ONZIEME RENCONTRE INTERNATIONALE DU GERPISA
ELEVENTH GERPISA INTERNATIONAL COLLOQUIUM

Les acteurs de l'entreprise à la recherche de nouveaux compromis ?
Construire le schéma d'analyse du GERPISA

Company Actors on the Look Out for New Compromises
Developing GERPISA's New Analytical Schema

11-13 Juin 2003 (Ministère de la Recherche, Paris, France)

BETWEEN CENTRALISATION AND DECENTRALISATION OF PRODUCT DEVELOPMENT COMPETENCIES: RECENT TRAJECTORY CHANGES IN BRAZILIAN SUBSIDIARIES OF CAR ASSEMBLERS[1]

Flávia CONSONI[2]
Ruy QUADROS[3]

This paper is concerned with technological activities accomplished in Brazilian subsidiaries of car assemblers, particularly with their involvement in product development and the related acquisition of design competencies. Previous research (Quadros and Queiroz 2001; Consoni and Quadros 2002) revealed that car assemblers located in Brazil reacted differently to the challenges the automobile industry has undergone in the past decade. Faced with growth in intra firm trade, acceleration in product innovation and increasing integration in global manufacturing operations, some assemblers have stepped up local product engineering and enhanced local design capabilities, while others have gone the opposite way, in the hope of relying on product development activities further centralised in European or North American R&D centres. At that time, these findings led us to reject the (still) common belief that globalisation would entail a general reduction in R&D activities of multinational companies located in Brazil and the consequent re-centralisation in developed countries.

The paper resumes these issues in the light of new findings produced by a new research project[4] on Brazilian car assemblers' product and technology strategies. Research is based on interviews carried between 2000 and 2002 with all car assemblers located in Brazil, but one.[5] Interviewees were product and process managers, particularly those focused on local

---

[1] Paper presented at the XI International Colloquium of GERPISA – Company Actors on the Look out for New Compromises.: Developing GERPISA' New Analytical Schema, Paris, 11-13 June, 2003. The authors are grateful to FAPESP (Fundo de Amparo a Pesquisa do Estado de São Paulo) for funding this research.

[2] Researcher at GEMPI - Group for Research on Firms and Innovation and PhD student at the Department of Science and Technology Policy, University of Campinas

[3] Leading Researcher at GEMPI - Group for Research on Firms and Innovation and Associate Professor at the Department of Science and Technology Policy, University of Campinas

[4] This article is part of the research carried out by Flávia Consoni in her doctored project: "Technological Activities in the Brazilian Automobile Industry: an analyzes of the product development process".

[5] This includes the major players which have been competing for the car market leadership for decades, namely, General Motors (GM), Ford, Fiat and Volkswagen (WV); and the new entrants of the second half of the 90s, that is, Renault, PSA - Peugeot Citroën, Toyota, and Daimler Chrysler. Honda was interviewed in 2000 and

product development and technological activities. Interviews focused multinational car assemblers' strategic plans in regard to technological activities in Brazil and what can be expected in relation to local technological capabilities in the future

In addition to this introduction, two sections follow. Section 2 presents elements of the economic and institutional Brazilian environment which help understand product strategies of carmaker subsidiaries in the country. Section 3 suggests that Brazilian car assemblers have been following different product strategies, which can be either more centralized or more decentralized, according to headquarter decisions. Thus, the role to be played by Brazilian subsidiary in global strategies has important impacts on automotive engineering in Brazil. It means that Brazilian automotive engineering may became a relevant player in terms of product and knowledge development in the global strategies of the multinational car assemblers. However, our findings have indicated that the picture is more complex than the initial hypothesis claimed. In some cases, car assemblers have adopted product policies oriented to emerging countries (like Brazil), and local engineering teams have increased and have been working more integrated with the R&D centres abroad. However, in other cases, product adaptations to local requirements have been mostly performed by the headquarters abroad with only narrow inputs from the Brazilian engineering. Finally, some conclusions from this research are presented, emphasising the different trajectories amongst the car assemblers located in Brazil and trends about the future of the Brazilian automotive engineering.

