

The potential of new product development in the automotive industry in Brazil: an exploratory study

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Abstract: This paper provides an overview of new product development activities in Brazil considering the potential of the automotive industry. It consists of descriptive research mostly using secondary data. It also includes some site visits in OEM and autoparts in addition to field data collected from previous research. The first part of the paper provides a Brazilian-related literature review on product development and production in the automotive industry considering OEM and autoparts. The second part of this article describes the technological capabilities in new product development together with some recent examples of the development of a complete derivative product at a world level. Findings have indicated that the automakers present in Brazil have different levels of capabilities and competencies. Furthermore, there has been a change in the quality, complexity and responsibility of activities that Brazilian engineering has carried out. Finally, research implications are highlighted, including some perspectives for future research.

Keywords: brazilian automotive industry, new product development, product development capability, modularity

1. Introduction

Due to an increasingly complex and competitive global market-place, automotive companies are looking at new ways to improve their business operations around the world in order to remain profitable. Automotive industry still holds a prominent place in the vanguard of technological and managerial innovations. In the past decades, it has been recognised as one of the most competitive industry of the world, and has driven most innovations in the entire industry. Up to the 80's, the perception was that the subsidiaries of main automotive corporation located in developing countries performed a limited role in terms of technological development in those countries (KATZ, 1987; LALL, 1992). The main reason was due to the fact that those subsidiaries were totally dependent on headquarters with respect to the development on innovative new products (CONSONI, 2004).

During the 90's, competition has significantly increased in all over the industrialised regions of the globe. Many industries in the developed countries were faced with very competitive markets and the reality of an open economy and the challenges of global competition. This situation are then present in several market places; from developed nations to emerging economies. New demands redirected strategies searching for achieving more technological capacity in the sense that companies should be capable of generating their own technologies to provide innovations from this accumulated capacity. Those demands have influenced

the decision of introducing capital and human resources directed to technological infra-structure towards research and development (R&D) and a managerial capacity that stimulate and make viable R&D activities.

In this context, competition in the automotive sector significantly increased through the world, and automotive manufacturers have demanded a more involvement with the autoparts suppliers in new plants worldwide, rationalised the supply base, defined a new set of supply requirements, and have outsourced part of their traditional activities, mainly in an attempt to decrease production costs and increase the speed of the development of new products (COLLINS et al., 1997). In this respect, research has shown that product development is a vital process for most manufacturing firms' growth and prosperity.

The required infra-structure for dealing with those challenges and demands were not present in developing countries, as stated earlier. Automakers tend to centralise technological activities with high added-value in the headquarters. The result is a geographical concentration of R&D activities in industrialised nations. However, it seems that this picture is (slowly) becoming different. SUGIYAMA & FUGIMOTO (2000), cited by SALERNO (2001) suggest four basic strategies in product design: 1) global product design using newly developed platform; 2) local product design using newly developed platform; 3) global product design using old platform; and 4) local product design

using old platform. Although in the past third and fourth strategies were present in Brazil, it seems that the second strategy is now in place in the country. In this context, this paper provides an overview of product development activities in Brazil considering a perspective of global competitiveness for automotive companies operating in the country. It consists of a descriptive research mostly using secondary data. In general, data and information are spread out and few studies have adopted a wider perspective to study technological and managerial capacity of the Brazilian automotive industry.

The paper has also been structured as follows. Section 2 describes the research design adopted to conduct this research. Methodologically, it can be categorised as a theoretical-conceptual research, although it includes some empirical data from some site visits in OEM and autoparts in addition to field data collected from previous research. Section 3 contains a review of the literature related to new product development (NPD) in Brazil, focused into the auto industry. Section 4 presents an analysis and discussion of data. Finally, section 5 draws the conclusions and managerial implications of this work in addition to some issues for further research.

2. Research methodology

This work can be categorised as a theoretical-conceptual research. It expects to identify product development activities within the automotive industry in Brazil. The research is carried out by analysing current publications in this field (especially those related to the Brazilian context) and, at some extent but limited, by getting empirical non-structured data from some company visits. Figure 1 shows the analytical process framework adopted as the methodological approach. It consists of identifying issues to be investigated, next what the literature have to say, followed by data collection about each situation, and, finally, data analysis grounded to the theory. Then, the cycle is closed but continuously restarted.

