange rates and tracking of new sub-suppliers. As quoted by a member of the CSC: "With the nomination of a supplier, the sourcing process does not stop. It is a continuous process of price optimisation and quality improvement, all at the same time."

Quality Assurance of Buy-Parts

Quality Assurance (QA) is divided into four groups: interior; exterior; chassis, and; electrical parts. Once a supplier is nominated, the QA of the OEM collaborates with the supplier in order to build up a mature series production process. The supplier sends initial samples from the series tooling to the Head of Quality for assessment. Parts have to pass three phases of evaluation (dimensional, material and functional/ assembly) with grade 1. The Production Trial Series (PTS, 6 months before Start of Production, aka SOP, see Fig. 1), and Zero Series (aka 0S, 3 months before SOP) are both built using the required series production facilities, under series production conditions. This way, the OEM is able to perform all the tests with the cars at line standards. The supplier, in turn, has to provide line capacity 6 months before the start of series production.

A final assessment of the product and the process may include a two-day production experiment in front of a representative from the QA at the supplier's facilities, in order to assess its capability for production under line conditions. After SOP, the QA carries out quality measures during line manufacturing. Several cars are chosen every day for product-audits and defects are then categorised as A, B or C faults (see Fig. 3).

Defect category	A-Failure		B-Failure		C-Failure	
Audit points	140	80	60	40	20	10
Evaluation	Safety risk; break down	Extreme surface failures	Strong influence in function and design	Unpleasant, out of requirements	Noted by demanding client	
Effect on client	Not available for client	Immediately to workshop	Client will claim the failure at the next service appointment		Client criticises quality	
Detectable by	Every client					
	Average client					
	Demanding client and trained auditor taking into account the internal quality standards					
Actions	Failure has to be corrected, it must be assured that car will not get to the client; 100% firewall of stock					
Preventive actions	Initiation of actions in series process to prevent repetition of failure				Observe and avoid downgrade	

Source: adapted from internal company guidelines

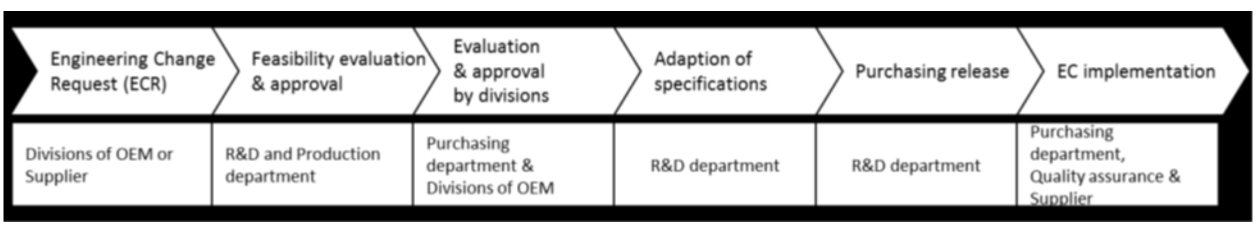
Figure 3: Audit Defect Categories

The auditors also differentiate whether the defects appeared during final assembly, stamping, or body production or whether they are due to failure of buy parts. If the defect is supplier-related, depending on the category of the defect, QA then takes action vis-à-vis the supplier. Some suppliers have resident engineers at the OEM plant for joint problem solving and faster reaction times. The QA keeps a database with the audit points of defected components that have been delivered by each supplier has, for the supplier performance assessment.

Engineering Changes

Once a component has been defined and released by R&D, it only can be modified through what is called an Engineering Change (EC). Modifications may concern the product itself (design, function, material, etc.) or the process (manufacturing, logistics, etc.). ECs can be requested either by the departments of the OEM (e.g. R&D, QA, and Production), or by the supplier. After an EC is requested (ECR), its feasibility has to be judged by the R&D and Production departments of the OEM. After feasibility approval, the ECR is sent to the Purchasing department. The Purchasing department then evaluates the ECR, together with all the divisions that are affected by the change (e.g. Finance, QA, Logistics, etc.). The final approval is decided later by the Product Management for that vehicle project, based on the overall impact of the EC on the vehicle (quality, cost, etc.).

