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Supplier-buyer Collaboration in New Product Development: Four Case Studies Involving SMEs

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Abstract

New product development at inter-firm level is clearly an important topic for researchers and managers. Although many papers have reported the importance of collaboration in NPD the collaboration involving partners with different technology endowments and how many small firms have managed to achieve a status of reciprocity have remained unaddressed. In this exploratory study four multinationals and sixteen suppliers were visited and their top executives interviewed to determine the key success factors of collaborative product development as perceived by suppliers. Four case studies were prepared in order to exemplify the supplier's perceptions to inter-firm product development involving differently endowed firms. The main findings are clear: suppliers and clients have different perspectives and play different roles due to the bargaining power exercised by the latter and by the *fight* for reciprocity of the former.

Keywords: product development, collaborative strategies, supply chain management, co-operation, Portugal

Introduction

Although the management of the supply chain is an important aspect of firm's competitive advantage, only recently proper attention has been given to New Product Development (NPD) activities as part of this supply chain.

Collaboration between two or more organisations is expensive, resource intensive and risky (Hartley et al., 1997). Effective integration of suppliers in collaborative product development (CPD) can yield some benefits as well (Handfield et al., 1999), namely achieving reduced cost at product development, decreased risk of failure and reduced time taken in product development.

Most of the research on CPD is the outcome of experiences carried out involving multinational players in technologically advanced settings. Despite the widespread

recognition of the success factors and of the reasons for failure in collaborative approaches, little research exists on the factors that affect the involvement of small and medium-sized firms with limited technological endowments. Thus, it is the aim of this paper to fill this gap addressing the main key factors that affect supplier's involvement in collaborative product development. An exploratory study was performed using data from 16 suppliers and four case studies have been prepared to address this context-specific situation in order to answer two questions. First, what key factors lead producers to involve their suppliers (SMEs) in CPD? Second, how are small suppliers responding to evolving challenges of their buyers?

The Development of New Products

The study of new product development (NPD) has been multidimensional in nature, highly complicated and has involved holistic and soft systems approaches.

The literature indicates that differences in NPD performance occur due to differences in availability of resources, in firms' size and organisational specialization. Lindman (2002) contends that the firm's ability to take advantage of emerging opportunities is a matter of management skills availability and the corresponding ability to create and apply new knowledge.

Cooper (1979) was one of the firsts researching on performance factors in single products. He found that excellent market knowledge, marketing skills, effective product launch and an adequate technical and production synergy were the most important factors of superior performance.

The importance of new product development for businesses was clearly put forward by Griffin (1997a). She demonstrated that while 49% of sales growth at successful companies comes from new products only half of that growth comes from less successful firms at launching new products. These results support Urban and Hauser's thesis (1993) that asserts that successful performance is highly connected with proper launching of new products and marketing performance.

Urban and Hauser (1993) studied the success factors and the reasons for failure in launching new products, as shown in Table 1. Although very relevant in the business arena, the main problem with the success factors stems from the definition of success, which is very ambiguous. For example, a failure in launching a new product may result in new knowledge that is used profitably in subsequent launchings. As a consequence, success may depend on the goals and objectives defined, on the appraisal perspective and on the lack of control of exogenous factors.

The identification of key success factors has been controversial with Ernst (2002) questioning some results obtained by NPD gurus, especially due to methodological problems. Based on a survey of the literature, Ernst (2002) found that the following five key success factors in new product development influences the firm's performance:

Table 1 – New product success factors and reason for failure.

Success Factors	Reasons for Failure
Global focus - world wide strategy	Small market
Short *Time-to-market*	Forecasting errors
Match customer needs	Not new/innovative products
High value to the customer	Insufficient return on investment
Innovative products	Organizational problems
Technical Superiority	Lack of cross-functional co-ordination
Screening, analysis and decision support system	Changes in customers tastes
Favourable competitive environment	Poor strategic positioning
Adequate firm-industry fit	Inadequate support to distribution channel
Cross-functional communication	Technological shifts during product development
Top management commitment	Disciplined new product development process
Disciplined new-product process	Changes in the competitive environment
Dynamic development department	Poor after-sales service
Avoid unnecessary risks	
Quality and customer satisfaction in all phases	

Source: Urban and Hauser (1993).

the NPD process, the organization of that NPD process, the managerial culture, the top management commitment and the NPD strategy.

