

Participation of suppliers in product development process: the case of the Fiat New Palio

José Carlos de Toledo

Federal University of São Carlos
Production Engineering Department
toledo@power.ufscar.br

Manoel Fernando Martins

Federal University of São Carlos
Production Engineering Department
manoel@power.ufscar.br

Sergio Luis da Silva

Federal University of São Carlos
Production Engineering Department
sergio@power.ufscar.br

Dário Henrique Alliprandini

Federal University of São Carlos
Production Engineering Department
dha@power.ufscar.br

Abstract: This article aims to characterize the co-design practice based in a case study carried out in the Brazilian automotive industry. This case study was accomplished in the development project of the “New Palio” specific to Brazilian market, in the FIAT company and three of its first tier suppliers. The project began in Italy with the participation of guest engineers from these suppliers and from FIAT Brazil. In next phases studied suppliers got different levels of autonomy in relation to the headquarter and to other units of the group. The results address to some characteristics found in this research that are important to the success of a co-design process, and also it is presented considerations about the performance in quality, time and productivity in the development project studied and its relationship with co-design practice.

Key Words: Co-design, collaborative engineering, product development.

1. Introduction

In the last decade, the Brazilian automotive industry was under significant changes that certainly have influenced the development of products and the relationship between automakers and suppliers in that development (LAPLANE E SARTI, 1998) (SALERNO *et al*, 1998) (QUADROS e QUEIROZ, 2000). In this context, the changes of larger impact were: the creation of the “car popular” (low cylinder capacity engine, maximum 1,000 cc), denationalization of most Brazilian companies, and concentration of the production in the autoparts industry, and the entrance of new automakers with new products to the national market.

“Popular cars” that reach about 75% of market share in nineties (SALERNO *et al*, 1998) (QUADROS E QUEIROZ, 2000), were the most expressive change in Brazilian automotive industry, and this kind of car is developed and manufactured by almost automakers operating in Brazil. Most of automotive companies efforts – automakers and autoparts – are concentrated in that kind of car.

The denationalization and concentration in the autoparts section of the automotive industry are due to the global politics of sourcing and follow sourcing adopted by automakers, and many Brazilian autoparts companies (the origin of the capital was Brazilian) were acquired for big multinational corporations. Besides automakers companies reduced the number of suppliers and they started a new supply relationship, so much in terms of development of new products as in terms of operations.

Finally, the entrance of new automakers took back the country to an important position in the world map of the global automotive industry, especially as manufacturer of small and medium cars performing in the regional market of Latin America. Moreover, new products were introduced in the national market, enlarging the options of the consumer’s choice, forcing the companies already installed to realize improvements in their manufacturing process and also in the product development in searching of competitive cost and better quality.

In this competitive environment, an important source of competitiveness for those companies is the development of new products, as it was already verified by several studies in other countries (CLARK e FUJIMOTO, 1991) (WHEELWRIGHT e CLARK, 1992) (WHEELWRIGHT e CLARK, 1995) (CLAUSING, 1994). Some of those studies demonstrated that the product development was some of the main sources of competitive advantage of Japanese companies in the eighties (CLARK e FUJIMOTO, 1991), (ROSENBLOOM e CUSUMANO, 1987) (GARVIN, 1988) (WOMACK *et al*, 1990) that served as learning and inspiration for the renaissance of the North American automotive companies in the nineties.

The development of an automobile is complex project and that happens more and more in a net of companies. That implicates in a larger participation of suppliers under the coordination of the automaker characterizing what has been denominated co-design. And, in a co-design context, the proposal of this paper is to analyze the relationship between automaker and suppliers in the product development by a case study about one specific project.

2. Product development management

The product development can be understood as a process by which the organization transforms data about market opportunity and technical possibilities in information (detailed projects of product and process) for a viable production of a product (CLARK e FUJIMOTO, 1991). So, the product development process (PDP) could be considered, essentially, as a process of creation and transferring of information (CLARK e FUJIMOTO, 1991). PDP is in the interface between market and the company, and it subjects the success of future products to be launched by the company and due to this specific characteristic PDP is important for the company's competitiveness.

The product strategy, the PDP organizational structure, and the management of this process are decisive factors for the performance of the product in the market, and also for the survival of the company. In the automotive industry, PDP can be characterized, in a generic way, by the following stages: generation of the product concept, product planning, product design, process design (manufacturing process), production-pilot and beginning of the production in scale (Clark e Fujimoto, 1991). It could be still included the stages

of product improvement and the decision of product retreat from the market.

This separation in stages is didactics and highlights the interdependence they have each other. However, in practice, the stages are realized simultaneous and in an interactive way in searching of solutions in the context of the development project. In fact, Simultaneous Engineering approach proposes that each stage should be realized simultaneously and interactivity to facilitate front-load problem solving, to integrate decisions taken along the project, and to minimize the total time of development, improving quality and reducing the costs (PRASAD, 1997).

PDP performance has been measured in terms of quality, time and productivity (CLARK e FUJIMOTO, 1991) (STALK, 1998). Quality basically refers to "how much" and "how" product specifications reach the customers needs and desires. Time is measured from the stage concept generation to the end of production-pilot stage that means the whole time spent to develop the project, and it is usually called time-to-market. Productivity is measured from the use of the resources during the whole development project (engineering hours, materials for construction of prototypes, resources for realized tests, etc.), hence it is related to the costs of the development.

Complexity and uncertainty present in development projects are difficulties to reach good performance in time, quality and productivity. During each stage of the development several choices are done and they involve a high degree of risk, and also they could affect others stages (positively or negatively) due to the interdependence between them (WHEELWRIGHT e CLARK, 1992).

Several critical factors are addressed as powerful factors in PDP management and performance (CLARK e FUJIMOTO, 1991) (CLARK e WHEELWRIGHT, 1993): team work, leadership and the way of leading the development project, involvement of suppliers and customers, simultaneous development, and the capacity of manufacturing in doing prototypes, tests, tools and run the production-pilot. Empiric researches on good practices in PDP also depict two others factors: formalization of the process with reviews in the stages using an integrated kit of methods and tools, and the usage of development strategies and both planning and design (GRIFFIN, 1997).

