A COMPREHENSIVE STUDY OF THE TRANSFORMATION OF THE BRAZILIAN AUTOMOTIVE INDUSTRY: PRELIMINARY FINDINGS

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Many studies of the automobile sector in Brazil have indicated that a lot of transformations are happening in the sector since the opening of the Brazilian economy in the beginning of the 1990’s (see, for example, Humphrey and Salerno, 1999 and Salerno, Arbix, Zilbovicius and Dias, 1998). In Brazil, the sector had to face a broader transformation and restructuring in global terms: the supply chain management, the product design process and, broadly, the value adding process were all conditioned by the globalisation process.

Traditional verticalized structures of the assemblers began to give way to smaller units with much less suppliers. A structure of tiers began to be established, causing a revolution in the supply chain. From the point of view of the traditionally established suppliers, many of them operating with Brazilian-owned capital, the picture has completely changed. New producers entered the country, establishing new operations and/or acquiring Brazilian companies.

After just a few years, Brazil is now the country with the bigger diversity of automobile brands produced in a single country. Furthermore, Brazil is a key place regarding new organisational designs. Almost all of the new plants present new schemes of production organization and supply chain management: it is possible to observe the “modular consortium” (VW trucks, in Resende – see Marx, Salerno and Zilbovicius, 1997) and some variations around the idea of “industrial condominium” (GM Celta plant, in Gravataí, southern region of Brazil, and Ford Amazon plant, in Bahia, northeast region – see Salerno and Dias, 2000).

The traditional suppliers sector developed locally an important capability of product design along the first 30 years of the industry. This was important not only for the sector itself, but also for the whole Brazilian metal-mechanics industry. The new strategies of globalisation of technological activities and the result of a number of acquisitions of Brazilian companies transformed completely the perspectives of the sector.

1 Thaise Graziadio and Steven Iveson are working with us in the research. The research would be impossible without their contribution but they are not responsible for the assumptions made in this paper.
The new configuration of the industry has been studied in many research works, but mainly in a case studies basis. Some of these research findings are inductions for the whole panorama, and will be taken, in our research, as hypothesis to be tested.

Those studies indicate that the main aspects of the changes taking place in Brazil include (see Arbix and Zilbovicius, 2001 for a broad review of the literature):

- Reordering of the value-added sequence, with assembly firms showing a strong reduction in vertical integration. Linked to this, it is possible to note an increase in the frequency of delivery of parts along the chain and more long-term contracts between firms.
- Concentration and internationalisation of the Brazilian parts industry, especially among companies that used to supply directly to assembly plants.
- Reduction in the number of direct suppliers to assembly plants. In some cases, suppliers are involved in designing parts of the vehicle, producing components that are supplied as complete packages to the assembly firms.
- Co-participation of some top-level suppliers with assemblers during the design stage, through co-design.
- Reduction in the level of design activities in remaining locally owned companies, which are relocated to lower levels of the chain, since most of the companies that supply to final assemblers are foreign and more integrated in an international chain of product and process development, with global contracts.
- Concentration of suppliers near to the assembly plant, seeking to reduce logistical costs as well as facilitate support in case of problems in the production process.

Most of the studies were dedicated to assemblers or first tier suppliers, but there is still need for an empirical comprehension of the situation in the lower levels of the chain\(^2\), as well as a broader comprehension of the new situation of the industry regarding management, structure, design activities, location and the regional impacts of “modularity” (condominium model). For instance, are suppliers located in Brazil still developing design activities\(^3\)? What kind of division of labour there is between subsidiaries and headquarters concerning design activities? Which patterns of finance do companies use? Who provides capital for companies that operate in the lower levels of the chain? Is “modularity” spread all over the chain or is it only for first tier suppliers? Which productive activities are being located nearby greenfield plants – are these plants inducing the creation of a regionally integrated supply chain or, on the contrary, production remains mostly concentrated in traditional areas?

