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INTERNATIONAL DIVISION OF LABOUR IN PRODUCT DEVELOPMENT ACTIVITIES: TOWARDS A SELECTIVE DECENTRALISATION?

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The aim of this paper is to analyse the international division of labour among headquarters and subsidiaries located in emerging markets, concerning product development activities; in other words, we intend to identify how product development activities are being organised world-wide, how subsidiaries are being integrated (or not) in the development of global products and why their integration occurs (or not) following this or that pattern. In order to do so, we went through the cases of four car assemblers, looking at their headquarters as well as their Brazilian subsidiaries.

In the last decades, the car industry was shaken up by the idea of a "global industry" producing a "global car", that is, a vehicle that could be conceived once to be simultaneously produced and sold no matter where. Indeed, in the beginning of the 1980's, Theodore Levitt (1983) claimed that firms could manufacture and sell standardised products world-wide in order to guarantee more efficiency and competitiveness; according to Levitt, this could be made possible due to a trend towards an homogenisation of markets, which would overcome national and cultural differences, different tastes or different standards. Thus, the main rationale was that a "global product" – a "global car" in the case of the automobile industry – could lead to economies of scale in production and product development. From the point of view of the car assembler's units in emerging countries, the arrival of the "global car" paradigm largely meant a shrinkage of their engineering structures, as concentration of product development activities in one "global R&D centre" – almost always located near the firm's headquarters – was the "one best way". This was the case to many Brazilian car assemblers' subsidiaries, as shown, for instance, in Quadros and Queiroz (2000). The centralisation of global product development represented a major concern to emerging countries, since the existence of local engineering teams

in the subsidiaries, with the responsibility of developing products aiming the local market, may increase the local industry's engineering competences through spillover effects. Downsizing of local engineering has impacts on the local units' long-term survival as well – it is easier to shut down a simply productive facility than a development centre, which may own some competences that are important to the company as a whole.

At present, we may notice that the "global car" concept has changed, and, although the word "global" is still used, it is now a fact in almost all major car assemblers that a real "global" car is impossible to exist; though the diffusion of information technology and the liberalization of markets have contributed to some changes in tastes and preferences, national and cultural differences persist and are not likely to disappear so easily. Nevertheless, product development structures had already changed, global R&D centres had already been built, and the roles played by emerging countries in these structures are not the same as they were ten years ago. One question arises: under this panorama, why and how subsidiaries located in emerging countries are integrated in global product development structures?

This paper is structured as follows. In the first section, we discuss the literature referring to global product development structures and reasons for decentralisation of product development activities towards subsidiaries; we show that this literature is not enough to explain the "selective" global productive development decentralisation – that is, a decentralisation that reaches some, but not all, foreign units – we may find in the automotive industry. We then propose some other, complementary explanations for the decentralisation of global product development activities towards units located in emerging countries. In order to support these propositions, along with the discussions we present some evidences from our field research, conducted in the last four years in four car assemblers that have facilities in Brazil – Fiat, General Motors (GM), Volkswagen (VW) and Renault; data were gathered through semi-structured interviews with product development engineers, managers and directors, as well as with some representatives of unions, thus aiming to reduce biased opinions. For the same reasons, we interviewed engineers, managers and directors from the subsidiaries as well as from the headquarters. We finish this paper presenting our main conclusions.

DECENTRALISING GLOBAL PRODUCT DEVELOPMENT ACTIVITIES: A BRIEF LITERATURE REVIEW

As the concept of "global product" had changed, some authors also began to discuss different ways of organising "global" product development activities, taking into account that most "global" products in reality needed to be adapted to local conditions of usage, tastes, preferences; a move towards decentralising product development activities on a world-wide basis has been identified and classified. By "decentralisation" we mean not only the integration of local engineering in the global product development teams (which could be done by simply allocating these local engineers or designers to the product development centre) but also a real move of some product development activities to the local facilities, as well as the attribution of responsibilities and a certain degree of project autonomy to the local development teams.

The ideas about multinational corporations achieving more efficiency through better balancing global and local activities, proposed by authors such as Dunning (1993) and Bartlett and Ghoshal (1989) – who called these companies "transnational corporations"– contributed as

well to legitimise decentralisation of product development. According to these actors, multinational firms should exploit their subsidiaries' competences, integrating their foreign units in the headquarters' global strategies. In this sense, decentralisation of global product development could not only lead to the development of products which better fit local conditions, but also could allow the company as a whole to profit from local technological competences.