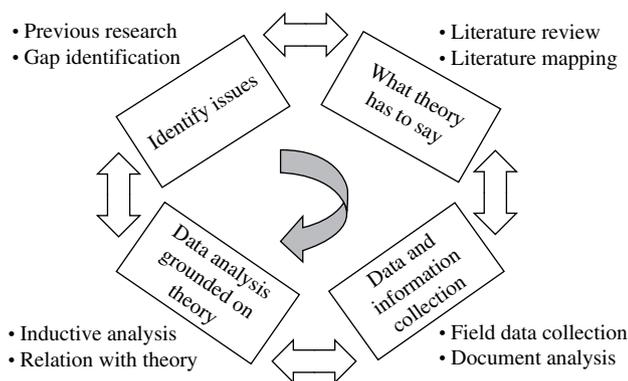


Figure 1. Research project cycle.

As stated earlier, other sources of evidence were used. Those include plant visits at some OEM and autoparts companies. In addition, document analysis were also employed in addition from some research data from previous research (e.g. PIRES, 1998; 2002; SALERNO et al., 2002; CAUCHICK MIGUEL, 2005a; CAUCHICK MIGUEL, 2005b). The whole set of data were then organised and described at following sections, considering NPD at OEMs and some of their suppliers.

3. Dominant issues in the NPD literature in Brazil

In the end of 50's three automotive companies, Ford, GM and VW started their operation in Brazil. Fiat initiated in 1976 and Honda is the first automotive plant installed after many years. The Japanese facility was inaugurated in October 1997. The initial investment was US\$ 100 million to produce 15,000 Honda Civic Sedan in 1998 (today it produces 240 vehicles per day). Just afterwards, there were other newcomers from which four of them started their operation prior to the end of 1998. Those newcomers included but were not limited to Audi/VW, Mercedes-benz (cars; now Daimler Chrysler), Mitsubishi, PSA – Peugeot/Citroën, Renault, and Toyota (cars). In order not to stay behind the scene, the 'old' Brazilian automotive companies (i.e. Ford, GM, VW and Fiat) have also built new plants.

In parallel, new autoparts companies also entered in the market by installation of new plants or by acquisitions of smaller Brazilian companies. As a consequence, the automotive sector in the country become more internationally and integrated to the global supply chain. Moreover, product development and design activities assumed a more relevant role in this scenario through the introduction of a development strategy of a 'world car' or a 'world platform'. In fact, the usual chosen strategy is to develop a world platform since it enables adaptations for the particularities of each market (HUMPHREY et al., 2001). This strategy raises the possibility of redirecting design activities to emerging economies resulting in positive effects in terms of attracting new investments and achieving more strategic importance to the operations in Brazil (SALERNO et al., 2002). Therefore, a number of initiatives have been undertaken for the past 5-10 years. These are outlined next.

3.1. Contemporary product development in Brazil

A broad research project to study the new configuration of the automotive supply chain in Brazil was conducted by SALERNO et al. (2002) a few years ago. Results from this study can be found in ZILBOVICIUS et al. (2002). Among various issues, the study investigated design activities for product development establishing the concept of 'project

head office'. The country in charge of design develops a platform that will become a derivative after necessary changes and adaptation to a local market, differently from the one where the design was made. Those design adaptations and variations usually have to involve a number of players including company headquarter, a subsidiary company as well as first tier suppliers in the current market and abroad. Figure 2 illustrates the relationship among players for product development.

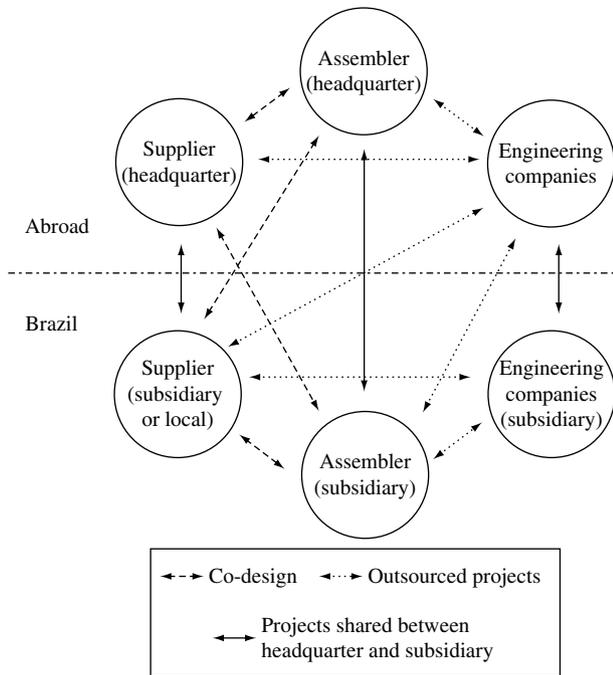


Figure 2. Relation among companies for product development (SALERNO et al., 2002).