This article concentrates on the participation of suppliers in development projects.

3. Suppliers involvement in product development process

Eight out of some authors address that the involvement of the suppliers in PDP contributes significantly to improve the performance of this process, especially in time and quality (CLARK e FUJIMOTO, 1991) (WOMACK *et al*, 1990) (BROWN e EISENHARDT, 1995) (KESSELER, 1997). Besides, the supplier specialization allows to realize technological innovations faster and to facilitate company to strengthen in its core business (PRAHALAD e HAMEL, 1990), and also to spend more time in coordination of the project.

It is almost impossible for an automaker to develop competences in thousand of automobile components and systems, and in the several kinds of technologies applied in a car. It should specialize more and more in to project and to assembly automobiles (KESSELER, 1997).

The decision of involving suppliers in the product development process is beyond of a “make or buy” decision (LIKER *et al*, 1996). That is more relevant in the case of the automotive industry because the decision of buying a component doesn't necessarily implicates in do not project it. That was already demonstrated in some specific studies in the automotive industry with prominence for the Japanese automakers (CLARK e FUJIMOTO, 1991) (WOMACK *et al*, 1990).

Obviously not all suppliers are involved equally in development projects. Automakers are disposed to adopt a hierarchy system to lead with suppliers, creating levels or tiers among them (LAMMING, 1993). Usually, only suppliers of first tier are involved in the product development with automaker.

The suppliers of first tier tend to have a long period and a solid relationship with their customers (automakers). They join to the development project soon, in the beginning of the project. So, suppliers exchange information with automaker intensely, and they usually get the responsibility for the development of systems (KESSELER, 1997) (LIKER *et al*, 1996). Projects that the first tier suppliers usually

participate are black box type, and in some cases in gray box types (CLARK e FUJIMOTO, 1991) (KESSELER, 1997).

Specifically for the automotive industry it is possible to find three types of projects that are characterize in agreement with the information flow between automaker and suppliers involved in the project. The types of project are: parts with development project totally done by the supplier, parts with high involvement of the supplier in the execution of the project but close to the automaker (black box), and parts that automaker executes the whole development (also known as gray box) (CLARK e FUJIMOTO, 1991) (KESSELER, 1997) (LIKER *et al*, 1996).

The type of relationship between automaker and supplier when both join each other to develop in collaboration is denominated of co-design. The main characteristics of co-design are (KESSELER, 1997):

- ◆ automaker requirements are made sooner than usually, including specifications about price-target and functional description of the product;
- ◆ suppliers are chosen by the engineering department, and not only by purchase department;
- ◆ know-how is transferred to the supplier;
- ◆ few suppliers are selected per product (one or two);
- ◆ guest suppliers representatives participate in the development team;
- ◆ a project manager is named in the supplier;
- ◆ supplier has autonomy to choice methods and techniques to be used in the development of the system or component that it was responsible, but he has to declare clearly each choice;
- ◆ intense communication between both supplier and automaker;
- ◆ possibility of change solicitations in project requirements by automaker during the development;
- ◆ earlier integration of financial and technical aspects of the project; and
- ◆ validation of the results is a continuous and an interative process.

In the co-design the decision for recruiting of a supplier is different from traditional ways that was based just in the cost aspects. The most common criteria are the supplier performance, the past relationships, and also cost aspects (KESSELER, 1997).

An important aspect of the co-design is that the contracts are made for long periods and technical and financiers aspects are discussed jointly in order to give to suppliers more security in the relationship with automaker.

ZOTTERI *et al* (2000) tried to verify which are the factors that more influences in the adoption of the co-design, and their results showed that the size of the company and the degree of vertical integration have great influence. Co-design is usually adopted by companies that compete through product innovation more than those ones that compete through cost, quality, time or others criteria. Finally, this study showed that is necessary consistence between development strategy and supply strategy for the adoption of the co-design (ZOTTERI *et al*, 2000).

4. Methodology

Motivated by the lack of empiric studies in the literature about the adoption of co-design approach in product development in Brazilian automotive industry, this article presents a contribution and new issues for co-design. Based in the theoretical considerations exposed previously, an exploratory research was accomplished, looking for the perspectives from both automaker and supplier involved in a case of practicing co-design approach.

The research is a qualitative research approach, with the use of the case study method into a specific development project. To collect data and information, semi-structured interviews were conducted in the automaker and in three suppliers that had participated in that development project (YIN, 1989) (BRYMAN, 1989).

The interviews were led using a questionnaire for the automaker, another one properly customized for suppliers. The questionnaire covered the following topics:

- ◆ strategy of development product of the company in terms of scope, level of suppliers involvement (1st and 2nd tiers) and organization of the project team;
- ◆ management practices used in product development;

- ◆ qualitative performance of PDP specifically in the project studied;
- ◆ relationship between the management practices adopted and the performance cited previously;
- ◆ difficulties found in the project; and
- ◆ suppliers involved in the project, and which systems or components were under their responsibilities.

Chosen suppliers for this case study were defined after the interview with the automaker. The criteria for choice were: supplier that already had developed a product jointly with the automaker; and when the collaboration had been a learning relationship for both supplier and automaker.

The project studied allowed to understand the relationship between automaker and supplier in a co-design context, specifically in new style development of the car "Palio" by FIAT that was launched in Brazilian market for 2000 years. According to the automaker, this kind of project is complex due to the great modifications accomplished, and engineers and designers from Brazilian site of the company and from headquarter in Italy.

The case study was accomplished just after the release of the product to the market. So the project was already concluded (it was concluded in the end of nineties). This study included interviews with managers and chief engineers. The interviews were conducted in the FIAT automaker, and in three first tier suppliers, that had worked in a co-design environment with the automaker in this project. The study also used, as complementary way, documents of the project from the automaker and the suppliers companies.