After final approval, R&D adapts the drawings and specifications to the demands of the EC and then provides the new PR (purchasing release). With the new PR, the Purchasing department requests that the supplier implement the change in their production. After the implementation is completed, the supplier is required to send initial samples of the "new" part to the respective quality engineer for assessment. Once accepted by the quality engineer, the supplier starts the series production of the changed part (see Fig. 4). The whole process takes about 3 months (but can take up to one whole year).



Source: adapted from internal company guidelines

Figure 4: Engineering Change Process & involved parties

Sub Unit of Analysis 1: Decorative Films

The 'SP-Model 2' is a special version of the current OEM Model, which is fabricated at OEM Inc., a European production unit of the OEM. The idea was to build an image of a loud sports car i.e. "the evil of OEM", and to stimulate the life cycle of the OEM A-segment, a mixture of a sporty hatchback and a coupé. The car should continue the characteristics of the OEM 'SP-Model 1' from the early 1980s, through the placement of decorative films and nostalgic features, such as the ball gear stick, among others. The focus of this case is on the decorative films, which are relatively simple in terms of product and process technologies, yet have to meet high quality standards and aesthetic demands.

In December of 2011, R&D gave the purchasing release for the decorative films, and the CSC (Central Sourcing Committee) nominated Supplier 1 and Sub-supplier 1 to supply the decorative films of the SP-Model 2. Supplier 1, located in Central Europe, possesses advanced manufacturing and developing capacities for product design and labelling solutions for both the automotive and non-automotive sectors. Supplier 1 supplies scuff-plates for all current models of the OEM. In this process, Supplier 1 receives the raw material and then cuts and combines it to the desired dimensions and colour combinations, according to the specification from the R&D department. Sub-supplier 1 supplies the raw material to Supplier 1, in preparation for series production.

According to a purchasing representative, the main reason for the nomination of these suppliers was the cheaper A-price of the components. One of the Product Managers expressed his 'tongue in cheek' view about the nomination of Supplier 1: "what a pity… I thought that it was due to their experience…". The CEO of a competitor company (Supplier 2) recognised that his firm would not be able to compete on price with Supplier 1 for the decorative films.

In preparation for series production, Supplier 1 and OEM Inc. made several dedicated investments, e.g. an 'application chamber', a special room with low air circulation, and cupboards for the foils, special light and anti-static suits for anyone who entered. Furthermore, OEM Inc. carried out several workshops with Supplier 1, to train those involved in the process of applying the decorative films. OEM Inc. was the first production unit of the OEM to integrate these stripes in their series production. Other production units only provided "after sales" solutions.

During 2012, several problems began to arise with the supply of the decorative films. In April of 2012, Supplier 1 missed the delivery date for the initial samples, due to bottleneck problems with Sub-supplier 1. In June of 2012, some non-conformances were identified, regarding dimensions, colours and material. Master samples for colour measuring and material structure, signed by R&D (foil glued on body steel) had not been made available. The Production Department initiated an ECR (Engineering Change Request) to change the dimensions of the foils. Supplier 1 and Quality Assurance agreed that the base material was the most critical issue and suggested using other suppliers, e.g. Sub-supplier 2. However, R&D accepted the surface characteristics after comparing it with raw material from other suppliers, and the ECR dimensions. The Sales and Marketing Department of the OEM Group prepared, together with Supplier 1, a "Photo Car" and announced the car as already being available for sale.

However, in July 2012, the OEM Inc. Quality Manager did not approve the structure of the base material when the '0-series' cars were built. The issue escalated to the OEM's top quality management and, a few days later, all production was cancelled.