Therefore, most of the literature on the (re) integration of subsidiaries in product development activities justified this decentralisation on two basis: market proximity or technological sourcing. This pressuposes that proximity to local market guarantees that local conditions, tastes, preferences will be considered in product definitions; proximity would be necessary due to the fact that some of these conditions, tastes and preferences are characteristics that can not be easily codified by local engineers in order to be transmitted to the engineers and designers located in the product development centre – in other words, these characteristics involve tacit knowledge about the market. Decentralisation as a result of technological sourcing, by its turn, means that subsidiaries hold some technological competencies their headquarters do not possess at present and will not possess in the short term, either because this competence cannot be transferred to the global product development centre or because headquarters are not willing to make this transference. This last issue is of major importance to the local units; if this theory is correct, in order to guarantee the establishment of local product development activities, it is not enough to own a distinct technological capability, but it is also necessary that this capability cannot be transferred to the centre. In fact, when liberalization of the Brazilian market occurred, in the beginning of the 1990's, many multinational companies – including autoparts ones – acquired local firms and transferred local knowledge to their centres, downsizing local product/process/technological development teams, in a process largely analysed by many authors (see, among others, Unctad, 1999) – hence, in these cases, although local units owned technological competences, decentralisation did not occur, as firms preferred to centralise these competences in the headquarters.

The organisation of global product development activities may take different forms. Chiesa (2000), for example, classified global product development structures as specialisation-based or integration-based ones. In the first case, full responsibility for the development of a new product, process or technology is assigned to one lab, which is denominated "centre of excellence"; this lab may not be located in the headquarters. Chiesa identified two types of specialisation-based structures: the "centre of excellence", the centre does all the R&D in a given field; and the "supported specialisation", in which the centre of excellence is supported by other units, whose function may vary from scanning local environment in order to get innovation and new product ideas, to adapting products centrally developed to the local markets.

In integration-based structures, different units may contribute, in distinct ways, to the development of new technologies or products. There are also two types of integration-based structures: the "network" structure, in which different units work together in the same technological field, aiming to develop new products or technologies, being coordinated by a central unit; and the "specialised contributors", where responsibility for the technologies is divided among the units, which means that there is a division of labour among them; when there is a R&D program, each unit is assigned a specific task, related to its technological field. In this structure there is also a central coordination to each program, and every innovation is necessarily a result of the integration of different units' efforts.

Gassmann and von Zedtwitz (1999) also created a typology for the possible organisational structures for product development activities. Their classification is based on the opposition between headquarters and subsidiaries, and comprises five kinds of structures: 1) the "ethnocentric centralised" structure, where all R&D activities are carried out in the headquarters, under the argument that central laboratories are technologically superior than local ones; innovations (including products) are then simply transferred to local units, without adaptations; 2) the "geocentric centralised" structure, which also centralises R&D activities in the headquarters' laboratories, but these labs also adapt innovations to local realities, according to market information that are collected by the subsidiaries and further transferred to the centre; 3) the "polycentric decentralised" structure, in which several foreign units have laboratories that may do R&D activities independently – there is no global product, actually; according to Gassmann and von Zedtwitz, this structure has been abandoned by multinational firms mainly due to costs reasons; 4) the "hub" structure, where there is a central R&D that carry out basic innovation activities, but there are local R&D units, under the supervision of the central one, that may adapt products or even contribute to product/process/technology innovation; 5) the "integrated network" structure, in which there is no central laboratory; innovation activities may occur in several units, each one fully responsible by a technological field.

All these authors consider that the process of choosing between one structure or another is a matter of verifying which of the possible structures could lead to a better balance of costs, development time, and foreign technologies and market sensibility (that is, the ability of identifying and exploiting foreign-developed technologies and the ability of developing technologies/products/processes suitable to local conditions). Generally speaking, centralised structures would lead to lower development costs and time, while decentralisation would have a positive effect on foreign technology identification and market sensibility.

Though the propositions discussed above may be considered pertinent when we analyse the whys and hows concerning the setting up of global product development structures, some evidences from Brazilian car assemblers' subsidiaries show us that the decision about decentralising (or not) product development activities, and how to do it, is affected by some other factors not contemplated by the bibliography we presented. Indeed, although carmakers' Brazilian subsidiaries are operating in the same environment – with the same market conditions and similar technological competences – they are not integrated the same way in their headquarters' global product development structures. Our proposition is that local market and local technological competences may contribute to decentralisation, but only if this decentralisation is seen by the parent company as positive to the firm's main strategy; we also propose that, contrarily to what most of the literature says, a decentralised structure can lead to lower development times, under certain conditions. We will discuss this point in the next section.

