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Risk Sharing and Supplier Development in the Spanish Automotive Industry

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Abstract

In the automotive industry, where a large and increasing share of the final product value is produced by Car Makers' suppliers, the vertical inter-firm relationships are of major interest to academics and practitioners. Traditionally the close inter-firm vertical collaboration is a key element of the "Japanese model" that is contra posed to the adversarial US model. Key features of the first one are the efforts of the Car Makers to develop their suppliers and absorb part of their business risk. During the years there is an evolution in the models applied: The Western and the Japanese enterprises learn from each other and this leads to a convergence in the approaches used.

The thesis is structured in four chapters. The first one provides a review of studies related to the supplier relationships in the automotive industry.

The second chapter explores how the Car Makers' policies and actions concerning the management of supplier relationships influence the supplier's performance in terms of development of capabilities and improvements. We analyze the relations between Nissan's and Seat's plants in Barcelona and their most important Spanish suppliers. Our sample includes 46 suppliers for Nissan and 77 suppliers for Seat. We find positive relationship between improvements achieved by suppliers and their dependence on Car Makers, the assistance provided by Car Makers, their involvement in design and technological decisions and the level of collaboration.

Chapter number three analyses how the purchasing function is organized at Nissan Europe and describes its evolution. The information we use is gathered during my internship at the purchasing department of the Nissan Barcelona plant.

Chapter number four investigates the levels and the determinants of risk sharing in buyer-supplier relationships. Building on previous research we test an agency model that relates the level of buyer's risk absorption to supplier's environmental uncertainty, risk aversion and moral hazard. We use data related to the relationship between Nissan Barcelona plant and its first tier supplier network. Our results confirm agency theory predictions and show that Nissan absorbs risk from its suppliers to a non negligible but lower than before the alliance with Renault degree.

Abstract (in Italian)

Nell'industria automobilistica, dove grande a crescente parte del valore del prodotto finale è prodotta dal fornitori degli assemblatori di macchine, le relazioni di fornitura sono di grande interesse per gli academici e i manager. Tradizionalmente, il modello Giapponese di partnership e collaborazione e' contrapposto al modello Occidentale di relazioni tra avversari. Elementi principali del primo modello sono gli sforzi degli assemblatori di macchine di sviluppare i loro fornitori e assumere parte del rischio di fluttuazioni dei costi delle materie prime. Negli anni si nota evoluzione dei modelli di fornitura applicati. Lo scambio di best practices tra le imprese porta alla convergenza tra gli approcci usati dalle imprese Occidentali e Giapponesi.

La tesi è composta da quattro capitoli. Il primo revisiona e commenta degli studi relative alle relazioni di fornitira nel settore automobilistico.

Il secondo capitolo studia come le politiche e azioni dell'assemblatore di machine relative alle relazioni di fornitura influiscono sulle prestazioni dei fornitori in termini di svulippo delle loro capacità. Noi analiziamo le relazioni tra le fabbriche di Nissan e Seta a Barcelona e i loro più importanti fornitori Spagnoli. Il nostro campione è composto da 46 fornitori di Nissan e 77 fornitori di Seat. I risultati delle stime del nostro modello confrmano la relazione positiva tra i miglioramenti ottenuti dai fornitori e la loro dipendenza dagli assemblatori di automobili, l'assistenza fornita dagli assemblatori di automobili, il loro coinvolgimento nella progettazione e decisioni tecnologiche e il livello di collaborazione nella relazione di fornitura.

Il terzo capitolo analizza come è organizzata e come evolve la funzione acquisti presso Nissan Europe. L'informazione usata è stata raccolta durante il mio stage presso l'ufficio acquisti della fabbrica Nissan a Barcelona.

Il capitolo quattro studia i livelli e le determinanti della condivisione dei rischio tra assemblatore di automobili e i suoi fornitori. Basandosi su ricerche precedenti, abbiamo stimato un modello economico di agenzia che mette in relazione il livello di assunzione del rischio di fluttuazioni dei costi delle materie prime da parte dell'assemblatore di macchine e l'avversione al rischio e il azzardo morale dei fornitori. Noi utilizziamo dati relativi ai

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rapporti di fornitura tra la fabbrica di Nissan a Barcelona e una parte rapperesentativa dei suoi fornitori di primo livello. I nostri risultati confermano le ipotesi della teoria dell' agenzia e mostrano che Nissan assume un rischio, considerevole ma minore rispetto al periodo prima dell'alleanza con Renault, legato alle fluttuazioni dei costi delle materie prime.

Introduction

The thesis structure spans four chapters: Chapter 1 - Literature Review On Supplier Relations In The Automotive Industry, Chapter 2 -Supplier Development In The Automotive Industry: The Case Of Nissan's and Seat's Plants In Barcelona, Chapter 3 – Nissan Europe Purchasing , Chapter 4 - Risk Sharing And Supplier Relationships In The Global Automotive Industry: The Case of Nissan Europe.

Chapter one provides a review of studies related to the supplier relationships in the automotive industry. Here we explain why this issue is important in general and in particular for this industry. We describe and comment the two main models used to capture the approaches to suppliers- the "Japanese model" and the "US model". Traditionally the close inter-firm vertical collaboration is a key element of the first model that is contra posed to the second one. During the years there is an evolution in the models applied: The Western and the Japanese enterprises learn from each other and this leads to a convergence in the approaches used.

Chapter two studies the supplier relationships of two Car Makers and investigates how they influence their supplier's performance in terms of development of capabilities and improvements. The data we use comes from a survey answered by the most important Spanish supplier of Nissan's and Seat's plant in Barcelona. The sample includes 46 Nissan's and 77 Seat's suppliers. Through econometric analysis we estimate our model that link some characteristics of the buyer-supplier relationships perceived by the last one and the improvements achieved as a consequence of working with the specific Car Maker. Our results confirm our hypotheses:

1. There is a positive relationship between supplier's dependence and supplier development.

2. There is a positive relationship between buyer's assistance and supplier development.

3. There is a positive relationship between supplier's involvement in design and technological decisions concerning the product exchanged and supplier development.

4. There is a positive relationship between the level of collaboration between supplier and automaker and supplier development.

Interestingly our data confirms that the mechanisms we have studied are related in the same way to suppliers' improvements independently from which the Car Maker was- Nissan or Seat.

Chapter three describes and analyses how Nissan Europe Purchasing is organized. This department is responsible for acquiring all that Nissan plants in the United Kingdom and Spain need. Our study investigates how the purchasing function evolves after the alliance between Renault and Nissan.

Chapter four represents a study of risk sharing in vertical inter-firm relationships. Our results show that Nissan still absorbs risk from its supplier to a non negligible degree, but that global competition and organizational changes related to the alliance with Renault made it switch to a more market-based approach to supplier selection and development. Building on previous similar studies, but improving the relevant modelling techniques, we apply regression analysis to test an agency model of the determinants of risk sharing on the supplier network (113 firms) of Nissan Europe's Barcelona plant. The study confirms agency theory predictions that the buyer absorbs more risk (a) the greater the supplier's environmental uncertainty, (b) the more risk averse the supplier, and (c) the less severe the supplier's moral hazard. It also clarifies the relationship between risk sharing and the supplier's size, technological capability, financial stability, and cost fluctuation. Finally, it contextualizes the findings with the automotive industry suggesting how automakers may adjust their risk-sharing strategy and supply chain integration policies as suppliers grow, become more global, develop technological capabilities, and change financial structure.

CHAPTER 1 - LITERATURE REVIEW ON SUPPLIER RELATIONS IN THE AUTOMOTIVE INDUSTRY

1. Importance of supplier relationships

During the 80' researchers began paying increasing attention to the effects of inter-firm and in particular to supplier relations on achieving competitive advantage and superior returns.

Dyer and Singh (1998) propose a framework that puts in evidence the importance of the collaboration between enterprises in achieving competitive advantage and superior returns. The authors introduce the notions of "collaborative advantage" and "relational rents". They start out from the question how firms earn rents through collaboration. Therefore the relevant unit of analysis should be the dyad or network of firms. Dyer and Singh (1998) define a relational rent as a superior to normal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific partners.

Dyer and Singh (1998), successfully balance the two major views emerged previously in management literature:

- The first- the Industry Structure View (ISV) - associated with Porter (1980), suggests that supernormal returns are primarily a function of a firm's membership in an industry with favourable structural characteristics. Consequently, many researchers have focused on the industry as the relevant unit of analysis.

- The second view- the Resource Based View (RBV) of the firm- argues that differential firm performance is fundamentally due to firm heterogeneity rather than industry structure (Barney, 1991). Firms that are able to accumulate recourses and capabilities that are rare, valuable, non replaceable, and difficult to imitate will achieve a competitive advantage over competing firms. Thus, RBV theory uses the firm as the primary unit of analysis.

Although the two traditional perspectives (ISV, RBV) have contributed greatly to our understanding of how firms achieve above-normal returns, they overlook the important fact that the (dis)advantages of an individual firm are often linked to the (dis)advantages of the network of relationships in which the firm is embedded. Proponents of RBV have emphasized that competitive advantage results from those resources and capabilities that are owned and controlled by a single firm. Consequently, the search for competitive advantage has focused on those resources and capabilities that are housed within the firm.[1]

However, a firm's critical resources may extend beyond firm boundaries. And an example of this can be given by the situation in the automotive industry. With respect to other industries the automotive is in advanced stage of implementing supply chain management developments. This industry has long been used as an exemplar of important economic phenomena involving supply chains. It is a useful context for examining modes of inter-firm economic exchange, since its global scale, technological scope and huge product and process complexity generates a diverse set of decisions concerning the purchasing strategy of car makers. In fact, a typical passenger car contains more than 30.000 parts. Although automakers assemble the final product, outside suppliers are often involved in design as well as manufacturing, and may account for 70 percent of manufacturing costs and 50 percent of engineering costs (Clark and Fujimoto, 1991).

Automakers purchase always higher percentage of the value of each product and many of these inputs are highly customized by suppliers. Due to environmental changes such as globalization, outsourcing and virtualization more and more companies get involved in activities that are outside the boundaries of the traditional company (i.e. single autonomous legal entity). This is typically achieved through collaboration with other firms.

Actually, many of the strategy scholars agree on the fact that the two views (RBV, ISV) are complementary and the success depends both on internal and external of the firm

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[1] Some scholars classify the Relational view as a pure extension of the RBV(as one of the RBV theories) as the relations cam be viewed as one of the resources of the firm. But Dyer, Singh (1998) claim that , this is not certain, because a relational capability of a firm is not a sufficient condition for realizing relational rents.

factors. There is a need to integrate this traditional 'outside-in' (exogenous) and 'inside-out' (endogenous) views of the firm. The underlying logic of this integration is that competencies (endogenous resources) are difficult to transfer because of high asset specificity (i.e. the involvement of tacit of proprietary knowledge lying in human and physical capital), that causes high transaction costs (i.e. exogenous barriers). Asset specificity refers to the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value. Because of this, core competencies can usually only be deployed effectively internally. However, firms that need resources which they do not possess will have to use inter-firm collaboration even when cooperation would not be justified from the traditional Transaction Costs Economics (TCE) perspective. This challenges the notion of competitive advantage and suggests that 'collaborative advantage" (Dyer, 1998) can sometimes be more suitable. This occurs when the minimization of operational transaction costs has become a less significant factor than the gaining of new external competencies through collaboration with other firms.

Dyer and Singh (1998) argue that there are four sources that lead to achieving relational rents. These are the relations specific assets, the knowledge sharing routines, the complementary resources and capabilities, and the effective governance.

2. Supplier relations in the automotive industry

Since the 80s the automotive industry is characterized by strong and increasing competition in both prices and services offered. Despite the growing complex nature and technical nature of automobiles, the price remains relatively stable, putting continued pressure on costs. The sector is characterized by weak worldwide growth. Coupled with cost and quality control, innovation is therefore, more than ever, the key to success in this highly competitive industry. In this highly competitive situation the Car Maker subcontract increasing shares (volume and extent) of the activities. Indeed, suppliers typically provided goods and services that account for 50 to 70 percent of a Car Maker's total expenses to produce an end product. That is why the coordination of competences and knowledge in design, manufacturing and assembly between Car

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Makers and their suppliers has become a critical issue in this industry. This development shifted the attention from "make vs. buy" to the different issue "how to buy".

During the 80s, scholars and practitioners created a new best practice model of supply chain management based on their interpretations of the success of Toyota and the so called Lean Production. This new model was claimed to be a pre-requisite to competitive survival in the 21st century (Womack, Jones and Roos, 1990). This enhanced the importance of supply chain management and most of the research has been focused on analytical approaches, while the area requiring the most work is in managing supplier relationship. Supply chain systems and IT solutions have become the focus of many reengineering projects aimed at solving supply chain problems.

Economists created models that tried to explain the apparent superiority the Japanese production approach. This success in the world markets has been greatest for complex product industries, defined as whose production processes involve a large number of components, functions and process steps (Clark and Fujimoto 1991, Dyer 1998). The production in such industries is normally characterized with interdependence between the tasks of the different agents. Economists called this situation "team production" (Alchian et. al., 1972). The agents can be considered as individuals inside an organization or different organizations. The problems concerning the joint profit maximization in this situation are fundamentally two- the motivation problem and the coordination problem. The first one exists because the agents are supposed to have different and in most cases conflicting objectives. The second is that the agent has to coordinate their actions in order to realize together in the most efficient way the production. Solving the two problems requires actions that are costly. Some of the economic models claim that the superiority of the Japanese approaches comes from the fact that there the objectives are aligned and therefore there is no need to resolve the motivation problem because it does not exist. They call this model team organization and associate it to the Japanese production model. The profit maximization problem in this case coincides with the solution of the coordination problem (only the second problem). This leads to the superior returns with respect to organizations that have to solve both the coordination and the motivation problems because solving each problem requires costs.

Maybe that is why the Japanese government claims that Japanese manufacturing industry owes its competitive advantage and strength to its subcontracting structure. The close inter-firm collaboration is a key element that defines the "Japanese model" (Dyer 1998).

3. Japanese model vs. US model

During and after the 80s many academics and consultants working on the automotive industry paid increasing attention to the Japanese model due to the superior performance of Japanese Car Makers and their suppliers. Various version of this model have been developed, though all of them share two essential characteristics in common (Mair, 2000):

- They incorporate long-term, co-operative partnership relations between Car Maker and suppliers, with high levels of interaction between firms. Empirical evidence show that this approach deliver superior performance in terms of cost, quality and speed in daily interactions and in new product development.

- The contraposition of the new model against opposite practices traditionally widespread in the West (particularly in the US).

Several studies compare the characteristics of the supplier relations management and what emerges is the existence of two main approaches - the collaborative partnership and the adversarial approach. Different authors give them different names, but what comes up is the contraposition of the Japanese way and the Western way.

A common point made by various researchers related to the comparison between Japanese and Western approach to the supplier relation is the degree of vertical integration, or the percentage of the components manufacturing, assembly and even product development done in house, differed between automakers in the two countries. American automakers appear to be more vertically integrated than the Japanese (Dyer 1998), although the Japanese appeared to buy a variety of components, rely on fewer

parts suppliers than their US counterparts, and have closer relations with these suppliers. The Japanese also appeared to be organized more in a pyramid structure, with affiliated suppliers which in turn have their own suppliers, creating a high level of group integration. In contrast, US automakers seemed to buy more lower-level components and have several independent suppliers for each component, with supplier selection mainly by competitive bidding (Helper 1990, Nishiguchi 1989, Lamming 1989).

Numerous studies indicated that the relationships between buyers and suppliers in the Japanese auto industry tended to be longer term and more stable than in the US and European industries. Japanese automakers seemed to continue purchasing new components form the same suppliers after model changes, although without formal guaranties of extending their contracts beyond an initial 2 or 4 years. In addition, Japanese automakers appeared to select their suppliers through competitive bids in the product development stage and then rate suppliers periodically by the value of their product (for example quality and price), continuing business contacts with those who scored high (Asanuma 1989, Nishiguchi 1989).