THE BRAZILIAN CONTEXT AND THE ROLE OF CAR ASSEMBLER SUBSIDIARIES

Benefiting from high protection, the Brazilian automobile industry developed until the 1990s exclusively oriented to the internal market. During this period, Brazilian automotive sector was composed by four foreign car assemblers, Ford, GM, VW and Fiat, known as the traditional players, as well as four light commercial, bus and truck assemblers, Volvo, Scania, Daimler Benz and Toyota. Closed to the influence of external trends, car assemblers used to introduce in the Brazilian market vehicles that had been designed and introduced in other countries many years before. Furthermore, such products used to have long life cycles in Brazil, fifteen years in average. All car assemblers counted on internal engineering teams in order to adapt products developed abroad to specific local conditions, such as bad road conditions and usage, climate differences, ethanol fuel, lower consumer income, peculiar consuming taste, and so on.

Although most vehicles produced in Brazil were adaptations of designs developed in Europe, there were some exceptions. The main illustrative case happened in 1980, when VW designed the BX Family, which was the platform of the Gol vehicle and its derivatives. Both the design and the project of that platform were developed in the Brazilian unit of VW, under the local engineering team responsibility. It is important to emphasise that Gol has been the most popular vehicle in Brazil. Since 1987, Gol has ranked first in Brazilian car sales. A similar experience had happened years ago, in 1973, when the subsidiary of VW designed the body of the Brasilia, a vehicle designed to be produced and sold only in the local market.

It is worth noticing that this kind of strategy intended to manufacture cars for the local market, with no need of significant technological activity. One important quantitative

---

has refused to participate again in research. Daimler and Toyota have been manufacturing trucks and utility vehicles in Brazil for long, but are new entrants as far as the car market is concerned.

indicator to sustain this argument is the share of engineers in total employment in the assembly industry in Brazil. In the late 1980s this share was less than 1%..

Major changes in the Brazilian automotive market and industry happened in the early 1990s, which account for a new phase in this industry. These changes implied a significant redefinition of local product and technology strategies of car assemblers in Brazil. Two elements had great influence on these changes, namely, trade liberalisation and government polices specifically focused on the automobile sector.

Market liberalisation

The process of trade liberalisation in Brazilian economy started in the early 1990s and took unaware car assemblers located in the country. The sudden explosion in vehicle imports intensified domestic competition and turned evident the need to update products and improve productivity rates and quality standards in car manufacturing in the country. In consequence, the investment realised by car assemblers in Brazil rose from US$ 5.4 billions during the 1980s to US$ 16.6 billions in the 1990s (Anfavea, 2002). The largest share of such investment was made by car assemblers already located in Brazil, either on modernising local assembly units and upgrading product portfolios, which were strongly obsolete in relation to international standards, or on building greenfield assembly units. The other share of investment was accounted for by new entrants in Brazilian automotive industry. Toyota (vehicle division), Honda, Renault, PSA Peugeot-Citroën, VW Audi and Daimler Benz (vehicle division), along with light commercial assemblers like Chrysler (before the venture with Daimler Benz), Nissan, Land Rover and Mitsubishi, all of them inaugurated new car plants in Brazil, between 1997 and 2002. Completing this cycle of investment is the coming of Fiat Iveco and International, both assemblers of trucks.

Such investment effort aimed at, firstly, take the opportunity to enlarge the consumer vehicle markets. As Lung (2000) holds, the relative saturation and stagnation of the mature markets in the industrialised countries contrasts with the recent dynamism of the newly emergent countries. According to the author, the emergent countries have a real potential for growth, albeit not certain due to frequently economic problems. In fact, Brazil is one of the large potential consumer markets in the world, as it has a population of about 175 million people and presents a relation of inhabitants per vehicle around 8.8. The scale of production is another factor that influences investment flows into Brazil. The peak was observed in 1997 when 2 million vehicles were manufactured in the country. In 2001 the output was around 1.8 million vehicles, of which the domestic market absorbed 78%. The fact that Brazilian subsidiaries are best positioned to explore other Latin American countries, including Argentina and Mexico, and the South African market has contributed to motivate investment in Brazil. This is so due to having attained economic scales in the manufacturing of compact cars, to having developed a considerable knowledge of particularities of such markets and also due to geographical proximity.