THE GLOBAL PRODUCT DEVELOPMENT STRUCTURE AS A WAY TO ACHIEVE STRATEGIC GOALS

According to Porter (1989), firms should build their strategies aiming to be more competitive in their environment, that is, to achieve a "competitive advantage" that would lead to market leadership. Some environmental characteristics might influence a firm's competitiveness and so shape its strategy: characteristics concerning consumers, suppliers, the firm's present and potential competitors, and potential substitutes for the firm's main product, each of these aspects

having different strengths according to each industry. Given these "competitive forces", Porter says a firm should evaluate its environment and choose between a strategy of competing through costs – operating at lower costs in comparison with its competitors –, through differentiation – offering clearly distinctive products when compared to its competitors' products –, or through focusing on the attendance of a market niche – concentrating its offers to a selected part of the market.

Taking Porter's definitions of strategy, we may figure out how the choice of a strategy can shape global product development structures. Centralised structures may lead to lower costs, only if a standardised product is being developed, so some economies of scale can be exploited. According to Porter, firms that follows a cost leadership strategy often choose to produce and commercialise standardised products, but if products commercialised locally are different from the central ones, then centralisation may *increase* costs and development time. This is so because the development centre has a limited capacity (in terms of number of products that may be developed simultaneously); the necessity of modifications and adaptations aiming to make products more adequate to local conditions may generate an excess of work in the centre, and either some of the adaptations (generally the ones considered to be less important, from the development centre's point of view) will stay in line, or an increase in capacity will be necessary (through overtime work, hiring people or duplicating facilities). Competition through differentiation may signify product diversity, innovativeness or high quality. Product diversity and innovativeness may also demand some decentralisation, in order to capture local conditions, preferences and market evolution, as well as some local technology; therefore, in this case market proximity and technological sourcing are factors that can influence product development dispersion – only if these local conditions and technology cannot be transferred to the centre. In the case of product diversity, a decentralised structure may lead to lower costs and development time, as discussed above.

Porter affirms that competition through focusing in market niches may take place considering one or several market segments as the niches. Hence firms that focus in distinct market niches (achieving economies of scope) could profit from product development decentralisation; it might create various product development centres, each one dedicated to a niche. Firms aiming at one market segment, considered as a niche, may concentrate product development activities in one central location.

Boyer and Freyssenet (2000), whose analyse is based on firms from the automotive sector, show six possible sources of profit linked to the production of goods and services: economies of scale (that reduce unit costs), diversity of products, quality of products (which allows higher prices), innovation (that assures, at least for some time, a first-mover advantage), productive flexibility (which allows to adjust costs according to the variations in demand) and permanent reduction of costs, aiming to maintain profit margins. These six sources of profit may be combined, in order to be exploitable, generating five possible "profit strategies". The "profit strategies" are: diversity and flexibility (production and offer of different models aiming to respond to distinct market needs, and an internal capacity of adjusting costs according to the demand); quality (production and offer of luxury models, distributed world-wide); volume (production and offer of high volumes of a standardised product, achieving economies of scale); volume and diversity (combination of economies of scale on visible parts and economies of scope

on invisible parts of the product); innovation and flexibility (profits coming from innovative models, and an ability of changing production rapidly if the product is not successful) and permanent reduction of costs (through a permanent concern on reducing costs at constant volumes, exploiting other sources of profits only if they do not increase costs, avoiding to take risks).

Each of these profit strategies has a pertinent product policy. Thus, in the "diversity and flexibility" strategy, products are diversified, answering to different market needs; they must be conceived rapidly and at low costs, and produced in medium to small series. In the "quality" strategy, products must reflect the high social position of consumers; in the "volume" strategy, products are standardised and must answer to the basic needs of consumers. In the "volume and diversity" strategy, products have common parts (or a common platform) but are different in the surface, except from high-end and entry level models. In the "innovation and flexibility" strategy, products must be conceptually innovative ones, anticipating consumers' needs; as a consequence, organisation must be reactive in all activities – product development comprised. Conversely, in the "permanent reduction of costs" strategy, products must not be conceptually innovative – since this means commercial and financial risks; volume, quality and diversity must be offered right according to the market needs.

