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**Title: Automotive Cluster in Brazil**

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INDEX

ABSTRACT.................................................................................................................................3
Introduction.................................................................................................................................4
Objectives and Methodology.....................................................................................................5
Overview of Fundamentals of Cluster and Automotive Industry..............................................6
Cluster concepts .......................................................................................................................... 6
Porter’s Diamond Model and Factors .......................................................................................... 6
Production factors ....................................................................................................................... 7
Supporting factors ....................................................................................................................... 7
Demand condition ....................................................................................................................... 7
Rivalry among the firms .............................................................................................................. 7
Government role .......................................................................................................................... 8
Vehicular Platform and Car Makers Overall Strategy .................................................................. 8
Vehicular Platform ........................................................................................................................ 9
Car Makers Overall Strategy ...................................................................................................... 9
Brazilian Automotive Cluster- ABC region ..................................................................................11
Brazilian scenario ........................................................................................................................ 11
Brazilian Cluster – ABC Region ..................................................................................................12
The Beginning (1st Wave) ..........................................................................................................12
The Evolution (2nd Wave) ...........................................................................................................14
Production factor Evolution: .....................................................................................................15
Supporting Institutions: .............................................................................................................16
Rivalry ...........................................................................................................................................18
Demand conditions .....................................................................................................................18
Government Role .......................................................................................................................19
The Consolidation and Turbulence of post 2nd Wave.................................................................20
The Transition to 3rd Wave up to now ......................................................................................22
The Car Making Value Chain ....................................................................................................24
Final Discussion .........................................................................................................................26
References .....................................................................................................................................29
Abstract

The Automotive Sector is regarded as one of the modern sectors of Brazilian economy and also holds an important share of country’s GNP. This paper analysis the automotive chain, under Porter’s cluster theory.

By following strictly Porter’s theory, the conclusion is that the automotive group is not a “cluster”, although the configuration meets three of four points of diamond: the gap is on demand, which does not drive companies into innovation, and consequently to the supported competitive advantage. By the other hand, if another kind of innovation is considered, we have a second conclusion: Brazil has innovated both: in engines technology by projecting a dual fuel engine and developed the alcohol chain, and successful implementation of assembling plants, which are considered as models for other operations.

Another important conclusion through the dynamic movements throughout the auto chain is that Brazil is leading the redefinition of core competencies along the automotive chain.
Introduction

The auto industry has been one of the main actor in the world economy through the XX century. It has created and driven the world life styles, generated innovations, redefined management theories and practices (Ford, Sloan, Toyoda, and so on), changed the society and now get into its second century of existence.

The transition of the century is been characterized by the hyper competitiveness of the sector. Entire auto industry segment and its chain is becoming even more efficient and thrust big challenges, mainly in the production system. What is vertical is being moved to horizontal, given a new format to the entire supply chain.

Old Steel making activities, components manufacturing and other non core business are being sold or spun off, changing the current auto industry into a even more lean and focused.

The growing pressure, over auto industry and its chain, has being changing the entire cities, regions, states and also countries into a true industrial pole of development and production in order to match the growing customer needs that is becoming even more sophisticated and complex.

This chain has growing through a set of common factors, such as technology, infrastructure and human resources which provide a mutual gain.

Brazil in this scenario has leading the worldwide changes and its becoming the benchmark of new structure of supply chain and its being considered a model to other business segment and its being exported to other planet regions.
Objectives and Methodology

This paper is concerned with identification and characterization of Brazilian automotive industry cluster, given specific attention to an region of Sao Paulo State called “ABC paulista”, located at southeast of Sao Paulo city, where this kind of industrial segment started their activities, in the beginning of 1920, in Brazil.

This paper is based on exploratory research through data and official information available and provided by car makers, government agencies and automotive supporting institutions and added to a multiple case study, which allowed us to characterize the structure of Brazilian auto industry and also identifying the embryonary process of dynamic transformation of the cluster, which is changing the entire supply chain.