Although the size of the Brazilian car market has been one of the main factors behind the wave of investment, the importance of Brazilian government policies focusing this sector, specifically the Automotive Regime, should not be underestimated as additional incentive in the process of attracting new car assemblers to Brazil. Thus, product development strategies especially among the four traditional players (VW, GM, Ford and Fiat) have been greatly influenced by the new phase in the domestic automotive market, characterised by fiercer competition as well as a deep restructuring process. Until then, car assemblers located in Brazil were protected from external competition in the internal market and from new entrants;

under such pattern of competition, local product strategies tended to be more locally oriented and product cycles were longer. Trade and investment liberalisation has contributed to approximate and integrate Brazilian subsidiaries into parents' s global strategies.

In fact, the number of new car platforms launched in Brazil in the 1990s was three times the observed in the 1980s (Quadros *et al*, 2000). Furthermore, most new platforms were launched in Brazil either simultaneously or even before they were launched in other countries. This has contributed to both keeping product portfolios updated and to narrow the gap between the local and European product portfolios. The same applies to innovations in manufacturing processes. Overall, the new product strategies have replaced the launching of vehicles based on or derived from obsolete platforms, which has prevailed for decades.

Policies for the automotive industry in Brazil

Brazilian government played an important role during the 1990s, implementing sectoral policies for the automobile industry. Systematic policies were adopted aimed at recovering the consumer market growth and giving incentives to investment and exports.

The first policy initiative was the organisation of the Sectoral Chamber for the Automotive Industry, between 1992 and 1994, which put the Brazilian government, assemblers, suppliers, dealers and unions together to discuss the automobile sector problems and defined policies specifically oriented to increase/sustain local consumer demand. The final outcome was an agreement to reduce consumer taxes and the consumer vehicle prices, in order to increase local demand and output and maintain the level of employment. One of the most important measures adopted during that period was the reduction to zero in the Industrialised Product Tax (IPI) on vehicles powered by engines up to 1.000cc. This has given birth to the "popular car", a concept defined by low price, low powered cars, with no offer of optional items. In other words, it was the beginning of the simple and cheap car era. Following this measure, there was a boost in popular car sales, which became the spearhead of the growth in demand for vehicles in Brazil. Consequently, the share of popular car models reached the magnitude of creating a special segment in the Brazilian automobile market. The market share of popular vehicles, which was 4,3% in 1990, came to 50% in 1996, when a new policy for the automotive industry, namely the Automotive Regime, was adopted by the federal government.

The Automotive Regime was the type of sectoral policy aimed at giving incentives to investment made by assemblers and auto parts producers committed with export targets, which would be later banned by the Brazilian compliance to the TRIMs (trade related investment measures) agreement. The Regime operated as catalyst for new investment in the sector. It was valid until the year 2000. In addition, the Automotive Regime raised the IPI for popular cars from zero to 10%. For vehicles above 1.000cc the IPI was kept in 25%. Accordingly, in relation to the vehicle final price, the popular car still was considerably less expensive than the others. Sale prices, of course, have always been critical for Brazilian average consumer. As a consequence, the popular car sales continued to grow and, in 2001, the share came to 70% of all the domestic vehicle market in Brazil, creating a qualitative change in automotive market and na industry bias towards specialising in sub-compact platform. In September 2002, the IPI rate was modified again, narrowing the gap between vehicles powered by 1.000cc engines and the other vehicles (above 1.000cc). For instance, the popular cars started to pay 9% IPI for ethanol fuel version and 10% for gas fuel. For vehicles powered by engines between 1000cc and 2000cc, the IPI was 13% and 15% respectively (down from the 25% rate which was adopted during the 1990).

Why has the IPI rate been modified recently? In fact, the adoption of lower IPI rates as an incentive to the demand for low powered sub-compact cars has never been a consensus amongst car assembler subsidiaries in Brazil. On the one hand, some assemblers have been very interested in keeping the IPI incentive for popular sub-compacts, as their product portfolio was strongly formed by popular car derivatives. The case of Fiat is the most illustrative. Nowadays, Fiat has the largest market share in Brazilian automotive industry due to the sales of its popular cars Uno and the Palio Family. On the other hand, assemblers like GM, which count on a broader product portfolio, have been keen on modifying the IPI taxation. The new assemblers installed in Brazil in the nineties have supported the latter position.