The study (SALERNO et al., 2002) has identified a causal relationship between 'project head office' and decisions taken in the product development life cycle. Of course, products developed in the country lead to more intensity of design activities and this result in more autonomy for supplier selection and choice of suppliers located in the country. The rationale is because the Brazilian engineering establish the specifications (definition and modification of part numbers) and command the supplier selection process.

Another relevant factor that might favour product development in the country is regard to an existing infra-structure in the companies. Table 1 shows a summary of the infra-structure available for new product development at the older assemblers established in Brazil for many years. Data and information on these companies are presented since they present more density of activities in the country (SALERNO et al., 2002). There are assemblers that practically have no design activity (not shown in Table 1). Of course, some adaptations to the market is necessary, i.e. a process called 'tropicalization'. Those involve, for instance, modifications in the suspension, development of alternative fuel, etc.

As can be seen in Table 1, there is a trend in the assemblers to build in design centres in the country. For instance, Fiat has invested about US\$ 200 million to develop a vehicle completely designed in Brazil. Besides, the assembler has brought an engineer from its Italian Design Centre to be responsible for the centre in Brazil with a team of 25 people, and new equipment and software.

All infra-structure presented in Table 1 has surely contributed to offer more opportunities for product development in the country. Those opportunities can be represented by new products recently developed by Ford (*Ecosport*), GM (*Meriva*), and VW (*Fox*). Those are examples of a 'complete derivative', i.e. although it is not

Table 1. Infra-structure for NPD (Sources: CONSONI, 2004; CAUCHICK MIGUEL, 2005b).

	Fiat	Ford	GM	VW
N° of engineers	235	337	430	550
Total people NPD	470	425	900	680
Infra-structure	laboratory, design centre ¹ , prototyping facility (limited)	laboratory, design centre (limited), prototyping facility	laboratory, design centre ² , prototyping facility, field test track	laboratory, design centre ³ , prototyping facility, field test track
Competencies	Tropicalization (engine ⁴ and suspension), basic derivatives ⁵	Tropicalization (engine), basic derivatives	Tropicalization (engine ⁷), basic ⁸ and complete ⁹ derivatives	Tropicalization (engine ¹⁰), basic ¹¹ and complete ¹² derivatives

Notes (added by the author):

¹ Design centre in initial stage with a team of 25 people.

² Design centre with a team of approximately 70 people.

³ Design centre with a team of approximately 60 people.

⁴ For example: dual fuel engines.

⁵ For example: Fiat Palio.

⁶ For example: engine Supercharge with dual fuel.

⁷ For example: engine VHC Flex Power (dual fuel).

⁸ For example: Corsa, Astra Sedan, and Celta.

⁹ For example: Meriva.

¹⁰ For example: engine 1.0 Turbo Flex (dual fuel).

¹¹ For example: Gol.

¹² For example: Fox.

a new platform, their extension of changes in the product and processes (manufacturing and assembly) specification goes beyond a typical project developed in the country. Traditionally, engineering activities are usually more active in terms of process design, i.e. when developing manufacturing and assembly specifications. This is corroborated by some studies (e.g. SALERNO et al., 2002; CONSONI, 2004). However, despite previous examples, a relatively recent study (CONSONI, 2004) revealed that there are efforts towards new product development in Brazil but they do not extensively contributed to the advance in technological research and local research and development.

3.2. Product development at OEM

Table 2 shows a summary of the profile of automakers in Brazil with emphasis on the existence of new product development, adoption of modularity in design and responsibility for production. As can be seen in the table, design activities vary among the assemblers. There are some companies (e.g. Fiat, GM, and VW) with some degree of decentralised design activities from the headquarter. General Motors is perhaps the benchmark with regard to the decision to develop new products in Brazil. GM LAAM (Latin America-Africa-Middle East) Engineering Development Centre is one of the 5 product development

centres in the world. GM argues that it is highly competitive not only in terms of engineering costs but also people qualification and competence. Currently, 40% of its capacity is used to support other GM plants in the world. The company is going to expand the centre by doubling the quantity of engineers in 2006. The plan is to have a work force of 1,200 professionals until 2009.