In the US, automakers reportedly set contracts for one year at a time and tried to locate the least suppliers for the expensive components through annual competitive bidding (Asanuma 1989, Lamming 1989). In few exceptional cases, large parts manufacturers supplying system components received implicit long term commitments (Helper, 1990).

The Japanese mode to manage suppler relations is determined by a high level of involvement of the supplier in the product development process. Researchers have categorized the role of suppliers in product development into three modes:

- supplier that develop parts on their own as standard products (supplier proprietary parts)

- suppliers that do the detailed engineering for the parts based on functional specifications provided by automakers (black box parts)

- suppliers that produce parts developed by automakers according to the buyer's detailed specifications (detail controlled parts)

Researchers found sharp contrast between the percentages of these categories in the US and Japan (Clark 1989, Fujimoto 1989, Clark and Fujimoto 1991). Furthermore, there is

evidence that Japanese suppliers become involved in product development earlier (Asanuma 1989). Japanese firms also appeared to push suppliers to make a greater commitment to technological improvement, giving Japanese automakers more effective product development than the US counterparts.

The pricing practices drew attention as an area that constituted perhaps the most striking operational differences in purchasing behaviour between US and Japanese auto producers (Clark and Fujimoto, 1991). Traditionally, American automakers seemed to rely more on direct market forces among suppliers (competitive bidding) and the Japanese more on subtle and indirect forms of competition, utilizing what they called target pricing. Japanese automakers reportedly set a target price for each part based upon the sales price for the new car model, and then urged and helped suppliers to reach their target. (Nishiguchi 1989). Researchers also reported that Japanese automakers negotiated semi annual reductions in part prices throughout the model life cycle, based on the notion that suppliers should be able to reduce their costs through experience and continual efforts to improve their product designs, materials, and manufacturing methods.

In the US though automakers used price bidding to pressure suppliers to lower prices, they also seemed to allow suppliers to pass wage and other costs increases back to the buyers for as long as the contract continued (Asanuma 1989, Lamming, 1989).

There is evidence of high levels of quality and low percentage of defected products of the Japanese Car Makers and their suppliers. These are a consequence of management practices that required suppliers and the automakers themselves to examine, on a continual basis, defects found in designs, materials and manufacturing methods, customer responses to products, employee training and involvement in problem solving (Nishiguchi 1989). In contrast, US firms seemed to rely more on the detection of errors after the fact rather than prevention of the problems, with less systematic efforts to learn from their experiences with defective parts or diffuse quality responsibility among employees (Helper 1990).

Mutual information exchange and problem solving through suggestions form the Japanese automakers to suppliers appeared to stem from the stability and closeness of the relationship, active participation of suppliers in product development, as well as

effective cost and quality management practices in general. Japanese auto projects overlapped more activities and exchanged more frequently through formal and informal mechanisms (Clark, Fujimoto 1991). Nishiguchi (1989) described the Japanese problem solving orientation as opposed to the bargaining orientation of American firms, noting that Japanese suppliers pursued continuous cost reductions and quality improvements.

Cusumano and Takeishi (1991) realize a study on Japanese and US carmakers and observe that the data form the survey support observations that Japanese and US practices tend to differ in key areas and Japanese suppliers perform better in dimensions such as quality (defects) and prices (meeting targets, reducing price over time). The results of the study indicate that Japanese car makers, in Japan and abroad have managed to persuade or help suppliers to meet their standards for quality and pricing. *Transplants* (i.e. Japanese plants abroad) appeared to manage suppliers as well as the Japanese plants in Japan and this shows us the important influence of the supplier relations management on the supplier's performance no matter the supplier's country origins. Cusumano and Takeishi (1991) observe that Japanese car makers located in the US received much higher quality from US suppliers than US automakers received from US suppliers. It seems that this is the result of the higher extent of information exchange with suppliers and more to the offered assistance by Japanese car makers.

Through the more open, frequent and accurate exchange of information typical of a long term supply chain partnership, parties can ensure ongoing improvements. Collaborative relationships lead to rapid improvements in logistics facilitated by candid information exchange and better coordination (Corbett, Blackburn, Wassenhove 1999). Longer term commitment to the partnership encourages parties to invest in further improvements of the joint supply chain to mutual advantage.

A more general approach that explores the US- Japanese dichotomy is the *Exit Voice* model (Helper 1990). Helper (1990) identified deferent responses to problems arising in buyer supplier relationships and measured the degree of administrative coordination and commitment. She argues that the practices of higher vertical integration and ending relationships with poorly performing suppliers gave American automakers string bargaining power but did not encourage technological progress. Helper (1990) distinguishes between *exit* and *voice* relationships. In the second firms and their suppliers cooperate to resolve problems rather than abandoning their partner. The

application of *exit* and *voice* to supplier relations captures the orientation of the parties towards their relationship and frames the issues of information sharing that crucially affect the relationship beyond transaction specific costs. *Exit* is characterized by the creation and exploitation of information asymmetries by both parties, even when the relationship endures over long periods of time. *Voice* requires shard norms of reciprocity that balance the willingness of the customer to undertake investments in suppliers' capabilities against the supplier's responsibilities to invest in new technology and capacity.

According to the *Exit Voice* model (Helper, 1990), relations have two dimensions:

1. information exchange level, which includes both the nature and the mutuality of the information flow between supplier and customer. At the lowest level, the only information exchanged is the price of the products. At the intermediate level, the parties may share information about finances, plants, and equipment. At the highest level, customer and supplier provide continuous feedback and suggestions for improvement about each other's operations.)

2. Commitment , which refers to the supplier's degree of certainty that the customer will continue to buy its products for some length of time. This assurance can be provided by any mechanism that makes it harder for the customer to exit, such as vertical integration, asset specificity (Williamson 1985), long term contracts, or desire to retain suppliers' trust (Sako, 1992). Commitment is necessary both to obtain suggestions for improvement (which may be based on proprietary information) and to make investments that respond to these suggestions. (Helper and Sako 1995).

A customer who wants to have a *voice* relationship with its suppliers must make a commitment to them. For three reasons the information flow requires and engenders a high degree of commitment to the relationship:

- First, it is costly to establish and maintain extensive communication systems with more than one supplier for a component.

- Second, exchanging proprietary information requires trust.

- Finally, customers and suppliers can both reap substantial benefits from working together over time.

Although, during the 90's, the *voice* relationships are considered by scholars to function better, in practice Western managers rarely adopt it. Empirical studies give evidence that also with suppliers considered as partners- Western Car Makers have relations that actually do not differentiate a lot (an exception is the duration of the relation) from the *exit* mode (Dyer 1998). Uniquely the duration of the buyer- supplier relationships was what differentiated the more and the less collaborative ones. More recent research (Helper and MacDuffue, 2005) claims that the typically American *exit* pattern has been pushed towards longer-term relationships. And conversely, the Japanese *voice* pattern has been confronted with greater competition form new entries into the once-closed group of suppliers- more wider and open range of relationships that the traditional *keiretsu*[2]. Thus, the firms with an *exit* legacy find themselves needing to develop collaborative capacity in response to de-verticalization; and firms with voice legacy must be more prepared to face competitive pressure. This is a consequence of the increasing need of collaboration between suppliers and Car Makers due to the global trends in the industry. The market trends had transformed the automotive industry from vertically integrated hierarchies to networks where suppliers provide a larger and more complex products and services. The dissemination of increasingly larger responsibilities to suppliers has created a need for OEMs to work with their suppliers to improve overall productivity, effectiveness, and efficiency. As a consequence the competition in the automotive industry has changed from company versus company to supply chain versus supply chain.

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[2] A keiretsu is a grouping or family of affiliated companies that form a tight-knit alliance to work toward each other's mutual success.

4. Contingency approach

A more detailed and closer to the reality view acknowledges that whenever there are significant differences between US (Western) and Japanese buyer-supplier relationships, there are also differences in the way these relationships are governed by the same buyer for different suppliers/products. The logic here is that there is no one best way, the best way depends on the context. The papers that support such contingency approach claim that purchasers should use both partnership and arm's length models, depending upon the context. Such approach permits forms to gain the advantages of both arm's length and partnership models, not by attempting to combine them but by keeping them separate from each other.

The so called *supplier segmentation* is claimed by J. Dyer (1998) to be the next best practice in terms of managing supplier relations. According to the contingency approach the buyer-supplier relationship should be adversarial when the transaction is related to standard components and partnership when related to customized components. For example, Wasti and Liker (1999) find that as not all the suppliers participate in the same way in new product development the same carmaker uses different approaches to different suppliers with different level of involvement in the new product development processes. The main factors that the authors found to influence the participation in new product development are the technological uncertainty and the technological capability of the supplier.

Portfolio management literature addresses the features of exchange contexts influencing the configuration of buyer supplier relationships. Research on portfolio models in purchasing has been published by Olsen and Ellram, Kraljic and Bensaou. Their contributions are related to situations where the decision to outsource has already been made. These authors' models have three steps in common, though the steps are given different terms. The three steps are:

- analysis of the products and their classification;

- analysis of the supplier relationships required to deliver the products; and

- action plans in order to match the product requirements with the supplier relationships.

Notably, Kraljic's (1983) seminal portfolio model is the main reference in this field. He developed his model in which the appropriate relationship type was contingent upon a combination of the value and the criticality of the product/service purchased.

Kraljic starts his model by classifying components into four groups. Kraljic (1983) integrates a management dimension in the first step and talks about the four groups as purchasing management, sourcing management, materials management and supply management.

The next step in Kraljic's model consists in mapping the buyer's strengths versus the suppliers' strengths. The emphasis on the buyer's and supplier's strengths may help OEMs to assess areas of opportunity or vulnerability, assess supply risks and derive basic strategic thrusts for the attributes characterizing the strengths. On items where the buyer plays a dominant market role and supplier's strength is rated medium or low , a reasonably aggressive strategy ("exploit") is indicated. On items where the buyer's role in the supply market is secondary and suppliers are strong, the indicated strategy is defensive ("diversity") i.e. the buyer should search for material substitutes or new suppliers. For supply items with neither major visible risks nor major benefits, the strategy has to be well-balanced intermediary ("balanced").

The last step is to develop action plans connecting the supplier relationship analysis with the component categories. These include the individual elements of the purchasing strategy: volume, price, supplier selection, material substitution, inventory policy and value engineering.

The Olsen and Ellram (1997) model classifies products into four groups, namely leverage, non-critical, strategic and bottleneck. This classification forms the first of the three steps in their model. It is based on two dimensions: the difficulty of the purchasing situation and the strategic importance of the purchase. The positioning in terms of the difficulty of the purchasing situation will depend on a ranking of different items such as product novelty and complexity, supply market characteristics, and environmental characteristics such as risk and uncertainty. As for the second dimension- the strategic importance of the purchase - the positioning will depend on competence factors,

economic factors, and image factors such as brand and safety. The labels applied to the suppler classification are different from those used by Kraljic. Olsen and Elram (1997) extended the scope of Kraljic's dimensions but the essence of the classification is similar. In other words, non-critical components corresponds to purchasing management, bottleneck components corresponds to sourcing management, leverage components corresponds to materials management and strategic components corresponds to supply management.

The second descriptive step in the Olsen and Ellram model refers to a company's current supplier relationships in order to determine the way supply is managed. The positioning in terms of supplier attractiveness will depend on financial factors, performance (delivery, quality, and price), technology and innovation, and organizational, cultural and strategic factors. The positioning in terms of the strength of the relationship will depend on economic factors, exchange relationships, co-operation and the distance between the buyer and supplier (social, cultural, technological and geographical distance). This essentially corresponds to the Krajic's analysis of the buyer and supplier strengths.

In the third step, Olsen and Ellram (1997) propose strategies and action plans for different categories. In the case of low attractiveness, the strategy could be to change supplier if the relationship is weak. With a strong relationship, it might be recommended to develop the suppliers' capabilities. With high attractiveness and strong relationships, the strategy could be to reallocate resources among different activities in order to maintain a strong relationship and to continue to encourage the supplier to develop state-of-the-art performance, thus maintaining attractiveness. Low to average strength of relationship together with high or moderate attractiveness implies long-term resource allocation in order to strengthen the relationship. In the short term, the OEM can show willingness to improve the relationship by improving communication, for example.

Bensau (1999) proposes a portfolio model which is very rich in terms of the external and internal aspects of supplier relationships. The first step in his model consists of classifying supplier relationships into four categories based on buyers' specific investments, on the one hand, and suppliers' specific investments on the other. The

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author call them are market exchange, captive buyer, captive supplier and strategic partnership.

Step two consists of identifying contextual profiles in terms of component, market and supplier characteristics for the four distinctive relationships. Bensau (1999) proposes three key environmental factors to consider. These are the product exchanged and its technology, the competitive conditions in the upstream market and the capabilities of the suppliers available

The third and final step relates to the design of management profiles for each of the contextual profiles in order to match relationship requirements and relationship capabilities. In the market exchange case, Bensau (1999) states that suppliers manufacture to buyers' specifications in a situation where there is little interaction. The captive buyer situation calls for `broadband' communication in design. The strategic partnership situation is based on standardized rules and procedures such as electronic data interchange and schemes for the exchange of guest engineers.

Bensau (1999) found out that the level of specific investments made by either partner to the relationship significantly correlates with practices commonly associated with strategic partnerships, such as long-term relationships, mutual trust, cooperation, and wide-scope relationships that include multiple components. According to the author successful supply chain management requires that the firms match the optimal type of relationship to the various product, market and supplier conditions. Afterwards firms must adopt the appropriate management approach for each type of relationship and should improve their performances.

CHAPTER 2 -SUPPLIER DEVELOPMENT IN THE AUTOMOTIVE INDUSTRY: THE CASE OF NISSAN´S AND SEAT´S PLANTS IN BARCELONA

1. Introduction

Central issue in the management research is how some firms achieve superior profits with respect to others (M. E. Porter, 1980 , J. B. Barney. 1991). One of the ways to explain why determinate company obtains higher profits is that this works with highly efficient and qualified suppliers (D. R. Krause, 2000). This explanation is particularly adequate in industries like the automotive where high percentage of the value of the final product is created by the suppliers of the car makers.

Finding suppliers already organized to meet a buyer's requirements for quality, delivery, flexibility and cost reductions is likely to be a challenge. One effective way buying firms can meet this challenge is by developing their suppliers in ways that improve suppliers' capabilities (Krause et al., 1998). By intensifying the relationship with determinate suppliers, the customer firm's supplier development effort can aim improving the product sourced by this supplier in hope of upgrading critical processes. This kind of effort has been taken for granted in the Japanese automotive industry for several decades but there is a gap in the research as related to the US and European Car Makers (Sako M., 2004).

Our research analyses how Car Makers' actions and policies concerning the supplier relations are related to the improvements done by the suppliers. For this objective we study the relationships between Nissan's and Seat's plants in Barcelona and samples of their most important suppliers located in Spain. We use data from a survey answered by 46 suppliers for Nissan and 77 suppliers for Seat in 1997. Nissan represents the Car Maker with Japanese origins and Seat the one with European ones.

The study is organized as follows. Section two frames the issue of supplier development. Section three presents our model and sets the research hypotheses.

Section four describes the data, the context of the study and the research methodology. Section five presents the findings of the econometric analysis. Section six discusses the implications of the findings and highlights directions for future research.

2. Literature review

The supplier development literature proposes that increased competition in the marketplace and the increased pace of technological innovation are two primary factors driving companies' needs for capable suppliers. Finding suppliers already organized to meet a buyer's requirements for quality, delivery, flexibility and cost reductions is likely to be a challenge. Over the last decade, researchers have empirically investigated a variety of issues that are related to supplier development activities. These issues include critical factors of supplier development (Krause and Ellram, 1997a, b); the process of supplier development (Krause et al., 1998); the factors that influence buying firms' involvement in developing their suppliers (Krause, 1999); and the effect of technical support provided to suppliers on the performance of both suppliers (Krause, 1997; Prahinski and Benton, 2004, Modi and Mabert 2007) and buyers (Krause et al., 2000).