The NPD literature is varied and multifaceted, which makes it difficult to select an appropriate body to rely on. Thus, taking into account the five above-mentioned key success factors some selected articles are put forward on Table 2. Clearly, Cooper and Kleinschimdt (1995; 1996) approach NPD success factors extensively. After analysing 48 characteristics in a written questionnaire involving 135 industrial firms in Canada, USA and Europe they concluded that:

- High quality NPD process involves: a) quality of process execution; b) completeness and thoroughness of the process; c) an emphasis on pre-development activities; d) a sharp, early product definition; e) a tough go-kill milestone; f) the flexibility of the process; and g) a strong market orientation;
- High quality NPD development teams involve: a) a dedicated project leader; b) frequent communication and team meeting; and c) efficient decisions with minimum bureaucracy;
- NPD cross-functional teams involve: a) assigned teams of players; b) a multifunctional team; and c) a project leader and a team accountable for all facets of the project;
- Senior management commitment in NPD success involves: a) participation in go/kill decisions; b) allocation of necessary resources to NPD; c) identification of NPD annual objectives; d) NPD measures; e) adequate R&D budgets; and f) personnel resources; and
- High quality NPD strategy: a) definitions of goal for NPD programme; b) definitions of roles and business arenas of new products; and c) long-term projects and focus.

Table 2 – Selected literature on NPD key success factors.

NPD Process	Cooper and Kleinschmidt, 1993b; 1995; 1996; Athuahene-Gima, 1995; Balbontin et al., 1996; Griffin, 1997b
Organizational Aspects	Cooper 1994; Cooper and Kleinschmidt, 1993b; 1995; 1996; Song and Perry, 1997; Song et al., 1997; Balbontin et al., 1996; Griffin, 1997b
Cultural Aspects on NPD	Cooper and Kleinschmidt, 1993b; 1995; 1996; Barczak, 1995; Song and Perry, 1997; Yap and Souder, 1994;
The Role and Commitment of Senior Management	Cooper and Kleinschmidt, 1993a; 1995; 1996; Balbontin et al., 1999; Johne and Snelson, 1988; Song and Perry, 1997; Yap and Souder, 1994;
NPD strategy	Cooper and Kleinschmidt, 1995; 1996; Griffin, 1997b;

Suppliers' Involvement in New Product Development

Collaborative approaches have been receiving a growing attention in the technical literature, with global competition and technological change pointed as the main drivers of these approaches. However, when NPD is included in collaborative approaches the traditional perspective of network of firms is in jeopardy because the competitiveness of several companies along the supply chain is differently affected due to the radical, interactive and multifaceted nature of CPD.

Although the reasons behind partners' involvement in partnerships vary extensively, the main issue for the producer in inter-firms relationships is the progressive integration of some key suppliers, which implies a serious commitment among partners in terms of *shared* competitive attitude (Bertodo, 1991; Clark, 1989). This attitudinal change paves the way for cooperative approaches to stand out as an alternative to antagonistic approaches. In this way, vertical cooperative strategies allow that the supplier's competitive advantages complement the client's ones and therefore are synergistic in nature.

Lamming's (1993) work gave supplier-client relationships a new life. He demonstrated that this relationship is evolutionary and cumulative in nature and depends on the mutual involvement of both the supplier and the client, the atmosphere of both firms' interaction and the environment in which the relationship takes place.

Lamming (1993) made public that the challenge of product design integration along the supply chain depends on multiple factors, not just in the two partners' convergent interests as originally thought.

Clark and Fujimoto (1991), Imai et al., (1985) and Womack et al. (1992) gave new light to NPD studies emphasising the importance of the different parties involved in NPD and addressing the importance of cross-functional, inter-firm product development

The shortening of the cycle time as a means of introducing new products more quickly into the market gave the involvement of suppliers in the design phase a fundamental importance. Clark (1989) concluded that supplier's involvement in the design phase and in problem resolution were critical in CPD. Suppliers' engineering competencies are also important: they influence NPD scope and project quality. Clark (1989) proposes not only that suppliers get involved in the initial phase of the product development, but also that both suppliers and clients base their relationship on what he called *reciprocity*: the clients should nurture their suppliers' competencies in order for them to assume some critical tasks in the development process. Wheelwright and Clark (1995) go even further defending that the development of product design competences is of fundamental importance in the long run of industrial companies' competitiveness.

Liker et al. (1995) demonstrated that the involvement of first-tier suppliers in co-design activities has positive impacts on NPD performances in terms of cost, quality and lead times.