Given these considerations, we may think that different product development structures will have positive or negative impacts on the main strategy of the firm, depending on which is this strategy. Considering the five profit strategies proposed by Boyer and Freyssenet, a centralised product development structure may have a positive impact on the "quality" profit strategy and on the "volume" profit strategy – as it reduces development costs and time; on the other hand, the same structure may have a negative impact on the "diversity and flexibility" and on the "volume and diversity" profit strategies – as it increases development time. This is so because in the "quality" as well as in the "volume" strategy, products are conceived to be real "global", that is, to be commercialised in the different markets without major adaptations; in those cases, "real global", standardised products may exist, and their development may be done in an unique centre; this is has happened, for instance, with the A Class DaimlerChrysler's model: it was conceived centrally in Germany, although company knew, from the beginning, that the A Class would be produced in Brazil as well.

In the other two profit strategies mentioned above, profits are generated through diversity, which means production and commercialisation of different products – or, at least, adapted products. Then there may be a development centre, responsible for the basic development; but, as we discussed in the previous paragraphs, the capacity of development centre is limited, and, if modifications and adaptations on the "basic" product are centrally made, an excess of tasks may occur, generating queues – and rising development costs and time. A decentralised development structure offers more liberty in allocating tasks, even if it raises costs due to doubled investments[1]; it is a more flexible structure. Indeed, from our field research, either Fiat, Volkswagen and General Motors´s Brazilian units are responsible for the adaptation ("tropicalisation") of centrally designed vehicles; according to our interviewees, the main reason for it is to speed up time-to-market. Knowledge about markets' preferences and conditions could be a reason for decentralising adaptation, but this sensibility to local condition can be achieved

[1] The adoption of a platform (centrally developed) and derivatives (locally developed) policy, which will be analysed further, follows this same logics.

through sending local people to the central development unit – this is what happens to some of the products in those companies' portfolios, generally products that are less important to local markets, in which the number of necessary adaptations is smaller.

Recently, the development of the GM's monovolume Meriva gave us an example of how a decentralised product development structure can add flexibility and diminish time-to-market. Its development was split between Opel and the Brazilian subsidiary; much of the engineering activities were done in Brazil, with the participation of German engineers. All decisions about the product as well as the project management were carried out by a steering committee composed by Brazilian and German directors. Product development directors from GM claimed that the main rationale for it was to reduce development time, since the Opel's engineering structure was almost fully occupied; as the Brazilian unit has some engineering experience and physical structure (as virtual analysis softwares, prototypes laboratories, crash test laboratory etc), it was decided that the new model would be developed in Brazil, profiting from this structure. Eventually, the Brazilian unit also profited from this experience, increasing its product development capabilities and consolidating its product development local centre. The Meriva was first launched in the Brazilian market, in 2002; it is worth to stress that it is not an entry level model, therefore it is not the main product in GM Brazilian unit's portfolio; this means that neither market proximity nor technology sourcing (since there is no technology dominated exclusively by the Brazilian unit) can explain the decentralisation of product development.

As Boyer and Freyssenet say, in the "volume and diversity" profit strategy, entry-level models may be considered "niche" products – returning to Porter's definition. In this case, communalisation of parts belonging to other models may exist, but in a lower level; products are so different from other models that the setting up of specialised centres for their development may be an interesting policy. For instance, Fiat has concentrated in Brazil the development of products destined to emergent markets – considered as niche products from the headquarters' point of view. The development of products focusing the European markets stays centralised in Italy – even if these products are commercialised and produced in emerging countries (as Brazil itself) as well, but in a smaller scale. According to our field research, VW also may adopt this strategy; Brazil is carrying out the development of the "249" model, also known as "Tupi" – a smaller and simpler version of the New Polo, aiming to emergent countries, and named after a Brazilian native tribe in order to stress the fact that it is locally developed; a policy of setting up a Brazilian "competence centre", specialised in this niche, is apparently arising. General Motors also developed locally an entry-level model, the Celta – which GM is beginning to export to other emergent markets. Experience in developing the Celta was important to attract the subsequent development of the Meriva.

According to Boyer and Freyssenet, in the "innovation and flexibility" profit strategy – where innovation and product development activities play an important role –, products should answer to new demands from consumers. Hence, it is fundamental to know exactly what are these new demands and how these demands evolve – a direct contact with the consumers is then preferred. Also, Boyer and Freyssenet show that at Honda – which follows the "innovation and flexibility" profit strategy – research and product conception activities are separated from the product engineering activities, so as to stimulate conceptual innovation. Thus we may figure out a global product development structure where there is some decentralisation in order to capture evolution (and not necessarily actual demands) of local market, or local niches, and to get in touch with local technologies – this may be achieved through local "scanning units" (Chiesa,

2000), or through complete local development units. Research and product conception may be centralised, since co-location of technical people favours communication and, as a result, the generation and the exchange of new ideas and the reduction of errors (Carrincazeaux and Lung, 1997); nevertheless, the research centre must stay in contact with local "scanning units", otherwise it is preferred to decentralise product conception as well as product engineering. This is the case of Renault: in 1997 the company inaugurated the Technocentre, a R&D centre designed for the development of all Renault's products. The main reason was, according to our interviewees and to some company's official documents, to reduce development time and to accelerate innovation. As stated by the firm, in the Technocentre facilities up to 5 models may be developed simultaneously. In the Brazilian unit, there is a local engineering team responsible for some product and process adaptations, some process development and to monitor market's evolution.