Supplier development has been defined as any effort by the buyer to increase the performance and capabilities of its suppliers to meet its short and long-term supply needs (Krause and Ellram, 1997). This requires both the buyer and the supplier firms to commit financial, capital and personnel resources to the work; to share timely and sensitive information; and to create effective means of measuring performance. Thus, companies are most likely to concentrate their efforts on their strategic suppliers. Buyer executives must be convinced that investing company resources in a supplier is a worthwhile risk. Supplier executives must be convinced that their best interest lies in accepting direction and assistance from their customer. The important role of top management has been greatly emphasized in supply chain literature (Monczka et al 1993, Krause 1999). Monczca et al. (1993) claim that top management must commit the time, personnel and financial resources to support the suppliers through supplier development practices and cooperation.

In their study based on a survey of 96 US companies, Krause and Ellram (1997) found significant differences between buyers involved in supplier development from those not involved in supplier development. The former saw their suppliers as partners, placed greater emphasis on two-way communication, involved top management in the buyer–supplier relationship, used cross-functional teams, and purchased a large percentage of the suppliers' annual sales. Interestingly, there were some areas where there were little differences between the two groups. Both focused on cost of ownership rather than price, sought long-term relationships with their suppliers, and formally evaluated their suppliers' performance. In the latter case, this is perhaps because both groups have tried to use this information to identify and improve any general areas of weaknesses of their suppliers (Hahn et al., 1990).

Supplier development can be distinguished by the role of buying firm plays , i.e. according to the resources committed to a specific supplier. In case of direct (Monczka et al 1993) or internalized (Krause et al 2000) suppler development, the buying firm plays an active role and dedicates human and/or capital resources to a specific supplier. From transaction cost economics perspective, direct supplier development refers to a transaction specific investment by the buying firm (Williamson 1985, 1991). Direct supplier development includes activities such as on-site consultation, education and training programs, temporary personnel transfer, inviting the supplier's personnel, as well as the provision of equipment or capital. Hence, the firm must safeguard its supplier-specific investments, for example by establishing long term buyer supplier relationships. The buyer supplier relationship shifts in this case from spot market to relational (repeated). Contrariwise, the buying firm commits no or only limited resources to a specific supplier in case of indirect (Monczka et al 1993) or externalized (Krause et al 2000) supplier development. In this case, the firms offer incentives or enforce supplier improvement, and hence make use of the external market to encourage supplier improvements. This is frequently done by assessing suppliers, communicating supplier evaluation results and performance goals, increasing supplier performance goals, instilling competition by the use of multiple sources or promising future business (Krause 1997, Krause et al 2000, Monczka et al 1993, Prahinski and Benton, 2004).

Direct supplier development is usually preceded by indirect supplier development activities (Krause et al 1998). It has been shown that indirect supplier development is

usually preceded by indirect supplier development activities (Krause et al 1998). It has been shown that indirect supplier is an enabler for direct supplier development (i.e. has only indirect effect on performance). Direct supplier development, however performs a direct and critical role in achieving performance improvement (Krause et al 2000). The buying firm should build the decision to conduct direct supplier development on a supplier evaluation system. In their empirical study, Krause et al (2000) found that firms which evaluate their suppliers formally and based on defined criteria and procedures, and which communicate the evaluation results, are more successful with their subsequent direct supplier development activities. Additionally, a formal supplier evaluation system is also important for controlling the supplier's progress in improving performance (Krause and Elram,1997, Krause 1999).

In the paper "A structural analysis of the effectiveness of the buying firm's strategies to improve supplier performance", the authors empirically test the relationship between a firm's supplier development effort and buyer's own product performance. Krause et. al. (2000) characterize four useful supplier development strategies. These are supplier assessment, providing incentives for improved performance, direct involvement of the buying firm's personnel with suppliers through activities such as site visits and help offered to the supplier. The authors conclude that direct involvement activities, where the buying firm internalizes a significant amount of the supplier development effort, play a critical role in performance improvement. Their results suggest, in addition, that supplier assessment and supplier incentives are key enablers of supplier development efforts for the manufacturing firms in their sample. Supplier incentives motivate suppliers to improve by sending a message that improved performance is awarded with increased business and preferred status for future business. Supplier assessment allows buying firm to evaluate a supplier's performance and provide suppliers with direction to drive improvement objectives. The results of this study suggest that in the sample used of manufacturing firms, the combination of direct involvement, supplier assessment and incentives yield performance improvements without the need for competitive pressure. In my opinion this can be also explained by the fact that this paper studies the buyer's point of view and the competitive pressure may be more credibly assessed by the suppliers.

Modi and Mabert (2007) complement the Krause's research by directly investigating the impact of supplier development on supplier performance improvements. Their results suggest that evaluation and certification efforts are the most important supplier development prerequisites before undertaking operational knowledge transfer activities such as site visits and supplier training. These activities lead to increased supplier improvement. In addition, collaborative Interorganizational communication is identified as important supporting factor in transforming an organization's efforts to develop supplier performance improvements.

Interorganizational communication has been documented as a critical factor in promoting strategic collaboration between firms. Literature in relationship marketing has recognized how collaborative communication is critical to fostering and maintaining value enhancing interorganizational relationships (Mohr and Nevin, 1990). Henke (2007) found that the open and honest communication between buyer and supplier lead to the long term orientation of the latter. This is important for the performance of supplier relations become longer term orientation is associated with higher level of suppliers' efforts and investments and consequently better performance. Operations management researchers have also documented how inter-organizational communication enhances buyer supplier performance. Paulraj et al (2008) develop a conceptual model linking key antecedents and outcomes of interorganizational communication. They use the relational view framework and conceptualize the interorganizational communication as a relational competency, which mediates the links between several antecedents and outcome variables for buyer and supplier firms. Communication among supply chain member may foster interorganizational learning that is crucially important to value enhancing relationships and competitive success. The greater and bidirectional information exchange may foster confidence, build cooperation and trust, reduce conflicts and therefore generate relational rents. Such exchange may lead to increased behavioural transparency and reduced information asymmetry and therefore reduces transaction costs and enhancing transaction value by approaching the first best- the optimal maximization solution. Pauraj et al (2008) consider as antecedents interorganizational communication the network governance adopted, the buyer-s long term orientation and the information technology used. As hypothesized by the authors, their results show that the effect on communication of the considered antecedents is

positive. In addition, the communication result positively related to buyer and supplier performance.

Successful management of supplier relationships can potentially enhance the productivity of the trading partners through diffusion of knowledge and mutual assistance, with the implementation of good practices. Numerous studies involve the analysis of the successful Japanese supply networks and the way the knowledge is transferred (Helper Sako 1995, Dyer and Nobeoka 2000, Sako 2004). The use of supplier development programs proved to be successful strategy for several organizations in Japan, over the last 50 years (Helper Sako 1995, Helper MacDuffie 1997).

Inspired by the Japanese paradigm, western companies launched similar programs, but their success has been limited. According to Sako (2004), one of the underlying reasons for their failure has been the unquestioning imitation of the Japanese SD model. The majority of the supply chains in the west however have different structural characteristics and the cultural and economic environment are different to those in Japan. Krause and Elram (1997) claim that the lack of the buying firm power in terms of the percentage of supplier's output is a significant reason for lack of commitment on behalf of supplier and failure of this programs. As a result, many suppliers either are uncertain whether to participate in such programs and if they do so, their appreciation is limited to the achievement of certain performance indicators in short term (Sako 2004). This does not facilitate substantial learning and knowledge diffusion between and amongst the trading partners and therefore an adapted model for supplier development is needed. Traditionally management researchers focus on the knowledge management approaches inside the organization. In today's global scale-driven and technology intensive global economy, the new concept of knowledge management initiative transcending organizational boundaries is essential. Several recent studies that focus on the importance of supplier development and improvements touch issues related to knowledge transfer (Handfield et al 2000, Sako, 2004, Modi and Mabert 2007, Kotabe et al 2003). A focus on collaborative supplier relationships for knowledge sharing purposes has been argued to be a very important determinant of competitive advantage in the automobile industry (Dyer and Nobeoka, 2000). Kotabe et al (2003) study sources of operational performance improvement in supplier partnerships. The authors argue

that supplier performance benefits most where time-bound relational assets have developed between a buyer and supplier and the firms exploit the resulting communication efficiency by transferring productive knowledge. Kotabe et al (2003) differentiate the knowledge exchange into two types. These are the technical and the technological exchange. The authors examine the effects of these two types of exchange together with the prior duration of the buyer-supplier relationship.

3. Model and hypothesises

Our model explores how the buyers' policies and actions concerning the management of supplier relations are related to the supplier's performance in terms of development of capabilities and improvements. The unit of analysis is the buyer supplier relation.

3.1. Dependent variable

The dependent variable in our study is represented by the improvements and investments realized by suppliers because of working for determinate customer. These include improvements concerning quality control, training activities, deliveries and production processes and equipment. These may require considerable investments and may be of critical importance for achieving and maintaining the competitive advantage of the suppliers and as consequence also for the Car Maker with which they work. Frequently, these investments are specific to the relation with particular customer and their utility cannot be transferred to relationships with other buyers.

3.2. Independent variables and hypothesis

- *Supplier's dependence on the buyer*

Researchers acknowledge the role of dependence in buyer supplier relationships (Mukherji and Francis, 2008). Dependence can be conceptualized as the economic power one firm has over another, which in turn may result in significant levels of adaptation. In a relationship where a supplier firm depends on a larger buyer for a substantial part of its output, the buyer may have a degree of power over the supplier. According to Ganesan (1994), the increased dependence on one buyer is the

consequence of the extent to which the supplier firm is affected by losing the buyer, of how critical is the buyer and of the lack of alternative buyers. Therefore, the supplier perceives stress in fulfilling customer's suggestions and requirements because concerned about the continuity of the relation and about the demanded volumes.

We argue that the more the supplier is dependent on the buyer, the more likely is it to adapt itself to the needs of its buyer and to realize improvements in its operations and management. The dependence works as an incentive to improve and to fulfil buyer's requirements. Therefore, we hypothesize that:

H1: There is a positive relationship between supplier's dependence and supplier's improvements.

- *Buyer's assistance*

Direct involvement of the buying firm's personnel in supplier development includes activities offered to the supplier in order to improve. When realizing this kind of activities, the buying firm internalizes a significant amount of the supplier development effort. According to Krause (2000) the direct involvement of the buying firm in the supplier development plays a critical role in buying firm performance improvement (Krause 2000). According to Modi and Mabert (2007), these activities lead to increased supplier improvement.

When the Car Maker offers assistance in improving problematic areas for the supplier, there is direct interaction between supplier and buyer personnel. These interactions at individual level facilitate the demonstration and transfer of tacit knowledge. This helps the supplier personnel to resolve production problems and streamline their process for better performance and therefore buyer's collaboration is expected to lead to supplier improvements of the supplier's operation.

H 2. There is a positive relationship between buyer's assistance and supplier's improvements.

- *Collaboration between the automaker and suppler in design and technological decisions concerning the product exchanged*

Collaboration in design and technological questions refers to the participation of the supplier and the automaker in the decision making processes concerning the product exchanged. In the automotive industry, the supplier involvement in the design has been found to contribute to the performance of the buyer-supplier relationship (Takeishi 2001).

Supplier involvement in product development process leads to major responsibilities for the supplier and requires making specific investments. These investments are often specific to a focal purchasing relationship, subsequently, if used in an alternative relationship their value will be significantly lost. Suppliers, realizing this, are more willing to collaborate with Car Makers on a long term basis in anticipation of the eventual joint benefits of the collaboration. Furthermore, the involvement in decisions can provide suppliers valuable knowledge which may help them improve and therefore being more competitive in their industry.

In addition, when the buyer and the supplier work together in product development, there is less information asymmetry concerning the efforts and capabilities of the supplier. And this is a further incentive to improve and develop for the supplier. Therefore, we hypothesize that:

H 3. There is a positive relationship between collaboration in design and technological decisions concerning the product exchanged and supplier's improvements.

- *Level of collaboration perceived by the supplier*

The efforts and the investments the supplier is likely to exert in order to answer to the buyer's requirements depend on the level of collaboration and trust between the two parties. These are also related to the expected length of the relationship and the expected profits from such specific investments. The higher level of efforts and investments are likely to lead to more improvements. That is why we believe that:

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H.4 Higher level of collaboration perceived by the suppler is positively related to supplier's improvements.

3.3. Control variables

- ***Whether the supplier works for Nissan or for Seat***

We include this variable in our model in order to analyse whether the results of supplier development are linked to the buyer's policies in a different way for the different automakers.

- ***Whether the supplier works exclusively for the automotive industry (sector)***

We can expect that suppliers involved exclusively in the automotive industry tend to invest more in a relation with a Car Maker than suppliers working also for other industries, because we assume that these investments tend to be easier to transfer to other customers and are likely to be more linked to the core business of the supplier.

4. Context, sample and measures

4.1. Automotive industry in Spain and Catalonia

Spain has consolidated its position by becoming the third largest automobile producing country in Europe, behind Germany and France, as well as leading producer of commercial vehicles. The main car makers have facilities in Spain. These are Seat, Volkswagen, Nissan, Renault, Ford, PSA Peugeot-Citroën, Opel (General Motors), and Daimler Chrysler. All the car makers maintaining presence in Spain modernize and expand their operations regularly and as a consequence Spanish automotive plants are competitive at European level.

In Spain there are plants dealing with all the stages of production. The majority of the car makers make use of JIT production process, which involves a major subcontracting

of components. The number of workplaces of the auxiliary motor industry (suppliers) has increased as a result of the decentralization of activities of the large automotive companies through subcontracting of component manufacture.

Subcontracting is spread over the whole of Spain. The components industry is dominated by multinationals that each have several plants. These companies have grown as a result of the high degree of outsourcing of the automotive factories in Spain. Employment in the components industry increased during the 1990s. In particular, in the period between 1993 and 1999, the number of the employees had increased by 37%, representing 64 000 jobs.

Table 1: Employment in the components industry, 1993-1999 (in thousands of workers)

1993	1994	1995	1996	1997	1998	1999
174.1	180.5	196	203.1	214.7	229.2	238.5

Source: Sernauto. Quoted by CCOO: Report of Sectors of the Mining and Metal Federation of CCOO. Second Congress, 16-18 November 2000.

The volume of employment in the large automotive companies has decreased, with 14 000 jobs lost between 1990 and 1999. This was a result of the reorganization and rationalization of production and coincided with a period of expansion of production and demand rather than a crisis in demand.

Table 2. Evolution of employment in the automotive sector

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
94.5	94.6	90.3	82.3	76.8	74.6	74.6	75.6	78.1	79.9

Source: ANFAC, quoted by CCOO (2000). Second Congress of the Mining and Metal Federation. Madrid.

It is significant that the large automotive companies reduced their workforce at a time of increasing production and sales during the 1990s. The restructuring of companies

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through decentralisation and subcontracting has been the general tendency. The White Paper of the Automotive Sector commissioned by the government forecasts the closure of factories in Spain. Today the Spanish automotive sector is still competitive, but in the medium and long term its future is at stake. One of the main problems lies in comparative labour costs and delocalisation towards Eastern Europe in the manpower-intensive industries. The social partners have called for more government intervention to improve Spain's competitive capacity through technological research, research into design and safety, improvement of professional qualifications, improvement of rail goods transport, and development of a powerful ADSL network.