In spite of such divergent standpoints, the popular car policy promoted both a recovery of the domestic consumer market and the specialisation of the Brazilian automotive industry in sub-compact platforms. This tendency has had important impacts as it helped increase output scale and improve product development activities and internal capabilities in Brazilian industry.

PRODUCT DEVELOPMENT STRATEGIES OF CAR ASSEMBLERS IN BRAZIL

Before dealing with product development strategies of car assemblers in Brazil, two conditioning points shall be emphasised. First, the process of R&D globalisation in the world car industry has been very limited, both in terms of activities and regions. According to Miller (1994) and Calabrese (2001), global car assemblers have great inclination towards centralising R&D activities in their home-base countries. It means that frequently the major R&D centres have been located near to headquarter and/ or decision-making centres.

Second, it has become a commonplace to associate globalisation in the automobile industry with the adoption of global platforms. According to Muffato (1999), a platform can be defined as a set of integrated components and systems, physically connected, which shape a common base for different models. It includes both underbody (front floor, underfloor, engine compartment and frame) and suspension. The advantage of adopting the concept of global platform in product development and manufacturing is that many different vehicles can be assembled on the same base, sharing tools and equipment. Therefore, both development cost and lead-time are reduced, as platform and vehicle development become separate processes to a certain extent. Moreover, the tendency of adopting such global development strategy has implied reducing the number of platforms and increasing their derivatives.

In spite of the two global tendencies mentioned above, car assembler subsidiaries in Brazil have adopted different paths of globalisation of products and product development. To put it in a simplified manner, but easy to understand, such paths could be classified in two groups, that is, centralising or decentralising strategies. Each of these strategies has different impacts on local product policies adopted by car assemblers outside their home-based country.

At one hand, product centralised strategy implies a single global product policy, in which the most significant activities of product development (platform and its derivatives) are centralised abroad, not in the Brazil. This means that car assembler subsidiaries tend to adapt vehicles to local markets without making use of complex knowledge, promoting only minor changes in the final product. As a consequence, local adaptations as well as local technological activities tend to be reduced due to the tendency of increased homogeneity of markets and their products. On the other hand, product decentralised strategy has been associated with product policies more oriented to local/regional market needs. It implies a

kind of organisation of product development in which the main functions of car assemblers are structured according to regional spaces, which are inter-related but keeping a certain degree of autonomy. Diverging from the centralised strategy, the decentralised policy contributes to increasing local engineering staff and upgrading local technological activities and competencies.

In contrast to the Indonesian case, where almost all vehicle adaptation activities are carried out abroad under (Japanese) carmakers' headquarter co-ordination (Sugiyama & Fujimoto, 2002), we found a different tendency in Brazil. In our research we could not find a unique product strategy among Brazilian subsidiaries of car assemblers. Conversely, we noticed that car assembler subsidiaries have adopted different product strategies, between the centralised/decentralised orientations, according to the definition of their headquarters and the capabilities accumulated in the subsidiary. In the following, we discuss our understanding of the three basic groups of Brazilian assemblers presenting similar trajectories as far as product development is concerned.

New comers' centralised strategy

At first place, we could notice some similarities between product strategies adopted by the new comers, that is, Toyota, Honda, PSA Peugeot-Citroën, Renault, and Daimler Chrysler. Albeit some differences in terms of their trajectory and amount of local investment, all entrants have launched products in the Brazilian market which have not only been conceptualised and designed for mature markets, but whose re-engineering (adaptation to local technical and taste conditions) has been carried out abroad (either in Europe or in the US). These findings seems to confirm the picture we found in previous research, concerning Renault and Honda in 1998 (Quadros et al. 2000). In our view, the main reason behind extreme centralisation of product development and product policies is the low scale of new comer operations. These car assemblers have moved into Brazil recently and, due to their lower local output and sales volume (in comparison with traditional players), the Brazilian operation can not "pay" for local technological activities and product development in Brazil. In 2001, the output of new comer assemblers represented 8.7% of total output in the Brazilian automotive industry and their domestic sales (including nationally manufactured and imported vehicles) represented roughly 13% (Anfavea, 2002).