The contribution of this research will be given to academic, industrial and also government agencies, once it clarifies the determinants of auto industry cluster since it is formation, development, growth, competition and sustainability here in Brazil, more specifically in the regarded region, providing relevant guidelines for industrial development and sustainability of entire supply chain as well as insights of dynamic transformation now on going.

This article will cover some fundamental concepts in order to harmonize some of them, relevant to drive to an unique understanding of the mainstream of this research.
Overview of Fundamentals of Cluster and Automotive Industry

In this section, some important concepts of Cluster theory and auto industry specificities will be presented synthetically:

Cluster concepts

Porter (1998), states that cluster is a group, geographically closed, of firms and associated institutions, linked by similarities (competition and rivalry) and complementsaries. This proximity among firms, at first stage, will generate transactions under a hard competition environment, leading them to some kind of specialization and operation excellence, looking for an innovation for market differentiation needs.

Government and its institutions have an active role in this process, as transactions facilitator and stimulator.

A cluster has a regional characteristic, where location is one of competitive advantage in comparison with other regions.

Porter’s Diamond Model and Factors

As per Porter (1998), the basic configuration of any cluster could be identified and mapped using the same “diamond” model, where, due to its geometrical shape, each determinant factor is located at one corner: Production factor, Supporting institutes, Demand conditions and Rivalry environment.
**Production factors**

It is based on quality and specificities of natural, human and capital resources and also by all information, administrative, science and technology infra-structure, that the region and government can provide.

**Supporting factors**

It is based on the entire, capable and competitive supply chain located in the region and also by non related firms, which take advantage of the benefits generated by the firms included in the cluster.

**Demand condition**

It is based on the existence of hard to please and sophisticated customers and demand. It is, as per Porter (1998), will define the competitive advantage over the others regions.

The products and services will be perceived by extra-cluster customers, by means of value added through the entire supply chain motivated by competition and supporting and production factors.

**Rivalry among the firms**

It is drive the strategy of the firms, where each one is continuously looking for a unique position in the market.
All the investments and efforts of the firm supposed to be used to create and generate some kind of innovation, that could lead the firms to find out some competitive advantage, perceived by customers, and also sustain its position ahead of the competition.

In summary we could conclude about cluster as a set of firms and institutions linked themselves, where the value of the final product or service has to be higher than the linear sum of individual values throughout the entire supply chain.

**Government role**

The government usually has an important role to a country, states and regions economy by means of providing properly conditions in terms of macroeconomics and political stability. The two basic and elementary conditions for cluster sprouting.

The government must reinforce and stimulate the clusters already in full operation, because new firms, industry and clusters used to originate new clusters.

The true role of the government in the cluster, looking at into the Porter’s (1998) diamond model, should be in the center of the diamond, eliminating barriers to promote the true competition, attracting new investments, organizing and eliminating bureaucracy in the relations inter and extra cluster, and so on.

**Vehicular Platform and Car Makers Overall Strategy**

Some basic concepts about vehicle specificities are presented as follows:
**Vehicular Platform**

In accordance with Muffato (1999), platform can be defined as a set of integrated components and systems, physically connected and used as a common base for different models. As an example, we could say that an usual standard for platform could be the vehicle underbody which includes, in general: front floor panel, floor panel, engine frame, and some reinforcements.

Also Sakuramoto (2002) suggests that platform can be defined as a fundamental structure of a vehicle, over which variations of the same vehicle can be assembled, in general used to use the same assembly line and has the large amount of standardized components and system.

**Car Makers Overall Strategy**

Car making organizations are in general multinational ones, with a headquarters in a country and several subsidiaries distributed around the world.