Catalonia is a leader in the automobile industry and one of Europe's key locations with three large car manufacturing plants Seat, Nissan and Irisbus (Iveco) accounting for almost 40% of Spain's total sales in the automobile industry. The sector accounts for 10% of Catalonia's GDP, it provides jobs for 100,000 people in the sector and a further 100,000 in dependent sectors. The car makers work in synergy with other major manufacturing firms in the transport sector (railway, aeronautics, motorcycles, bodywork, etc.). Catalonia exports 80% of the vehicles and 60% of the components it manufactures, which is an indication of its prestige in terms of quality and competitiveness.

The capital Barcelona represents the biggest and more important automotive cluster in Spain. Here are located three OEMs plants (Seat, Nissan and Ivecco) and a big portion of the component and equipment producers. In addition, Catalonia is increasingly becoming one of Europe's major design centers in the automotive sector and this is important as innovation is considered one of the keys of success in this industry.

4.2.   The Car Makers' plants studied

In 1997 Seat's and Nissan's plants differ substantially in their dimension as number of employers and sales. The minor percentage of material cost on the total production costs shows the major degree of vertical integration in Seat with respect to Nissan. As for the number of suppliers we can see that Seat has much more suppliers than Nissan.

Table 3: Seat vs. Nissan

Description (all data is related to year 1997)	Seat	Nissan
number of national suppliers	360	166
number of non national suppliers	360	84
Number of employees	12 811	6 027
Sales (Euros)	4 651 290 000	1 443 670 000
Cost stucture		
-materiales	70%	85%
-direct work force	8%	6%
-other costs	22%	9%

In relation to links with other enterprises and in particular with suppliers, both Nissan's and Seat's managers declared to prefer quality as supplier selection criteria and to collaborate in aspects related to the production with suppliers. Both car makers evaluate and audit their supply base. One of the main differences between the two car makers is related to quality management. Nissan has established a coordinated quality system with the most of its suppliers while Seat has not. Nissan concentrates significant effort on quality issue both internally, by its large quality department and in collaboration with its own supply base and as result can be considered as one of the best ones in terms in quality. Nissan has established JIT with the most of its suppliers while Seat with in the minority of its suppliers.

- **SEAT**

Seat has a symbolic meaning for Spanish market, because it was a pioneering company that was set up in the 1950s by the National institute of Industry (Instituto Nacional de Industria, INI). Initially, Seat manufactured Fiat models that differed a bit from the products of the Italian parent. In Spain people used to joke about Seat translating its

letters as "Siempre Estamos Apretando Tornillos", which literally means "we are Always Tightening Screws", implying that the cars need to be fixed often. This is related to the "Fiat Years".

After the withdrawal of Fiat in 1981, the Volkswagen group signed a cooperation agreement with Seat, becoming the major Shareholder in 1986, and owner of 100% of the company in 1990. After the so called Volkswagen revolution, many subsequent motoring surveys have rated Seat among the most satisfying cars to own.

The company develops and designs its own models of cars in accordance with the policies of the Volkswagen Group. They have also their own research and development centre near the plant in Martorrel. The Seat's Martorrel plant is one of the newest car maker's plants in Europe. It is established at 1992. Its supplier's park is the longest-lasting example in Europe of the clustering of automotive suppliers. When Seat decided to relocate its assembly plant in 1990, one of the requirements was proximity of the suppliers. That was in order to facilitate sequential JIT deliveries with minimum inventories to the assembly plant. However, most of the companies subcontracted by Seat are within 16 kilometres of Martorell. 75% of the suppliers in the park are foreign owned and the most important origin is Germany.

- **NISSAN**

Nissan Motor is a Japanese automobile maker. It used to be Japan's second-largest car company, after Toyota, but it has dropped to third in size after Honda.

In 1980, Nissan acquired manufacturing plants in Spain by purchasing shares in Motor Iberica, S. A. and started production in the Franca plant (Barcelona) in 1983 which was established in 1923. Incompetent production management in that plant caused grave problems that weakened productivity. An excessive number of suppliers and surplus stock impeded its smooth and efficient production. From the late 1980s, Nissan embarked on the reconstruction of the parts logistics system of the Franca plant. First, it drastically reduced the number of suppliers by selecting them in terms of quality, cost, and delivery, and aimed to establish stable relationships with a limited number of suppliers. Then it implemented a new parts procurement strategy (Materials Requirement Planning, MRP) to perform periodic parts delivery from their suppliers based on "just-in-time" (JIT) production. The geographical distribution of suppliers has been considered to be the key element in the implementation of JIT. The locations of

suppliers that Nissan had inherited from Motor Iberica were spread among the remote preexisting core areas of automobile production in Spain. Furthermore, the car maker has expanded its parts supply network outside Spain since the early 1990s, especially in Germany and the UK, due to both the enforcement of common certification in the European Union and the development of joint parts procurement with Nissan Motor Manufacturing UK in Europe (Saito, 2001).

4.3. Sample of suppliers

We tested our research hypotheses on the supplier networks of Nissan and Seat's plants located in Barcelona (Spain). These are important industry players in the Spanish automotive industry. We analyzed the supplier network of the two manufacturers by focusing on their most important suppliers located in Spain. The unit of analysis in our model is the supplier-automaker relationship.

The data used in this study is form a survey addressed and answered by the sample of the most important suppliers of the two plants based in Spain. The objective of this research (M. C. Torreguitart and J. L. Parra, 2000) was to study the supplier relationships in the Spanish automotive industry. The authors analysed the supplier relationship models used from Nissan a Seat plants in Barcelona. They gave a score to the Seat's and Nissan's supplier relationship management and concluded that both Car Makers have partnership relations with their main Spanish suppliers and Nissan is more collaborative with respect to Seat.

The authors distributed their questionnaire to the suppliers in 1997. We use the supplier's answers to this questionnaire for our study. The survey was formed by 82 questions related to the relationship with the relative Car Maker. These include queries on characteristics of the supplier and the product exchanged, the involvement of the suppler in decision making, the level of information sharing, the main carmaker concerns perceived, the areas improved because of the existence of the relationship with the relative car maker, the delivery modes etc.

In 1997 Nissan's plant in Catalonia had 230 suppliers, form which 166 are located in Spain and 64 abroad. The questionnaire was forwarded to the 88 of the suppliers

located in Spain and useful responses have been received by 46 Nissan's suppliers (52% response rate). In the same year Seat had 360 domestic and 360 suppliers located abroad. The survey was forwarded to 180 of the most important domestic suppler in terms of cost share. Useful responses were received by 77 Seat's suppliers (43% response rate).

4.4. Measures

As the survey we use in our study was answered by suppliers, the measures reflect the perceptions of suppliers regarding the relation with the relative Car Maker.

- **IMPROVEMENTS**

The variable ***Improvements*** measures the extent of improvements realized by the supplier because of working with the relative car maker. This is our dependent variable. It is the sum of 18 binary variables concerning technological improvements, introduction of instruments for quality control, implementation of methods in order to control costs, reduction of the time for preparation of the machines/equipment, reduction of the size of the production lots, implementation of programs for preventive maintenance, integration of informatics and automatic devices in the production, quality controls by auditors, improvement and reorganization of the production processes, improvement of the delivery methods, investments in machines and equipment, investments in training of employers, hiring work force with technological education, reduction of the level of defects to the minimum level, increasing the inventory stocks in order to be able to guarantee the supply, reduction of the inventory levels in order to be more flexible, control on the suppliers.

The 18 items take value one for "yes" (the suppler improved the relative area because of working with the specific car maker) and value zero for "no". As the 18 items are binary, in order to measure the reliability of the construct, we cannot use the Cronbach Alpha coefficient, but have to use the Kuder-Richarson coefficient of reliability (KR-20). The KR20 coefficient is 0.9202 and thus, this construct is a reliable. As the dependent variable in our model is the sum of these items it takes values form 0 to 18.

- **SUPPLIER'S DEPENDENCE**

The proxy we use in order to measure supplier's dependence *(Dependence)* is a binary variable that takes value one when the supplier feels stressed in fulfilling all customer's suggestions and requirements because concerned about the continuity of the relation and about the demanded volume. The variable takes value one when the supplier feels stressed to fulfil the requirements and suggestions of the Car Maker and value zero otherwise.

- **ASSISTANCE**

In order to reflect the direct buyer's involvement in suppler development activities we use a binary variable *(Assistance)* that takes value one when the supplier receives assistance on order to improve and resolve problems, and value zero otherwise.

- **LEVEL OF COLLABORATION**

In order to represent the level of collaboration we use the classification done by each supplier when answering the survey. We create three binary variables:

- *Adversarial*- takes value one when the supplier perceives its relationship with the Car Makers as adversarial and zero otherwise,

- *Collaborative*- takes value one when the suppler perceives its relationship with the Car Maker as collaborative and zero otherwise,

- *Partnership*- takes value one when the suppler perceives its relationship with the Car Maker as a strategic partnership and zero otherwise;

- **COLLABORATION IN DESIGN AND TECHNOLOGY**

The collaboration in design and technology is represented by three binary variables:

- *Collaboration*- takes value one when the design and technological decisions related to the product exchanged are taken in collaboration between the Car maker and the supplier and value zero otherwise,

- *Suggestions*- takes value one when the design and technological decisions related to the product exchanged are taken by the Car Maker after the supplier has given his suggestions and value zero otherwise,

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- *__No collaboration__*- takes value one when the Car Maker or the supplier takes the design and technological decisions related to the product exchanged on their own and value zero otherwise;

- **CONTROL VARIABLES**

We use two control variables in our model:

- *__Sector __*is a binary variable that takes value one when the suppliers works exclusively for the automotive industry, and value zero otherwise.

- *__Client __*is a binary variable that takes value one when the supplier in the sample works for Seat and zero when this works for Nissan.

5. Methodology, results and implications

We test our hypothesis by estimating an OLS regression with the extent of the supplier improvements as dependent variable. The independent variables are relative to the buyer actions and strategies concerning the supplier relations. These are the supplier's dependence from the Car Maker, the buyer's assistance provided to the supplier, the level of collaboration in design and technological decisions and the level of collaboration perceived by the supplier in its relationship with the Car Maker. In our model we control for who is the Car Maker in the relationship and whether the suppler works exclusively for the automotive industry or no.

In addition, as our dependent variable is not continuous, but takes values from zero to eighteen (only whole numbers) we also estimate our model with an ordered probit. In this way we improve our estimation methodology. In addition we estimated probit models in relation to each single area of improvement. The results of these can be found in table 4.

Table 4: OLS and Oprobit estimations of the model

	OLS	Oprobit
Dependence	2.33067* (0.7061742)	0.6517208* (0.2016136)
Assistance	1.571801** (0.7650718)	0.3177903 (0.2165573)
Collaborative relationship	5.085621* (1.29338)	1.211969* (0.3824457)
Partnership	7.539703* (1.362069)	2.111331* (0.4099198)
Suggestions in des_tech	2.446273* (1.143818)	0.4598414 (0.3285882)
Collaboration in des_tech	3.828997** (1.032112)	0.9274274* (0.2985487)
Automotive	2.020274* (0.7024624)	0.6018382* (0.1991766)
Car Maker	-0.9905974 (0.729335)	-0.3973783 (0.2073033)
Constant	0.1125455 (1.464454)	
R^2 Adjusted R^2	0.57 0.54	0,14

+ = p < 0.10; * = p<0.05; ** = p < 0.01

The coefficients estimated through our OLS model confirm all our hypotheses. All the coefficients have the expected sign and are significant. The coefficients estimated through the Ordered probit model has the expected signs. In conclusion, we can say that the supplier realizes more efforts and investments in order to improve the performance related to the relationship with the Car Maker:

- when feels dependent and stressed to fulfil all the buyer's requests and suggestions in order to maintain the volume of the business;

- when the Car Maker helps him by offering assistance in order to improve;

- when the supplier perceives higher level of collaboration in the relationship.

The coefficients for Collaborative relationship and Partnership are positive and significant, and the value for the second one is higher than for the first one. This means that the dependent variable is higher when collaborative relationship and partnership were perceived by the supplier with respect to the base case of adversarial relationship perceived. In addition, as the coefficient for Partnership is higher with respect to the one related to Collaborative relationship we can conclude that there are more improvements when the supplier perceives its relationship with the Car Maker a strategic partnership than in case where the supplier perceives it as Collaborative relationship. We can summarize that the closer relationship between car maker and supplier is related to higher degree of supplier development due to this relationship.

- when the supplier collaborate with the Car Maker in taking design and technological decisions as this leads to the situation where the supplier has more responsibilities and is able to accumulate experience and learn by the buyer;

We can notice that the coefficients relative to the variables that represent the level of collaboration in design and technological decisions are positive and significant. This means the more improvements are related to the cases where the Car Maker takes consideration of the supplier's suggestions and collaborate with the supplier when taking this decisions with respect to the base case where there is no collaboration in such taking such decisions. In additions, the coefficient related to Collaboration is higher than the one related to Suggestion. Therefore, we can conclude that the higher level of collaboration in taking design and technological decisions related to the product exchanged are related to more improvements.

All the coefficients estimated by the Ordered probit model has the expected signs, but two of them are not statistically significant. The first one is the coefficients related to the assistance provided from the Car Maker to its suppliers. This puts some doubts on the confirmation of our Hypotheses two. The second one is related to the variable that represents the cases where the Car Maker considers the suggestions of the supplier when takes the design and technological decisions related to the product exchange. This result shows that only the collaboration with the supplier when taking such decisions is

related to more improvements than in the case where there is no collaboration. According to the estimates, the case where the Car Maker considers the supplier's suggestions is equivalent to the one when there is no collaboration as related to the improvements done by the supplier.

As related to our control variables, both the OLS and the ordered probit models confirm that the suppliers that work exclusively for the automotive industry realize more improvements related to their work with the client Car Maker.

As the variable Client has non significant coefficient, we can claim that the studied mechanisms that give incentives to the supplier to realize more improvements and investments do not depend on who the Car Maker is- Nissan or Seat.

CHAPTER 3 – NISSAN EUROPE PURCHASING

Nissan is a Japanese automobile maker. It used to be Japan's second-largest car company, after Toyota, but it has recently moved down to third place, size-wise, behind Honda. The Barcelona plant was acquired by Nissan in 1980. From the late 1980s, Nissan embarked on the reconstruction of the parts logistics system of the plant. First, it drastically reduced the number of suppliers by selecting them in terms of quality, cost, and delivery, and aimed to establish stable relationships with a limited number of suppliers. Then, it implemented a new parts procurement strategy (based on Materials Requirement Planning, MRP) to perform periodic parts delivery from their suppliers, based on the Nissan version of "just-in-time" production (*doki seisan* later defined Nissan Production Way). The geographical distribution of suppliers has been considered to be the key element in the implementation of JIT. The car maker has expanded its parts supply network outside Spain since the early 1990s, especially in Germany and the United Kingdom, due to both the enforcement of common certification in the European Union and the development of joint parts procurement with Nissan Motor Manufacturing UK in Europe (Saito, 2001).

The Renault-Nissan alliance, established in March 1999, is the first industrial and commercial partnership of its kind involving a French and a Japanese company. Renault and Nissan pool their expertise and cooperate on purchasing, engineering, production and distribution. As regards the purchasing function, RNPO (Renault-Nissan Purchasing Organization) defines the worldwide purchasing strategy by component family and selects the best suppliers on the basis of quality, costs and delivery times. Through this organization Renault and Nissan combine order volumes and develop component standardization. Currently RNPO covers 100% of Renault and Nissan purchase volumes.

The alliance with Renault is an equity sharing venture between the two companies: Renault owns 44% of Nissan and Nissan own 15% of Renault. The companies share a common CEO, charismatic Carlos Ghosn. His Nissan Revival Plan to return Nissan to profitable growth included the divestment of equity owned in affiliated suppliers and the establishment of Renault Nissan Purchasing Organisation (RNPO) in 2001 to manage approximately half of the combined global annual purchasing spending. The new purchasing organization resulted in a pressure to switch to a more market-based approach to supplier selection and

management, within the context of sharing a global supplier base with Renault. Consequently, some smaller suppliers lost business within Nissan, and amongst those that continued to trade, some suppliers merged with each other or were sold. Nevertheless, supplier development activities continued, especially those aimed at spreading the Nissan Production Way (NPW). Overall, these activities contributed to reducing Nissan's purchasing costs by 20% during 2000 and 2002.