As showed in Table 2, some decisions involve the adoption of the development of modular products, not only in terms of design but also in production. The decision of adopting a modular product might influence other organizational aspects related to the production and to the supply chain. Some of these aspects are discussed next.

3.3. Modular product development

Automotive products are usually complex structures in various aspects such as design integration and physical functions. Product structure can be obtained by either an integral or a modular architecture, depending on the interdependencies shared between components and respective interfaces. Auto industry has adopted modularity as a strategic concept. In a few words, modularity can be understood as a way of building a complex product or process from smaller subsystems that can be designed independently and yet function together as a whole

Table 2. Product Development in Assemblers in Brazil.

Assembler (place)	Main product(s)	NDP in the subsidiary?	Recent project	Modularity in design	Parts produced by the assembler
Daimler Chrysler (Juiz de Fora)	<i>C-Class</i>	Limited ⁰	-	Data not available	Data not available
Daimler Chrysler (São Bernardo do Campo)	Trucks from 7 to 41 ton	Yes	<i>Axor</i>	Yes	None
Fiat (Betim)	Palio/Uno/ Marea	To some extent ²	<i>New Palio</i>	Yes (<i>Camuffo</i> , 2001)	Final assembly, body shop, painting, engines, heavy press
Ford (Camaçari)	Ecosport	Yes	<i>Amazon (Ecosport)</i>	Yes	Final assembly, body shop
GM (Gravataí)	Celta	Yes	<i>Meriva</i>	Yes (<i>Graziadio</i> , 2004)	Final assembly, press shop, body shop
Renault (São José dos Pinhais)	Scénic/Clio	No ¹	-	Data not available	Final assembly, body shop, painting
VW (Taubaté)	Gol/Parati	Yes	<i>PQ-24 (Fox)</i>	Yes	Final assembly; press, body and painting shops ³
VW (São José dos Pinhais)	Golf/Audi A3	No (for these vehicles)	-	Data not available	Final assembly; press, body and painting shops
VW Trucks (Resende)	Trucks from 7 to 47 ton	Yes	<i>Costellation</i> ⁴	Yes ⁵	No direct production

Sources: CAMUFFO (2001); SALERNO (2001; 2006); CONSONI (2004); GRAZIADIO (2004); plant visits; secondary data.

Notes:

¹ Only adaptations, i.e. tropicalization (in case of Renault, even the adaptations are made in the headquarters in France).

² 50% of design hours of the new *Palio*.

³ It also includes thermoplastics.

⁴ The project has involved 200 professionals (from the automaker and from the module suppliers) from whom 20 had worked collaboratively with the corporate product development centre in Germany for two years (CAUCHICK MIGUEL & PIRES, 2006).

⁵ The degree of modular design is now more relevant, especially because the assembler is now confronted with the challenge of shipping its product in a SKD basis and, more recently, the introduction of new products (CAUCHICK MIGUEL & PIRES, 2006).

(BALDWIN & CLARK, 2000). Basically, modularity can be present in design and in production. Modularity in design can be defined as choosing the design boundaries of a product and of its components (HUANG & KUSIAK, 1998; CAMUFFO, 2001) while modularity in production means choosing plant design boundaries to facilitate both manufacturing and assembly to meet product variety, production flow, cost and quality requirements (CAMUFFO, 2001). There are other types of modularity, e.g. modularity in use, but is out of the scope of this paper and, therefore, it is not described.

A number of publications have discussed modularity in production mainly by presenting the experience of VW trucks (e.g. COLLINS et al., 1997; MARX et al., 1997; PIRES, 1998). The VW plant has a production concept which integrates seven suppliers directly in the production line. The so-called modular consortium was established by VW in 1995 with an investment of approximately US\$ 250 million at a plant at Resende in Brazil where about 3,500 people are employed, from whom only 530 are directly contracted by the assembler. Although the benefits of adopting modularity in production through the modular consortium is acknowledged, there are very few studies that deeply deal with modular project in the country. It can be assumed that a configuration of truck architecture follows a sort of 'natural' modules then justifying the prior decision to modular production. Nevertheless, there has been a need of redefining the modular logic with regard to the product design due to the delivery of SKD kits to other countries (e.g. Mexico) as well as the development of a new product platform (CAUCHICK MIGUEL & PIRES, 2006).