Parnership activities in upstream activities involving NPD have traditionally followed two strands: the Japanese and the western style (Dyer and Ouchi, 1993; Liker et al., 1996). There are clear misunderstandings about the transfer of best practices from Japan to the Western world. As Fujimoto (2001) and Dyer (1998) demonstrated, a long-term relationship setting is missing when applying procedures as cost control and profit and information sharing.

Based on the nature of cooperative buyer-supplier relationships characterised by concepts such as trust and mutual dependence, Zirpoli and Caputo (2002) proposed seven principles for implementing buyer-supplier relationships:

1. The OEM should set the rules of the supply relationship in order to organise this vertical market;
2. There should be a preference for a long term obligational contractual relation instead of an arm's length contractual relation;
3. The use of techniques such as target costing, target pricing and value engineering are important means to implementing a fair distribution of relational quasi-rents;
4. The OEM should have a small number of suppliers for each type of part in order to provide them with enough production volume so that they can invest in R&D;
5. There must be competition between suppliers;
6. Sharing and managing information and knowledge is crucial for OEMs to impose transparency; and
7. Reputation should be one of the most powerful discipline mechanism for managing the supplier-buyer relationship.

As collaborative product development involves internal and external actors and functional areas, firms need to intensify cross-functional communication among the

network of suppliers in order to increase speed-to-market responsiveness and flexibility in the creation of new products (Imai et al., 1985). As a consequence, hierarchical relationships with suppliers are giving way to more collaborative approaches.

Taking into account the extent to which suppliers are involved in product development, they may be divided in four categories according to the type of products they supply (Clark and Fujimoto, 1991; Lamming, 1993): as *Supplier-proprietary parts*, as *Black-box parts*, as *Grey-box parts* and as *Detail-controlled parts*. *Supplier-proprietary parts* are standard components whose development is the supplier's responsibility. Their influence in downstream activities in the value chain is small. *Black-box parts* are components whose functional and performance requirements are specified by the customer, but whose engineering details are handled by the supplier. This allows the producer to use the supplier's knowledge and engineering base while maintaining the technological control over the end product. *Grey-box parts* are similar to black-box parts but the producers control a great deal of the parts' internal functioning. Finally, *detail-controlled parts* are components whose technical and design requirements are carried out entirely by producers. In this case the involvement of the suppliers is perfectly passive since the whole decision process is the producer's responsibility.

Clearly, the supplier is not *de facto* involved in product development neither in the *supplier proprietary parts* nor in *detail-controlled parts*. In the first case the "relationship" is almost null due to the fact that *supplier proprietary parts* can be viewed as off-the-shelf components. In the second case the supplier's involvement is perfectly passive since the whole decision process is the buyer's responsibility.

An important tacit aspect in this typology is the degree of involvement of the suppliers, which is related with two reciprocal aspects: the supplier's capability in assuming NPD responsibility and the client's commitment in a bilateral relationship. Kamath et al. (1994) criticize this tacit relationship defending that only some first-tier suppliers are *de* facto partners.

Kamath and Liker (1994) approached the supplier-client relationship from the perspective of the suppliers addressing the evolutionary dynamics in inter-firm relationships. The main characteristics of those relationships are shown in Table 3. As can be seen, the supplier only assumes the design responsibility in mature and partner phases. Although there is a shared responsibility in the child stage, the supplier has to follow detailed information and specifications imposed by the client, which implies that its role in NPD process is incipient.

Suppliers' Involvement in Collaborative Product Development: Potential Benefits and Critical Factors

The management of NPD process at inter-firm level is a key element of competitiveness. It involves the management of different a) strategic interests; b) knowledge and

Table 3 – Supplier roles in product development.

	Contractual	Child	Mature	Partner
Design Responsibility	Client	Joint	Supplier	Supplier
Product Complexity	Simple Parts	Simple Assembly	Complex Assembly	Subsystem
Specifications Provided	Complete Design	Detailed Specifications	Critical Specifications	Concept
Supplier's Influence on Specifications	None	Present Capabilities	Negotiate	Collaborate
Stage of Supplier's Involvement	Prototyping	Post-concept	Concept	Pre-concept
Component-testing Responsibility	Minor	Moderate	Major	Complete
Supplier's Technological Capability	Low	Medium	High	Autonomous

Source: Kamath and Liker (1994).

technological capabilities; c) perceptions of the external environment; and d) collaborative involvements. Therefore, the integration of the NPD process implies shared challenges at R&D level as well as common efforts at new product development level, which according to Nishiguchi (1994) involves an inter-firm co-specialisation among participants.