The alliance between Nissan and Renault leads to a convergence of their strategic direction and a tightening of the relationship such that there is frequent transfer of staff between the organisations. As for every car maker, purchasing is a particularly important function. In the Nissan case, the value of purchased components accounts for approximately 70% of the cost per vehicle. At Nissan, the role of Purchasing is to negotiate the most competitive purchase price, while minimizing the economic risk and safeguarding the performance criteria with regard to design, manufacturability, logistics and quality. That implies identifying candidates to work with, evaluating and negotiating with candidates and selecting appropriate supplier. The purchasing function of Nissan is governed by Renault Nissan Purchasing Organisation (RNPO) and Nissan Europe Purchasing. RNPO was established in 2001. It ensures that Renault and Nissan coordinate their purchasing activities and leverage economies of scale. Joint purchasing through RNPO has made it possible to generate approximately 0,5% of yearly cost savings on each component since 2002. In addition, having common Renault and Nissan suppliers makes it possible to design shared components, which generates design cost savings of approximately 2-5% a year on each component. RNPO helps Renault and Nissan to select the best suppliers with respect to quality. This organization is responsible for the determination of the supplier panel for the two car makers. The information exchange between Renault and Nissan favors the use of best practices. Renault has adopted the strict quality procedures of Nissan and Nissan has adopted the cost analysis and price target-setting approaches of Renault.

Nissan Europe Purchasing organisation manages the relations with Nissan suppliers to its European plants- the one in the United Kingdom and the on the two in Spain. It employs approximately 200 people. Its main divisions are:

- Parts: Components that are used directly for the assembly of vehicles within the Nissan Europe manufacturing Plants (NMUK – NMISA - Trucks).

- Materials: Raw materials that are also used directly within the manufacturing plants. For example, Steel, Paint, Plastic

- After sales: Component parts that are required for the aftermarket (vehicle servicing and repair); and Accessories that are not assembled by the manufacturing plants.

- F&SS (Facilities and Support Services): Capital Equipment, Services & Consumable items used within Nissan Europe.

With regard to vehicle part purchases, buyers are grouped in an organizational structure that includes: Chassis (Stamping and exterior trim), Body, Electrical, Trim and Powertrain. The buyers are grouped by the type of commodity and not according to the vehicle project or supplier. The main reason to organize buyers in this way is to make the communication with the design department easier, since the latter is organized in the same way. Besides, this purchasing organization allows component specialization and the acquisition of component specific knowledge, which allows to compare and evaluate effectively the quotations and prices of different suppliers. Finally, buyers grouped by component category can fully leverage high purchasing volumes to put pressure on suppliers in order to get price reductions. Nissan Europe's purchasing organization includes also people fully dedicated to vendor tooling. There is a conflict of interest between part buyers and vendor tooling specialists. Both have the objective to reduce costs but while buyers adverse more expensive tooling, vendor tooling specialists favour it because it reduces unit costs. After receiving the technical specifications by the design department, buyers prepare and send the request for quotation to suppliers that are within the supplier panel prepared by RNPO. The objective is to find the lowest price that satisfies Nissan technical and quality requirements. There is no commitment in terms of quantity, although a volume forecast is given to the supplier. The supplier has to assure that its production capacity can afford 120% of the forecasted quantity. In addition, buyers negotiate the productivity levels the supplier have to meet and target yearly cost improvements objectives, i.e. the percentage by which the supplier has to reduce the initially negotiated price each year. Each buyer receives from the cost department target prices and has to negotiate a price that is below the targets. If this is impossible, or the supplier is not able/willing to commit, Nissan can offer to the supplier technical support on how to organize its production in order to be more efficient. The emphasis is on total cost of ownership. This includes all the costs related to the part exchanged until this enters the production process of

the auto maker. The logistics costs, for example, are a particularly important share of the total cost of ownership when the supplied item is large size-wise and when the supply has to be synchronized with Nissan's plant production process according to the Nissan Production Way.

Price increases due to increases of the cost of raw material are negotiated when considered to have significant effect on the supplied item cost. Anyway, the price increase is the last alternative after studying ways to make the supplier's production process more efficient. There is a team of technical personnel specialized in improvements in production processes.

Our interviews with Nissan Europe's design and purchasing managers highlighted an important distinction between Nissan's approach to suppliers before and after the merge with Renault. Before the alliance with Renault (1999), Nissan's supplier development teams provided general support to suppliers helping them to become more efficient across the board. This was consistent with the Nissan's supplier capability building approach described by Sako (2004) of helping suppliers to be more competitive in their business and to cultivate trust and willingness for long term relationships with suppliers. This Nissan's costly efforts to develop suppliers was geared towards getting benefits in the long run and was based on the assumption that no knowledge spillover would take place to competing buyers (or, alternatively, that the supplier is not selling to competing automakers). This assumption corresponds to the traditional domestic practices of Japanese automakers, which tended to have separate supplier networks with few or no overlaps (in the case of Nissan, its supplier association, Takarakai, and its developments over time).

Since the alliance with Renault, Nissan's supplier development teams and activities have focused more narrowly on the improvement of Nissan components' production cost, promoting and activating joint cost reduction projects. Nissan provides technical and managerial support to certain suppliers on how to reduce their production costs and when the project is implemented buyers ask for price reduction. The main criterion for selecting which suppliers to involve and which projects to develop, is the proportion of the component's cost to the vehicle's full manufacturing cost. Supplier's participation in these projects reduces the information asymmetry between the tow parties and therefore reduces the supplier's moral hazard. The results of these projects are visible in the short term. Both car maker and first tier supplier exercise costly effort in order to achieve cost reductions.

CHAPTER 4 - RISK SHARING AND SUPPLIER RELATIONSHIPS IN THE GLOBAL AUTOMOTIVE INDUSTRY: THE CASE OF NISSAN EUROPE

1. Introduction

During the 80' researchers began paying increasing attention to the effects of inter-firm and in particular to supplier relationships on achieving competitive advantage and superior returns. This appears merited for at least two reasons. First, purchased inputs can account for up to 75% of a firm operating budget. And second, firms that find ways to lower input costs and/or increase input quality gain advantages over competitors (Barney, 1991). Managing supply chains in today's competitive world is increasingly challenging due to the greater uncertainties in supply and demand, globalization of the market, shorter and shorter product and technology life cycles.

With respect to other industries the automotive is in advanced stage of implementing supply chain management developments. This industry has long been used as an exemplar of important economic phenomena involving supply chains. It is a useful context for examining modes of inter-firm economic exchange, since its global scale, technological scope and huge product and process complexity generates a diverse set of decisions concerning the purchasing strategy of car makers. Although automakers assemble the final product, outside suppliers are often involved in design as well as manufacturing, and may account for 70 percent of manufacturing costs and 50 percent of engineering costs (Clark and Fujimoto, 1991).

Over the last decade, relationships between most automotive OEMs and their suppliers have been marked by the OEMs' relentless drive for lower prices (Henke, Parameswaran, Pisharodi, and Mohan, 2008). According to a Boston consulting group research (Maurer, A., Dietz, F., Lang, N., 2003) suppliers not only are taking over large portions of automotive production but also are becoming the key drivers of innovation. Managing the supplier relationships in a way that is beneficial for both parties is critical success factor. Car Makers find themselves increasingly dependent on their tier one suppliers for concept definition, series development,

and preassembly. Therefore, maintaining a healthy, capable and motivated to improve supply base is crucial for the competitiveness of the final product.

Several researchers (Asanuma, 1989; Smitka, 1989; Sako, 1996) notice that the Japanese Car Makers normally include mechanisms geared towards mitigating the effect of uncertainty and risk on suppliers. Since their discovery, the superior quality of Japanese-style supply relationship management practices has somewhat been taken for granted, and their nature considered as unchanged over time. Indeed, some studies have focused on their evolution, but they put prevalent emphasis on how these practices adapted in transplant situations in Europe and North America (Florida and Kenney, 1993; Liker, Fruin and Adler, 1999), not on how competitive pressure brought about by globalization, new technologies and M&As processes have impacted on them.

This study aims to contributing to fill this research gap analyzing post-merge (with Renault) Nissan supply relationship management practices in Europe with particular attention to risk sharing. We study vertical interfirm relationships at the Nissan Europe Barcelona plant and explore: (a) to what extent Nissan shares risk with its suppliers; and (b) whether and how the degree of risk sharing relates to suppliers' financial, structural, and technological characteristics. Our analysis shows, with regard to risk sharing, Nissan supply relationships in Europe after the merge with Renault seemed to have parted from the original domestic model and moved to a more competitive configuration.

The study focuses on a fundamental aspect of supply chain management, i.e. how buyers and suppliers accommodate for the risk resulting from unpredictable cost fluctuations (Ellram and Zsidisin, 2003). Contingent on the characteristics of suppliers and transactions, buyers may opt for different risk allocation strategies. These can be conceptualized as lying within a continuum defined by two opposing strategies: risk shifting and risk absorption (Kawasaki and McMillan, 1987; Aoki, 1988).

Under the risk-shifting hypothesis, buyers transfers the risk involved in their business onto their suppliers. Buyers wish to keep control of suppliers, try to exploit them to drive costs down and use them as a buffer against business fluctuations. However, as the information relative to suppliers' behaviors, technology and costs may be limited, suppliers may take advantage of this private knowledge. That is, there is potential for moral hazard and hold up problems. In order to decrease this potential, buyers wish to gather as much detailed

information as possible on suppliers (source of business, cost structure, product and process technologies, manufacturing capacity, inventories and financial position) and monitor, on the basis of this information, their behaviors and results. Because of their conflict of interests, buyers and suppliers determine their own course of action independent of the impact of their decision on other parties.

Under the risk absorption hypothesis, buyers are concerned not only with short-term reductions of purchasing costs, to be obtained by squeezing suppliers' profit margins no matter what the source of cost fluctuations or the cause of volume variability are, but also with building and maintaining long-term relationships with reliable and capable suppliers (Dawid and Kopel, 2003). Providing support to suppliers and sharing information with them on business and technological issues help establishing stable relationships which eventually improves the overall business performance also of the buyer (Dyer, 2000). Within this framework, buyers have an interest in absorbing at least part of the risk deriving from unpredictable cost or demand fluctuations. If they do not provide suppliers with some kind of "insurance" against unexpected cost fluctuations, suppliers' commitment and performance are likely to worsen and, eventually, negatively affect also buyers' bottom line.

The risk shifting and the risk absorption hypotheses underlie different logics in the design of supply contracts and in the management of supplier relations.

Elaborating on seminal work by McAfee and McMillan (1986), Holmstrom and Milgrom (1987), and Kawasaki and McMillan (1987), and on the developments proposed by Asanuma and Kikutani (1992), Tabeta and Rahman (1999), Yun (1999), Okamuro (2001), and Camuffo, Furlan and Rettore (2007), this study tests, through regression analysis, an agency model of the determinants of risk allocation in Nissan Europe's supplier relations.

It confirms agency theory predictions that Nissan absorbs risk to a non-negligible degree, and that it absorbs more risk (a) the greater the supplier's environmental uncertainty, (b) the more risk averse the supplier, and (c) the less severe the supplier's moral hazard. The study also shows that risk sharing is larger in presence of joint cost reduction efforts. The study clarifies the relationship between risk sharing and the supplier's size, technological capability, financial stability, and cost fluctuation. Finally, through a comparison with earlier, similar studies, it also suggests that Nissan's risk sharing strategy in Europe might be different, as regards the extent and determinants of risk sharing, with respect to the original domestic

approach. This change is probably due to the merge with Renault and competitive pressure related to the globalization of components' sourcing in the auto industry.

The study is organized as follows. Section two presents the agency model and sets the research hypotheses. Section three describes the data and research methodology. Section four presents the findings of the microeconometric analysis. Section five discusses the implications of the findings and highlights directions for future research. Sections six presents our conclusions.

2. An agency model for risk sharing in supplier relations

In the auto industry, risk allocation in buyer supplier relationships has been studied building on the seminal work by Kawasaki and McMillan (1987), who derived a principal agent model that explains the determinants of risk sharing in buyer-supplier relationships. The Kawasaki and MacMillan's (1987) model is an attempt to understand Japanese supply relationship management practices as the outcome of rational and self-interested behaviors and to ground it on the theory of repeated games and organizational economics.

Kawasaki and MacMillan (1987) consider the manufacturer/buyer as a principal who delegates to suppliers (agents) the task to produce different parts or components. The work that the buyer delegates to suppliers consists in the design and production of a good or a service that is part of a more complex product the buyer designs and assembles. Supplier relationships are conceptualized as contracts through which the buyer decides if and how to share the risk arising from unpredictable fluctuations of suppliers' production costs. The model's aim is to explain rationally the risk sharing in buyer-supplier relations and therefore assumes that both parties are selfish and their objective is to maximize their own profits. This represents a conflict of interest between the buyer and the supplier firm as the purchasing costs of the former represent the revenues of the latter. In addition, there is information asymmetry between the parties who cannot observe reciprocally their behaviors. More specifically, the supplier has information (about cost structure, cost reduction initiatives, etc.) the OEM does not have. Also, buyers and suppliers are assumed to have different tolerance towards risk. The buyer firm is assumed risk neutral and the supplier- risk averse or risk neutral. This assumption is based on the belief that OEMs are normally more capable to diversify its investment portfolio and, hence, risk. In addition, the fluctuations associated with a single contract, i.e. a single supplier, can be small relative to the OEM's total profit.

In the model, the contract is the payment scheme that the buyer offers to the supplier Kawasaki and MacMillan (1987) base their model on the Holmstrom and Milgrom's (1987) result that the optimal contract between principal and agent is linear in the end-of-period accumulated production costs. That is, even if the supplier produces and its costs take place in continuous time, the buyer pays the supplier only at discrete points in time and therefore the payment is based on the accumulated production costs up to the time of the payment. Therefore, the contract between buyer and supplier can be represented through the following payment function:

$$p = b + a\ (c - b),$$

where p is the price paid, c is the accumulated production cost. The parameters a and b are chosen in advance by the buyer. The parameter b reflects the target price. The actual cost, c, can be higher or lower with respect to the target. The difference between target and actual cost depends on agent's cost reduction efforts and on the environmental conditions.

The parameter a is the risk sharing parameter. It determines how the difference between target and actual costs has to be shared.

The payment is a sum of two components. The first (b) does not vary with cost fluctuations and represents the insurance part of the payment. The second ($a(c\text{-}b)$) is the variable part of the payment and represents the incentive part of the payment. It depends on supplier's actual cost value and therefore on the level of effort it puts to reduce costs.

Depending on the value of a there are fundamentally three types of contracts:

- If $a=0$, the contract is fixed price. The principal pays always the target. In this way, he shifts all the risk of cost fluctuations to the subcontractor. The principal gives to the agent incentives to reduce his costs. Supplier's cost reduction efforts are paid by the result they have generated.

- If $a=1$, the contract is cost plus. The principal pays to the subcontractor all his costs (these include the profit). Therefore, we can say he absorbs all the risk of supplier's cost fluctuations. The principal insures the suppler, by providing him the same profits. These are independent with respect to supplier's cost evolution.

- If $0<a<1$, the risk is shared between buyer and supplier firm. The contract balances the incentive and the insurance part of the payment.