5. The field research

The integration between customer and supplier in a complex process, as the product development, can bring good results for the companies involved, but it also demands efforts for the overcome some difficulties. This case study presents the characteristics of the relationship between automaker and suppliers in a specific project, and also depicts some of those difficulties or barriers that need to be overcome for a good co-design process.

5.1 The product development process at fiat auto

To understand this process at FIAT AUTO automaker, in Brazil and in a global context, it is necessary to understand

the paradigm change in product development that happened in the nineties in this corporation.

The development of the first version of Palio that happened in the beginning of the nineties represented a great challenge and changes for the corporation (IANSANTI, 1994). The platform Palio was conceived to be a world product of the FIAT Group, seeking to enlarge its participation in emergent countries, as for instance Brazil, Argentina, Poland, and Turkey (Balcet e Enrietti, 2001). This purpose of product development was under a great responsibility context because this new model would take place of the model UNO that were a product of success of the company up to that time.

The CEO of FIAT on that moment considered that FIAT PDP was too slow and inefficient, and the company was unable to reach a high level of performance in project and product, and that was a indispensable condition for the product that would be the UNO aftercomer. Due to this, company tried to take advantage of the occasion to rethink and to change the way new cars were designed and developed in FIAT. The main implemented changes were: the use of the concept of products platform; development using “heavy weight” project teams; and the attribution of a larger importance for the consistence between the strategies of development, marketing and manufacturing (IANSITI, 1994).

The case study presented in this article was not about the development project of the first version of Palio. It was focused in the style project of the car that was denominated “New Palio”. Therefore, after analyzing the project “New Palio”, there are indications of definitive incorporation of the mentioned changes, now as consolidated practices, that were reached by:

- ◆ a team that was responsible for the development of this new version, with great autonomy and full dedication for the project, and the team leader was “heavy weight” one;
- ◆ the consistent involvement of marketing and manufacturing during whole the project, besides with certain autonomy of the FIAT of Brazil to make decisions, considering the potentialities of the marketing and of the manufacturing places.

The product development organizational structure of FIAT Corporation is based in a matrix structure, and the engineering are divided in four principal functional areas (vehicle layout, engines, gear boxes, systems & components). They supply

technological solutions the several platforms of vehicles. Among the models that constitute the same platform, there is a great sharing of components and the solutions are similar. Among different platforms there is much less sharing and when it is necessary, technologies should be properly adapted.

Some components, systems and technical solutions are developed in the functional areas of the automaker engineering (and more and more in suppliers) without a specific focus in one model or platform. A basic and independent development is made, that later is adapted to each development projec (each car), as the requirements needed for this, such as air bag, applied telecommunications in vehicles, ABS brakes, electronic injection, and others.

FIAT car platforms are organized based in three factors: common chassis, segment of common market, and arrangements with other corporations through joint venture. In FIAT Brazil are produced vehicles of the platform “Segment C” basically (models “Brava”, “Marea”, etc), and other that are “World Car” (“Palio”, “Siena”, “Strada”, Uno”, etc). The second group of models has more importance in terms of scale production and market share of the automaker in the Brazilian market.

In a wide vision of the organizational responsibilities in the product development process, it could be said that there are three agents or main elements in FIAT Corporation, and that they are interrelated, such as:

- ◆ *functional areas (functions)* – they take the responsibility for the acting of the functional tasks (specializations) in all the units of the corporation in the world, supporting them with the functional competences or professional specializations when necessary;
- ◆ *platform teams (platforms)* – they take care of new product development (improvements or new models in existent platforms or creating new ones);
- ◆ *local units (branches and subsidiaries)* – they represent the local interests of Fiat and they are responsible for the local operations (therefore they have hierarchical responsibility for the local functional areas).

So, it is noticed a cross organizational structure crossed between these three agents that make Fiat Auto to operate globally. The product development a global process, led based in platforms approach, under the control and supporting of

the functional areas (functions) and the participation of the local units (in some types of platforms).

The product development, such as a new platform or modifications in an already exist platform, and also new models derived from a platform, is realized by a team (vehicle platform core team) that practically is full time dedicated to that. A specific development model orients the whole development products at FIAT Auto called “Product Life Cycle Process”.

That team as main coordinator the following members: platform director, product manager, controller, plant general manager, purchasing manager, platform manufacturing manager, and engineering manager. These members have different levels of power for decision, participation and involvement in technical and management activities of the team.

In Fiat Auto this team is considered as being a “heavy-weight” type, and it accomplishes the development of products following the elements of the simultaneous engineering approach (the team is denominated “simultaneous engineering team” for new product development). In the case of improvement and adaptations of products already existent, a team denominated “diagnosis teams” (that can be derived of the simultaneous engineering teams) follows the problems that appear, not well-explored opportunities by the product, and new needs and desires of customers, and then they realize those improvement or adaptations.

Product Life Cycle Process adopted by FIAT Auto, that guides all the development teams work can be detailed in five main phases. These phases are accomplished in a complete and simplified way, according to the type of project that is being done (for instance, a product totally new versus the derivation of a product already existent). The following bullets try to specify these phases:

◆ *Component Plan and Product Plan* – it is related to the strategic planning of the products and components considering at the long date (about next ten years). Annually, long date sceneries and trends (long date) considering aspects related to innovations in concepts and technology for some components of an automobile (such as engine, electronics, safety, fuel, etc), with the feedback of suppliers, and also about own automobile as a product. Based on this, they are updated decisions related to the portfolio of products of FIAT Auto (the updating and

innovations that the current products need to receive, the release of new products, new markets for exist products, modifications in the estimates of commercial life of products, etc). This is a strategic planning (brand book to define product guidelines), and the results are enrolled in specific documents. In this phase is also verified how is the integration between different programs of product development to avoid redundancies in development and in manufacturing, assuring the coordination (regularity) among the releases, and focusing in the market coherence in order to avoid that different products come to dispute the same space in the market-place.