PriceWaterHouseCoopers (2001, 2001a, 2001b, 2001c), presents a scenario as follows:

- General Motors Group has participation, alliances and also control of 24 automotive brands (Chevy, Fiat, Opel, Suzuki, Pontiac, Cadillac, Hummer, Chevrolet, Daewoo, Isuzu, and so on), with a total production volume about 13 millions of vehicles. Excluding alliances brands the production volume goes down to 8 millions;

- Daimler Chrysler Group has a participation and control of 12 vehicle brands (Mercedes Benz, Chrysler, Plymouth, Smart, Dodge, Mitsubishi, Hyundai, Asia Motors, Jeep, Syangyon, and so on), with a total production about 8 millions. Excluding the mergers, partnership with Mitsubishi and korean car makers, the production hardly achieves a total of 1 million. Including the merger with Chrysler the total production achieves a score of 4.5 millions;
• Ford Group has a participation and control of 9 vehicle brands (Ford, Mazda, Jaguar, Mercury, Aston Martin, Land Rover, Volvo, Lincoln and another one), with a total of 7.5 millions car produced a year. Excluding mergers and strategic partnership the Ford’s volume is around 5.5 millions;

• Toyota Group has a participation and control of 4 vehicle brands (Toyota, Lexus, Daihatsu, Hino) with a total of 6 millions car produced a year.

• Renault Group has a participation and control of 5 vehicle brands (Renault, Nissan, Infinity, Dacia, Samsung) with a total of 4.5 millions car produced a year. Excluding the Nissan merger, hardly its production could achieve a score of 3 millions.

• Other car makers, including Volkswagen, have a production volume below 6 millions.

In accordance with PriceWaterHouseCoopers (2001, 2001a, 2001b, 2001c), McKinsey, IMVP (International Motor Vehicle Program) from MIT (Massachusetts Institute of Technology), we can mention: Bermudez e Ealey (Mckinsey 1996), Rommel, Kempis e Kaas (Mckinsey 1992), Boyer e Freyssenet (1999), Freyssenet e Lung (2000), Doig, Ritter, Speckhals and Woolson (2001) and Shimokawa (1999), they state that car makers strategy are converging and they are looking for consolidation of scale economy, which success depends upon the success of scope economy as well, through mergers, acquisitions and strategic alliances with a strong effort on standardization, cost reduction and also reducing the amount of vehicle platform down to 8 at maximum at world wide level.
Brazilian Automotive Cluster

From now on, the Brazilian auto industry market and structure of the firms will be presented as well as how it was formed.

Brazilian scenario

Brazil is the 10th biggest car producer of the world and the 1st in South America, with an average, in accordance with ANFAVEA 2002, of 1.8 millions of vehicle produced a year.

Brazil has achieved a peak production of 2.5 millions during 1997, in the middle of consolidation of MERCOSUL (South America Common Market), where Argentina, Brazil, Uruguay and Paraguay have agreed to make a Common Market.

Brazil agrees with other countries in considering auto industry one of the most important and strategic industry to the entire economy. Most of the other productive chains has a link to automotive chains.

Attracted by a high potential market, and access to MERCOSUL, several car makers decided to move their investments to Brazil, bringing their plants (Chrysler, Mercedes Benz, Audi, Fiat-Iveco, Honda, Peugeot, Citroen, Renault, Toyota, Mitsubishi, International, Nissan, and others, to Brazil (ANFAVEA & SINDIPEÇAS 2002).

Nowadays, the auto industry represents an important variable in the national account, because it represents 2% of country GNP, 11% of Industrial INP and 13% of overall exportation.

Latin America has today, in accordance with ANFAVEA 2002, a relation of 7 inhabitants per vehicle, and Brazil is very closed to the average, while in the developed countries this
relations achieve the rate of 1.3 in the North America and 1.8 in the Japan, so that a long way ahead could be seen.

**Brazilian Cluster**

From now on we will present the beginning, evolution, current structure of the Brazilian automotive cluster and finally the current dynamic movement of the chain.

The Brazilian auto industry, as per Latini (1997), had two waves: (i) First wave is considered from 1920 up to 50’s, where the mainstream was to assembly the finished import parts, called kits; (ii) Second wave from 1950 up to 80’s, was considered when the Brazilian auto industry was obligated to nationalize de entire cars.

**The Beginning (1st Wave)**

The ABC region, located at southeast of Sao Paulo city, is formed by Sao Bernardo do Campo, Santo Andre, Sao Caetano do Sul, Diadema, Maua, Riberão Pires and Rio Grande da Serra, all cities in the vicinities of Sao Paulo city, around 20 km.