Supplier change – Series Production

In August of 2012, the CSC (Central Sourcing Committee) nominated Supplier 2 and Sub-supplier 2 to become the line suppliers for the project. Supplier 2 is a small company, specialising in cutting and combining decorative films and already supplies decorative films to two production units of different brands of the OEM. Sub-supplier 2 is a major company in vehicle surface solutions, and is a global player in industries such as healthcare and fire protection, amongst others. Through Supplier 1, it supplies two other production units of the OEM Group with similar products.

After SOP (start of production) of the SP-Model 2 in November 2012, some of the stripes sets supplied to OEM Inc. were found to be defective. OEM Inc. rejected several of them and returned them to Supplier 2 to assess the identified defects. Due to the situation (stripes had already been glued to the car bodies and were then ripped off them), Supplier 2 and Sub-supplier 2 could not analyse the defects before application.

In February 2012, a meeting between quality representatives from OEM Inc. and the OEM, Supplier 2 and Sub-supplier 2 was held to openly discuss questions relating to the failed analysis and the lack of feedback from the supplier. Representatives from R&D and the Purchasing department did not attend the meeting. The application specialist of Sub-supplier 2 claimed that the damage of the scratched rejected parts was due to incorrect application. Therefore, the suppliers suggested carrying out further workshops to train the application personnel, in order to guarantee a high level of quality during the application process, as well as a three days stay of the suppliers at the OEM Inc. plant to analyse the defects. Moreover, suppliers claimed that OEM Inc. should pay them some compensation. OEM Inc. rejected this idea, and claimed that they had all the competences they required for application of the film. They also insisted that Supplier 2 and Sub-supplier 2 rent external installations to analyse the failures, together with representatives from the Quality Department, and to set up a failure/ defects catalogue.

Sub-supplier 2 indicated that in foil projects, failures or defects could appear at any point along the whole process chain, which included production activities at the Sub-supplier 2 and Supplier 2 units, and logistics and application processes at OEM Inc. The suppliers requested better quality control (Quality Gate at OEM Inc.). However, as the zero defect strategy challenges suppliers to send only good parts, rather than a ppm (parts per million) target for the supplier, this proposal was not accepted by OEM Inc. Sub-supplier 2 also pointed out that the supplied quality satisfied the standards of the current projects at the OEM.

Usually, the OEM scraps rejected parts and fines their suppliers for these rejections, alleging the disturbance cause to the manufacturer's production process. However, in this case, Supplier 2 was exempted from paying these fines, due to a bilateral agreement with the Quality Department.

In April 2012, there was second meeting with the suppliers, to seek an agreement regarding the non-conformance of the line process. The CEO from Supplier 2, as well as the Key Accounts Manager and Application Specialist from Sub-Supplier 2, met the quality manager and engineers from production and the exterior buy-parts department, as well as representatives from logistics from OEM Inc. A breakdown of the scrapped parts showed that 18% of parts had been delivered with defects, 55% were due to process failures, and 27% had been FCP (Final Check Point) quality audit rejections. In other words, the acceptance criteria of the Application Supervisor is different to that of the QA Auditors.

According to the OEM's engineers, the main problem in the application had to do with dust in the environment. However, the application specialist from Sub-supplier 2 disagreed. He pointed out that no problem had arisen in another production unit in the OEM Group which happens to be located close to an active volcano, hence with large amounts of dust in the atmosphere. In the opinion of this application specialist, some parts had been rejected for defects, such as scratches, that would not be visible after application. Moreover, additional training of the operators would allow them to have more success in discriminating good parts from parts to be rejected. However, the exterior buy-parts engineers did not accept these contentions.

Anyway, the sub-supplier 2 had already compiled a training manual for another OEM Inc., and it was his intention to standardise the application process across the plants of the OEM Group. He also requested permission to analyse several defective parts with a microscope, and to elaborate a defect catalogue intended for use by the whole group.