We have launched in the end of last year a new research aiming to deal comprehensively with these questions. In general terms, the main objectives of the whole research are related to build a broad, integrated and understandable framework of what is happening in the sector in Brazil and what are the perspectives for local development of technological capability and local value adding. To do so, case studies or limited surveys are

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\(^{2}\) Thaise Graziadio is working especially on the 2\(^{nd}\) and 3\(^{rd}\) levels of the chain. See her paper in this volume.

\(^{3}\) It is not our objective to discuss modularity in itself. For the purposes of the research and of this paper, we are adopting the term in a broader sense, that is, “involving the supply of sub-assemblies, sub-systems, indicating that some assembly activities was absorbed by (some) suppliers”. In the last Gerpisa’s colloquium some papers discussing the concept of modularity have been presented.

\(^{4}\) Quadros & Queiroz (2000) presented last year a survey on design, concerning some companies.
not enough. We aim to get the biggest sample possible, almost a census, to have better and stronger answers to the questions. Case studies or surveys are excellent to identify changes and to look for directions and movements of social actors. But after some years it is necessary to validate the assumptions suggested in studies conducted within limited samples to verify their reach and limits.

Since the research is sponsored by a state owned development bank (BNDES – Banco Nacional de Desenvolvimento Econômico e Social), which has provided special loans for almost all assembly and first tier new plants, the research will try to contribute to the design of new and up-to-date industrial and development policies. We also believe that it is crucial to identify the bottlenecks along the productive chain and opportunities for investment and induction of more local value added.

The next sections are divided as follows. First we present the research methodology in more details. Then the first findings are presented and discussed, concerning data gathered from the first 154 questionnaires processed. We finish with a brief presentation of the next steps to be followed by the research team.

METHODOLOGICAL ASPECTS

Institutional Liaisons

One of the key aspects of a project like this is the interest it can raise among institutional actors like Government, associations, professionals and unions acting in the automobile sector. As a result of a long and time-consuming effort, we have now a number of partners that are supporting the research. With most of them we have signed formal agreements in which it is stated that we could use those names to stimulate firms and professionals to attend to our demands. By partners we do not necessarily refer to those who provided financial support. Some of them have supported us in sending mailing lists, opening spaces in official meetings and conferences, contacting companies, governmental agencies etc. At the moment, our partners are:

- SINDIPEÇAS (Auto parts companies association);
- ANFAVEA (Final assemblers companies association);
- AEA (Automotive Engineering Association, affiliated to FISITA);
- DIEESE (Inter Union Department for Statistics and Social and Economic Studies);
- SEADE (Statistic agency of the State of São Paulo);
- ABC metalworkers trade union;
- Paraná Automotivo (an organisation conducted by the Government of the State of Paraná\(^5\) and the local companies association);
- SAE Brasil (the local branch of the Society of Automotive Engineers);
- Other research teams and projects, like G-CARS-UFRGS (researching the industry at the State of Rio Grande do Sul) and the IFICS/UFRJ team (researching the industry at the State of Rio de Janeiro\(^6\));
- Ministry of Labour (RAIS database).

\(^5\) Where companies like Volvo, VW/Audi, Renault, Tritec (a BMW-“Chrysler” joint ventures to produce engines), Chrysler (Dakota production, stopped), Denso, Bosch, and Siemens Electronic Automotive Branch are located.

\(^6\) Where VW Resende and Peugeot plant are located.
Just as examples of the importance of those liaisons, the first batch of questionnaires was sent by SINDIPEÇAS, utilizing its own mailing list. Returning answers were addressed directly to the research team. In the case of ANFAVEA, final assemblers have indicated a facilitator to act as the point of contact between the firm and the research team.

As far as no single database covers the whole components sector (we are not considering raw materials suppliers nor dealers or retailers), we adopted a “snowball” technique. In every questionnaire we ask for the suppliers; the answer feeds our own database, and the snowball (our mailing list) grows. We have also asked for assemblers and first tier suppliers to send us their list of certified suppliers.

Research Phases

Two fronts of research are being followed:

1. A comprehensive mapping of both the new supply chain in the automobile sector and the product design activities questions like those listed above. Questionnaires are being sent to all manufacturing companies in the sector. This is the “quantitative” phase of the research, since official statistic data are very limited and there are no official studies on work organisation. In this paper we are presenting the first preliminary results of this phase.