The degree of responsibility of the Brazilian unit regarding product development activities has augmented since the plant inauguration, following a rise in the degree of adaptations in locally produced passenger vehicles – the Scénic, the Clio and the Clio Symbol (the three-volume version) – which means a slightly increase in the diversity of models (as Brazilian models are getting more different from European ones). The curious thing about this evolution is that it was not planned from the beginning; on the contrary, total centralisation was the goal of the Technocentre. But, as Renault noticed that, in the segment it competes, it is not possible to conceive a completely standardised product aiming at markets of developed and developing countries, total centralisation strategy was smoothed. Since the beginning of 2002, some Brazilian engineers and technical people spend some months in the Technocentre, in order to be aware of the company's procedures as well as new technologies, new products, new processes, and also to get in touch with French engineers – thus building personal networks. However, it is unlikely that the degree of participation of Brazilian engineering will get to the same levels as those observed in Fiat, VW and GM, which follow different strategies.

Considering the "permanent reduction of costs" profit strategy, where innovation is avoided**,** product differentiation is restricted to the market needs, and quality is slightly higher than competitors' – only enough to differentiate the firm's product from the competitors' ones – decentralisation due to market needs is not an imperative. Scanning units may collect information about local consumers and transfer them to central product development structure – unless local markets are extremely important and considerably different from the headquarters' one.

Therefore, decentralisation of product development activities due to market proximity and technological sourcing is important to some of the strategies, but not to all of them; in other words, decentralisation driven by one or both of these two conditions will be adopted only if it contributes to the firm's profit strategy. Obviously, in all these cases local markets are important to increase company's returns, otherwise firms would not operate in these markets – but decentralisation is likely to occur only in some of the five cases, due to the difference in the product policies of each profit strategy.

Depending on the main strategy of the firm, we may notice that within the company's product portfolio there may be different ways of competition, according to the niche aimed by each product. Car assemblers following a "volume and diversity" strategy usually have a relatively large product portfolio, that goes from the market entry level to relatively luxury products; for instance, in the Brazilian market, Volkswagen do Brasil offers the Gol, a local

developed product that aims the entry level, the New Polo, the Golf – all these models are locally produced –, the Bora and the Passat (both imported). Competition concerning each of these products does not occur following exactly the same patterns: in the entry level, price is much more important than in the high-end level. Conversely, superior quality is more important in the high end than in the entry level. The consequence for the product development structure is that, within the same unit, engineering teams will have different roles according to the product that is being developed. A subsidiary may be integrated in a certain way in the product development activities to one product, this integration may occur in another way to another product, and may not occur to a third product – even if the three products are commercialised by the unit. In VW, Fiat and GM, the decentralisation of development towards the Brazilian unit or the integration of Brazilian engineering in the product development activities is much stronger for entry-level models than for high-end ones.

With the discussion presented above, we do not mean that proximity of market or technology sourcing are not important to the definition of the product development structure, but else that their importance – that is, their degree of influence in the decision about why centralise/decentralise global product activities and how to do it – varies according to the strategies followed by the companies. This relativist point of view partially explains the differences we may find on global product development structures among different companies. Another possible explanation is the role played by actors such as the subsidiary or the host country in the definition of the company's strategy and structure, as we shall discuss in the next section.

THE GLOBAL PRODUCT DEVELOPMENT STRUCTURE AS A RESULT OF POWER RELATIONS AMONG DIFFERENT ACTORS

In the previous section, we discussed how different strategies may lead to different ways of organising global product development activities. These strategies are often conceived in the company's highest hierarchical levels, but this doesn't mean that these strategies and the consequent global product development structures are not affected by different opinions or demands coming from other actors. In this sense, one of the most evident sources of influence is the subsidiary itself. The choice for a more centralised or decentralised product development structure and the roles the unit is assigned in product development activities affect it at least in two ways: first, the more competences (including product development ones) the subsidiary possesses, the more important it is to the corporation; second, products developed in a centralised structure may be less suitable to local markets and then decrease local profits – even if the same structure lead to higher global profits (since profits may decrease in one unit and, at the same time, increase in others). Therefore, foreign units often are interested in participating in the product development process, and particularly in attracting product development activities to their facilities, hiring engineers, inaugurating laboratories, carrying on partnerships with local universities and research centres etc – and they show this interest struggling for more participation and for a more important role in the company's product development strategies.