The industrialization of the region started during the second half of last century, by means of expansion of the railroad from Santos city, where is located the biggest Brazilian harbor to Jundiai city, 80 Km far from Sao Paulo city. This railroad crosses the ABC region, specifically through Sao Bernardo do Campo and Sao Caetano do Sul.

In the middle of 50’s, the president Juscelino Kubtschek, thrust the region in the direction of total industrialization, attracting the car makers and its suppliers.
The 1st railroad in Brazilian territory was the Santos – Jundiai, which started operating in 1887, and by 1892 Santos city harbor was officially operating.

The car makers started its operation by 1920, in the ABC region, due to: (i) The proximity of main consuming market: 59% of Brazilian population was concentrated in the southeast region which represented about 83% of total GNP (IBGE 2002); (ii) In the middle of Santos – Jundiai Railroad and crossed by Rio de Janeiro - Sao Paulo Railroad.

The beginning of auto industry in Brazilian territory was characterized by assembling finished parts exported by their factories from Detroit (EUA) to Brazil (ABC region). Those parts came by ships and arrived at Santos harbor, where by train parts were transported to their assembly plants in the ABC region. At that time only Ford Motor Company and General Motors Company used to operate their plants in Brazil. (see figure 1)

Up to 1950 the auto industry could not be considered a cluster, because: (i) the production factor was almost absent and embryonary. (ii) there was some competition between Ford and GM car models, (iii) supporting institutions was also embryonary, (iv) demand was already sophisticated due to high concentration of GNP in the Brazilian southeast region, and (v) government has not so many influence about the auto industry and its chain. But from de 20’s up to 50’s we could consider that the seeds of industrialization had been established, due to the influence over the all diamond factors.

Workers which used to come from the farm side, completely lack of industrial skills, started to be trained, engineering school started teaching more and more students, small metal workshops started getting familiarity about the car components and manufacturing ways, and also government started focusing in changing auto industry as a leading segment to thrust the Brazilian economy.
Other factors that have influenced the Brazilian auto industry such as depression of 29, second world war, Bretton Woods, and also internal political instability (Vargas and Dutra Government).

Up to 29, the importation of auto vehicle were predominant, and demand was growing so fast, so that the Government of Washington Luiz, during the 20’s, have thrusted the construction of roads, even though the machines, equipments, tractors, fuel, lubricants and spare parts were all imported.

From 1929 up to 1948, the depression of 1929 and second world war have changed the map of geopolitics, social and economics. Brazil was fully influenced by those events so that brought Getulio Vargas to power for long time.

The Bretton Woods agreement signed in 1944, forced Brazil to make the exchange rate equal to one, so that after the end of second world war, US dollar has become most attractive for importation again, provoking severe damage to national account.

In that mean time, international credits were frozen and importation was controlled and closed, given a chance to Brazilian small and incipient firms to start replacing imported parts and products mainly to a automotive segment, so that Brazilian automotive cluster has just begun.

**The Evolution (2nd Wave)**

Since the first appearance of the auto industry in Brazilian territory, the 50’s could be considered the true start up and evolution.

In terms of Porter’s diamond models we could present that:
Production factor Evolution:

Which is characterized by the presence of high quality specialized inputs available to firms, such as Human, Capital and Natural resources and also Infrastructure in: Physical, Administrative, Information, Science and Technology.