2. After the first phase of analysing the data obtained through the quantitative phase, a survey of some suppliers will be designed, including visits to some of the companies that answered the questionnaire. The assemblers will also be visited, especially the new factories built around the condominium model. With this we will try to understand what are the new relations established between companies, their operations organisation, what are the criteria for supplying or being supplied by someone, the reasons for location or relocation, and the economic and financial barriers that define the place in the supply chain one can occupy.

In this paper we present the first and preliminary results of the quantitative research, obtained after 6 months of a research project planned to take 18 months until the final results are available. Only few in-depth visits were conducted for this specific project until now.

Preliminary Findings

We present in this section some data and possible interpretation based on a sample of 154 firms. All data shown here are preliminary since: a) they are related to a part of the questionnaires; b) data was processed without a final revision of data entry (typing); c) further consistency analysis of collected data must be made in order to keep distortion under control.

This sample consists of 33 firms that supply autoparts mostly for the retailing sector. The remaining 121 ones are suppliers within the productive chain, covering all firm sizes.

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7 The questionnaire (in Portuguese) can be seen and downloaded in www.prd.usp.br/cadeia-automotiva, the home page of the research. Other information on the project is also shown there.

8 See Thaise Graziaio’s paper in this colloquium for some preliminary findings of the first in-depth study of the project, regarding new GM plant located in Gravataí (the so called Blue Macaw project).
38% (59 firms) are multinationals (i.e. 50% or more of foreign capital) and 62% (95 firms) are Brazilian controlled

52% of the firms in our sample supply directly to assemblers: 18% supply sub-assemblies (or sub-systems or modules) and 34% supply components. 22% direct their business to aftermarket and retailing system. 22% of the firms investigated are integrated in a sub-assembly (first tier) supply chain.

The Gap Between Brazilian and Foreigner-Owned Companies

Foreigner companies (multinationals) have taken over the most important Brazilian parts companies. As Humphrey and Salerno showed in the 1999 Gerpisa Colloquium, 19 over the 20 biggest Brazilian components companies (on income) were acquired by foreigners. This movement is strongly linked to the economic policy run by the government since 1994 (which is oriented to the efforts to attract foreign capital in order to equilibrate payment balance since imports have grown dramatically) and by the new investments set by assemblers in the country.

As far as the major Brazilian companies have been sold, it was expected that multinationals would occupy the highest levels of the chain.

Figure 1.- TNCs X Brazilian Owned Companies in the Chain
(% related to 154 companies)

Obs.: % means that x% of all TNCs (or Brazilian owned) are classified in that part of the chain. Sum is less than 100 because we did not consider few companies that classified themselves as raw material producers.

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9 For simplicity, we are naming as multinationals, transnationals, TNCs etc. the companies controlled by foreigners. Among Brazilian owned companies there are (few) multinationals as well.

10 Presentation on “perspectives for emerging countries” during the thematic opening of the Seventh International Colloquium “Internationalization: Confrontation of Firms Trajectories and Automobile Areas, GERPISA, 1999.
Figure 1 shows the distribution of companies according to the position in the productive chain. It is clear that TNCs (transnational companies\textsuperscript{11}) are best positioned in the chain, since:

- They are best positioned in the new form of supply via sub-assemblies, systems etc (37.5% against 6.5%);
- They are best positioned even as component suppliers for the assemblers;
- The majority of companies that supply for retailers without being OEM\textsuperscript{12} suppliers are Brazilian. It is known that margins are greater in that case but it is also known that the technological level and the possibilities to enter and compete in the assembler chain is much more limited. Moreover, many big players announced a strategy to increase aftermarket sales (a question we didn’t worked on it yet).

According to expectations, income reaches greater levels for foreign companies. As many companies do not like to show income data, we asked them to classify themselves in 6 levels of income (a non linear scale, but the one adopted by BNDES). 84% of TNCs occupy the 2 highest levels in contrast with 54% of national autoparts.