◆ *Concept Development* – it refers to the definitive concept of the vehicle to be developed, eliminating alternatives until reaching to the most appropriate choice (for instance: among several models of platform, to choose the more appropriate one for the reality of each market, considering a model that would be launched, to choose the most appropriate power train; etc). The whole vehicle is defined in conformity with the decisions taken in first phase (Component Plan), and in coherence with the performance target required for the product. This target involves quality, cost and time. After the choice of the concept, come the decisions about outsourcing (which parts of the project will be accomplished by suppliers and which will be the level of involvement of suppliers in each development phase and in the manufacturing process).

◆ *Product Development Process* – this phase involves starts just after the concept is defined, and the first activity is: conception of the product style, construction of prototypes (first virtual and later physical), transformation of the defined style in technical specifications of product design and manufacturing process, design of tools, tests for validation, accomplishment of changes and improvements in the product (based in the accomplished tests), verification of the manufacturing process through pilot production, production beginning (vehicles for market). It is in this phase that there is the effective involvement of the suppliers (they were already selected in the previous phase), so much in the deployment of technical parameters of the product as in the negotiations about cost costs, prices and contracts.

◆ *Launch Process* – it defines the internal and external actions necessary for the release of the vehicle. These

actions happen in different ways: Communication (advertisement, catalogs, press, internet, contacts, etc); Commercial (prices, credit, financing, after-sales, services, etc); Industrial (accessories, owner's manual, logistics, etc).

◆ *Product Management* – it refers to the accomplishment actions of following of product performance in the market, and it includes a continuous surveillance of this performance, valuation by customer of the price versus characteristics and performance of the product; control of the mix of versions and optional components; verification of the decision effects on volume and price variations of products; control of the contents about the products available in the internet, catalogs and advertisement, monitoring of the competitors' actions.

5.2 The involvement of fiat brazil in product development

Derived vehicles of “Segment C” platforms and World Car assist the market of FIAT Brazil. Among these models (vehicles), the new version of “Palio” was used for the case study about FIAT Brazil's involvement in the product development of the corporation FIAT Auto. This project, also denominated in Fiat as “Palio Restyling” or “New Palio”, is a complete re-design of the style of the model, that according to the company is similar to the development of a new vehicle under the same previous platform.

FIAT Brazil was involved in the development project of the “New Palio” because Brazilian market is a very important market for FIAT, and it was defined that FIAT Brazil would be participated in the development, due to this local unit is responsible for the manufacturing of cars for this market. TO realize this project, the “Vehicle Platform Core Team” was defined, and some functional areas from FIAT Brazil were part of the team, especially Product Engineering Department (one department from “Technical Director Office” of FIAT Brazil), as well as some areas from other countries (mainly Italy). Members of the team are full time located to the project and they followed the FIAT product development process “Product Life Cycle Process” presented previously.

It is possible to notice the intense cross relationship between attributions of three agents (countries, functions and platform) that structure the whole FIAT Auto development process.

It is possible to notice the intense cross relationship between attributions of three agents (countries, functions

and platform) that structure the whole FIAT Auto development process. Following, Product Engineering (from Technical Director Office of FIAT Brazil) is detailed, as well as its involvement in the Vehicle Platform Core Team in “New Palio” project. Some other details of this project, mainly the involvement of suppliers, are depicted.

Technical Director Office of FIAT Brazil is one of the centers of excellence of the FIAT Auto Corporation Technical Director Office that provides the guidelines in terms of strategic technical competences. The centers of excellence of Fiat Auto are in Torino, Arese, Balocco and Elasis in Italy, and Betim in Brazil. Each center looks for certain concentration in some specific technical competences, however working in collaboration and integration with others when necessary. For example, during the development of the new line of engines “FIRE” that was centralized and led in the center Elasis (south of Italy) there was the direct participation (not only learning, but effective involvement) of engineers from Betim (FIAT Brazil). That happened because of these engines were planned to be manufactured by FIAT Brazil, and also they would be used in Brazilian models what in fact happens nowadays.

Technical Director Office of FIAT Brazil is part of the organizational structure of subsidiary FAIT Brazil. Its Product Engineering Department accomplishes the engineering design and the manufacturing process plan for all products for Brazilian and Latin America market. There is integration of its activities with other FIAT Auto centers of excellence, or with different functions located in Brazil or in another unit of FIAT Auto. The continuous personnel exchange and the connection of systems through information technology and networking communication systems are the two factors considered fundamental for the success of this integration.

The Product Engineering Department joins a many persons that compose FIAT Brazil's Technical Director Office. In the matrix organizational structure department there are the following sections: Product Competitiveness; Management Systems (staff of the Product Engineering Department); Legislative and Normative Technical services; Experimentation of vehicles; Material Engineering; Engineering of Vehicles; and Platforms (that joins persons of the previous sections, from other areas of the department of Product Engineering from FIAT Brazil and from FIAT Auto, and from suppliers in co-design).

As soon the team is composed, it starts to work together in a same place with the declared purpose of in order to intensifying face-to-face communication that is still considered relevant in development.

5.3 The development of new palio

The Development of the “New Palio” – To develop the project “New Palio” the whole organizational structure previously described – Product Engineering and the Technical Director Office of FIAT Brazil – was involved and participated. Also, other functions of FIAT Brasil and from FIAT Auto participated to form the Vehicle Platform Core Team that led the development of “New Palio”.

This team started the job in Italy (more specifically the initial phases of Product Life Cycle Process, that involve the conception and style of the vehicle and preliminary designs, calculations and prototypes of the product). Over there, engineers and other members of the Brazilian team had worked for about eighteen months with other persons from FIAT of Italy that complemented the team.

Those Brazilian members full time dedicated to the project were 30 persons. The Italian members were participating more as partial collaborators in the team. Brazilian suppliers (from multinational autoparts companies installed in Brazil) also participated in the development phase in Italy, but as partial collaborators, involving personal from the headquarter or from some sites of the supplier in Europe.

When the team was involved to the final phases of Product Life Cycle Process, the whole team moved to Brazil (not only Brazilian members, but some collaborators from FIAT of Italy moved together).