The successful integration of suppliers in NPD involves many variables (Kamath and Liker, 1994; Handfield et al., 1999): the tier structure, the responsibility for design, the timing of supplier involvement, intellectual property agreements, inter-firm communication, membership on project team, supplier's capabilities, component-testing responsibility and technology risk assessment. It is not strange then to assess successful supplier integration in terms of new product development process.

Many benefits have been mentioned in support of the client-producer relationship and consequently only the most relevant ones will be mentioned. In terms of collaborative development Littler et al. (1995) state that frequent inter-firm communication, building trust, establishing partnership equity and employing a collaborative champion beneficial for NPD process. Hartley et al. (1997) found that the longer the time of supplier involvement the more the perceived contribution to new process design. Wasti and Liker (1997) concluded that early supplier involvement allows more focus for *Design for Manufacturing* and an improvement in the inter-firm design process.

The drawbacks of supplier-client partnerships in the supply chain have not been widely disclosed. Mohr and Spekman (1994) state that the evidences of superior competitiveness for both partners are much more implicit than explicit. Hartley et al. (1997) concluded that the adoption of generic techniques as suggested in the technical literature does not necessarily lead to a shorter product/project development lead-time. Littler et al. (1998) question the design collaboration asserting that in 40% of the companies studied the collaboration turned the NPD process more expensive, more complicated, less efficient,

more difficult to control and harder to manage. Terwiesch et al. (1996) defend that CPD only has financial interest when the suppliers are large companies. Reciprocally, it is not interesting for suppliers of small size. Finally, Eisenhardt and Tabrizi (1995) demonstrated that the suppliers' involvement in the reduction of product development lead-time was only interesting in mature industries.

This paradox between benefits and inconveniences leaves plenty of room to address the understanding of the critical success factors that make the supplier-client relationship well succeeded at NPD level.

An important aspect of the benefits, inconveniences and key factors of inter-firm relationships should be stressed: they represent the outcomes of researches carried out in large, multinational firms, which cannot necessarily be "exported" to other country-specific contexts as is the case of Portugal, a *less-favoured* European *region* with a myriad of SMEs. Nevertheless, since Portuguese companies have to face enlarged markets and to compete with very large, stronger companies, this kind of research can serve as reference of analysis.

Objectives and Research Methodology of the Study

The NPD process in collaborative relationships has many intricacies as mentioned in previous sections. Unfortunately, it has remained unexplored in the Portuguese context where the presence of a myriad of SMEs with varied resources and performances makes it difficult to exploit experiences from different economic settings. Thus it was decided to study the NPD process in Portuguese companies in order to set the ground for subsequent studies addressing the inter-firm partnership in *less-favoured* regions.

The main purpose of this paper is therefore to address the main key factors that make the supplier-producer relationship well succeeded in the supply chain, taking into account Portuguese firms embedded in an international setting. Thus, an exploratory study involving industrial companies and their direct suppliers was performed in order to test the critical factors found in the literature. Moreover, case studies have been used to address context-specific factors. Therefore, one objective of this work is not to obtain a complete list of those key success factors, but rather to find out the main characteristics that make the supplier-client relationships well succeeded in the Portuguese setting. Another objective is to pave the way for subsequent studies dealing with the intricacies of NPD in a *less-favoured* setting involving small and medium-sized firms.

To define the sample two subsets of firms were created: the producers and the suppliers. Due to the consequences of the globalization process at firm level, it was decided to include industrial companies under the "influence" of this process. Moreover, given the structural importance of the automobile and electronics clusters firms of these industries have been included. As a consequence, the first subset of firms - the producers - was formed taking into account foreign firms in Portugal and the second group - the suppliers - was composed

of indigenous companies supplying those multinational firms in which the NPD process was to be followed on the Portuguese suppliers.

The identification of the producers was done through secondary information and involved the selection of the two largest firms of each industry. The identification of the suppliers was based on information released by the producers during the interviews. It was decided to select four suppliers for each producer selected. This led to a final selection of four producers and sixteen suppliers.

The gathering of data was done through *in loco*, semi-structured, tape-recorded interviews at the producers and at the suppliers' sites. The use of semi-structured interviews allowed the researcher to explore the interviewees' points of view as well as to understand the NPD process at inter-firm level, which would have been difficult to obtain through a quantitative study. The aggregation of results was done *a posteriori*.