As the films could not be properly analysed after having been removed from the line, the application specialist (Sub-supplier 2) called for a gentlemen's agreement with the OEM regarding the rejection of parts. Cost sharing for the defective parts was agreed with the QA. Supplier 2 and Sub-supplier 2 would also meet at the OEM, at certain intervals, to examine the scrapped parts, together with the latter's quality engineers.

Sub Unit of Analysis 2: Sliding Door Module

Supplier A is a concept supplier of side-door actuators of the OEM's Multi-Purpose Vehicle (MPV). Located in Central Europe, in 1925 the supplier created the first automobile side-door latch, and since then it has developed over 200 lock families, with up to 96 latch variants. Supplier A supplies a wide range of automotive manufacturers, up to F-segment cars, and has patents of electrical solutions for sliding door modules.

The MPV was launched in 2010, being the first non-commercial vehicle from the OEM with a sliding door, which is available for customers on both sides of the car. In the concept stage, the supplier presented two different solutions to R&D, one for the left, and another for the right sliding door. In the design of the component, the gravity of the electric motor minimises the play between the actuator and the driving screw. This characteristic requires that the electrical motor be placed ahead of the actuator. R&D approved both modules.

However, afterwards, the Purchasing department agreed with R&D to introduce only one type of sliding module in the line, in order to reduce the A-price. Due to this decision, the fixing point of the motor changed, and now the electric motor of the right sliding door was placed underneath the actuator, which resulted in a gap between the actuator and the driving screw.

Several months after the SOP of the MPV, car owners complained about abnormal noises on the right sliding door. Car owners called for rectification under warranty conditions. Supplier A was invited to discuss the problems at a round table meeting at the OEM's premises. The first meeting took place in November 2012. Representatives from senior management, QA, and the Production departments from both sides discussed the issues.

The specification for noise level was 60 dB, whereas the complaint was about a noise level that was slightly over 50 dB. The component's technical requirement also indicates that no disturbing noises should be heard inside the car. The OEM has special acoustic requirements, a standard to which the device to be developed must conform, e.g. window lift, control motor relay, pump and valve. This specification mentions several norms to test the noises of the devices. The specification states: "Accessory device starting automatically with combustion engine switched off must not exceed 55 dB".

The supplier indicated that, during the last visit by the OEM's representatives to the supplier's installations, they had examined the control plan several times without significant problems. The main problem, according to Supplier A, was not the processes, but the concept and additional requirements added to the approved concept after the start of series production. In fact, the component is in its 38th generation, which means that it has been changed 38 times since being accepted for series production.

To test noises, the supplier uses a whole MPV body to measure the total sound pressure level of the motor when it is in use. Supplier A developed, for this purpose, a software to measure the total sound pressure, vibration, natural frequency and frequency peaks at end of line testing. As the car owners claimed to hear the noises mainly when the car was parked and inclined towards the front, the test centre from Supplier A used a hoist to lift the rear end, to simulate this situation.

Supplier A's End-of-Line tests revealed no dB difference in the analysed actuators, however, in the assembled cars, the right hand side was noisy. During the following week, Supplier A was to present improvement and quality control proposals, in order to solve the issue. OEM Inc. and R&D from OEM Group then evaluated these proposals with relation to cost, feasibility and timings. Thereafter, Supplier A was to perform experiments during a whole production week at the OEM, in order to evaluate the noise levels in road tests. However, the requests from the OEM were not satisfied.

At a second meeting in April 2013, two cars were displayed to the Quality Managers from Supplier A. Both parts made several proposals and agreed to implement four technical solutions. Supplier A was to present 200 modules, with all the four hypothetical solutions implemented in equal numbers.

The supplier also claimed that the touch area should be changed or isolated, but the OEM argued that several tests regarding this issue had previously been carried out, without improvement. As 200 modules meant a considerable investment for the supplier, the Quality Manager from the OEM recommended that the supplier should request a Deviation Permit[6] from R&D.