During all development activities always there were collaborators and communication procedures in both countries (Brazil and Italy) to take care of several specific problems for the functional areas when those problems appear along the development. This systematic happened in the first time in this project, and it has been configuring as a tendency in FIAT for development projects that would be manufactured in Brazil and that is destined mainly to this market.

It is noticed that in the “New Palio” project that some phases were not realized or were partial realized because the project was not a platform one, despite the model Product Life Cycle Process had been adopted. However, it was a

significant because about 80% of change were realized in relation to the previous model of “Palio”. Besides the style, modifications that occurred were chassis, vehicle dimensions, engine, internal panel, front suspension, transmission, and the electric and electronic system in the whole vehicle. The participation of suppliers in the development of some of the components and systems was significant, as it is exposed ahead.

5.4 Management practices in product development and supplier selection

In terms of management practices in product development was verified in the case study that elements of Simultaneous Engineering approach are the directress for this process, and also other practices such as FMEA, QFD, and DFM are used accordingly development activities or characteristics of the product.

It was also pointed as very important the fact of development process to be done by an exclusive team with the employment of technology information facilitators for accessing project information and to facilitate communication between persons involved. The resident engineers from suppliers at product development of FIAT were pointed as a important practice to the development process.

Considering the performance of the “New Palio” development, in qualitative terms, development time was better than the expectation, since the product was launched before the planned date. To measure this parameter is used the period of time between milestones of the project (gates). Cost (productivity) and quality performance reached the expectations, and hours of engineering are the principal indicator used for the first parameter and several types of indicators are used for the second, respectively.

With relation to the main difficulties faced in management development product in this project, it was pointed the pressure for time, in an interviewee’s words “too short for a so heavy project”, and the diversity of new items to be developed at the same time that requests a special care with the reliability of the systems composed by these components.

Fiat Brazil started to improve its relationship with suppliers in the nineties, when it to look for a better coordination with a more select supplier group, that were those ones involved with systems and critical or strategic components for the vehicles of FIAT, and with competence in research and

development of products (and not only in manufacturing) in Brazil. These components or systems are those ones with higher aggregated value or that required more customization to specific needs of the product. That guideline is in consonance with FIAT Auto's world policy of instituting a differentiated relationship with its critical and strategic suppliers (BRONZO, 2001).

There are three important functional areas of Fiat Brazil involved with suppliers in the phase that they are chosen during process in order to supply components or systems for a new model. This areas are: Engineering that works with the supplier on technical aspects; the Support to the Platform sector that basically intermediate the relationship between the supplier and the Engineering, taking the technical specifications from Engineering to the supplier, and technical conditions from suppliers to Engineering; and the area of Purchases that takes care of the negotiations of prices, costs and delay with the suppliers.

For Fiat, suppliers are usually seen as being basically of two types: the co-design, those ones that receives the specifications of a component or a system and realize product and process engineering activities (obviously there are an intensive coordination and communication with the Engineering from FIAT); and, the non co-design, those that receives all parts already designed and that are responsible just to manufacture them (and this type of supplier usually accomplishes the process engineering activities for the component). Black-box projects are considered a co-design because FIAT doesn't dominate the whole technological aspects of the project.

To choice a supplier, Engineering pass to the function "Platform Support" the technical specifications of the component or system, as well as its cost performance target, and it informs whether the supplier to be chosen will act or not in co-design. Since then that function of Platform Support gets all these information and registers them in a book, and so suppliers that are interested in participating present theirs proposals.

These proposals are analyzed then in a meeting denominaded "sourcing" that is coordinated by Platform Support area. This meeting is usually weekly when there are ongoing development projects (significant ones). Other areas from FIAT are also involved such as Quality that is responsible to evaluate the supplier competences in supplying as well as its performance

as a FIAT supplier. In the "sourcing" meeting is judged the proposal of the supplier not only in terms of technical aspects, but also in terms of its manufacturing capacity, quality assurance, attendance in the automaker site, etc, that means that just the attendance of technical requirements is not enough to define a supplier. Once chosen the supplier, "Purchasing" area takes care of the contractual details and the supplier is able to involve with Engineering of FIAT for the effective development of the component or system.

FIAT Auto tries to practice global sourcing (in other words, to use the same supplier for a same component or system of a certain model Fiat in Italy and in Brazil, for instance). However, there is in FIAT Brazil a relative autonomy to choice another supplier in Brazil if there would be advantages in terms of productivity, quality, capacity, and future possibility in working together.

There is a tendency in Fiat of working more with systemists, that act in the sense of integrating competences of smaller companies (giving the these scale economy and learning). The systemist can accomplish co-design with its client (automaker) as well as with its suppliers, the smaller companies (BRONZO, 2001).

Co-design at FIAT has been practicing in a incremental way, and not in a radical implementation. This could be observed in the research, as declared by Planning and Purchases department close to: "except body and power train (engines and transmission), the other components result of an united efforts of P&D and a co-design practices between the assembler and suppliers".

That is different from findings depicted by other authors that studied other subsidiaries of FIAT Auto. Those authors found that co-design and partnership in PDP with suppliers have been occurring only in Italy, where some suppliers of the first tier that have P&D and PDP departments in that country. But nowadays FIAT Brazil is practicing co-design and it took its engineering department increased in importance in FIAT Auto.

Some of the suppliers of New Palio that were previously chosen and selected were pointed by automaker as characteristic examples of high involvement in the project. These suppliers are: lights supplier; seat system supplier; supplier of the refrigeration system of engine; supplier of electronic systems. Three of them took part of this research.

5.5 Supplier of the refrigeration system of the engine

This company belongs to a German manufacturing of autoparts corporate, and besides Brazil, it has sites in USA and Spain.

The German headquarter centralizes research efforts in this area of refrigeration, and it assists the Brazilian unit with this technology when necessary. However, the Brazilian unit already has the knowledge on this product technology and its process technology, and this allows the unit to make decision with a great autonomy. This autonomy facilitates the co-design development process.