The subcontractor's accumulated production cost can be represented as the sum of three components:

$$c = c* + w - \quad,$$

where $c*$ represents the ex-ante (before signing the contract) expected cost that is common knowledge; w is a random variable that represents the unpredictable cost fluctuations observed by the supplier in the course of doing the work. The buyer does not know its value but knows its distribution, which is assumed to be normal with mean 0, and variance ^{2}; is the cost reduction achieved as a result of the supplier's cost- reduction effort. This effort represents an additional cost for the subcontractor, that Kawasaki and MacMillan (1987) model as a quadratic function:

$$h(\ ) = \ ^2/2\ .$$

The function is quadratic in order to represent the situation where the cost reducing effort has diminishing marginal returns. The buyer does not know the level of this effort and is not able to estimate it (or the estimation is too costly). This information asymmetry generates the potential for supplier's opportunistic behaviors or *moral hazard*. That is, the buyer/principal does not observe the supplier's/agent's actions after the parties signed the contract. Therefore, the buyer cannot pay the supplier on the basis of the effort dedicated to cost reduction. The cost reduction activities can include for example: searching lower priced inputs, carefully managing raw- material of final goods inventories and diminishing waste etc.

The buyer's optimal contract (and the corresponding optimal choice of), implies the minimization of the expected value of its payment (purchasing price) to the supplier, subject to two constraints:

a) the supplier optimizes its expected utility function by choosing the optimal cost-reducing effort (individual rationality constraint);

b) the supplier accepts the contract only if (the expected utility of) profit is at least as large as that it could gain from the best alternative option/buyer it has (this is taken to be given exogenously) (incentive compatibility constraint).

To solve for the optimal contract, the first step is to find the second mover (agent/supplier) optimal answer as a function of the offered contract. The principal (buyer) anticipates how the supplier will answer in terms of effort exerted, as a function of the risk sharing parameter (*a*). So he should decide which is the optimal payment scheme. The choice of the contract is essentially the choice of the risk sharing parameter, since once *a* is determined, the other contract parameter *(b)* is also determined.

As the agent is self interested and will maximize its own profit function, the optimal level of effort is:

$$= \ (1\text{-}a).$$

The optimal level of supplier's cost reduction effort decreases as *a* increases. The larger is *a*, the less the subcontractor is responsible for its own costs and therefore the weaker is the incentive to undertake cost reduction activities (efforts that are costly). The difference between production under cost plus contract (*a=1*) and production cost under fixed contract (*a=0*) is equal to . Hence this provides a natural measure of the extent of *moral hazard*.

The quantities here are normalized to one. That is, this economic model ignores uncertainty and risk deriving from demand fluctuations (Okamuro, 2001).

The solution of this constrained minimization problem[3] results in the following first-order condition for the buyer's optimal choice of :

$$= \ {}^{2}/(\ +\ {}^{2}),$$

where represents the supplier's risk aversion (0 is the Arrow-Pratt measure of absolute risk aversion) and ^{2} , the uncertainty.

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[3] For proof, see Kawasaki and McMillan (1987, 330-332). Using Holmstrom and Milgrom's (1987) theorem about the linearity of the optimal contract in end-of-period accumulated production costs, they solve a dynamic principal-agent problem as if it were a static problem, with the only additional restriction that the principal's payment function is linear.

This result relates the risk-sharing parameter , to three variables:

- the supplier's environmental uncertainty (cost fluctuations ^{2}),

- the supplier's risk aversion ( ) and

- the supplier's moral hazard (ease to drive down cost for given levels of cost-reducing effort).

Our research hypotheses follow these results.

> *Hypothesis 1. Suppliers' environmental uncertainty is positively related to risk absorption.*

Given our assumption that buyers are less risk averse than suppliers, they will absorb more risk the higher the uncertainty is. In this case, it is more costly for the buyer to shift risk on to the supplier. In order to represent supplier's environmental uncertainty, we use the supplier's cost fluctuations. Therefore the above stated hypotheses can be reformulated as:

> *Hypotheses 1A: Suppliers' cost fluctuation is positively related to risk absorption.*

> *Hypothesis 2. Suppliers' risk aversion is positively related to risk absorption.*

The more risk averse the supplier is, the higher is the cost for the buyer to shift risk. Indeed, the more risk averse the supplier is, the larger the risk-premium it requires to take on risk. Therefore the buyer shifts less risk. As we proxi the risk aversion with the supplier's size and financial stability, the second hypothesis can be formulated through two sub hypotheses:

> *Hypothesis 2A. Suppliers' size is negatively related to risk absorption.*

Here the relation is negative because of the assumption that the bigger the supplier is the less risk averse is it. With the same logic, as the more financially stable is a company, the less risk averse it is, hypothesis 2 can be restated as:

> *Hypothesis 2B. Suppliers' financial stability is negatively related to risk absorption.*

> *Hypothesis 3. Suppliers' moral hazard is negatively related to risk absorption.*

The more capable the supplier is to reduce costs, the less willing the buyer is to absorb risk, since it fears supplier's potential opportunism. We proxy the supplier's moral hazard with two variables. The first one is the level of responsibility in the design and technological development of the component they produce for the car maker. The higher is this responsibility the higher is the supplier's moral hazard. Therefore:

Hypothesis 3A. Suppliers' technological capability is negatively related to risk absorption.

The joint cost reduction projects are projects in which the buyer and the supplier team up to solve problems and improve the cost of supply at various stages (design, production logistics, etc.). These activities which *de facto* also reduce information asymmetries, are part of buyer´s supplier development initiatives. The car maker's supplier development team works jointly with the supplier's management, often in the supplier's plant and premises, providing assistance, for example through resident engineers, in the form of training and consulting on how to reduce cost. In this situation, both the car maker and the supplier exercise costly effort aimed at improving efficiency and share the risks and the benefits produced by it. Through these projects the car maker reduces the information asymmetry on suppliers operations, costs and way of working. In this way there is less room for opportunistic behaviour and therefore the suppliers' moral hazard is reduced. Consequently, the buyer has incentives to absorb the risk deriving from unanticipated fluctuations in the supplier's production cost. Therefore:

Hypothesis 3B. Supplier's participation in joint cost reduction projects with the buyer is positively related to risk absorption.

3. Data and research method

3.1. Data

In order to test our model we constructed a unique dataset that includes information on the supplier relationships of the Nissan plant located in Catalonia, Spain. This region represents the biggest and more important automotive cluster in Spain. Here are located three car maker's plants (Seat, Nissan and Ivecco) and a big portion of the component and equipment producers. In addition, Catalonia is increasingly becoming one of Europe's major design centers in the automotive sector and this is important as innovation is considered one of the key success factors in the industry.

Our sample includes 113 companies that supply 80% of the total purchased volumes for the Nissan car models produced at the Barcelona plant since 2002. For these suppliers, Nissan represents a significant share of their business, up to 60% of their revenues.

The data on which this study was based were gathered in 2008 during a 6-month internship at Nissan Europe Purchasing department in Spain. We built an original database, gathering data from a variety of sources. Nissan Europe provided the following data: a) purchasing turnover from each supplier in the sample, on a five-year period (2002-2007); b) type(s) of component(s) bought from each supplier in the sample over the same time-frame; c) bill of materials/product structure for vehicles assembled at the Nissan Europe Barcelona plant; d) full manufacturing cost breakdown (including the proportion of each component cost to the total).

The Nissan Europe's design department provided information with regard to the component's technological content and to suppliers' technological capabilities. The buyers and managers from the purchasing department provided information on the supply chain strategy and purchasing policies of Nissan Europe and how it has evolved over time. A supplier development specialist gave us a list of the suppliers that have participated in joint cost reduction projects in the period 2002-2007.

Finally, we gathered financial information for each supplier in the sample from the Spanish databases SABI and Amadeus. These databases, which are publicly available, include data from the financial statements of the suppliers in the period from 2002 to 2007.

3.2. Measures

- **DEPENDENT VARIABLE**

The dependent variable in our model is the risk sharing parameter ( ), calculated according to the Kawasaki and MacMillan's (1987) methodology. They argue that the effects of the choice of sharing parameter can be estimated without detailed information on individual contracts. The idea is that if the principal (buyer) absorbs part of the fluctuations of supplier's production costs, the variance of supplier's profit (s^2) will be lower than the variance of its costs (^{2}).

Kawasaki and McMillan (1987: 332) derive the expression for the risk-sharing parameter from the following:

$$s^2 = (1-\alpha)^2 \sigma^2,$$

and therefore the risk sharing parameter can be represented as:

$$\alpha = 1 - s/\sigma,$$

where α refers to a specific buyer-supplier contract or relation, s is the standard deviation of supplier's profit, and σ is the standard deviation of supplier's costs. α is close to 1 when the standard deviation of supplier's profit is low relative to the standard deviation of supplier's cost. In this case the buyer absorbs risk. α is close to 0 when the standard deviation of supplier's profit is high relative to the standard deviation of supplier's cost. In this case, the buyer shifts risk. Therefore s, σ, and, consequently, α could conceivably be measured using contract or relation-specific profit and cost data for each buyer-supplier contract/relation. Unfortunately, this data is not only unavailable in our data set but it would also be almost impossible to collect using current cost accounting techniques[4].

However, we know that Nissan is the key customer for most of the analyzed suppliers, and that the proportion of the supplier's sales to Nissan Europe to total sales is rather large (up to a maximum of 60%). In this situation, it is reasonable to assume that the variation of supplier's profit relative to the variation of supplier's cost in the analyzed buyer-supplier relationships is similar to the variation of supplier's overall profit relative to the variation of supplier's overall cost.

- **INDEPENDENT VARIABLES**

[4] For each buyer-supplier contract/relation it would be necessary to identify revenues and direct design and production costs. However, especially in small and medium companies such as the analyzed suppliers (although this also applies to larger firms), cost accounting is not carried out for different contract/relations, not even with regard to direct design and manufacturing costs. Furthermore, all indirect manufacturing costs, as well as most sales and administrative expenses, are shared across products, customers and contracts. None of the analyzed firms (whether buyers or suppliers) allocate these costs to obtain a 'full contract/relation' cost figure. However, we argue that, even if indirect and general costs were allocated to each contract/relation on a conventional basis (e.g., contract revenues) following standard cost accounting techniques, this would not provide a fair picture of the costs and profits of each contract/relation. Therefore, an assessment of contract/relation specific profits and costs on the basis of state-of-the-art cost accounting techniques would not be reliable.

- **Supplier's environmental uncertainty**

Following Kawasaki and McMillan (1987) and Asanuma and Kikutani (1989), we used the variance of the suppliers' operating costs as the measure for the suppliers' cost fluctuation (*VARCOST*).

Camuffo, Furlan and Rettore (2007) highlighted and solved an endogeneity problem in all earlier studies related to the econometric estimates of the standard deviation of supplier's cost, More specifically, the standard deviation of supplier's cost is used for determining the value of the dependent variable in the model and is also one of the independent variables. As a consequence, any error in the measurement of this variance induces a correlation between the explanatory variable uncertainty and the disturbance term of the regression. That is, the OLS analysis in Kawasaki and MacMillan (1987), Asanuma and Kikutani (1992), Yun (1999) are flawed by a problem of endogeneity. We follow Camuffo, Furlan and Rettore (2007) who solve this endogeneity problem by applying two-stage least squares using as instrumental variable for the endogenous regressor an alternative measure of the supplier's cost fluctuations: the variance of raw, subsidiary and expendable materials (*VARMP*).

- **Suppliers' risk aversion**

We used two proxies:

1. Size. Due to scale economies and risk-pooling effects, a supplier tends to be less risk averse toward any particular relationship, the smaller this is relative to its overall operations. The larger the supplier, the smaller is the impact of a single customer's variance on its profit, and the smaller its risk aversion. We used the supplier's number of employees (annual average) as the measure of the supplier's size[5] (*NUM*).

2. Financial stability. The supplier's capability of absorbing financial turbulence is a proxy for (the inverse of) its risk aversion (Okamuro, 2001). The more financially stable the supplier, the lower its risk aversion, since it is better able to face unpredictable financial turbulence

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[5] Following Asanuma and Kikutani (1992:15), we used the number of employees, not total net sales, to measure suppliers' size. Indeed, risk aversion has to be constant and not depend on profit (or, indirectly, on variables correlated to profit such as total net sales).

(e.g., interest rate and exchange rate volatility, exogenous changes in credit availability, etc.) without support from external entities. We used the proportion of supplier's equity to supplier's total assets as the measure of financial stability (*STAB*). The larger this ratio, the more stable, from a financial standpoint, is the supplier.

▪ **Suppliers' moral hazard**

We used suppliers' technological capability and suppliers' participation in joint cost reduction projects with the buyer as proxies for suppliers' moral hazard.

We used suppliers' technological capability as a proxy for suppliers' moral hazard. Eisenhardt defines task programmability as 'the degree to which appropriate behavior of the agent can be specified in advance by the principal' (Eisenhardt, 1989: 62). In our model, the more programmable the supplier's task, the easier it becomes for the buyer to control the supplier's behavior, namely, its cost reduction effort. A routine task (e.g., the mere production of a simple component designed entirely by the buyer) is more easily observed because information concerning the supplier's behavior is already, or more readily, available. If the buyer carries out the entire design process and the supplier just manufactures, the supplier is with little technological capability (Yun, 1999). In this case, the buyer probably has a fairly detailed knowledge not only of the overall final product architecture, but also of the components the supplier manufactures. This implies full knowledge of the supplier's processes and cost structure. Task programmability reduces informational asymmetries and moral hazard; consequently, the buyer is more willing to absorb risk. Conversely, if the supplier plays an innovative role in new product development, its task is not routine, and therefore its technological capability is high[6]. The supplier's technological capability is the highest in the case of proprietary technology and/or of in-house developed components, i.e., those designed and built by the supplier without any knowledge contribution from the buyer (so-called black-box parts). In this case, the supplier's task is not observable and the buyer has little knowledge of the supplier's processes and cost structure. Task complexity is positively related to informational asymmetries and moral hazard; consequently, the buyer is more willing to shift risk. On the basis of the information gathered during our interviews with

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[6] It could be argued that only large suppliers can afford investment in technology and to develop valuable know-how. We checked our data for collinearity and found no statistical correlation between the supplier's size (proxy for risk aversion) and the supplier's technological capability (proxy for moral hazard).

Nissan Europe's design department, we classified each component (and corresponding supplier) into the following typology, which entails an increasing level of the component's technological complexity and the supplier's design responsibility: (a) the buyer completely designs the component and the supplier just manufactures it (Drawings Supplied — DS), (b) the buyer defines the product concept domain and the functional parameter domain while the supplier works out the design details and manufactures the component (Drawings Approved — DA), and (c) the buyer purchases the component that has been fully designed and manufactured by the supplier (Marketed Goods — MG). We classified suppliers into one of these three categories[7], and transformed the variable into two dummies: DA and MG. DS suppliers are coded by DA=0 and MG=0, DA suppliers are coded by DA=1 and MG=0, and MG suppliers are coded by DA=0 and MG=1. Thus, DA and MG have, respectively, additional effects on the risk-sharing parameter as the supplier's technological capability increases from DS (the supplier's state taken as a floor) to DA and MG suppliers.

The second proxy we used to measure supplier's moral hazard is whether this is engaged in joint cost reduction project with Nissan Europe. The participation in such projects reduces the informational asymmetry between the parties and curbs potential opportunism, thus facilitating risk sharing. Communication and information sharing are integration mechanisms that coordinate inter-organizational relationships (Ring and Van De Ven, 1992). Buyer-supplier integration – also defined as relational integration, integration of the business processes or informative integration (Harrigan, 1985; Ring and Van De Ven 1992; Zaheer and Venkatraman 1995; Dyer and Singh 1998)- may regard all the different aspects of supplier relations, from logistics (Sahin and Robinson, 2001), to contract and price negotiation (Cachon and Lariviere, 2001), to new product development (Sobrero and Roberts, 2002), to quality management (Romano and Vinelli, 2001), to innovation and knowledge management (Takeishi, 2001; Kotabe, Martin, and Domoto, 2003: Lee and Veloso, 2008).