Due to the huge differences found among suppliers, in terms of resources and behaviours, four case studies have been selected that address successful examples of suppliers' involvement in the development of the client's CPD process.

Results

This paper aims at exploring the most important aspects of the supplier involvement in the development of its client's products. The findings discussed below are derived from an on-going study of NPD practices of Portuguese firms. The paper reports on the initial tranche of interviews and case studies from which different types of firms and different specific situations are assessed. The four suppliers under study are identified here as ***Alpha***, ***Beta***, ***Epsilon*** and ***Lambda*** for confidentiality reasons.

Case 1: Alpha

It is a family business producing stamped metallic parts for the electronics cluster. It has around 30 employees and supplies several multinational companies of the electronics industry. Its Engineering and Quality department has 7 resident engineers and three of them work closely with the largest client of stamped metallic parts. The company has been co-operating with its clients in the development of new products. The company is undergoing the ISO 9000 certification process and its two main clients consider *Alpha* as *preferred supplier*.

Alpha is involved in CPD process after the product concept phase and before the prototype is built. There is plenty of information exchange with its main client in terms of cost, product quality and production process. JIT delivery is currently on practice (*Alpha's* main client is less than a mile away from *Alpha's* premises.

As *Alpha* produces metallic stamped piece-parts, it usually follows the client's specifications and the proposals of new products. The creation of brand new solutions is quite difficult: stamped metallic parts are one of many components of the car-radio (the client's final product), that it is also part of the car dashboard, which is designed and

developed by project teams of car manufacturers. Consequently, the company is committed to satisfying the car-radio producer's demands in terms of price, delivery time and product quality, in order to strengthen supplier-client relationship.

Alpha foresees an evolution towards a product-specialist/partner relationship as being *difficult* due to the following facts a) car-radio development decisions take place two levels downstream in the value chain; and b) car-radio metallic parts are not considered as *strategic* in the design phase. Then, it can be argued that although *Alpha* has a reactive product development type due to the non-strategic nature of the component, it has managed to abandon a dependent strategy and to increase value for its clients in the supply chain.

Case 2: Beta

Beta is a SME with 25 employees and produces prototypes and specialized solutions based on automation for a diversified group of clients. Its main customers belong to the automobile and electronics industries. Its *R&D department* has 7 people, being four of them resident engineers.

Since its start up *Beta* has managed to diversify its customer base in such a way that it produces a wide range of automation equipment/solutions for several multinational companies in Portugal and abroad. Its main competitive advantage rests on the *competence to solve its customers' problems*.

Beta's technological strategy is underpinned in the creation of new products and has as starting point the clients' technological needs. *Beta* claims that they systematically use reverse engineering and benchmarking tools to improve its technological base. Its approach is quite simple: the NPD process begins with the client's formal request and involves the creation of a cross-functional, inter-firm team in order to gain lead time, knowledge and to avoid future technical problems.

Case 3: Epsilon

Epsilon manufactures plastic components for the automobile, telecommunications, electronics and home appliances industries. Epsilon has around 400 employees and a sales volume around 20 M €. Its *development and engineering* department has 39 people, being 28 of them resident engineers. It holds the ISO 9000 registration. It has strong production capabilities and its production process fully automated. Its core business is the design of plastic injection parts and is technically considered one of the best firms in the industry.

Epsilon has managed to evolve in the NPD process. It creates new concepts with the clients' involvement, which clearly represents an important evolutionary step in *Epsilon's* technological ladder.

The firm's technology base evolved from a passive to an active product-engineering base because the firm has managed to accumulate knowledge in its relationship with its clients in such a way that it enabled *Epsilon* to create new concepts for carmakers according to their volumetric constraints.

Epsilon has managed to design and produce dashboards for two large German automakers. This means that *Epsilon* has managed to evolve from an OEM to an Own Design Manufacture (ODM) approach. In the future it is expected that the firm can evolve to deeper, more intertwined relationship in the supply chain due to their design capabilities.

Epsilon intervenes in the CPD process in the product concept phase where it is involved in the client's corporate development project team, which includes external consultants and other components suppliers. Specific responsibilities are affected to all participants and despite Epsilon responsibilities in the design of dashboards, Epsilon's client hold the final authority for design. Apart from a non-disclosure agreement signed between Epsilon and its main client, there are no other intellectual property agreements signed.