While subsidiaries want to increase their integration in the global product development structures, a contrary movement may occur in the headquarters or the development centre. Indeed, if being responsible for some part of the product development represents an increase in the subsidiary's importance, and, consequently, in its power within the corporation, units that

benefit from the more centralised product development process will struggle for the maintenance of this centralisation, thus maintaining the power balance. The final global product development structure is then a result of these conflicts, reflecting the balancing of power inside the corporation. Some authors, such as Birkinshaw and Hood (1998), support our proposition, as they affirm there are three mechanisms driving the determination of the subsidiary's role: besides the headquarters assignment, the subsidiary choice – that is, the decisions the subsidiary itself takes concerning its role in the corporation – and the local environment determinism – some environmental factors that can influence the decisions made by the headquarters or the subsidiary. Subsidiaries are then seen as "semi-autonomous entities" (1998:780), whose decisions and actions are constrained by the corporation's goals and by some environmental conditions.

The influence of the subsidiary on the formulation of strategies and on the definition of the global product development structure is proportional to its importance to the corporation. The foreign unit may be recognised as important to the corporation, among other factors, if it has control over scarce resources (including financial resources, access to raw materials, technology, consumers…), decreasing its dependence on the headquarters; if it controls some knowledge and information that flows through the corporation; if it shows ability in dealing with incertitude (inside the organisation or related to suppliers, consumers, government…); or due to personal relations and alliances inside the organisation – for instance, a local product development manager that has already worked with the headquarters' directors and has a good relationship with them (Morgan, 1996). Also, power generates power; for instance, when a subsidiary attracts product development activities due to its power, its dependence regarding the headquarters will diminish, increasing the power it already had – making it easier to attract more product development activities; this is another reason why, in some cases, head-offices directors fear decentralisation of R&D activities.

This is quite clear in the case of VW. Its Brazilian unit is the second best in terms of production volume (behind Germany) and the third one in terms of sales (behind Germany and USA); it also is the oldest foreign unit inside the corporation. In the period of protected market, VW do Brasil developed local products over German platforms, and in some cases these products obtained an enormous success – the Gol, which we mentioned in the previous section and is still in production, is the best-selling car since the setting up of the Brazilian automotive industry; VW has been the market leader since it arrived in Brazil in the 1950´s – only in 2001 and 2002 it was beaten by Fiat. In the end of the 1990´s, the company tried to centralise its product development structure; it must be said that this period coincided with the period of Fiat's growth in the local market – and, in opposition to VW's Brazilian engineering, Fiat's local product development structure had increased; for instance, the Brazilian unit had an important participation in the development of the Palio model, which began in 1992. Nowadays a contrary movement may be noticed at VW, as Brazilian engineering participated in the development of the New Polo model – specially the sedan version, whose design was in charge of the Brazilian centre of style – and is the responsible for the development of the "249" or "Tupi" model.

Much of this integration has been a result of internal conflicts, since directors from the Brazilian unit (some of them are ex-directors from the headquarters) literally struggled for more participation; the "249" model, for instance, was proposed by the Brazilian unit and, at the beginning, was not approved by the headquarters. Only after a 2-year negotiation the development of the model was authorised. Within this period, VW do Brasil had to prove its technical and financial capacity, and also that a new entry level model was really necessary, since

the Gol is a very old model (first generation was launched in 1980; at present the model is in its third generation), and Fiat's growth in Brazil is largely explained by its performance in the entry level niche (with the Uno and the Palio). Interviewees in Brazil said that the resistance of headquarters had much to do with a fear of loosing power. Brazilian unit had been quite independent for some time – so, there is some local competence and some facilities that might permit this independency to return, or even allow the Brazilian subsidiary to become a competence centre for some niche products. Even if headquarters authorised local development of the "Tupi", they keep some control over the project, since final approval is always their responsibility; as stated by our interviewees, in most of the cases headquarters approve what Brazilian engineering had done, or just ask for some minor modifications – this may signify that the reason for maintaining final endorsement at the headquarters would be much more political than technical.