Some important events must be presented in order to give an overview of evolution of production factors such as:

1887 – Start Operation of the Railroad from Santos City to Jundiaí City;
1892 – Start Operation of Santos Harbor;
1928 - Start Operation of railroad from Rio de Janeiro City to São Paulo City; 1939 - 1st Brazilian Oil Well was discovered (Bahia State)
1941 – 1st Brazilian Government Agency to control Oil wells was created (CNP – Conselho Nacional do Petróleo); 1941 – Steel Makers such as CSN (Companhia Siderúrgica Nacional), COSIPA (Companhia Siderúrgica Paulista) and CST (Companhia Siderúrgica de Tubarão) were created between Sao Paulo and Rio de Janeiro state;
1953 – Petrobras a firm to extract, produce and refine petrol was created;
and so on …

In terms of knowledge and human skills, in order to attend auto industry and other segment needs, some universities and technical and business schools were created through the subsequent years, as follows:

1893 - Escola Politécnica – Politecnica Engineering School was created in Sao Paulo; 1896 - EE Mackenzie – Mackenzie Engineering School was also created in Sao Paulo; 1899 - USP/IPT – 1st University was created in Sao Paulo covering several fields of knowledge and IPT – 1st Research Institute was also created to provide means of investigative knowledge;
1910 – Escola Técnica Federal de São Paulo– 1st technical high school was created in Sao Paulo to provide specific and specialized workers to industry in general;

1920 - ETE Getulio Vargas – 2nd technical high school was created in São Paulo;

1941 – ESAN – 1st business school was created in Sao Paulo; 1942 – SENAI – 1st Junior technical school was created to attend the specific demand of the auto industry;

1946 – FEI – 1st engineering school in the ABC region was created;

1950 - ITA – 1st engineering school specialized in airplanes was created in the São Jose dos Campos, a city between Sao Paulo and Rio de Janeiro;

1954 - EAESP/FGV – Most important Business school up to now was created;

1957 - ETE Lauro Gomes-SBC – 1st technical high school was crated in the ABC region;

1961 – MAUÁ – 2nd Engineering school was created in the ABC region; and so on …

As per events describe above, we could inferred about the evolution and maturity of the production factor in the Sao Paulo state and consequently in the ABC region.

**Supporting Institutions:**

Which is characterized by access to capable, locally based suppliers and firms in related fields and also by the presence of clusters instead of isolated firms;

Some important events must be presented in order to give a overview of evolution of Supporting Institutions such as:

1941 – Steel Makers such as CSN (Companhia Siderúrgica Nacional), COSIPA (Companhia Siderúrgica Paulista) and CST (Companhia Siderúrgica de Tubarão) were created between Sao Paulo and Rio de Janeiro state;

1939 – Goodyear – Multinational manufacturer of wheels started its operations in Sao Paulo;
1941 – Pirelli - Multinational manufacturer of wheels and rubber parts started its operations in Sao Paulo;
1942 – Cofap – Brazilian manufacturer of several automotive parts started its operation in Sao Paulo;
1950 - Metal Leve - Brazilian manufacturer of automotive engine parts started its operation in Sao Paulo;
1953 – Petrobras - Brazilian firm responsible to extract, produce and refine petrol was created
1963 – SKF – Multinational manufacturer of bearings parts started its operations in Sao Paulo;
And so on…

1940 - ABNT (Associação Brasileira de Normas Técnicas) – Institute for Standardization of technical standards was created to guide the use of right standards; 1944 - ABM (Associação Brasileira de Metais) - Institute for providing technical information and standards for metals was created to guide and thrust the researches and standardization of the metal;
1951 – CNPq – Conselho Nacional de Pesquisa was created to control, guide and thrust researches in the universities;
1955 - ABDIB – Governmental agency to guarantee the continuous development of Brazilian market in terms of infra structure and base products firms enhancing its competitive level;
1956 – SINFAVEA (Sindicato dos Fabricantes Veículos Automotores) – Independent union that joins the car makers was created;
1956 - ANFAVEA (Associação Nacional dos Fabricantes de Veículos Automotores) Independent association that joins the car makers was created to defend the interests of car makers;
1956 - SINDIPEÇAS (Sindicato dos Fabricantes de Autopeças) - Independent union that joins the car makers part suppliers was created;
1956 à GEIA (Grupo Executivo da Indústria Automobilística) – Governmental agency was created to define guidelines for sustainable growing of the auto industry throughout the years; And so on…

As per events described above, we could infer about the evolution and maturity of the Supporting institutes in the Sao Paulo state and consequently in the ABC region.