A similar picture is found in exports. 84% of TNCs have some level of exportation against 76% of Brazilians. And exports weights more heavily in the TNCs income: for 37.5% of the companies, exports weight more than 20% of the income – but for only 11.8% of the Brazilian companies exports weight more than 20% of their income. To some extent, this could be attributed to the international liaisons of TNCs, but also to a Brazilian policy for the automotive sector that benefits exporting companies\textsuperscript{13}.

Regarding quality certification, our sample shows a high level of certification. ISO9000 is held by 77.6% of TNCs and by 74% of Brazilian companies (plus 3.4% and 6%, respectively, that state they are implementing it). QS9000 shows a different panorama, since 75.6% of TNC but only 50% of Brazilian companies are certified. One must always take into account that the Brazilian sample contains a greater number of aftermarket driven-companies, supposedly not so interested in certification as the OEMs producers.

Consistently with some analysis in other sectors (Fleury, 1997), Brazilian companies have greater level of local process design but lower level of product design activities. Out of 42% of Brazilian owned companies have nothing developed regarding design for their main product. For TNCs the percentage falls to 20.6%.

\textsuperscript{11} We will not differentiate transnationals, multi-regional etc. TNCs in this paper are those companies controlled by foreign capital.

\textsuperscript{12} By OEM we refer to companies that supply directly to an assembler or to a company within the assembler’s supply chain.

\textsuperscript{13} Companies can import with lower taxes with the necessity to compensate it with exports in a period of time. We argue that it benefits TNCs because they can import with low taxes to run the first jobs of their production.
Surprisingly, Brazilian companies seem to be involved in a great effort in R&D activities (in a broad sense\textsuperscript{14}). In 1999, the expenditure of local companies measured as \% of their income reached the mean of 5.75\%, against 5.23\% of TNCs. The picture gains significance as far as in this analysis all non-OEM suppliers, mainly local firms, are included. Moreover, these expenditures are related to companies positioned mainly outside the so-called direct “modular supply” that tends to rule the production chain.

However, some aspects put nuances in the picture: a) as the income of TNCs reaches highest levels, their overall expenditure seems to be greater than the local ones; b) as many TNCs are involved with the launching of new car models based on global platforms, it is possible that some R&D expenditures are related to production (routine labs etc.) and not to real R&D in a strict sense; c) R&D expenditures of local firms could be related just to an effort to diminish the gap with global players or to qualify themselves to supply assemblers or first tier companies. These are questions for further investigation, since a quantitative analysis is not the most effective tool to develop them – but the quantitative analysis points out some path one can follow.

A Sub-Sample Only with OEM Supplier Companies

Let us exclude from our analysis the companies that do not supply to OEMs, in order to have a sub-sample only with firms that are really competing in the assemblers’ direct supply chain. We have got 121\textsuperscript{15} OEM supplier firms and 33 firms primarily linked to aftermarket / commerce. 47\% of the OEM are multinationals and the remaining 53\% are Brazilian controlled firms – 35\% of the OEM showing 100\% of Brazilian capital. If this data could be extrapolated to the whole components productive tissue it reveals a strong penetration of TNCs but also the persistence of Brazilian companies. For instance, a government that desires to benefit or induce the development of Brazilian-owned companies would have some field to work on it. Nevertheless it still remains the possibility for TNCs to acquire hypothetically supported Brazilian companies.

Are they investing in modernisation?

We did not ask directly about the amount of investments to avoid the refusal of answering the whole questionnaire, but there are proxy variables related to investments and R&D expenditures.

One of the main proxy is depreciation. 51\% of firms\textsuperscript{16} declared that depreciation costs have increased in the last five years. From those, 58\% are transnational firms\textsuperscript{17}. This kind of data may suggest that the sector as a whole is investing in modernisation, even the Brazilian owned firms. Probably, more TNCs declared rise in depreciation costs than Brazilian

\textsuperscript{14} Including salaries of engineers and technicians dedicated to design or innovation in product/process, labs, technical centres, and technology contracts. The questionnaire permits to isolate each component, but we haven’t done a disaggregated analysis yet.