Through joint cost reduction initiatives, Nissan Europe and its suppliers share information and reciprocally obtain knowledge on several aspects of the supply, including cost structures and production processes for the exchanged item. Lower informational asymmetries facilitate

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[7] In the case of suppliers selling more than one component, we picked the one that was the most technologically complex.

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integrative negotiations, help trust building, reduce moral hazard and, hence, favour risk sharing.

On the basis of data gathered during our interviews, we measure the extent to which suppliers participate in joint cost reduction programs through a dummy variable (*CPR*) that takes value one when the supplier does, and value zero otherwise.

4. Findings

4.1. Suppliers' risk aversion

As a preliminary step, we verified two basic underlying assumptions of the agency model we apply: (a) suppliers are risk averse and (b) large suppliers are less risk averse.

Following Kawasaki and McMillan (1987: 338), we tested suppliers' risk aversion assuming the existence of a linear relationship between the mean (μ) and the variance (s^2) of suppliers' profits:

$$\mu = (\tfrac{1}{2}\ )\, s^2 + k$$

where $(\tfrac{1}{2}\ )\, s^2$ is the risk premium and k is the residual profit. In case we find positive and significant relationship between the mean and the variation of the supplier's profits, we can say that   is positive. Therefore, we can be sure that suppliers are risk averse. We estimate the above mentioned equation by ordinary least squares (OLS). Results are reported in Table 1.

Table 1. Estimates for suppliers' risk aversion (standard errors in parentheses)

Sample data	Number of observations	½ (s.e.)	k (s.e.)	R^2
Total sample	113	0.7700743** (0.1325047)	1055820* (500599.2)	0.2333
Subsample "small suppliers" (Suppliers with less than 394 employees (total sample median)	57	0.9610825** (0.1869168)	718309.3** (278866.4)	0.3287
Subsample "large suppliers" (Suppliers with more than 394 employees (total sample median)	56	0.7413373** (0.1942938)	1329170 (1001607)	0.2124

$+ = p < 0.10; * = p < 0.05; ** = p < 0.01$

The OLS results confirm the positive and significant values for the s^2 coefficient. Therefore is positive and we can say that suppliers are risk averse. Furthermore, in order to verify that larger suppliers are less risk averse, we estimate the same model for two subsamples, obtained dividing the total sample into two subsamples: the first including "small" suppliers, i.e. suppliers with a number of employees lower than the median number of employees of the total sample; the second including "large" suppliers, i.e. suppliers with a number of employees larger than the median number of employees. The results of the corresponding OLS models presented in Table 1 show that the estimated value for is higher for the "small" suppliers' subsample. This confirms that larger suppliers are less risk averse.

4.2. Risk sharing parameter values

The risk sharing parameter is calculated by using the following formula:

$$= 1 - s/ \; ,$$

as derived in section 5.2.1. The sample mean value of is 0.72, while the median is about 0,80.

Although it is difficult to assess the degree of risk-sharing, these values seem to suggest that Nissan absorbs supplier's cost fluctuations risks to non negligible degree (the closer is to 1, the more the car maker absorbs supplier's cost fluctuations). However, comparing these data with similar data from earlier studies in the auto industry (Kawasaki and MacMillan, 1987; Asanuma and Kikutani, 1992; Camuffo and Volpato, 1997; Yun, 1999), the mean values of for Nissan Europe's suppliers during the period 2002-2007 are lower than those of other automakers during the 1980s' and 1990s', and, even more interestingly, are lower than those for Nissan Japan in the 1980s. Table 2 reports the sample mean and variance values of for selected studies in the auto industry using the same methodology.

While the variance of is similar in the analyzed previous studies, it is interesting to note that Nissan Europe mean is much closer to Fiat's values during the early 1990s than to Nissan Japan's values during the 1980s, and it is widely known that Fiat's approach at that time was closer to GM's and Ford's "competitive" approach (multiple sourcing for the same component, short term contracts, little support and development, etc.).

Table 2. Descriptive statistics for the risk-sharing parameter α and international comparison with earlier similar studies

α	Nissan Europe (current)	Nissan Japan (Asanuma and Kikutani, 1992)	Toyota (Asanuma and Kikutani, 1992)	Mazda (Asanuma and Kikutani, 1992)	Mitsubishi (Asanuma and Kikutani, 1992)	Fiat (Camuffo and Volpato, 1997)	Korean Suppliers (Yun, 1999)
Number of observations	113	75	96	87	97	92	93
Mean α	0.7261	0.9133	0.9061	0.9081	0.9031	0.7273	0.85
Variance α	0.0567	0.0043	0.0056	0.0057	0.0052	0.0794	0.04

4.3. Determinants of risk sharing

We then tested the agency model and the related research hypotheses. We recall the buyer's optimal choice of :

$$\beta = \sigma^2/(\rho + \sigma^2).$$

We linearize the expression by rearranging and taking logarithms on both sides of the equation, which gives us:

$$ln(1/\beta -1) = ln(1/\sigma^2)+ ln(1/\rho) +ln \mu,$$

where σ^2 is the supplier's cost variance, ρ is the supplier's constant absolute risk aversion and μ represents the supplier's moral hazard. In order to conduct regression analysis on our dataset (113 Nissan Europe suppliers to the Nissan Barcelona plant) to understand the determinants of risk sharing, we used the proxies defined in the Method section for ρ, μ, σ^2 and μ, obtaining the following model:

$$ln(1/\beta -1) = a_0+ a_1 ln(1/\sigma^2)+ a_2 NUM+ a_3 STAB+ a_4.DA+ a_5 MG+ a_6 CRP + \varepsilon$$

Table 3 reports the descriptive statistics and the correlation matrix for the variables in the model.

	$ln(1/\ -1)$	ln(1/VARCOST)	NUM	STAB	DA	MG	CPR
Mean (S.E.)	1.295783 (1.431414)	-13.129 (3.501822)	945.3628 (1512.221)	35.5677 (24.0185)	0.4247788 (0.4965112)	0.2035398 (0.404424)	0.3893805 (0.4897818)
$ln(1/\ -1)$	1						
ln(1/VC)	0.2779**	1					
NUM	0.5796**	0.1712[+]	1				
STAB	0.2835**	0.1270	0.1801[+]	1			
DA	0.0869	-0.1936*	-0.0255	-0.0423	1		
MG	0.4009**	0.1798[+]	0.2646**	0.0526	-0.4344**	1	
CPR	-0.3850**	-0.2231**	-0.2343**	-0.0829	-0.0621	-0.0882	1

$+ = p < 0.10;\ * = p<0.05;\ ** = p < 0.01$

Then we tested our model through OLS analysis (results in Table 4). Plain OLS analysis, however, suffers from the same endogeneity problem which flaws Kawasaki and McMillan's (1987), Asanuma and Kikutani's (1992), Tabeta and Rahman's (1999), and Yun's (1999) studies. This problem of endogeneity arises because the variance of the supplier's operating costs enters in the definition of both an independent variable $ln(1/\ ^2)$, that represents environmental uncertainty, and the dependent variable, $ln(1/\ -1)$. As a consequence, any error in the measurement of this variance induces a correlation between the explanatory variable $ln(1/\ ^2)$, and the disturbance term of the regression.

Following Camuffo, Furlan and Rettore (2997), we solved this endogeneity problem by applying two-stage least squares (TSLS) using as an instrumental variable for the endogenous regressor an alternative measure of the supplier's cost fluctuation: the variance of the cost of raw, subsidiary, and expendable materials (VARMP). It is noteworthy that the possible measurement errors of these costs are likely to be uncorrelated, or at least less correlated, to the measurement errors of the dependent variable. The results of the TSLS analysis are also reported in Table 4.

Table 4. OLS and TSLS results. Dependent variable is log(1/ – 1). For the TSLS model, LOG(1/VARMP) instrument for LOG(1/VARCOST). N=113

	OLS model	TSLS model
constant	-1.719734** (0.431035)	-1.737677** (0.4323722)
ln(1/VARCOST)	0.0516767^{+} (0.0283152)	0.0502762^{+} (0.028439)
NUM	0.0003532** (0.0000663)	0.0003536** (0.0000663)
STAB	0.0106447** (0.0039563)	0.0106614** (0.0039564)
DA	0.8143855** (.21307)	0.8126546** (0.2130976)
MG	1.350151** (0.2657497)	1.350825** (0.2657558)
CPR	-0.5970572** (0.2006583)	-0.5990343** (0.2006954)
R^2 Adjusted R^2	0.5515 0.5261	0.5515 0.5261

+ = $p < 0.10$; * = $p<0.05$; ** = $p < 0.01$

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The regression models in Table 4 show an adjusted *R squared* of 0.52. This value is high compared with that of earlier, similar studies. Besides, the *F*-statistic is significant at 1%, indicating that the current variables together significantly explain the variation in the dependent variable.

We obtain the same significant coefficients when we estimate robust OLS and TSLS models. Our tests for homoskedasticity and omitted variables confirm the goodness of our model.