**Rivalry**

Which is characterized by a local context and rules that encourage investment and sustained upgrading and also open a vigorous competition among locally based rivals.

In this subject the competition was not so intense due to up to 1950 only 2 competitors were operating here in Brazil.

Ford started its operation in 1919 and General Motors in 1925.

Only after 1950, due to government action to attract investments in this industrial segment, another players came to rivalry context such as: Volkswagen, Fiat, Mercedes Benz and another ones with came and went out rapidly, and this scenario was kept up to 90’s.

**Demand conditions**

Which is characterized by an existence of a core of sophisticated and demanding local customers, whose desire that their needs could be anticipate elsewhere.

And also characterized by the existence of unusual local demand in specialized segments that can be served nationally and globally. In that time the demand of the auto industry was, in accordance with IBGE and ANFAVEA:
Passengers cars: In the 1940, total of 120,710 units were sold while in 1950 the amount of produced and sold vehicle has increased to 276,845 units, representing a growing rate of 129%, and about 1979 the volume was 956,204 units, which gives a growing rate of 245%.

About Trucks: In the 1940, total of 86,426 units were sold while in 1950 the amount of produced and sold trucks has increased to 236,732 units, representing a growing rate of 176%.

In the 1950, total population of Brazil was 52,650,000, in accordance with IBGE, and the rate of inhabitants per vehicle was about 100.

**Government Role**

In this age, the government had played an important role by creating GEIA (Grupo Executivo da Indústria Automobilistica) in 1956, which was responsible for defining the auto industry sustainable politics. Among all we can explicit the control of import and export trading and also determining the nationalization rate which has to be at least 90% up to 1960.

Government had stimulated and attracted investments for the infra structure and base industry, such as steel, electricity, roads, and so on.
The Consolidation and Turbulence of post 2\textsuperscript{nd} Wave

The subsequent years up to 80’s were the consolidation of what has been initiated during the 2\textsuperscript{nd} wave, but this age was characterized by turbulence and crisis, due to the antagonism of subsequent governments. There were an alternating role between monetary control/stabilization against industrial stimulation and growing.

Growing rate achieved by GEIA was closed to 98% at 1959 helping to consolidate the auto parts chain, but the political turbulence let the inflation achieved a score of 24% a year in 1961, and 73% a year in the 1963, which was the one of the reasons for military taking over the government in 1964.

In 1964, GEIA was replaced by CDI (Comissão de Desenvolvimento Industrial – Industrial Development Commission) responsible to provide the same guidelines to entire metal and mechanic industry segment, avoiding excess of capacity.

Along the next years, government programs like “Reserva de Mercado” (Market Reservation) it means that information technology was a priority segment to government and its protected in order to let local industry develop its own national technology, and “Lei de Similaridade” (Similarity Law) that forbid importation of any equipment or technology which has any similar in the local market. This both programs has helped the Brazilian auto industry to get worse and worse, in comparison with American, Europeans or Japanese auto industry.

The 70’s was characterized by a event called Petrol Crisis, which drove the Brazilian auto industry with Government institutions to develop an alternative engine to use alcohol (ethanol), extracted from sugar cane, as a fuel.
Instead of crisis the Brazilian demand still growing achieving a score of 1 million cars in 1979, but the this growing rate was based in the internal demand and importation replacement and its finite, and has exhausted by 80’s.

The logical way-out supposed to be the external market, but due to market and national industry protection, Brazilian cars were obsolete compared to the international competitors and with a high cost, so that instead of going too far external market, they decided to start arrangements to start an integration with Argentina in the end of 70’s. The results of this agreement was the MERCOSUL, started in 1988 and consolidated officially in 1991.

The Brazilian demand through 80’s was around 1 million vehicle a year, with a singular characteristic of being about 70% up to 80% of vehicle powered by alcohol. (ANFAVEA 2002)

The market share through the 80’s was leaded by Volkswagen with 40% of the share, General Motors with about 22%, Ford with about 20% and Fiat about 18%, and Toyota. They are also installed at ABC region. This market share express the competition level in domestic market. (ANFAVEA 2002).