Case 4: Lambda

Lambda is a large firm that produces industrial and starter batteries for the automobile industry. It has more than 400 employees and produces batteries not only for large automakers but also for the original equipment spares (OES) market, which exposes *Lambda* to a global competitiveness. *Lambda* has been very active in R&D activities: it has been granted a world patent and has signed several technology-based joint ventures. Its *R&D and product engineering* department has 45 people, being 30 of them resident engineers

It holds the ISO 9001 registration and has a strong R&D department that underpins the participation in the development of new products in co-operation with its main clients. Its technological accumulation process has allowed the firm to leapfrog from OEM to ODM to Own Brand Manufacture (OBM) activities. *Lambda* produces and commercialises its own brand name for the OES market.

Lambda has managed to evolve to an active stage in the inter-firm NPD process. It has developed a partnership with a German engineering firm to design batteries for a German automaker according to their vehicles energetic needs. This active participation in the NPD process has allowed *Lambda* to take advantage of this important strategic positioning since it is closer to its client's core decision centre in the product development phase. In order to maintain its relationship in the CPD process Lambda has to reach target costs imposed by the client as well as quality and delivery targets. As Lambda produces a commodity-like product the firm is only involved after the client concept has been specified.

Discussion

In order to give a broader perspective of the four case studies discussed above, Table 4 shows the main suppliers characteristics and Table 5 presents their project management processes.

Only *Epsilon* and Lambda, which are larger than the other two firms and have a previous experience in collaborative activities, have managed to reach the mature stage proposed by Kamath and Liker (1994).

Table 4 – Suppliers' main characteristics.

	Alpha	Beta	Epsilon	Lambda
Collaborative Experience	No	No	Yes	Yes
Prior Involvement with Client	No	No	Yes	Yes
Quality Registration	In Process	No	Yes	Yes
JIT Relationship	Yes	No	Yes	Yes
Types of Parts	Supplier Proprietary Part	Detail Controlled Project	Grey Box Part (Aesthetic)	Supplier Proprietary Part
Design Responsibility	Supplier	Supplier	Supplier	Supplier
Design Authority	Joint	Joint	Customer	Supplier
Product Complexity	Simple Assembly	Entire Sub-system	Complex Assembly	Simple Assembly
Specifications Provided	Detail Engineering	Concept	Concept	Concept/Early Product Design
Supplier Information Specifications	Collaborate	Collaborate/ Negotiate	Negotiate	Collaborate
Stage of Supplier Involvement	Early Product Design	Pre-concept Concept	Concept	Concept/Early Product Design
Component Testing Responsibility	Complete	Complete	Complete	Complete
Supplier Technological Capability	Medium	High	Autonomous	Autonomous
Type of Relationship	Child/Contractual	Contractual	Mature	Mature/Partner

While *Epsilon's* product can be characterised as a *grey-box* part, *Lambda's* is a *black-box* part. In both firms the supplier-client relationship is based on the co-specialization of both partners.

Beta still has a contractual relationship due to its project-by-project involvement. On the other hand, *Alpha* is still in the child/contractual phase and its evolutionary perspective towards a mature relationship is expected to be difficult due to the product that it manufactures.

The type of product is responsible for wide differences in inter-firm relationships. Suppliers are in better conditions of having a symbiotic relationship with their customers when products are characterised as *black-box* and *grey-box* parts. Inversely, whenever products are characterised as *supplier-proprietary* parts the relationship seems to be condemned to a contractual/child one.

Beta is in a very specific situation because it is closer to a project-based relationship whose purchase is non-repetitive in nature and therefore they will hardly achieve the mature/partner relationship.

Interestingly, quality is felt differently felt in all firms. While Epsilon and Lambda are certified according to ISO 9000 standards (Alpha will soon apply for it), Beta has no intention to register according to the ISO 9000 standards. This difference is explained by Beta's project orientation *vis-à-vis* the product orientation of the remaining suppliers.

Table 5 – Project management process.