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: fitted values of lnalpha

        chi2(1)      =      1.51
        Prob > chi2  =    0.2189

. ovtest

Ramsey RESET test using powers of the fitted values of lnalpha
        Ho:  model has no omitted variables
                F(3, 99) =      1.07
                Prob > F =      0.3639
```

Both the OLS and TSLS models support our hypotheses. All the coefficient are significant, although their impact on risk sharing is modest and lower than that of previous studies. VARCOST has a positive and significant ($p<0.1$) coefficient, which support our first hypothesis. The greater cost fluctuation the supplier faces, the more willing the car maker is to share risk with the supplier. Data also support hypothesis 2A. The regression coefficient of the number of employees (NUM) is positive and significant ($p<0.01$). The buyer absorbs more risk the smaller the suppliers are. The regression coefficient for supplier's financial stability (STAB) is positive and significant ($p<0.01$), which confirms the agency model predictions. Moreover, this variable seems to be more influential on the degree of risk absorption than the supplier's size. Overall, the more the supplier is risk averse, the higher level of risk sharing because the larger is the risk-premium the supplier requires to take on risk.

As regards moral hazard proxies, all of them have regression coefficients with the expected signs and significant values ($p<0.01$). This confirms that the higher the supplier's moral hazard, the lower the level of risk sharing with the supplier, because the buyer fear its opportunism.

More specifically, The MG and DA dummy variables (which are proxies for the technological capability of the supplier and, hence for moral hazard) also have positive and significant ($p<0.01$) coefficients. Furthermore, the value of the regression coefficient for DS is smaller than that for DA which is is smaller than that for MG, which indicates that α values for "black box" component suppliers (MG) are larger than those for "grey box" component suppliers which are larger than "white box" component suppliers. These findings confirm that the higher the supplier's technological capability (and, hence involvement in design), the lower is the level of risk the carmaker is willing to absorb. However, this moral hazard potential from the supplier is mitigated by the involvement in joint cost reduction projects. Indeed, the dummy variable that measures the supplier's participation in the Nissan Europe's cost reduction projects has a negative and significant ($p<0.01$) coefficient. This confirms our hypothesis, that the participation in such projects reduces informational asymmetries, curbs opportunism and facilitates risk sharing.

5. Discussion

Our microeconometric analysis of Nissan Europe's supplier relations provides some insights into how buyers and suppliers share the risk deriving from unpredictable cost fluctuations. It shows that Nissan Europe absorbs risk to a non-negligible degree, but that this level of risk sharing is lower than that of Nissan Japan in the 1980s and similar to that of other European and Korean automakers during the 1990s.

This result is consistent with the anecdotal evidence we gathered during our interviews and seems to suggest that, due to the merge with Renault and to competitive pressure related to the globalization of components' sourcing in the auto industry, Nissan Europe has adapted the original Nissan supplier development practices, moving towards a more competitive configuration characterized by a lower, or at least more selective, degree of risk absorption.

Nissan's alliance with Renault has probably had an impact on this comparatively lower degree of risk absorption. On the one hand, although Nissan is present in all continents of the world, its presence in Europe is relatively small. For this reason, Nissan Europe's operations and

purchasing activities are largely grounded on and determined by the use of the structures and systems of its local based partner Renault, whose supplier relations management practices remain closer to a market-based approach (multiple sourcing for the same component, competitive bidding, short term contracts, little support and development, etc.). On the other hand, the establishment of RNPO as a centralized global purchasing unit generated pressures to switch to a more market-based approach to supplier selection and management, within the context of sharing a global supplier base with Renault whose supplier relations .

With regard to the determinants of risk sharing, our study confirms agency theory predictions that buyers absorb more risk:

(a) the greater the supplier's environmental uncertainty;

(b) the more risk averse the supplier; and

(c) the less severe the supplier's moral hazard.

In order to measure supplier's moral hazard we use a new proxy, never used in earlier studies, to complement the supplier's technological capability. This proxy is the supplier's participation to joint cost reduction projects promoted by the car makers. This variable measures the extent to which the buyer and the suppliers share information and collaborate for a common goal which curbs the potential for moral hazard. Alternatively, these joint cost reduction projects can be interpreted as the means through which the parties implement "voice" practices (Helper and Sako, 1995 and 1998; MacDuffie and Helper, 1997) like benchmarking, co-design, and 'root cause' error detection and correction, i.e. the pragmatist mechanisms that constitute 'learning by monitoring' -a relationship in which buyers and suppliers a) continuously improve their joint products and processes; and b) control opportunism and share risk. (Helper, MacDuffie, and Sabel, 2000).

Our findings clarify the relationship between risk sharing and the suppliers' size, technological capability, collaboration through cost reduction projects, financial stability, and cost fluctuation, offering new insights into how automakers have adjusted their risk-sharing strategies as suppliers become larger, global, and more technologically capable.

The trend we observed in the Nissan case can be probably generalized to other carmakers, especially to the Japanese. How automakers manage their supplier relations (and the extent to

which they are willing to share risk with suppliers) is a consequence of the structural changes that have transformed the vertical contracting structure of the automotive industry. Both carmakers and first-tier suppliers have become larger and with global presence. First-tier auto suppliers are often large multinational firms, comparable in size with respect to their customers. While cars become more complex products, ever richer in technological content, global competition has kept prices relatively stable, putting continuous pressure on cost reduction from suppliers, which fight to defend their thinning margins.

With the only exception of Toyota, during the last decade assemblers have narrowed the scope of their activities in order to reduce investment risk, respond more flexibly to volume changes, speed up models turnover, facilitate equipment upgrading, minimize job impact and social cost in case of crisis. Financial considerations (debt) have become especially critical to this aim given the enormous amount of money required by foreign direct investment strategies and the uncertainty of their rate of return and payback time. All these factors have worked as incentives to transfer component design/manufacturing responsibility to suppliers, and have determined a power shift in favor of suppliers (Fine, 1998), as they continue to grow and consolidate in a wave of M&As (mergers and acquisitions) operations. Thus, supplier has progressively taken on design and system integrating activities, growing to achieve economies of scale and of specialization. These general trends are reflected in our data. As suppliers become global, larger, more technologically capable, incentives to share risk decrease.

6. Conclusion

Our microeconometric analysis shows that Nissan still absorbs risk from their supplier to a nonnegligible degree, but that global pressure to reduce cost and organizational changes related to the alliance with Renault have moved its approach to a more competitive configuration.

This study also confirms agency theory predictions and its findings are consistent with the theory of repeated games and the theory of relational contracts that provide a rationale for cooperation and risk-sharing in buyer-supplier relations (MacAfee and MacMillan, 1986; MacMillan, 1990; Dyer and Singh, 1998; Baker, Gibbons, and Murphy, 2002).

These results are consistent with other previous, similar studies of the auto industry conducted in other countries.

From a research perspective, this study improves previous analysis of the auto industry by: a) allowing for longitudinal comparisons; b) proposing new proxies for moral hazard; c) constructing original firm-level databases, mostly on primary and certified data sources, which provides a more reliable ground for statistical analysis; and d) solving, through the use of TSLS instead of OLS regression, the problem of endogeneity which affected all previous studies.

This study also offers to practitioners some insights as regards the design of supply contracts, the optimal allocation of risk across supply chains and the management of supply networks.

First, risk sharing could be included as a conceptual milestone in the design and management of supply networks. For example, a somehow refined, customer-specific version of the risk sharing parameter α, calculated applying activity based costing methodologies, could complement rating techniques and become integrative part of suppliers' assessment. In doing that, the economic, financial and technical variables we use in this study, all readily available at the business level, could constitute a sort of preliminary template for risk sharing analysis and reporting.

Second, some of the findings of this study could be used as a basis for supply chain policy making. For example, buyers who wish to engage in the technological development of small, rapidly evolving suppliers, should be prepared to measure and maneuver risk sharing as the supplier and the corresponding relation evolve. Buyers should be willing to absorb more risk in the early stage of the supplier relation life-cycle, nurturing and protecting the supplier against environmental uncertainty by stabilizing its profits. As the relation evolves and suppliers grow and become more technologically capable, however, since the supplier's potential moral hazard increases, they should become more cautious in risk sharing and invest even more heavily in "voice" practices (for example in joint cost reduction projects) to curb opportunism *via* informational asymmetry reduction and trust building. Similarly, the availability of data on how a buyer has shared the risk with suppliers provides a more solid basis for the *ex ante* design of "smart" supply contracts. For example, performing sensitivity analysis on risk sharing parameters can lead to more effective price and quantity negotiations in buy back and revenue sharing contracts.

Third, the availability of industry benchmarks for α values would help the parties pursuing the global optimization of the supply chain, and even provide support to government industrial policy. For example, buyers could use such data to monitor suppliers' free riding if suppliers enjoy some dominant position in the market for a given component. Alternatively, suppliers could use such data to monitor buyers' risk sharing policies and avoid exploitation.

Further research along three directions (largely corresponding to three limitations this study shares with similar, previous ones) would improve the scientific rigor and managerial relevance of this stream of investigation.

First, the estimation of the risk sharing parameter α remains somewhat problematic (Okamuro, 2001). The fluctuation of supplier's costs and profits depends on changes not only in unit costs and prices, but also in quantities. If reliable data on volume variability (and on inventory variations) were available (but in our case neither buyers nor suppliers were willing or ready to provide them), it would become possible to distinguish between the volume-related and the cost-related components of risk, leading to a more articulated estimate and understanding of risk allocation in supply chain contracting.

A second conceptual limit also relates to the nature of the risk sharing parameter α. Since α is calculated using the supplier's operating costs and income, it is a comprehensive measure which refers to all the supplier's clients and not to a specific customer. Therefore, α is a characteristic of the supplier and not of a specific buyer-supplier relation. Given this assumption, the models used so far remain oversimplified, especially when the supplier's portfolio of customers is diversified. Further research should address this issue breaking down the analysis by customer, for example calculating, using state-of-the-art cost accounting methodologies, customer specific α values, and then modeling risk allocation at this more disaggregated level of analysis.

Third, the agency model we applied does not *per se* clarify the relationship between risk allocation and the nature of the supplier relation. Further evidence of a direct link between cooperative, stable supplier relations and risk sharing should be sought complementing the model with variables able to capture relational aspects like trust or the degree of customer-supplier integration and technological aspects like the product architecture and the specification of product performance parameters.

Appendix (chapter 2)

Table 5: Descriptive statistics and correlation matrix (N=123)

	Improvements	Dependence	Assistance	Collaboration	Partnership	Suggestions in des_tech	Collaboration in des_tech	Automotive	Car Maker
Mean (S.E.)	11.31707 (5.36888)	0.5528455 (0.4992331)	0.5528455 (0.4992331)	0.5121951 (0.5018956)	0.3902439 (0.4898)	0.6097561 (0.4898)	0.2195122 (0.4156091)	0.6178862 (0.4878915)	0.6260163 (0.4858384)
Improvements	1								
Dependence	0.3469*	1							
Assistance	0.4570*	0.1778**	1						
Collaboration	−0.0547	0.0056	0.0056	1					
Partnership	0.3578*	0.0155	0.2167**	0.8198*	1				
Suggestions in des_tech	0.4527*	0.2862*	0.3197*	0.0862	0.0592	1			
Collaboration in des_tech	−0.0902	−0.1551	−0.1551	−0.0326	−0.0589	−0.6629*	1		
Automotive	0.2219**	0.1341	0.1004	0.0024	−0.0569	0.1598	−0.1489	1	
Car Maker	-0.2433*	0.0484	−0.2220**	−0.0820	−0.0361	−0.1017	−0.1178	−0.0545	1

$+ = p < 0.10$; $* = p < 0.05$; $** = p < 0.01$

Table 6: Results from probit regressions with dependent variable- each single area of improvement:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Dependence	+**	+***		+**		+**		+***	+*	+*	+**		+**	+***		+***	+**	+***
Assistance		+*	+*					+***	+***			+**				+**		
Collaborative relationship	+**	+**		+**		+***			+**	+**	+*	+**	+*	+*	+*	+*		
Partnership	+**	+*	+***	+**		+*	+***	+**	+*	+*	+*	+*	+*		+*			+*
Suggestions in des_tech	+*	+***		+*	+**	+**	+**	+*	+*				+***		+**			+*
Collaboration in des_tech	+*			'+*	+**			+**	+**									
Automotive	+***			+***							+*	+*	+**	+*	+**			
Car Maker					+*					+***						+**		
Constant	+*	+**	+**	'+*		+*	+*	+**	+*	+**	+*	+*	+*	+*	+*		+**	+**

+ = p < 0.10; * = p<0.05; ** = p < 0.01

The single areas for improvements are related to:

2. the technological level:

3. the quality control systems:

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4. the implementation of methods in order to control the costs:

5. the time for the preparation of the equipment:

6. diminishing the size of the production series:

7. realizing programs for preventive maintenance:

8. integrating informatics and automation in the production:

9. realizing quality audits:

10. improving or reorganizing the productive processes:

11. improving the deliveries:

12. investing in equipments and instruments:

13. investing in set of instruments

14. investing in training programs:

15. contracting personnel with technological education:

16. reducing the products with defects to a minimal level:

17. increasing the levels of stocks (products) in order to guaranty the supply:

18. decreasing the levels of stocks (products) in order to be more flexible:

19. exercising controls on your own suppliers:

Questionnaire

(only the questions answered by all the suppliers in our sample are included)

1. The product you supply to our client is:

    1. A specific component.
    2. A set of components
    3. A module
    0. Raw material

2. Do your enterprise work exclusively in the automotive industry :

    1. Yes.
    2. No.

3. How do you define your enterprise.

    1. International enterprise.
    2. National enterprise which works in international markets.
    3. National enterprise concentrated in Spain.

4. In the last years the commercial activity with your client:

    0. Has diminished .
    2. Has increased.
    1. Has been stable.

5. How do you define your technological capacities inside your competitive environment
    1. Very high technological level.
    2. High technological level.
    3. Average technological level.
    4. Low technological level.
    5. Very low technological level.

6. The design and technological level definition of the products that you supply is established by:

    0. Your enterprise.
    1. Your client .
    3. Through mutual collaboration.
    2. Your client defines and your enterprise gives opinion in order to establish them.

7. The quality specifications given by your client are:

    1. Concrete and have to be 100% followed.
    2. Generic and leaving some freedom.
    3. Are not defined.

8. Your client's concern level as regards the technological level of the products you supply is:

   1. Very high.
   2. High.
   3. Average.
   4. Low.
   5. Null.

9. Your client's concern level as regards your RD capacity is:

   1. Very high.
   2. High.
   3. Average.
   4. Low.
   5. Null.
.

10. Your client's concern level as regards the capacities of your personnel is:

   1. Very high.
   2. High.
   3. Average.
   4. Low.
   5. Null.

11. Your client's concern level as regards training on quality issues of your personnel is:

   1. Very high.
   2. High.
   3. Average.
   4. Low.
   5. Null.

12. Your client's concern level as regards the supply of product with zero defects:

   1. Very high.
   2. High.
   3. Average.
   4. Low.
   5. Null.

13. Your client's concern level as regards your financial situation is:

   1. Very high.
   2. High.
   3. Average.
   4. Low.
   5. Null.

14. Your client's concern level as regards the agility of the communication channels with you is:

1. Very high.
2. High.
3. Average.
4. Low.
5. Null.

15. Your client's concern level as regards your interest in improving as supplier is:

1. Very high.
2. High.
3. Average.
4. Low.
5. Null.

16. Your client's concern level as regards your cost structure is:

1. Very high.
2. High.
3. Average.
4. Low.
5. Null.

17. Your client's concern level as regards your design capacities is:

1. Very high.
2. High.
3. Average.
4. Low.
5. Null.

18. Your client's concern level as regards the application of the ISO-9000 norms is:

1. Very high.
2. High.
3. Average.
4. Low.
5. Null.

19. Your client's concern level as regards the processes' standardization is:

1. Very high.
2. High.
3. Average.
4. Low.

5. Null.

20. Your client's concern level as regards your quality control systems is:

    1. Very high.
    2. High.
    3. Average.
    4. Low.
    5. Null.

21. Your client's concern level as regards the controls you realize on your suppliers is:

    1. Very high.
    2. High.
    3. Average.
    4. Low.
    5. Null.

22. The prices of the products you supply to your client have to decrease with time during your contractual relation:

    1. Yes.
    2. No.

24. Which of the following aspects is at first place for your enterprise during the price negotiation?

    1. The market competitiveness.
    2. The payment conditions.
    3. The definition done by the responsible for the logistic systems and costs.
    4. The responsibilities assumed in the design, quality, technology…

25. Which of the following aspects is at second place for your enterprise during the price negotiation?

    1. The market competitiveness.
    2. The payment conditions.
    3. The definition done by the responsible for the logistic systems and costs.
    4. The responsibilities assumed in the design, quality, technology…

26. Which of the following aspects is at third place for your enterprise during the price negotiation?

    1. The market competitiveness.
    2. The payment conditions.
    3. The definition done by the responsible for the logistic systems and costs.
    4. The responsibilities assumed in the design, quality, technology…

27. Which of the following aspects is at last place for your enterprise during the price negotiation?

    1. The market competitiveness.
    2. The payment conditions.
    3. The definition done by the responsible for the logistic systems and costs.
    4. The responsibilities assumed in the design, quality, technology…

28. The orders are fixed with anticipation of:

    1. Less than one day.
    2. More than one day and less than three days.
    3. Between 3 days and one week.
    4. Between one week and one month.
    5. More than one month.

30. Do you receive information on the production plans of your client that permits you to establish previsions of the his demand in order to plan your production:

    1. Yes.
    2. No.

31. The delivery conditions regarding the time, quantity, transport used, the type of packaging and other logistic conditions, that can vary during the contract life, are fixed by:

    1. Your client.
    2. Your enterprise.
    3. Negotiation and mutual accordance.

33. The deliveries are:

    1. More than once per day.
    2. Once per day.
    3. Every two days.
    4. Between two days and one week.
    5. Every two weeks.
    6. More rarely.

34. Personnel by your client visits your plants:

    1. No, never.
    2. Sometimes, but it is not normal.
    3. There exist regular contacts.
    4. The contact with our client personnel is part of the regular daily relation between us.

35. Your clients personnel that maintains contact with you is from :

1. Buyers .
2. Quality.
3. Design.
4. Planning and control of the production.
5. Commercial.
6. General Management.

36. Is there exchange of information with your client:

1. Yes. (go to 37)
2. No. (go to 50)

37. How would you define this exchange:

1. They exclusively request information.
2. There is mutual exchange.

38. As regards economic data you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

39. As regards the technological level, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

40. As regards the RD capacity, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

41. As regards the cost structure, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

42. As regards the design capacity, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

43. As regards the quality control systems, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

44. As regards the stock management and control systems, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

45. As regards the logistics (distribution), you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

46. As regard the training of the personnel, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

47. As regards the improvements in the production systems, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

48. As regards the control systems regarding the set of instruments used (de utillaje), you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

49. As regards the production capacity, you and your client:

1. Mutually exchange information.
2. Your client requests information.
3. There is no exchange.

50. Does your client collaborate in order to improve aspects considered as problematic or with possibility to be improved:

1. Yes.
2. No.

52. Do you think that your client establishes priorities between quality, cost, design and delivery?
    1. Yes. (go to 53)
    2. No. (go to 57)

53. At first place for your client is:

    1. The quality.
    2. The cost.
    3. The punctual delivery..
    4. The design.

54. At second place for your client is:

    1. The quality.
    2. The cost.
    3. The punctual delivery..
    4. The design.
.

55. At third place for your client is:

    1. The quality.
    2. The cost.
    3. The punctual delivery..
    4. The design.

56. At forth place for your client is:

    1. The quality.
    2. The cost.
    3. The punctual delivery..
    4. The design.

57. As consequence of working with your client it was necessary for your enterprise to introduce improvements as regards the technological level:

    1. Yes.
    2. No.

58. As consequence of working with your client it was necessary for your enterprise to introduce quality control systems:

    1. Yes.
    2. No.

59. As consequence of working with your client it was necessary for your enterprise to implement methods in order to control the costs:

  1. Yes.
  2. No.

60. As consequence of working with your client it was necessary for your enterprise to work on the time for the preparation of the equipment:

  1. Yes.
  2. No.

61. As consequence of working with your client it was necessary for your enterprise to diminish the size of the production series:

  1. Yes.
  2. No.

62. As consequence of working with your client it was necessary for your enterprise to realize programs for preventive maintenance:

  1. Yes.
  2. No.

63. As consequence of working with your client it was necessary for your enterprise to integrate informatics and automation in the production:

  1. Yes.
  2. No.

64. As consequence of working with your client it was necessary for your enterprise to realize quality audits:

  1. Yes.
  2. No.

65. As consequence of working with your client it was necessary for your enterprise to improve or to reorganize the productive processes:

  1. Yes.
  2. No.

66. As consequence of working with your client it was necessary for your enterprise to improve the deliveries:

  1. Yes.

2. No.

67. As consequence of working with your client it was necessary for your enterprise to invest in equipments and instruments:

1. Yes.
2. No.

68. As consequence of working with your client it was necessary for your enterprise to invest in set of instruments:

1. Yes.
2. No.

69. As consequence of working with your client it was necessary for your enterprise to invest in training programs:

1. Yes.
2. No.

70. As consequence of working with your client it was necessary for your enterprise to employ (contract) personnel with technological education:

1. Yes.
2. No.

71. As consequence of working with your client it was necessary for your enterprise to reduce the products with defects to a minimal level:

1. Yes.
2. No.

72. As consequence of working with your client it was necessary for your enterprise to increase the levels of stocks (products) in order to guaranty the supply:

1. Yes.
2. No.

73. As consequence of working with your client it was necessary for your enterprise to decrease the levels of stocks (products) in order to be more flexible:

1. Yes.
2. No.

74. As consequence of working with your client it was necessary for your enterprise to exercise controls on your own suppliers:

1. Yes.
2. No.

75. The changes that you introduced as a consequence of your contractual relation with your client and/or because of being his supplier are beneficial for the competitiveness of your enterprise:

1. Yes.
2. No.

76. How do you define your contractual relations with your client:

1. As adversarial. The initiative and the exigencies go from the client to the supplier.
2. Collaboration between client and supplier.
3. As strategic partnership based on confidence and compromise, with initiatives at all the levels of management.

77. The contractual relations with your client are:

1. Short term relations (during less than one year)
2. Medium term relations (during more than one year but less than two years)
3. Long term relation or with indefinite duration.
4. Occasional, for a specific service.

81. Do you feel stressed by the necessities of your client. Do you think you should implement all your client's suggestions in order to maintain his demand level:

1. Yes.
2. No.

82. Your enterprise is located in:

1. Catalonia
2. Other Spanish regions

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