The concentration of car makers in the Sao Paulo’s ABC region together with the best infra structure provided by state, naturally has forced auto parts manufacturer to be installed closed to their customers, so that about 93% of all auto parts were located in Sao Paulo State, in accordance with SINDIPEÇAS 2002.

In this decade, the political instability was thrusting the inflation up to the upper position in the economy, providing a environment of uncertainty and high risk to the firms and industry. This kind of unstable environment is making the industries to take out any investments and investing some where else.

The 90’s had come with a great amount of positive perspectives to all economy segment, with an economy without an inflation, stable and attracting foreign investments again, and this
environment with some government programs has driven the auto industry to a another stage, covered in the next section.

The Transition to 3rd Wave up to now

This age started at 90’s, with a consolidated Production factor in terms of human and natural resources developed along the previous 40 years, as described already in this text.

The 90’s were characterized by globalization of the markets, resources and technology. Brazil had promoted a exchange rate parity again, and opened its boundaries to international trade, so that as soon as it had happened, there was an invasion of imported products, due to their better quality and cost compared to a local product.

As soon as this situation had started, at the same time Brazilian government had forbidden the importation of information and automation technology, so that Brazilian industry had to survive with their obsolete technology and processes so that, day after day, they were losing their competitiveness.

The government, as soon as he had identified the streamline of bankruptcy of entire industrial segment, had limited and impose quote for the importation volume, and then in 1975 had written a new law called: “Regime Automotivo”, which was the engine of dynamic changes over the entire Brazilian automotive chain.

This law was written to give a chance to:

(i) car makers, already, installed in the Brazilian territory, in upgrading and enhancing their technology and processes in order to achieve a worldwide competitive level;
newcomers (new car makers or auto parts manufacturers) to install their plants, in the
Brazilian territory, with a promise of reduced import tax for technology;

The 80’s in accordance with ANFAVEA 2002, was a age of salary reduction due to
inflation, and high tax level that moves price higher, so that to avoid loss of demand, the
government stimulated the production of a car called “popular car” with low cost and 1 litre
engine and it has represented about 70% of total sales in domestic market up to now.

The ascending demand, with a peak production of almost 2.5 millions cars in 1997,
attracted newcomers to Brazil: Nissan, Mitsubishi, Peugeot, Renault, Citroen, Iveco,
International, Audi, Honda, and also, car makers already installed in the Brazilian territory, has
brought new investments to install new plants.

By the other hand, auto parts segment had faced another situation, unable to follow the
same path of investments and growing rate of the car makers, most of auto parts were closed or
bought by multinational ones, so that nowadays, the first level of auto parts supplier is basically
composed by multinational companies, and for Brazilian ones has left to be the second, third or
even fourth level supplier.

Once, those newcomers and new plants were coming inside the territory, Brazilian states
start competing to receive those investments, so that each one was offering different kinds of
benefits. At the end they decided to install their plants out of ABC region, but they are all located
in a distance less than 800 km from ABC region. Only two new plants, from General Motors and
Ford were located about 1000 Km from ABC.

The new environment, new investments, new technology, free tax benefits, new auto parts
structure and power, stimulated the car makers like Volkswagen, General Motors and Ford in
trying new kind of manufacturing process, changing the entire supply chain as described in the
next section.
The supply chain during the first wave, in accordance with Gaittás (1997) and Latini (1997) at the 20’s, was based on importation of finished kits and then assembled in a plant.

In this chain, car making was fully vertical, so that all components and system used to be manufactured in house.

The second wave was already driven by a government plan of protecting and developing in Brazilian territory auto parts, so that, by 1960, at least 90% of the car supposed to be produced inside the Brazilian territory, it could be done by the car maker or any local supplier.
During the second wave, Brazilian steel makers, foundry plants for engine blocks, rubber and plastic manufacturers had started their operations in Brazilian territory, so that by the Porter’s diamond model’s, production factor, supporting institutions and government role has been already structured and mature enough to thrust Brazilian automotive cluster.