The development project of "New Palio" was the first case of co-design between this automaker and this supplier, even in world level. To due it was the first participation in PDP, there was some resistance at the beginning of the project, but as good results were obtained those beginning difficulties disappeared. It was gotten from the interviewees that the relationship between this supplier and FIAT would be a long-dated one, and Brazilian unit of this supplier reached a high level of prestige in the German headquarter.

This specific project can be classified as black box type, because automaker defined some specifications, and the supplier started the development of the refrigeration system. This project also presented many innovations for the supplier because no much could be used from existent products. Besides, German headquarter could not assist so much Brazilian unit due to the great number of ongoing development projects under its responsibility, and that stimulated local development.

In terms of the second level of suppliers (2nd tier), the refrigeration system supplier tried to involve in this project just some companies that already had partnership because it used as criteria the performance on technical capacity and time (cost criterion was not considered in this choice). This choice was based in the confidence mainly due to development time was short and many product modifications could be necessary along the development.

The performance the project in terms of time it was considered better than the initial expectations of the supplier. The lead-time for the development was extremely short and the supplier reached it. Even with this short period the performance in quality was also overcame the expectations.

The good results obtained in these criteria were recognized by headquarter of the supplier and also by the automaker.

In terms of productivity, the project had some won and some losses. The resident engineer in Italy completed his work in a very short time (before than it was planned), and this had increased productivity. On the other hand, some meetings not planned previously at the head office of the automaker, the necessity of sending prototypes through express mail, among other unexpected facts, endeared the project.

The interviewees marked some difficulties felt during this project, for example, the automaker took a long time to define which would be the supplier, and that decreased the period to development the refrigeration system. Another difficulty pointed out was the lack of technical information in some moments of the project. At the beginning, not even the automaker had some defined specifications of the new car that were necessary to design the refrigeration system. In the end of the project, the supplier had difficulties in obtaining the feedback of tests of its system accomplished by the automaker. Another point of difficulty in this project was the transmission of data between supplier and automaker and vice-versa. This problem was explained by some failures in the telecommunication infrastructures, and also due to the lack of compatible records. They outstanding as a problem the fact they have not used a rapid prototype tool (actually they did not have time to get prepare to use it, because they did not used it before).

The relationship supplier-automaker had gone improving as positive results had appeared. At the beginning, this supplier suffered some resistance from automaker, especially in terms of confidence (they had never worked in co-design before). During the development of the project, the involvement was intensified, and nowadays this supplier is recognized in the automaker as a partner. However, interviewees pointed out that the relationship of this supplier with some areas of the automaker still need to be gotten better, as it is the case of the area of Purchases. This area was used to another supplier of refrigeration system for about twenty years, and it was not easy to change.

5.6 Supplier of seat system

The supplier of seat system is part of a autopart North American manufacturing group that also supplies other components for auto industry. Despite of the headquarter of

the group is in USA, the connection with Brazilian, that sits close to FIAT Brazil, is stronger in technical terms than with the unit of this supplier in Italy.

This supplier is a systemist and it has some 2th tier suppliers in Brazil and outside the country.

In PDP, the Brazilian unit has autonomy in many areas. In some aspects, such as in design, the company has authority to change specification except whether alterations influence the functionality and the safety of the system. In that case this supplier needs to communicate and to be authorized by the Italian unit (this is due to the Italian unit already has connection with FIAT Auto in developer of new products).

In the “new Palio” project this supplier of seat system participated together with the Italian unit. The developed product was a black-box type as in the refrigeration system supplier. So, the supplier was responsible for the whole development.

The performance in time in this project was satisfactory and like the expectations. As frequently it happens, interviewees affirmed that the table time is always reached even if during the project they had to realize fittings. The performance in quality was also shown as the expected, but some rework was necessary in the project.

In relation to the productivity, the performance was below the expectations. Some modifications demanded by the automaker in the final phases of the project, and the searching for the execution of the timetable planning they were forced the use more resources than planned previously.

As in the refrigeration system supplier, interviewees of the seat system supplier pointed some difficulties in this project. One of them concerns the non-participation of the supplier in the development of the definition of finishing specification of the seat system (the automaker took care of this definition by itself), and as this finishing specifications affect the project, the supplier frequently had to realize adaptations when a problem came up.

Another difficulty is related to the tests of integrative proof, when the automaker gathers all the components of its vehicle and it carries on the necessary tests. According to the interviewees, this integration just happens in the final phases of the project, when modifications are more expensive for the supplier. According to them, it would be possible to realize those tests in earlier phases of the project.

As elements of success in this project, the supplier depicted the team work capacity, and the ability of the supplier in understanding what the customer really needed.

The communication between automaker and supplier was considered satisfactory in this project, and it was used electronic resources and personal contacts. Another important factor for a good co-design relationship is the fact of the automaker already had known the product of the supplier, and that the supplier had known the customer product.

5.7 Supplier of electronic systems of distribution of signs

This supplier is part of a North American corporation, and there are six units in Brazil. In the product development process that is being described in this case study, the Brazilian unit that participated in the project maintain a strong relationship with the Italian unit of the group (more intense than with the headquarter in USA) due to it is close to the FIAT Auto that is the customer.

This supplier had already worked in co-design with FIAT seven years ago, during the development of the first version of the Palio. So, it knew the first project of the car.

The system developed by this supplier was based on a system already developed by the Italian unit for another FIAT car, therefore this could be considered a follow-source project. Also, this product can be considered a black-box one because it has technology from the supplier (automaker defined specifications and the supplier realized the development).

In relation to the performance in this project, the supplier considers the performance in time and cost of the development in accordance to the expectations, and the performance in quality was better than the expected levels.

As difficulties in this project, it is possible to stand out the needs to reach the costs target of the product established by the Purchases area of the automaker, because to that it was necessary to make modifications during the development. This fact points out problems related to the lack of integration between some customer areas with the supplier, and it address to the importance of the integration to PDP.