Furthermore, all activities performed by these car assemblers are mostly oriented to small adaptation in product or process, to nationalisation of components and mainly to technical contact with their local suppliers[6]. For instance, Toyota has tried to equalise the supply of Brazilian auto parts according to Japanese standards while Renault has tried to adapt to Brazilian auto parts and local materials, which are very different from French ones. For more complex technological activities, new comers have counted on major R&D centres abroad. The same applies to adaptation required in of manufacturing process, in general related to lowering the use of automation technologies in the original process projects, due to the fact that Brazilian plants operate at much lower output volumes.

Any significant product modification, involving more complex technological adaptation, must be approved by headquarters. Thus it is clear that affiliates of new comer assemblers in Brazil are subject to a lower degree of autonomy in comparison with their more established competitors. In spite of such limits regarding decisions on products and

[6] The exception was the design of the sedan derivative of Renault Clio, in order to compete in this market segment. Three volume sub-compact cars are very appreciated in the Brazilian market.

technological activities, Brazil subsidiaries of new comers have been given the role of centre of manufacturing and sales for Latin American countries. Brazilian units have been responsible for the co-ordination of their regional activities, especially when there is more than one plant in the Latin American region. Moreover, the responsibility of Brazilian units includes technical support to other LA units.

To summarise our findings for this group (new comers), Toyota, Honda, Daimler Chrysler, PSA and Renault have strongly pursued centralised product strategies in Brazil. The vehicles they have launched in Brazil were developed in their headquarters, going through only small adaptations to Brazilian conditions, adaptations which have also been engineered abroad.

Evolution of GM's and Fiat's decentralised trajectories

In contrast, product strategies adopted by the major car assemblers located in Brazil (VW, GM, Fiat and Ford) have been less centralised. These corporations have been manufacturing and assembling cars in Brazil since the 1950s[7], and have kept a relatively stable and strong position in the Brazilian car market. 2001 they accounted for approximately 87% of the Brazilian car market (domestic sales of nationally manufactured and imported vehicle), while their output (1.4 million units) represented 92% de domestic output (Anfavea, 2002).

During the phase of import substitution industrialisation and protected internal market, these assemblers built local autonomous areas of product engineering for designing and developing products specifically focused on the local market, often adapted from European and North American old versions. Domestic sales volume was sufficient to maintain these activities in Brazil, although at a level of technological sophistication which was considerably lower than that of European counterparts.

However, with trade liberalisation and greater integration into global strategies commanded by parent companies, such subsidiaries have substantially changed their product and product development strategies in Brazil. They have redefined the way their products were conceptualised, designed and engineered, in the sense that assemblers sought cost reduction through eliminating of asset and task duplication, particularly regarding technological facilities and engineering staff. This move has had significant implications for the organisation of local engineering activities. In this respect, the traditional Brazilian car assemblers divided into two contrasting groups. While from the beginning of this phase Fiat and GM have been pursuing a rather decentralised product strategy, VW and Ford (the latter more clearly) have initially pursued a centralised strategy, which has been recently subject to major revision.

As indicated in our previous research, since 1995/96 GM and Fiat have been mostly inclined to adopt decentralised strategies. Both car assemblers have built local autonomous engineering centres with capability to participate in global platform projects providing inputs related to local requirements, as well to design regional derivatives to suit the local preferences. "Global thinking but local doing" seems to well describe their local product strategies, which we have referred to as product glocalisation.

GM do Brasil is the most clear-cut case of decentralising path. In the 1990s GM do Brasil accumulated local technological competencies based on the design of regional

[7] Except for Fiat, whose manufacturing operation in Brazil stated in the 1970s.

derivatives such as the Corsa sedan and pickup and the Astra sedan. The combination of capabilities and technical infrastructure in the GM Brazilian subsidiary together with the volume of popular car sales in the domestic market created the pre-conditions for the development of the Blue Macau Project. This project gave birth to the Celta model, a sub-compact car derived from the Corsa platform, with substantial modifications and re-design. The Celta project entailed two major advances for local unit of GM. First, GM Brazil, specially its engineering team, had a major participation during all product development stages of the Blue Macaw project. Thus, the Celta vehicle was specifically planned and designed for the Brazilian market and GM Brazil co-ordinated all the development process. Second, it promoted major innovations in car manufacturing process organisation, by introducing the concept of "industrial condominium" for the first time into GM Corporation. This concept is defined by a compact and modular plant at which the assembly line is segmented into modules operated by suppliers. Suppliers are installed inside the GM plant (at Gravataí, a greenfield site) and take responsibility for the whole development, delivery and assemble of modules or complete systems. Such responsibilities include the employment of direct workers, the development of tools and equipment and the control of the assembly logistic. In addition, the Blue Macaw project introduced the concept of e-commerce, as Celta was the first car model to be sold through the world wide web in Brazil.