The transition to 3rd wave, has been a challenge for all players, because the spin off and buyout process that has occurred.

Fig. 3 Chain in the 3rd Brazilian Automotive Wave

The car makers have spent almost a century buying, developing, structuring and organizing core competencies on auto parts, but the clockspeed of the technology and also of knowledge, has reduced the development time and cost, but the process was getting even more complex. This complexity has been changing the management of the resources needed.

The final result of such process can be seen in the spin off process performed by General Motors and Ford, when they have spun off Delphi and Visteon respectively, moving them to a condition of first level supplier.
The car makers are looking for lean their portfolio of competencies, and spin off what is not related to the new definition of core competency of the maker.

Ford and General Motors have spun off the entire manufacturing of components, keeping inside the assembly line under their responsibility, and forced them to be located at the same plant reducing the distance from supplier to customer. This system can be seen in the General Motors’s Gravataí plant and Ford’s Camaçari plant.

Volkswagen in its Resende’s plant, where trucks and buses are produced, both assembly line and components manufacturing and assembling were under suppliers responsibility. Volkswagen is under responsibility only for design, engineering, sales, and services.

The Brazilian auto industry, is been characterized by process innovation and is leading the change over the entire chain in the worldwide level.

The success of the General Motors’s Gravataí’s, Ford’s Camaçari and Volkswagen’s Resende plant, is the photography of the automotive cluster in Brazil. All vertices of Porter’s diamond models such as production factors, supporting institutions, rivalry, and demand for low cost and mass market vehicles are mature and also government has held some initiatives trying to sustain the growing rate of auto industry.

Final Discussion

The current status of the automotive industry, here in Brazil, is the photography of most successful, effective and productive plant from all over the world.
By following strictly Porter’s theory, the conclusion is that the automotive group is not a “cluster”, although the configuration meets three of four points of diamond: the gap is on demand, which does not drive companies into innovation, and consequently to the supported competitive advantage. By the other hand, if another kind of innovation is considered, we have a second conclusion: Brazil has innovated both: in engines technology by projecting a dual fuel engine and developed the alcohol chain, and successful implementation of assembling plants, which are considered as models for other operations.

The spin off and buyout process carried on by car makers has changed the first level of supply chain, moving car components development and manufacturing from in-house activity to outside supplier, so that the what was inside became first level supplier, while the old first level ones became second level and so on.

The first level supplier has become as stronger as the car maker, so that they could attend the new requirements of car makers, to be responsible to develop, manufacture and be locate closed to car assembler plant and be responsible for the entire logistic up to deliver components and full system to the assembly line.

What can be seen is that assembler plants have been moved to a place far from ABC region, where government benefits are higher, but the engineering center of the auto maker as well as the auto parts still located at the ABC region.

In this new assembling plants system only manufacturing competencies have been moved to new locations, this could be explained by the high level of automated process and technology used in order to minimize the needs for skillful hand worker at the assembling line.

Another point that can be seen in the ABC region is that, Volkswagen, Ford and General Motors, have been engineered their own cars, for domestic market, such as Fox, Ecosport and Celta, respectively, through the last years.
As long as they have designed and engineered their own cars, their competence on making that is clear and also mature. It was possible due to the evolution of production factors, basically in the university degree courses currently updated and adapted to new reality, and also by presence of all firms which sales and provide high level of engineering services and softwares (CAD-Computer Aided Design, CAE – Computer Aided Engineering and CAM – Computer Aided Manufacturing) here in the Sao Paulo region, only 20 km far from ABC region.

This could be seen as a new cluster in the ABC region, where production factor are abundant and updated, supporting institutions are all located with high level quality based on intensive knowledge (Engineering services), demand is very sophisticated because is formed by the auto maker engineering center, and rivalry is getting more and more tough, because other car maker are bringing their development center to Brazil, like Fiat.

So that 3rd wave of Brazilian auto maker can be photographed as described above, being a benchmark on productivity and manufacturing process and also with a high level of engineering center.
References


IBGE- Censos de 1957 a 2002