Supplier A made it clear that they had invested in an ongoing improvement process, without having received the whole budget for the project from the OEM. The supplier indicated that the parts are spec-wise. As the project was evaluated by the QA of the OEM with Grade 3 (conditional acceptance), supplier A was only paid 70% of the project budget. The Purchasing Department was to fund the rest of the project, once Supplier A had received Grade 1 from QA. Consequently, the supplier reduced its support for the project to a minimum.

[6] A Deviation Permit is requested from the R&D to produce a limited number of components deviating from the standard specifications. This measure is used for large scale tests to define improvements which afterwards may be implemented through ECs

Following the meeting, Supplier A was attributed Grade 1, in order to receive the shortfall. The modules with the Deviation Permits were to be tested, and the best improvement was to be chosen for subsequent implementation through an Engineering Change in the process. Again, the modified parts would be evaluated, according to the normal first sample assessment process. Once the "new" parts received Grade 1, the Purchasing Department would then pay the shortfall to the supplier. Based on this decision, the supplier would be able to meet the requirements regarding module optimisations.

Concluding analysis

This study sought to analyse the emergence and resolution of failures in achieving functional specifications, both within the broader context of the business relationship between the parties, and also the specific framework constituted by the criteria for assessing suppliers. More specifically, we contend that the non-accomplishment of functional specifications, together with the search for solutions in the stage of series production, depend on the relationship between the firms, the division of work in the specification process, and a possibly fragmented assessment from different departments.

Regarding the first question, i.e. the relationships between firms, the cases made clear that there can be a 'tension' between a firm's formal (or procedures) approach to its suppliers, and the approach that is actually adopted on the shop floor. It should be remembered that if the emphasis is on price as the main criterion for the selection of the suppliers (in the first case), or for the selection of technical solutions (in the second case), then this reflects the predominance of a short-term orientation with regards to firms' relationships with their suppliers. As we saw, new suppliers may provide quotations during the series production process.

However, in the face of specific problems in the preparation for series production, or during series production, tensions emerge around non-conformance issues and these force changes or deviations from the customer's formal (adversarial) orientation. In fact, on the shop floor, some functional departments of the customer tend to be more collaborative with suppliers when it comes to non-accomplishment of functional specifications. In order to improve process and product quality, both specific functional departments and the suppliers have to make dedicated investments and must gradually adapt to certain company rules and processes. These informal adaptations on the shop floor can be interpreted as being a manifestation of reciprocal willingness for commitment and trust building (Hallén et al. 1991). In other words, despite the formal purchasing orientation, a degree of consistency emerged between a new informal orientation (more collaborative) and the criteria used to assess and maintain a working relationship between the customer and the supplier.

Our cases provide further evidence of these changes, if we consider conflict resolution mechanisms. Our focal organisation uses a method called 'round table meetings' to discuss openly and without domination and confrontation, emerging conflicts between the OEM and the supplier. When, in meetings, the customer unilaterally demands improvements from the supplier without its support, then some stress creeps into the relationship, and trust and commitment tend to falter. In contrast, these meetings lead to good results when both parties contribute with ideas and knowledge in order to solve non-conformance.

Secondly, in face of the problems related with the non-accomplishment of functional specifications in the production unit, some of the problems can be traced back to a lack of involvement of the suppliers in new product development activities. As stated in the exposition of the cases, the specifications are generated exclusively by the OEM Group's R&D during the development phase. The supplier has to fulfil these specifications, otherwise failing will lead to losing business, or failing to be paid the budgeted sums that they invested in producing the component. As suppliers of Detail Controlled Parts (Clark, 1989), the supplier is responsible for development, but it has no influence on the integration of the component in the final system. Additionally, when a supplier is given development responsibilities, they are supervised by the R&D department and do not necessarily become line suppliers. It is worth remembering that, since the supplier is not present in SET (simultaneous engineering teams), mutual adaptations of technical issues are hard to obtain at this stage of the product creation process. These adaptations would be essential for the function of the product itself and integration in the whole system, in order to prevent the dissatisfaction of future car owners (case 2). As illustrated in our cases, engineering changes are financially costly and time-consuming processes, and it is suggested that both disadvantages might be contained if the manufacturer sough inputs from the supplier at earlier development stages.