\textsuperscript{15} Although 121 firms are OEM, we excluded from the present analysis 4 of them because data entry (typing) showed some (reworkable) inconsistencies. As we didn’t have time to retype them before the writing of this paper, we preferred to exclude them of the analysis. So, OEM analysis has been done with 117 firms.

\textsuperscript{16} Percentage related to all 117 OEM firms considered; 4 firms did not respond this question.

\textsuperscript{17} All data comparing TNCs with Brazilian-controlled companies are not weighted by the \% of TNCs in the sample. As far the number of Brazilian companies in the sample is greater than TNCs, a weight could be introduced as a mean to balance it in a better way.
companies because some of them have recently started Brazilian operations or have recently inaugurated new facilities to supply new assembly plants.

Anyway, the greater level of percentage of income directed by national companies to R&D expenditures (as discussed in the previous item) suggests an effort of the local remaining firms to survive, despite the positioning in the supply chain and the higher income of TNCs.

Approximately the same conclusion arises when firms where asked to respond about expenditures in R&D. 57% of OEMs declared raise in total expenditures in salaries of engineers and technicians dedicated to design and innovation, 62% raise regarding labs and related equipment, and only 50% raises in expenditures on technology acquisitions. In terms of the results of the investments made, 70% of the OEM sample declared that the number of new products launched has increased. From those 70%, 53% are Brazilian.

An extremely high level of quality accreditation

ISO 9000 accreditation is no more a differential among the companies concerned in the preliminary results of the quantitative research we are carrying on since 94% of OEM companies already have the certificate and 2% are on the way to get it. Only two companies stated a non-interest in ISO9000 certification. 57% of OEM with ISO9000 are Brazilian-owned.

As it is known, ISO9000 requirements are being replaced by QS9000 even for non-USA companies. Here, accreditation level is lower (84%, 53% of them Brazilian), but other data suggest that in the short run the picture will be the same as with ISO: 9,4% of OEM companies are on the way to get QS (which sums 93,4%) and 6,6% are analysing the issue. Moreover, 77,6% of OEM companies have or are on the way to get another certification (like VDA, ISO14000 etc).

An interesting issue can arise when we direct attention to quality requirements data: as almost all companies have or are on the way of having ISO 9000 accreditation, only 40% of them stated accreditation as a requirement made to their suppliers. On the other hand, 47% of their customers require those standards. But the data is not contradictory because: a) if ISO is no more a competitive differential, clients tend not to stress it as a necessity and it is taken for granted; b) in previous research conducted by our team (Salerno and Dias, 2000; Salerno, Zilbovicius and Dias, 1998; Marx, Zilbovicius & Salerno, 1997) assemblers have considered quality accreditation (ISO, QS or others) as order-qualifying, i.e., hardly any “non ISO” company could be homologated as a potential supplier.

Long-term contracts only by some TNCs

Only 34% of the firms surveyed have long-term (more than 1 year period) contracts with their suppliers. From that 34%, 74% are transnational firms. 20% of the sample requires exclusivity in (some of) their contracts with suppliers, but the majority of this requirement is made by transnational firms (83%). To investigate this, it would be necessary to cross variables like “position in the chain” x “long term contracts”, what we will do in the next steps of the research.
On the side of the relation with customers, 67% of firms have long-term contracts (53% of them transnational companies) while 53% have exclusivity agreements with them (45% of them being TNCs). This does not mean that all the contracts are long term or exclusive ones, but the firms declare to have some contracts like that. It is also not possible to state the importance of these contracts in the whole company’s portfolio. But our data do suggests that transnational firms have more long-term contracts – especially with their suppliers. If one takes into account that the vast majority of new entrants in the Brazilian market are transnationals, data suggests a greater difficulty for local companies to get longer contracts. This is a question for further investigation.