A recent study that dealt with modular production also highlighted modular product development (GRAZIADIO, 2004). A single case study conducted in a major automaker in Brazil (GM) compared two supply chain: a conventional and a modular one and two levels of suppliers (1st and 2nd tier) were investigated. Although this study was not directly carried out on product development, it raised interesting issues with regard to modularity in design. As described by GRAZIADIO (2004), the idea of modular design came from the need to facilitate production leading to an effective modular production. It has been thought since the conception of the GM *Celta*, aiming at simplifying assembly. To develop a modular vehicle, product engineers 'dismantled' the previous vehicle model (*Corsa*) and divided it into basic modules, which were: cockpit, cooling system and ventilation system, seats, roof and doors (internal), wheels and tyres, windscreen, rear and lateral windows, fuel system, rear axle, front suspension, exhausting system, engine, transmission, and light system. *Celta* was designed in Brazil although the initial idea was to start from carry over parts from *Corsa* aiming at achieving a more economic engineering solution. The Brazilian subsidiary has worked

in the design since concept definition and developed more complex parts such as engine and bodywork, which is generally developed at Germany. As a result *Celta* has had more engineering hours in Brazil than any other GM vehicle designed so far. The result in design has led to an effective modular production. Five modules are simultaneously assembled in the plant at *Gravataí* (engine, transmission, rear axle, exhausting system, and fuel system). Other benefits include a reduction in the supplier base and stock. The plant has 100 suppliers and each company responsible for a module has at least 30 suppliers under its coordination. The cockpit supplier, for instance, represents 40 second tier suppliers.

In 1996, VDO qualified for supplying the cockpit module to GM *Celta* programme. The design was conducted collaboratively by VDO and GM in partnership. It means to share costs and knowledge with regard to the concept design, prototyping, product specification, and tooling development. The design initiated in 1997 (product launching was scheduled to 1999), following a GM recommendation that the car should cost 30% less than the *Corsa*. Firstly, VDO produced a specification book approved by GM; then, a 15 people project team was established involving professionals from Brazil and Germany, where the company had a previous experience to supply modules to VW *Passat* and *Smart* (Daimler Chrysler/Swatch) in France. In the second phase, until the end of 1997, the concept was extensively discussed, followed by design planning and tooling project. In the third phase (until the end of 1998), the final tooling was constructed and, finally, from 1999 to the beginning of 2000, the production was validated through PPAP (Production Part Approval Process). The price of the cockpit includes components costs, assembly, supplier management and quality control, engineering costs, and the investments made in the new plant. According to VDO, 'this business adds more value and much more risks and, as a consequence, is necessary to evaluate where to invest' (GRAZIADIO, 2004). An interesting conclusion from the previous study is that it is possible to have modular production in place without modular design. On the other hand, when a component is modified according to the modular logic, its production process will be modified to comply with this change. Therefore, modularity in design might lead to modularity in production.

3.4. Development of 1,000 cc engines

One important initiative in NPD in the country is the design of low capacity engines (1,000 cc) and engines with dual fuel (petrol and alcohol). The result is an effective technological effort and more autonomy for developing new products since the national engineering possesses known how to do so. Table 3 presents some results of a research

Table 3. Main characteristics of the studied companies (adapted¹ from CERRA & MAIA, 2005).

	VW	GM	Fiat
People in NPD	180	190	163
N^o of people	reduced in the past years (20%)	increased by 35% (50 people)	Increased (precise data not available)
Products	1.0 to 1.6 engines	1.0 to 2.4 engines	1.0 to 1.8 engines
Recent projects	gas engine, emission reduction, adaptation to new transmission	not available	'many' (the company did not inform types of projects)
NPD Strategies	NPD for emerging markets with autonomy	NPD for emerging markets with autonomy	NPD for emerging markets with low autonomy
Outsourcing	high ² (since the beginning)	high ³ (recently)	low ⁴
Co-design	for some components (e.g. blowby system)	For some components (e.g. transmission)	for some components (e.g. injection system)

Notes:

¹ The original source (CERRA & MAIA, 2005) did not identify the companies. The source also consider other aspects such as training and relationship with research centres and universities.

² Machining of parts is made internally and foundry is outsourced

³ Machining of parts is outsourced and foundry is made internally with the intention to be outsourced in a near future

⁴ Machining of parts is made internally (crankshaft, cylinders and cylinder head) and foundry is made internally with the intention to be outsourced in a near future

conducted by CERRA & MAIA (2005) on three major engine manufacturers.