	Alpha	Beta	Epsilon	Lambda
Characterisation of Process	Phases and Gates	Contract driven, but oriented to client	Customer-focused multi-functional team	Phases and Gates
Dominant Characteristics	Cross-functional team with project manager that oversees entire project	Project-team focus with dominant project manager	Project-team focus with dominant project manager	Cross-functional team involving technology transfers to other sister units. Project manager that oversees entire project
Key Control Mechanism	Project manager. Review meetings each two months.	Contract. Project manager lead relationship between Beta, suppliers and client.	Senior product manager. Senior management reviews at milestones.	Senior product manager. Senior management reviews at milestones.
Primary Performance Drivers	Quality control and delivery reliability.	Delivery reliability. Functional Conformance of Prototype. New product support.	Volumetric and aesthetic conformance, speed in prototyping building, design capabilities and quality control.	Engineering functionality, delivery reliability and quality control.
Major Phases	Three-stage process (according to customer approval process)	Defined by customer process.	Five phases with tasks and milestones.	Seven phases with tasks and milestones.
Formality of Process	Standardised according to client's NPD introduction.	Flexible for each contract, but well defined procedures.	Highly formalised procedures according to management procedure document.	Highly formalised according to corporate handbook, which includes timing, cost, design information, quality approval for different milestones.

As shown in Table 5, although suppliers' project management tools and processes are varied only *Epsilon* and Lambda have highly formalised management procedures tuned with those of the buyers. This is a consequence of both the influence of the automotive industry management practices and of their past experience in collaborative agreements with their clients. On the other hand, *Beta's* project management tools are simpler and more internally focused.

The ***suppliers NPD capabilities*** are relatively homogeneous. All suppliers have managed to abandon dependent subcontracting behaviours and to be involved as product specialists. On the other side, the producers try to exploit the suppliers' know-how and resources. Although the NPD capabilities differ, with Alpha and Beta being categorised as reactive product specialists and Lambda and Epsilon as active product specialists, it is plausible to argue that the supplier-producer relationship in terms of NPD capabilities is based on the search of a wide reciprocity. Nevertheless, the product characteristics play

an important role with key component suppliers (Epsilon and Lambda) better off than standard parts suppliers (Alpha).

The ***cooperation with suppliers*** in upstream activities is unbalanced: only in cases 3 and 4 collaborative relationships follow a win-win approach. In cases 1 and 2 the producer seems to be more interested in taking advantage of the supplier's co-specialization than in a long-term relationship. This difference may be explained by the type of product: while in cases 3 and 4 the repetitive nature of the product and the cumulative past experience in product development positively influences the supplier-producer involvement, in case 2 the sequential project-by-project nature of the product limits the product development involvement between players to a single project. In case 1, the reactive nature of the product-engineering involvement leaves the supplier in a serious disadvantage. In conclusion, the larger the strategic interests of the client in upstream activities along the value chain the larger the expected benefits of suppliers.

All companies confirmed the need and the importance of ***early involvement***, which was considered as a critical success factor because it allowed the suppliers to influence the design, to present solutions and to promote a long-term relationship.

If it is taken into account the stage of supplier involvement, the supplier's design authority and the supplier's product complexity it is possible to conclude that early involvement should be seen as the supplier's willingness to evolve in the relationship, which is very positive for the relationship: while suppliers still have incentives to innovate, the buyers still have room to improve supplier's efforts.

Paradoxically, ***inter-firm cooperation*** in the NPD phase between ***the suppliers and their suppliers*** is nonexistent, which clearly stresses the need of an integrative industrial strategy.

At ***strategic level*** suppliers and clients showed a congruent point of view. The involvement is notorious in the communication of objectives, planning and common projects, which helps both partners in the creation of a long-term involvement. NPD was facilitated by the fact that all the producers have considered that, although the core competencies belonged to the suppliers, the design for manufacturing was controlled by the producers, which allowed the latter to strategically control the participation of the suppliers.

Project management was also very important. The outcomes in the electronics industry and the auto industry were quite different. In the automobile industry there seems to be a larger complexity in terms of a) task specification; b) both partners' participation; and c) implementation periods, which may be explained by the complexity of the product and by the partners' co-specialization. The pressure in the relationship is very explicit when there are changes in the prototype phase and when there are delays in the production start up.

One problem seems unaddressed in the technical literature: when there are changes in an advanced phase of the project - close to the production start-up date - involving

a) changes in tools/equipment; b) costs related to those changes or; and c) potential delays in the project, the pressure between both partners dramatically increases mainly due to the bargaining power unilaterally exercised by the client.