These previous experiences and the capabilities accumulated have assured GM do Brasil a significant role in product development activities. This has recently been reinforced in the process of conceptualising, developing and launching in 2002 the minivan Meriva, the most recent vehicle of GM brand in Brazil. The case of Meriva has been considered a new phase in terms of product development mandate, not only for GM do Brasil but also in the context of the Brazilian automobile industry. Firstly because it is a global concept and project proposed by the Brazilian subsidiary and later incorporated in the GM's European product portfolio (thus inverting the knowledge flow, in this specific case). Secondly because it has been the first product development project located in the country which has involved a thorough re-engineering of the original platform (Corsa), including the original dimensions. All stages of development occurred under the GM do Brasil responsibility. According to Clark & Fujimoto' s (1991) typology, these stages include conducting concept studies, building models, testing prototypes, solving problems in pilot plants and getting the car ready for commercial productions. Even thought GM Brazil had been worked integrated with Opel (subsidiary of GM in German), the co-ordination of the Meriva project was under responsibility of the Brazilian staff. The size of the Meriva project justified the allocation of an exclusive development team to this project. Also in this respect this project inaugurated a new experience.

Fiat is also an interesting case of decentralised trajectory. Fiat do Brasil has been engaged in designing derivatives from the Uno platform. Another interesting example is related to the 178 Project, the Palio platform. That project was specifically designed for emergent markets according to their specific needs and conditions of production. Although the 178 Project was developed under the co-ordination of Fiat Italy, the Brazilian engineering team had an integrated role during all this process, specifically in the final stage of development, during the design of its derivatives sedan, wagon and pickup. Later, in the re-design of Palio second generation, 50% of the engineering workload was carried out by the Brazilian product development team (Dias, 2001) That strategy contributed to the growth of the engineering staff and the upgrading of technological facilities at Fiat Brazil. In terms of capability in project design, Fiat do Brazil has been recognised as an excellence centre for hard suspension modules within Fiat Corporation.

The combination of local capability in product development and the attainment of sales leadership in the Brazilian automobile market has contributed to Fiat increasing technological activities in Brazil, including some of the more complex ones. Recently Fiat Corporation announced that Fiat Brazil would assume the mandate for the complete development of vehicles manufactured and marketed in the country. The announced objective is to carry out a "100% Brazilian vehicle", as result of investment of US$ 150 million in product development facilities. This means that all the phases of product development will be performed in Brazil, from design and product concept definition to production process. Indeed, the company has implemented technological facilities in Brazil, such as stilling and prototyping laboratories, and has increased the local engineering employment.

Evolution of VW's and Ford's trajectories: reversion of centralisation?

A quite different situation was found in relation to VW and Ford. Due to the 1980s crisis in Brazilian economy and stagnation in the domestic demand for cars, VW and Ford subsidiaries in Brazil merged into a joint venture named Autolatina, in 1986. VW held 51% of the shares and Ford 49%. Autolatina was an *ad hoc* outlet to the crisis, aimed at increasing economies of scale and reducing fixed costs by sharing platforms and power trains. In 1994, trade liberalisation and the new pattern of competition (above discussed) has brought the Autolatina arrangement to an end. Following this both VW and Ford adopted substantial changes in their local product strategies.

VW do Brasil had pursued a product strategy aimed matching requirements of the internal market, with strong local engineering and technical facilities. Until 1990, VW was the carmaker located in Brazil which was most advanced in terms of local technological activities, designing and developing products specifically for Brazilian conditions. The case of the Gol model was the most illustrative. Nevertheless, with the end of Autolatina VW do Brasil abandoned the strategy of developing products locally. Actually, this was in line with the VW headquarter' s resolution to adopt a unique global product strategy for all its subsidiaries in the world. According to such policy, all vehicles launched in Brazil should be derived from a global project and adapted only to match most critical local technical requirements. This was the situation found in our previous research and the local product engineering team was afraid to be made redundant on the grounds that a large local product development unit was not necessary anymore under the new directive.