For all companies, product mix has increased in the past years. Overall, companies has autonomy for developing new products (especially low capacity engines); Fiat has the goal to achieve more autonomy to develop products for emerging markets. Co-design activities are also a reality for all companies using different suppliers, except when they designed the engine with bi-fuel and used the same supplier. Indeed, all studied companies demonstrated capacity and competency for developing new products, especially due to the relevance of the local unit in corporate business.

3.5. Investments in production expansion – not in product development

Not all assemblers have the strategy of developing new product in the country. When a new product should be introduced there is either a simpler adaptations (e.g. changes in the suspension to adapt to road conditions, so-called 'tropicalisation') or search for suppliers in the internal market ('nationalisation'). Honda, for instance, has practically no design activity. When initiated its operation in the country, Honda produced 30 vehicles per day with 414 employees. Today, 240 vehicles are assembled per day in two shifts with 1,570 employees and the plan is to extent to 300 and 360 vehicles per day, respectively, in 2006 and 2007. The expansion will involve an increase of 35 thousand square meters in the production sectors of welding, painting, final inspection, machining, assembly line as well logistics. In addition, it will acquire new equipment for painting and injection moulding. The number of domestic suppliers has increased from 34 in December, 1997 to 130 in November, 2005. The company has invested US\$ 300 million in the

country with a current production capacity of 55 thousand vehicles/year. The goal is to achieve 100 thousand vehicles/year until 2008. Although the automaker launched a compact car a few years ago (besides the production of Civic) there is no plan to develop new products in the country. At this level, only nationalisation and adaptations are made.

Other car assembler which is not active in terms of NPD in Brazil is Renault. The company makes in France the necessary adaptations to the products to be sold in Brazil. Nevertheless, the company announced a US\$ 120 million investment in the country in 2006. Renault plans to launch five new models in Brazil until 2009, expecting 6% of operational margin and an increased in sales up to 800 vehicles from 2005 to 2009. Therefore, the company might increase its plant production capacity and intends to increase the level of integration of local component suppliers.

3.6. Product development at autoparts companies

A survey on practices and constraints on new product development was conducted in the country a few years ago (TOLEDO et al., 2001). A questionnaire was sent to 140 companies with a response rate of 11%. The nationality of most respondents was German with other origins such as American, Brazilian, Italian, and Japanese. One third of respondents indicated to be within 100 to 499 employees and the remaining distributed below and above this range (upper limit up to 1000 employees). The annual sales in almost half of respondents varied from US\$ 13 to 250 million and most revenue come from domestic market (less than 20% of sales come from export). Most respondents (60%) provide

modules or systems as first tier suppliers. The main results from this survey were:

- The majority of companies (nearly 60%) participate in product development;
- Almost 60% of projects, on average, were 'follow-source' but 46% platform projects were cited;
- Companies that develop platform projects are usually those that work collaboratively in NPD;
- Companies has a functional and matrix organizational structure (40% of companies in each category); the remaining work on project-based organizational structure;
- All companies have adopted some sort of NPD framework, usually based on Advanced Product Quality Planning – APQP (in 67% of respondents) and use design reviews during NPD;
- Almost all NPD activities are present in the companies (market research, prototyping, product certification, etc.). Nevertheless, most activities are those related to final design and manufacturing process specification (e.g. pilot production);
- A number of tools and techniques are adopted (Failure Mode and Effects Analysis – FMEA, Computer Aided Design – CAD, Simultaneous Engineering, Electronic Data Management – EDM, and Design of Experiments – DOE). Of course, some of them are compulsory requirement, like FMEA;
- Less used tools and techniques are Quality Function Deployment – QFD, Product Data Management – PDM, and simulation techniques;
- The more complex the project the more tools and techniques are used during NPD;
- Performance criteria for NPD process are customer satisfaction and internal failure costs (all companies), new product return, external failure costs and percentage of products launched at the planned time (80% of respondents);
- In average, 33 products were launched in the past three years with a rate of success (% of financial success) of 76%;
- An average of 47% of annual sales came from products launched in the past three years and the average time of ROI was 20 months; and
- The average developing time was 7.5 months (follow source project), 4.6 months (derivative project), 8 months (platform project), and 12 months (break-through project).