If we look at Fiat's Brazilian operations, we will notice a somewhat different situation. Although Fiat group is in a huge financial crisis, the Brazilian subsidiary has presented a continuous growth and, more important, realized profits in the last years. Hence, headquarters' themselves recognise the Brazilian unit's importance and assign product development activities to it. The local unit also tries to attract these activities, and to reduce its dependency on the Italian development centre; for instance, in 2002 it was announced a US$ 100 million investment in a Brazilian centre of styling and laboratories. Our interviewees did not mention the existence of major conflicts during the process of obtaining the headquarters' authorisation for these investments. Indeed, the expansion of local capacity for product development is in agreement with Fiat's explicit policy of creating a Brazilian competence centre to the development of products for the emergent markets.

Though subsidiaries can be seen as one of the most important actors in the process of designating roles within the corporation, they are not the only ones. Host and home countries, for example, are also important agents. As we affirmed earlier in this paper, innovation activities conducted in one firm, including product and process development ones, may increase other entities' technological competences, due to spillover effects – competences of suppliers, competitors, technical centres and universities may then improve. Therefore, along with subsidiaries, host countries are interested in attracting innovation activities to its territory, and may create policies aiming to incentive or even force such activities to happen locally. Conversely, home countries try to keep innovation activities inside their frontiers, and may also adopt similar policies.

Good examples of government policies in the Brazilian case are the local incentives to the production of small engines and especially the incentives to the use of ethanol as an alternative fuel. These two policies, which may be criticised in some aspects, had positive impacts in the local engineering capabilities, since, to some extent, they forced car assemblers to adapt their engines to these local conditions. As to many of the companies these engines are considered as "niche" ones – that is, they are not produced or commercialised in the central markets – they chose to develop them locally, in order to leave central engineering free to work in other products, considered as more important ones. Nevertheless, the development of engines that work with ethanol has brought good results, and as the Brazilian government tries to export this technology to other emergent countries, firms seem to be more interested in investing in this development. As an example, VW do Brasil has just launched a new version of the Gol model, with an engine equipped with a "flex fuel" injection system, capable of working with gasoline,

ethanol or any mixture of them. Magneti Marelli developed this injection system, and its Brazilian unit takes much part of the credit for it.

It is important to notice that, as product development activities involve strong incertitude and suffer much influence from external variables, generating a negative cash flow during their occurrence (since returns will come only when the product which is being developed is commercialised), companies tend to decentralise these activities towards continuous growing or at least stable markets and political stable countries, trying to reduce uncertainties and to ensure returns. Hence local governments may indirectly contribute to the establishment of local product development activities, laboratories, research centres, through social and economic policies that guarantee a sustained market growth and political stability. Host countries may also create adequate local conditions for the setting up of product development activities by assuring the achievement of a good educational level for the population and by financing local technological development in entities such as universities and technical centres; nevertheless, as we discussed in the previous section, local technologies will only be considered as attractive if it contributes to the main strategy of the firm – that is, these conditions are not sufficient for the decentralisation of product development activities.

THE GLOBAL PRODUCT DEVELOPMENT STRUCTURE AS A CONSEQUENCE OF SOME CHARACTERISTICS OF PRODUCT DEVELOPMENT PROCESS AND POLICIES

In the previous sections, we discussed some reasons why selective decentralisation occurs in product development activities. Our goal in this section is to discuss how this decentralisation occurs, that is, which is the actual international division of labour within the global product development structure. We will consider two dimensions in this analysis: the different stages in the product development process and the division between platforms and derivatives.

Starting from the international division of labour according to the different stages in the product development process, we will adopt Clark and Fujimoto's (1991) definition, which establishes that there are four main phases in the development process: concept definition, product planning, product engineering and process engineering. Although this definition considers product development process as a linear one, Clark and Fujimoto stress that product development is more likely to be a cyclic process, with feedbacks among the stages. From the point of view of international division of labour, we propose that early phases (concept definition and product planning) are more often centralised in the main development centre, while the last stages (product and mainly process engineering) are decentralised towards foreign units. One explanation is that early stages, specially the concept definition, deals with long-term strategic issues, that have impact not only on the future of each unit, but on the future of the whole corporation. Another reason is that when there is a main development centre, it often has more experience and technical memory, it dominates the most important technologies and has contacts with all the other product development units, acting as a "hub". For example, in the development of the first Palio model, the concept definition, product planning and, to some extent, product engineering stages were concentrated in Italy, and Brazilian engineers and technical people from purchasing and marketing were sent there to participate in these activities from the beginning.