It was intended to assess to what extent the producer played the ***coordinator's role*** and if the collaboration involved a ***reciprocity*** between both partners. All suppliers were unanimous in considering the producer as the coordinator of the relationship. Equally important, the suppliers mentioned that the producers should develop project management capabilities and simultaneous engineering competencies in order to improve the reciprocity of the supplier-producer relationship. On the other hand, all producers have a different opinion regarding coordination and reciprocity. They claim project management capabilities are not considered a strategic issue. Regarding reciprocity they claim that suppliers need to improve their technological capability and their allocation of resources to R&D activities in order to be reliable suppliers. The producers' perspective is clear: the coordination would be simpler if the suppliers' technological capability were stronger. That in turn would enable a reciprocal, smoother relationship in the supply chain.

The different point of views in both subjects can be explained by the different expectations of both players. The buyers are seen as natural product/project coordinators by their roles in the relationship: they "impose" quality policies, product specifications, target prices, NPD times, delivery times and technology strategies. As a consequence, it is not strange that suppliers, despite their competencies in production, quality, JIT delivery and NPD activities still see buyers as "paving the way" of the relationship. Consequently, reciprocity might be differently understood by both partners: for example, when changes in an advanced phase of the project are put forward by buyers, as above mentioned, suppliers feel that buyers exercise their bargaining power and blame them for not introducing the changes earlier and consequently for jeopardising the relationship. On the other hand if for example suppliers had been intensively involved in project management activities and if changes in advanced phase of the project needed to be done, would they claim lack of reciprocity? Clearly, transparency, reciprocity and coordination are difficult to manage when both firms have different interests.

Conclusions

This paper addresses the success and failure factors of Collaborative Product Development in a less technologically endowed environment involving SMEs. For such purpose, a qualitative study was deployed along the supply chain involving sixteen Portuguese firms, four multinational companies and the preparation of four case studies. The goal of this study was to *question* the conclusions obtained in different contexts involving small and medium-sized firms with "*limited*" technological endowments and to pave the way for a broader study.

The methodology allowed the exploration of knowledge obtained during the interviews, the clarification of doubts and the deepening of important aspects that would remain unanswered through the analysis of a quantitative study.

Generically, the involvement of suppliers in the NPD phase is more complex than the technical literature describes.

The four cases involved suppliers with different products and sizes. Nevertheless, there were not large differences among them in the willingness to collaborate in the NPD phase.

Alpha did not have any prior involvement with multinationals of the electronics cluster before they rooted their factories in Portugal. Although following a slightly reactive strategy due to the product type it manufactures, its successful relationship with its multinational clients stems from its technological competences. On the other side *Beta* departed from a pure dependent strategy and along time it managed to diversify its customer base. Its relationship with its clients is quite specific due to the nature of product it manufactures.

Epsilon and *Lambda* have been following a relatively similar path: their technological capability allowed them to be progressively more involved in CPD in such a way that they have managed to participate in the development of new products with their clients' corporate development department at headquarters level.

The interviews and the organisation of case studies led to the conclusion that the suppliers seek NPD collaborative approaches so that they can improve their competitive position *vis-à-vis* their clients.

Generically, it can be said that firms of the automobile industry are better tuned than the ones of the electronics cluster to the needs and difficulties of the NPD collaborative approach, which may be explained by the differences in industry maturity and the competitiveness of the auto industry.

Four successful case studies were presented. Clearly, a critical aspect in the development of a technological complementary is the suppliers' capacity in developing R&D competencies. Although the case studies showed evidence of the suppliers' clear commitment in developing their technological competence in order to abandon passive subcontracting behaviour and positioning themselves as product specialists, it is plausible to say that the client's role should not be underestimated: dynamic complementarities must be underpinned upon the involvement of both partners. As a consequence, broader studies addressing both partners involvement should be performed in order to understand their commitment in the relationship.

Subsequent studies should address the following topics in order to complement the ones covered in this article:

1. How buyers set the rules and organise NPD management; Using target costing, value engineering, quality policy mechanisms, ..?;
2. How buyers manage the intricacies of production capacity management in order to provide suppliers with production volume so that they invest in R&D; and

3. When differences between partners arise, what mechanisms are used to manage transparency in the relationship.

Although this exploratory study helps in understanding the supplier involvement in CPD process, it has three limitations. Firstly, the group of case studies was purposively selected to present different situations and do not correspond to an average result. Secondly, the type of product should be addressed carefully because key components suppliers and standard parts suppliers may have different types of involvements with their clients due to differences in strategic interests. Thirdly, the client's involvement should also be addressed. Some clients seem to be keener than others in tapping into the suppliers' competencies and consequently the search for reciprocity is differently *felt* along the value chain.

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Biography

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