Some trends can also be identified, such as shorter innovation cycle, increased new products introduction, fostering co-design and collaborative new product development and partnership, and adoption of new techniques and framework (e.g. six sigma methodology). Interesting is that few companies consider as a trend the

headquarter centralization in new product development. In fact, 40% indicated more autonomy of the subsidiary in the country. This is partially confirmed by the other results and shows a relatively clear picture of better new product development structure (resources and competencies) in the autoparts operating in Brazil.

Overall, the investigated autoparts have a certain infrastructure for product development. They usually have a NDP process in place with design reviews in the gates and adopt a number of supporting techniques and tools. Although it is yet limited some projects are conducted with partnership with suppliers and the trend is towards a wider adoption of co-design. Indeed, two thirds of companies stated that the number of new products tend to increase and, therefore, the supplier participation is of course relevant. Different from expected, the study indicated that the capacity and competency for new product development is under-utilised, especially due to the subordination to the headquarters.

4. Analysis and discussion

A first general analysis have indicated that the automakers present in Brazil have different levels of capabilities and competencies for new product development. This can be explained by the argument that these capabilities depends on both the knowledge already accumulated by the subsidiary and the role the subsidiary performs within the global corporate strategies.

Before the 90's, Brazil was a peripheral design basis, only adapting vehicles to an existing platform, although there are evidence of unique models such as VW *Brasilia* and VW *Gol*. The former is out of the market for decades while the latter is one of the best selling compact cars (it used to be the top selling one a few years ago) and is now in its fourth design generation (although it is fair to say that most changes in the past years were only face-lifting). Up to the 90's some automakers have designed 'simple' derivative vehicles based on a pre-defined platform. In recent years, the design of a more comprehensive derivative has been accomplished (e.g. GM *Meriva* and VW *Fox*), although part of the engineering hours were consumed at the carmaker headquarters. From the past developments, one can infer that there is an accumulated experience and competency in new product development but if further developments are a trend is an equation not yet been solved.

Of course, there are factors that stimulate and favour product development activities in the country: market niche and market conditions (necessity to adapt to market characteristics), competency in new product development, importance of the local unit in company business, and so on, as also identified by SALERNO (2001). In addition, the survey conducted with automotive suppliers also indicated design activities. This can also contribute to future projects. Almost contradictorily, another survey

(ZILBOVICIUS et al., 2002), collected from 224 companies from tiers 1, 2, and 3 of the automotive chain in Brazil, have pointed out that activities of product concept and engineering design are centralised overseas. Additionally, the participation of Brazilian subsidiaries grows in terms of product and process adaptation. Once again, this does not mean or assure a continuously new product development by the automotive firms.

A promising issue to investigate is related to the adoption of modularity in design. As hypothesised by SALERNO (2001), modularity could make easier to develop strategies characterised by the decentralisation of the design process. Moreover, this could identify opportunities to induct more local value-adding activity throughout the supply chain (ZILBOVICIUS et al., 2002; DORAN, 2003). Although the Brazilian-related automotive literature has explored the concept of modularity in production (e.g. COLLINS et al., 1997; MARX et al., 1997; PIRES, 1998), it seems that modularity in design and its relation to those previous issues are not extensively investigated. 'Technological' (or physical) modularity may affect organizational issues with intra and inter-firm relations.

5. Concluding remarks

This paper examined the product development activities in Brazil considering a perspective of automotive assemblers and autoparts companies. From data analysis, the following conclusions can be drawn and managerial implications hypothesised. Firstly, it can be assumed that there is a certain competency and accumulated experience in new product development in the country, although this activity is not fully-consolidated. Nevertheless, there are examples of local product design using relatively new developed platforms. The knowledge on product development get and incorporated by the Brazilian subsidiaries can be considered as an important starting point to develop product at global level. However, it is fair to affirm that this cannot be assured in the near future.

On a more general level (at least within the Brazilian context), it would appear that there is not enough emphasis on investigations on modularity in design. The literature and investigations largely concentrates on modularity in production. As identified by other researchers, the existence of modular products might facilitate co-design, since it would be easier for the assembler to coordinate the design of a few modules by a small number suppliers. Hence, more in-depth investigations on the impact of modularity in design in other organisations activities is a future issue to be explored. This could lead of identifying collaborative NPD practices throughout the chain. In this sense, the level of participation of other tiers in the design in terms of transferring some design activities could be a relevant issue. Future research is likely to shift from the assemblers to the suppliers focus

throughout the chain. This could contribute to a transfer of value-adding activities though the supply chain.

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