More recently, however, VW decided to revert (at least partially) to the opposite direction and maintain the engineering team and technological facilities in Brazil. In the latest visit to VW do Brasil, we found out that the subsidiary has been co-ordinating the development of a new product – the Tupi - specifically designed for emerging markets[8]. Tupi is a derivative from the PQ 24 global Platform, on which the new Polo has been built. In addition, VW Brazil accumulated considerable competence in developing small, efficient and cheap low powered engines, incorporating the turbocharger technology. As a result of such reversion in product development strategy, VW do Brasil has recently expanded its engineering team.

Yet, the clearest contrast to GM's and Fiat's strategies is Ford's. This has been the car assembler located in Brazil that has taken the centralised product strategy further. During the period of protected market, Ford do Brasil accumulated know how for designing local models. After the end of Autolatina, in 1994, the Brazilian subsidiary was reintegrated into

[8] Some sources suggest that the new model could also be exported to Europe.

the global strategies of the Ford Corporation, namely the Ford 2000 Programme. As a result, Ford abandoned completely its local product strategy approach in Brazil and dismantled its product engineering area. That strong centralised strategy advanced in such a way that all vehicles Ford launched in Brazil needed to be adapted in the USA or Europe (this was the cases of Fiesta and Ka vehicles). However this has proved to be an expensive and inefficient strategy, even clearer so after the problems Ford faced in the development of the Brazilian derivatives from the Amazon project. The original plan was centralising the whole project in Ford's England technology centre, including the design of derivatives for emerging markets. Brazilian engineers were expected to participate marginally, providing inputs related to market requirements. However, it became clear along the project that the differences between emerging market and Europe cost and technical requirements were so great that they could not be dealt with in a unique project. The Amazon project split led to the transfer of responsibility for the Brazilian derivatives to Ford US, which sub-contracted most of the job to engineering services suppliers. The overall result was a major delay in the Brazilian launching of the new Fiesta and the consequent (and further) reduction in Ford do Brasil's market share. However, after recognising that the absence of local support to product development was behind Ford's continuous losses in the Brazilian market, Ford seems determined to reverse this situation and reconstruct its Brazilian engineering area. Information collected in interview suggest that Ford do Brasil has been hiring product engineers again; some of them have been involved in adaptation of the Amazon platform for the design of a budget utility sport car (EcoSport).

CONCLUDING REMARKS

The statement that the automobile sector is increasingly globalised and tends to follow the global platform strategy does not mean that all car assemblers act in the same manner and have the same trajectory, or even the same concept of platform. In fact, this paper has pointed to how different product and product development strategies pursued by car assemblers located in Brazil can be and how different their options between centralised and decentralised technological activities have been.

In general, technological activities developed by carmakers in Brazil have been concentrated on platform adaptations to local conditions and development of derivatives from global platform to suit local demand. Notwithstanding, at the level of the individual firm, this general trend has evolved sometimes in a rather complex way. On one hand, there are cases in which technological activities have been developed abroad following completely centralised product strategy. This has been the case of the new carmakers installed in Brazil in the late 1990s, such as Renault, the PSA Group, Toyota, Honda and Daimler Chrysler. However, it is important to mention that their scale of operation in Brazil is very small given its initial phase of local activities. Thus, there is no evidence that these car assemblers will follow a more decentralised product strategy in the near future.

On the other hand, the recent experience of some car assembler subsidiaries, and their accumulated design competencies, suggest the possibility they are becoming partners to their headquarters in global products development. As a matter of fact, GM, Fiat and VW are the most illustrative cases. They have adopted decentralised product strategies (rather more recently in the case of VW), although following the global platform concept. Moreover, they have experienced a deepening in their development product activities and have been strongly engaged in designing regional derivatives from global platforms. Such strategy has implied an enlargement of the Brazilian engineering capabilities, increasing technical staff and improving

local technological facilities. In fact, GM and VW not only have historically accounted for the largest investment in laboratories in Brazil, but also employ more engineers. These two subsidiaries accounted for approximately 50% of the 2.013 graduated professionals employed in R&D in the Brazilian automotive industry, in the year 2000[9]. Fiat has employed approximately 250 product engineers and, although it has had a modest number of technological facilities, it has already announced plans to expand them. In addition, these subsidiaries have participated in the development of global products, not necessary designed for Brazilian market. Due to the large specialisation of Brazilian market in consume of popular car, these car assemblers have developed competence in the design of small and efficient engines (up to 1.000cc.) which are related to the design of subcompact vehicle. The development of suspension modules is another competence of some Brazilian carmaker subsidiaries.