Additionally, the cases also showed that it is possible for mutual adaptations to start, and to even continue during the preparation for series production, or even after the start of production. In these two cases it is evident that suppliers had been a source of new ideas to the OEM's technicians, which suggests that the knowledge boundaries between the supplier and customer became somewhat blurred. It is therefore natural that, in the face of recurrent problems of a similar type, quality engineers often claim that the Purchasing and R&D departments should be present at quality meetings that are held to clear out surging non-conformance issues arising during series production on the shop floor (case 1). The QA members see themselves as the area that has the closest contact with the supplier, where the competences of all involved parties converge.

Finally, the empirical studies illustrate how important it is to develop an integrated vision of internal and external resources and company policies that govern the way that resources and competences are combined in product development and series production. A lack of integration of a variety of perspectives and experiences with suppliers may generate, on the one hand, tensions and conflicts among internal departments and, on the other hand, inconsistencies between firms' purchasing orientations and the specific frameworks used in the daily interactions between customer representatives and suppliers. In one of the cases, the Purchasing department had selected a supplier based on its cheaper price, but the Product Manager would rather have emphasised this supplier´s experience. Emphasis on a single dimension, i.e. price, during the supplier evaluation process, can later lead to increased expenses throughout the whole product development process. These expenses become particularly clear during the preparation for series production and in production itself. Two processes, described in these cases, support this contention: one, when the OEM changed its foil supplier due to non-satisfying quality from the QA's point of view and, the other, the Engineering Changes of the sliding door module.

Our study reinforces the notion that what a supplier is willing to do for and with the customer depends largely on the relationship between the parts (Fredrikson and Araujo, 2003). As suggested by several authors, efficiency and innovation can be improved by early supplier involvement, combining internal with external resources and trough developing long-term partner relationships and integrating other functional groups within the company in the purchasing decision (Anderson et al., 2009; Axelsson et al., 2005; Gadde et al, 2010). In this context, supplier assessment can become a systematic effort to promote the sharing of different perceptions and experiences generated through time within specific supplier-customer relationships.

Our study added two important contributions to the literature. Firstly, the study reveals the potential for inconsistencies between the broader context of the prescribed business relationship with suppliers and the specific framework of criteria for evaluating them. Secondly, in the face of inconsistencies between the formal purchasing orientation and the specific frameworks used to work with and assess suppliers during line production, local solutions can emerge. These local solutions can translate into mutual adaptations, even after the start of production. As we have illustrated, operational level staff can actually suspend the formal transactional logic, at least temporally, and can act with a cooperative logic, in order to resolve non-conformances.

Closer to a prescriptive stance, it is suggested that the suppliers' informal disposition centres on technical challenges that should not be blocked by company rules, but instead should be considered for future sourcing decisions. Rather than view non-conformances as isolated events, they may be an opportunity to learn about their causes in close and remote routines and capabilities. In our focal organisation, this may mean that representatives from Purchasing and R&D need to be in close contact with emerging non-conformances on the shop floor.

This study has some limitations, and it suggests some opportunities for future research. For instance, it has not been possible to evaluate to what extent the restrictions set by the customer regarding components' specifications may have substantially reduced the suppliers ability to re-use their experiences and competences with other customers. Likewise, it has not been possible to explore how different interfaces might have been activated that envisaged diverse purposes (see, e.g. Araujo et al, 1999), involving a pool of suppliers (Axelsson et al., 2005; Gadde et al., 2010). This study also suggests that more research is required as to how the development process and changes in the specifications may occur along with their testing in user contexts, while new capabilities develop in-production contexts. This may place additional demands on the mechanisms used to combine such a variety of experiences (Dyer and Hatch, 2006).

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