Besides these two explanations, concentration of concept definition and product planning activities in the main centre may be justified by the power relations inside the company, since in these two stages some decisions are made which defines the whole future of the vehicle and its way of competition – consequently, its market success of failure. From the point of view of power distribution, early stages are more important than the later ones, thus there is an interest in maintaining these phases in the centre. In order to guarantee that local conditions and preferences will be taken into account during these phases, local technical people may be allocated to the centre; their function will be to inform central designers about the attributes the product must have with the aim of being successful in local markets. In the example of the Palio model, mentioned in the previous paragraph, final approval was the headquarters' responsibility.

Decentralisation of later stages – product and process engineering – has minor impacts on the power distribution among the units; at the same time, it makes it possible to speed up the development process – as we discussed before, with more engineering centres, there is more liberty of allocating development activities, reducing queues. The decentralisation of process engineering is also important to speed up local production – local process conditions are considered in the moment of the development, and errors may be reduced.

Regarding the adoption of a platform and derivatives policy, we assume that platforms are more likely to remain centrally developed, while development of derivatives may be decentralised towards foreign units. The reasons are similar to those discussed in the previous paragraphs, as platforms may be seen as the "first steps" in the development of a product family, with derivatives being the "final steps". According to some studies (Muffatto, 1999), much of the development of a derivative may be conducted independently from the development of a platform; since the platform is the centre of a product family, and therefore has much to do with the long term strategy of the company – and, again, with power over the future of the platform's family –, its development is likely to stay centralised in the main product centre. Indeed, the choice of the platform's basic technologies and the markets the platform shall supply through its derivatives are decisions made centrally. Conversely, derivatives are much more linked to local markets; consequently, in order to fit markets expectations and idiosyncrasies, its development should be conducted in a more decentralised way, involving engineering and marketing from local markets. We observed this division of work in Fiat, VW and GM: their Brazilian units are responsible for the development of the derivatives from the Palio (Siena, Weekend and Strada), the New Polo (Polo Sedan) and the Corsa (Corsa Sedan, Corsa Wagon and Pickup), respectively. It is also possible to mention the development of the "Tupi" by VW (over the New Polo modified platform) and the Celta by GM (over the Corsa modified platform).

CONCLUSIONS

In this paper, we tried to present a relativist analysis of the importance of proximity to markets and technological source as the main drivers to decentralisation of global product development activities. We argued that, although these two driver forces are present, their importance is modulated according to the strategy followed by the firms. Through the discussion of two approaches for the possible strategies a firm may follow, we showed that, while in certain situations product development centralisation may lead to lower costs and development time, in others this centralisation may lead to completely opposed results. More specifically, when the main strategy allows production and commercialisation of standardised products, centralisation is

better; on the other hand, when the main strategy claims for diversity and flexibility, decentralisation may be a better choice. When we look at how different car assemblers organise their product development activities worldwide, we find some examples that corroborate our point of view. The fact is that in many cases a real global product does not succeed, specially when we compare markets of emerging countries with the ones of developed countries; hence some diversity and/or flexibility is needed. This is what happens to VW, Fiat and GM, for instance. Also Renault is allowing its Brazilian unit to set up a local engineering, as local products are becoming different from the central ones. The usage of a platform/derivative policy is an alternative to achieve a higher level of diversity, and this policy also has consequences over global product development structure: development of platforms may be centralised, while development of derivatives may occur locally.

Besides the choice between a more centralised and a more decentralised structure, the setting up of a product development structure involves the selection of the possible development centres. This selection is not neutral, since product development activities are strategic ones: thus foreign units try to attract these activities, and, at the same time, headquarters try to keep them in-house. As a consequence, we expect that units that are more powerful inside the corporation are more likely to win the battle and carry on product development activities. VW do Brasil, for instance, had to struggle with the headquarters for the development of local products; Fiat's Brazilian unit is considerate as the most important foreign unit in the corporation, and although it is increasing its product development local structure, conflicts to attract development activities are not so common. Disputes for power also explain, to a certain extent, why early stages of global product development often stay centralised, whilst final stages may be decentralised – since in the early stages the most important decisions about the future of the product family are made.

Finally, we would like to stress that governments from host (and home) countries may be important agents in the process of defining which will be the global product structure in a company. In the case of Brazil, except from some quite isolated policies – that sometimes have other objectives but to attract product development activities – up to now we cannot observe the existence of a explicit policy of consolidating the country as a competence centre for the development of products to emergent markets, despite the fact that some firms are signalling in this direction, exclusively due to their internal strategies.

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