Ford represented the opposite trajectory, at least until recently. In spite of being a traditional car assembler in Brazil, it has chosen to further centralise its technological activities in its Europe and USA R&D centres. Recently Ford decided to re-invest in Brazilian engineering but it is not clear what will be the consequences for the constitution of local designing capabilities in Brazil.

Overall, the contribution of product development activities and capabilities for the upgrading of the Brazilian automobile industry should not be underestimated. According to the Ministry of Labour data, the component of engineers in the labour force of the assembly industry jumped from 2.110 professionals in 1993, representing 2% of total assemblers' employment, to 3.544 professionals in 2001 (4,3% of employment), while the share of engineers in the labour force of the average manufacturing industry has been steadily kept in 0,7% in the same period. As can be concluded from this paper, product and process development activities account for the largest part of those skilled jobs.

[9] The source for number of professionals employed in R&D is IBGE's recent innovation survey – PINTEC (IBGE 2002).

REFERENCES

ANFAVEA., 2002 Anuário estatístico da indústria automobilística brasileira. Anfavea, São Paulo. www.anfavea.com.br

BÉLIS-BERGOUIGNAN, Marie-Claude; BORDENAVE, Gérard; LUNG, Yannick., 1996. Global Strategies in the Automobile Industry. In: Actes du Gerpisa, n.18, pg.99-115.

CALABRESE, Giuseppe., 2002. R&D globalization in the car industry. In: International Journal of Automotive Technology and Management, vol.1, n.1, p.145-159.

CHANARON, Jean-Jacques., 1998. Automobiles: a static technology, a 'wait-and-see' industry? In: Technology Management, vol. 16, n.7. p. 595-630.

CLARK, Kim B.; FUJIMOTO, Takahiro., 1991. Product development performance: strategy, organisation and management in the world auto industry. In: Harvard Business School Press. Boston, Massachusetts. 400 p.

CONSONI, Flávia L. QUADROS, Ruy., 2002. Desenvolvimento de produtos na indústria automobilística brasileira: perspectivas e obstáculos para a capacitação local. In. Revista de Administração Contemporânea, vol.6, nº 1, jan-abril. pg. 39-62.

DIAS, Ana.V.C. Engenharia brasileira e o desenvolvimento de produtos globais na indústria automobilística: algumas proposições. In: 3º Congresso Brasileiro de Gestão de Desenvolvimento de Produtos, Florianópolis, 25-27 outubro, 2001. Anais**.** Florianópolis: 3º CBGDP, 2001. 8 p.

LUNG, Yannick., 2000. Is the rise of emerging countries as automobile producers an irreversible phenomenon? In. HUMPHREY, John *et al*. (Eds) Global strategies and local realities: the auto industry in emerging markets. London, MacMillan, p.16-41.

MILLER, Roger., 1994. Global R&D networks and large-scale innovations: the case of the automobile industry. In: Research Policy 23. p.27-46.

MUFFATTO, Moreno., 1999. Platform strategies in international new product development. In: International Journal of Operations and Production Management, vol.19, n.5/6. p.449-459.

QUADROS, Ruy. *et al*., 2000. Globalização e Capacitação Tecnológica na Cadeia Produtiva da Indústria Automobilística: qual é o papel do Mercosul?. Relatório Final de Pesquisa. GEMPI/DPCT/IG/ UNICAMP, Campinas, mimeo

QUADROS, Ruy e QUEIROZ, Sérgio, 2001.. The implications of globalisation, for the distribution of design competences in the auto industry in Mercosur. In: Actes du Gerpisa, Evry Cedex, n. 32, pg. 35-44, dec.

SUGIYAMA, Yasuo; FUJIMOTO, Takahiro., 2000. Product development strategy in Indonesia: a dynamic view on global strategy. In. HUMPHREY, John *et al*. (Eds) Global strategies and local realities: the auto industry in emerging markets. London, MacMillan, p.176-206.