Another problem in this project was the difficulty of treating with some second tier suppliers especially because most of the components were imported. Problems were related to delivery and to the information for validation these

components. The supplier tried to nationalize many components of the system in this project, but even so about 70% of its suppliers were still foreign.

The communication between customer and supplier had no problems during this project. The knowledge about the product and other components of this product, as well as the customer's knowledge about the system of the supplier, were important elements to the success of this co-design process.

6. Final Considerations

Since the beginning, in Italy, guest engineers from suppliers participated in the development of this project. After the initial phase, the development process in those three suppliers started to be different in terms of autonomy in relation to headquarter and to the other units of the group.

Those Brazilian units were responsible mainly for the development of the manufacture process, being the project of the product under responsibility of the Italian units of these suppliers. In the case of the supplier of the system of refrigeration, the Brazilian unit was responsible for whole the development process, counting with little support of the head office.

Another differentiation point among those three suppliers concerns the autonomy in the project in relation to the automaker. The seat system supplier is still very dependent of the customer's decisions. In the other hand, the other two suppliers have larger autonomy in their project despite they have worked with the automaker with the engineering department of the customer in a high level of integration. Table 1 shows an evaluation of autonomy level practiced by these three suppliers studied.

Generally it is noticed in the automaker and also in the suppliers that most of product design activities are centered at the FIAT Auto and in the supplier units that are close to the automaker, while process design is larger accomplishment in Brazil.

However, it is not possible to depict that there is no product design at local units in Brazil. The development activities that are carried on in local units are not limited to the "tropicalization" of products. It is reasonable to consider that there is an intermediate position between "whole project developed in local units" and "no product development activities in local units". Local units have significant responsibilities related to the design of the manufacturing

Table 1: Autonomy of the suppliers in PDP

	Autonomy in relation to the headquarter and to other units of the group	Autonomy in relation to the automaker
Supplier of the refrigeration system	High	High
Supplier of the seat system	Medium	Low
Supplier of the electronic system	Low	High

process, as well as related to the product design by guest engineers participating in PDP since the beginning in the headquarter of the automaker.

It is also reasonable to end that the engineering of the automaker from Brazil has a larger responsibility and participation in the project development team than the respective engineering of the suppliers in Brazil in their foreign units or headquarter.

Besides the autonomy issue, other difference among the three suppliers analyzed in this project is related to the level of innovation of the systems developed by them. The suppliers of the seat system and of the electronic system developed

their products based on an exist product in a follow-source approach from other units. The supplier of the refrigeration system realized a high innovation level in its system.

In relation to the performance in PDP, time and quality performance were above or same as expectations. In productivity terms, the suppliers of the system of refrigeration and of seat system considered the performance below the expectations, and they justified this by customer's alterations requests. For the supplier of the electronic system, the productivity in this project was same as expectations. The fact of this last one supplier have already worked in co-design with the automaker, in the first version of this vehicle, certainly

affected the better planning in terms of cost in this project. Table 2 summarizes the evaluations of performance of this project done by the three suppliers.

The three suppliers highlighted, among their difficulties in this project, problems related to the PDP management of the automaker. The refrigeration system supplier depicted the initial resistance of the automaker (due to it was the first time they worked together) that probably caused delays and barriers to obtain information. The seat system supplier pointed out as a big problem the fact of the automaker be responsible for part of product design of the component (there was a lack of supplier autonomy) and also the integrative

tests accomplished by the automaker just in the final phase of the project. The electronic system supplier detached the problem caused by the lack of integration between the Purchase area of the automaker and the Engineering department of the supplier that facilitated to occur some trade-off in the project.

Table 3 presents the characteristic of co-design practices that were found in this project. In this project the relationship automaker-suppliers was good and many aspects of co-design process were found, such as: the earlier searching for solutions; the involvement and the communication between them; and the knowledge the automaker had about the systems supplied and the knowledge on the product by

Table 2: Evaluation of the performance in this project

	Time	Quality	Productivity
Supplier of the refrigeration system	Better than expectation	Better than expectation	Lower than expectation
Supplier of the seat system	Same as expectation	Same as expectation	Lower than expectation
Supplier of the electronic system	Same as expectation	Better than expectation	Same as expectation

Table 3: Co-design characteristics found in automaker and suppliers studied

Co-design characteristics	Findings from the field research
Earlier involvement of the supplier	The three suppliers were involved since the beginning of the project in Italy
Supplier choice is done by Engineering department	Choice was done by the team work and the engineering department of the automaker
Know-how transferring to suppliers	There were no findings related to this characteristic in this case
Few suppliers for each component	Each component studied were from just one supplier
Guest engineers from supplier in the customer	This happened in the three cases
Project manager is defined in the supplier	It happened in the three cases
Supplier have autonomy to chose methods and techniques	All suppliers studied followed their own PDP reference model
Intensive communication	There was a high level of communication, but some failure had occurred during the project such as the report of test results to suppliers.
Earlier integration on financial and technical issues of the project	It happened in the three cases.
Continuous validation of the project	It happened in all cases but it is possible to improve this characteristic in the future
Long period contracts integrating financial and technical aspects	They did verbal commitment, and not even contracts.
Linkage between product strategy and supply strategy	This had occurred partially, and some problems happened specially for the electronic system supplier

suppliers, characteristics that need to be worked better for the configuration still exist it executes of a project in co-design. Despite of this, still there is some characteristics to improve to reach an effective co-design process.

To name their suppliers as co-designers could be understand as a practice to get more responsibility from them, and also it facilitates to reach a higher level of flexibility in the relationship especially in leading with alterations in the project. But automaker doesn't realize an effective transferring of know-how neither related to its development strategies. To face this unbalance suppliers end up committing their performance, especially in terms of productivity, as it was seen in the analyzed cases.

So the relationship automaker-suppliers could be durable and allows reaching benefits for both since they minimize this unbalance. And by this way could work together and share future projects in a complete co-design context.