Co-design in the first level of the chain is a widespread practice in companies’ view

Recent literature on assembler-supplier relations puts light on “modular supply” and “co-design”. The OEM sub-sample reveals a high level of co-design orientation: 56% of OEM firms declared to have some co-design practice with their clients involving product, process or R&D. It is clear that this data must be analysed cautiously since it is impossible to capture what companies understand by co-design. Anyway, the perception of co-design practices is widespread mainly among direct suppliers of the assemblers since 76% of them declared to have co-design with their clients (the assemblers). But the practice (still?) does not go to the lower levels of the chain in the same intensity: only 24% of 2nd and 3rd level suppliers have declared some practice based on co-design.

While companies declared a widespread co-design practice with clients, the levels involving their suppliers are lower: only 39% of the OEM firms declared some co-design practice with their suppliers. This data is consistent with the hegemony of co-design practices involving assemblers and first tier suppliers. Sub-assemblies and components suppliers for the assemblers are in the leadership of co-design relationship with suppliers, responding each one for 40% of the total. It can be argued that perhaps they are diffusing their practices downstream with the assembler.

…but inventories seem to be really pushed down to lower tiers

We asked companies about frequencies of delivery to clients and receiving from suppliers. 65% of the companies declared deliveries to their main client every day (48%) or many times a day (16%). There seems to be a clear change regarding old weekly / monthly frequencies observed some years ago. This high frequency of delivery is the counterpart of organisational systems like industrial condominiums or milk run based logistics. A recurrent question on the debate on just in time, low inventories etc. is: are inventories being reduced by all companies in the chain or it is just a rationalisation of the assemblers and the biggest companies so that inventories are being pushed down to the lower tiers of the chain? First data processed suggest the second answer. Only 27% of OEMs firms declared to receive from their suppliers in an up to a day frequency. 44% receive weekly and 7% in a monthly basis. Delivery frequency can be seen as a proxy of inventories. Data suggest a higher inventory of raw materials / purchased components than finished parts.

By crossing delivery frequencies by layer (tier) we could refine the analysis. Deliveries up to one day basis is mainly a characteristic of first tier ("modulists" or

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18 Not considering firms that gave no answer to the question the percentage rises to 72%. Not responding probably means that the firm does not have long-term contracts.
components suppliers for the assemblers) since 77% of sub-assembly suppliers and 67% of components suppliers deliver to their main client in a day or less than a day basis. Supplying more than 1 time per day is a practice much more widespread among first tier sub-assembly suppliers than among first tier components suppliers. 35% of the former stated this practice, and only 18% the latter. Although in the data processed up to now 2nd and 3rd tier companies are sub represented, such companies revealed higher delivery frequencies to their main client (i.e., less frequent, higher volumes per delivery).

Some possible conclusions could be pursued in a final analysis. In confirming the practice of first tier to have a gap in frequency periods between delivery and receiving (and probably a different practice of finished product inventories and purchase components / raw materials inventories), why such occurs? Is it only a matter of time or are there some structural limits (distance from supplier, logistical costs, cost of low volume batches, strength of the supplier19, inventories as security – for instance, due to importation problems etc.) explaining those observations?

CONCLUSIONS

Since research is in the beginning and data are preliminary, there are no final conclusions, as we have stressed before in this paper. However, our data seem like a very promising field for future stronger conclusions. A number of cross analysis is possible and as the number of questionnaires received goes up, the strength of our data will surely become more representative.

Nevertheless, some of the findings show that the tendencies pointed out in the recent literature seem to be confirmed, like the gap between first and other tiers in the chain, the denationalisation of the components sector, TNCs as winners of “modular supply” game, the spread of co-design activities. Others, like the issue of frequency of supply, long term contracts and the amount of design activities locally developed must be seen with care, demanding more analysis. Notwithstanding, there are a lot of other points the questionnaires allow to explore, like proximity, regional impacts, financing patterns - we did not work on them yet, but we hope to do it in the near future.

19 A point for further in depth analysis is the relation of autoparts with raw material providers (steel, aluminium etc), traditionally an oligopoly that imposes quotas and delivery frequencies for clients below a predefined volume of acquisition.
REFERENCES