Therefore, to reach a effective co-design practice is necessary to realize a good planning and to consider some issues that are critical. These issues based in the studied cases are:

- ◆ automaker should enlarge its role as coordinator in information exchange along the development as much between automaker and suppliers as between suppliers, specially in earlier phases of the project;
- ◆ automaker should give more warranties for the supplier, in other words, the relationship between customer and supplier should be treated as bigger than just in the development of a product, and it needs to assure that wider perspective in the relationship is real. That is more critical in the cases of companies that never worked committees;
- ◆ suppliers should develop methods to develop a component or system that are more suitable under larger uncertainty context than they are usually have done, specially due to the high level of flexibility in change requirements by automaker;
- ◆ the choice of suppliers units to participate in a development project should considered the autonomy level they have to make decision; and,
- ◆ when automaker doesn't know about a component or system, the know-how transferring flow could be inverse of that presented in the literature.

By the findings of this research it was possible to address that the co-design practice contributed mainly to improve the performance in quality and time of development, although there is potential improvements to reach better performance in productivity. Besides, it was possible to observe that is necessary that customer and supplier assume new roles and practices to minimize the uncertainties that usually are in an co-development project of new product.

5. Gratefulness

Authors thanked to Fundação de Apoio à Pesquisa do Estado de São Paulo – FAPESP for the financial support to this research, and to the companies that collaborated with this case study.

6. References

- BALCET, G.; ENRIETTI, A. Regionalisation and globalisation in Europe: the case of Fiat Auto. In: <<http://www.univ-evry.fr/labos/gerpisa/actes/20/index.html>, 2001 > .
- BRONZO, M. Inovação e Práticas de Co-Design no Contexto da Arquitetura Reticular: Um Estudo de Caso sobre a Rede de Suprimentos da Fiat Automóveis do Brasil, In: **Anais do III CBGDP**, Florianópolis, SC, 2001.
- BROWN, S. L.; Eisenhardt, K. M. Product development: past research, present findings, and future decisions. **Academy of Management Review**, v.20, n.2, pp.343-378, 1995.
- BRYMAN, A. **Research methods and organization studies**. London: Unwin Hyman, 1989.
- CLARK, K. B.; Fujimoto, T. **Product development performance: strategy, organization and management in the world auto industry**. Boston: MA, Harvard Business Press, 1991.
- CLARK, K. B.; Wheelwright, S. C. **Managing new product and process development: text and cases**. New York, NY: The Free Press, 1993.
- CLAUSING, D. **Total quality development**. New York, NY: ASME Press, 1994.
- GARVIN, D. A. **Managing quality**. New York, NY: Free Press, 1998.

- GRIFFIN, A. Research on new product development practices: updating trends and benchmarking best practices. **Journal of Product Innovation Management**, v.14, pp.429-458, 1997.
- IANSITI, M. **Fiat**. Harvard Business School Cases, n.9-694-041 e n.9-694-042., 1994.
- KESSELER, A. Evolution of supplier relations in European automotive industry: product development challenge for a first tier supplier. **Actes du Gerpisa**, n.19, 1997.
- LAMMING, R. **Beyond partnership: strategies for innovation and lean supply**. UK: The Prentice Hall, 1993.
- LAPLANE, M. F.; SARTI, F. The restructuring of the Brazilian Automobile Industry in the nineties. **Actes du Gerpisa**, n.20, 1998.
- LIKER, J. K.; KAMATH, R. R.; WASTI, S. N.; NAGAMACHI, M. Supplier involvement in automotive component design: are there really large US Japan differences? **Research Policy**, v.25, pp.59-89, 1996.
- PRAHALAD, C. K.; HAMEL, G. The core competence of the corporation. **Harvard Business Review**, pp.79-91, May/June, 1990.
- PRASAD, B. **Concurrent engineering fundamentals**. New Jersey, NY: Prentice Hall, 1997.
- QUADROS, R.; QUEIROZ, S. The implications of globalisation for the distribution of design competencies in the auto industry in Mercosur. In: **Seme rencontre internationale – Gerpisa**, Actes, 2000.
- ROSENBLOOM, R. S.; CUSUMANO, M. A. Technological pioneering and competitive advantage: the birth of VCR. **California Management Review**, v.29, n.4, pp.51-76, 1987.
- SALERNO, M. S.; ZILBOVICIUS, M.; ARBIX, G.; DIAS, A. V. C. Mudanças e persistências no padrão de relações entre montadoras e autopeças no Brasil. **Revista de Administração**, v.33, n.3, pp16-28, 1998.
- STALK, G. Jr. Time – the next source of competitive advantage. **Harvard Business Review**, pp.41-51, July/August, 1998.
- WHEELWRIGHT, S. C.; CLARK, K. B. **Revolutionizing product development: quantum leaps in speed, efficiency, and quality**. New York: The Free Press, 1992.
- WHEELWRIGHT, S. C.; CLARK, K. B. **Leading product development: the senior manager's guide to creating and shaping the enterprise**. New York: Hardcover, 1995.
- WOMACK, J. P.; JONES, D.; ROOS, D. **The machine that changed the world**. New York, NY: Maxwell MacMillian, 1990.
- YIN, R. K. **Case study research – design and methods**. London, UK: Sage, 1989.
- ZOTTERI, G.; SPINA, G.; VERGANTI, R. Factors influencing co-design adoption: drivers and internal consistency. In: **Proceedings of 7th EurOMA Conference**, Ghent, Belgium, pp.661-668, 2000.

Adress for mailing

José Carlos de Toledo – Federal University of São Carlos – Production Engineering Department, Rodovia Washington Luís, km 235, São Carlos – SP.

Sergio Luis da Silva – Federal University of São Carlos – Production Engineering Department, Rodovia Washington Luís, km 235, São Carlos – SP.

Manoel Fernando Martins – Federal University of São Carlos – Production Engineering Department, Rodovia Washington Luís, km 235, São Carlos – SP.

Dário Henrique Alliprandini – Federal University of São Carlos – Production Engineering Department, Rodovia Washington Luís, km 235, São Carlos – SP.

