¿To produce or to import? That is the question: A System Dynamics approach to the auto-parts industry in Mexico

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ABSTRACT

The Mexican auto-parts industry nowadays has a high dependency from the importation of raw materials and auto parts made in USA, China and Japan and some other countries from which it get supplied for the development of productive processes. Many of this importations can be substituted is the necessary mechanisms to produce in a national level get established, bringing an increase of the auto-parts industry and more competitiveness from Mexico in global scenarios.
This paper presents the modeling of the Mexican auto-parts industry, designing scenarios that allow observe the viability of imports reduction.

Key words: auto-parts industry, imports, National auto-parts production, production costs and investment.

1. INTRODUCTORY FRAMEWORK

The auto-parts industry as many other industries is composed by many variables that affect its behavior and tendencies. It counts with a big number of participants and is an important industry for the Mexican economy.

The potential market of this sector is wide. There is a marked tendency to the Asian countries, focusing on China and India. Some statistics show that China's population has 8 cars for every thousand inhabitants, while there is a forecast that says that in 2050 India will have more licit cars that any other country (611 million cars). This is an evidence of development in these markets.

Even though the leaders' countries of this sector are Japan and USA, it has been observed that there are a lot of factors that make manufacturers all around the world from this industry to turn his eyes to big emerging markets (China, Russia, Brazil and India).

1.1 Conditions and challenges that affect the auto-parts industry.

According to a study made by *PriceWaterHouseCoopers (PWC)*, there are conditions and challenges that affect this industry.

a. *Costs reduction*: This challenge is focus on the manufacturers with their suppliers and how difficult is to maintain high quality standards with low costs.

Manufacturer's suppliers have had to reduce costs by 3% annually in the last ten years. As a result, suppliers are creating fusions, acquisitions, and joint ventures to increase their income, standstill the market participation, use their assets in a more efficient way and increase leverage with the assemblers.

b. *Auto-parts industry consolidation trough fusions, acquisitions and divestments:* As mentioned in the previous factor, the so competitive auto-parts industry environment is characterized by globalization, consolidation and capacity excess in all supply chain segments, from the design and development to the manufacturing process and sale. The suppliers have to find a "global price" fixed and required by assemblers. In Mexico, assemblers and suppliers are facing capacity excess with a use rate lower than 80% in a global environment.
   As a part of the process, the companies from this industry compete to increase the use and obtain competitive advantages, frequently some of these companies resort to fusions, acquisitions and joint ventures.

c. *Excessive labor costs, production capacity, inventories and other pressures:* Characterized by a severe structural overcapacity and an increase on aggressive competitors, the auto-parts global industry is tie to a constant price war. It is estimated that incentives to North American consumers amounted $45 thousand millions of dollars in 2005 and in Europe the price war is equally constant. The high increase in China has been affected by the price deflation of new cars as the result of the competitors' intensification. The suppliers around the world of auto-parts components discredit the continuously price reduction by their clients, while the inputs price increase is strongly affecting the suppliers. As a result, we can conclude that the future of this competitive industry is uncertain.

d. *Improving the supply chain:*
   The pressure for an effective reduction costs policy has been generating assemblers to try to transfer this responsibility to suppliers that sometimes do not have the required experience to make these objectives to get accomplish. As a consequence, there are problems in trading vehicles more frequently because of the debilities in the supply chain.
   In the automotive industry the suppliers' failures are serious, ending in stopping the assemblage line and creating financial losses. The main assemblers have been observing that their suppliers do not have the capacity to control the sub-suppliers, making the assemblers to get involve to give support in making better production schedules with the implementation of actions, technique assistance, process or financial support that let the sub-suppliers to respond to changes efficiently.

e. *Sustainability and environment:*
   Day by day, environmental aspects are influencing the decisions that assemblers make about:
   - The materials mix use in manufacture (steel, aluminum, crystal and plastics), that affects the selection of suppliers;
   - Engine type (gas, electric, hybrid, hydrogen, LP gas) that affect technologies in production;
   - The life of the vehicle, which requires the adequate selection of materials and components.

   After all been mentioned, it is necessary to consider this evolution from the perspective of the product life cycle (production, use and functional life) to determine the global impact that these aspects produce.

1.2 Threats and opportunities for the Mexican auto-parts industry.

Threats

- Commercial aperture: The automotive industry prefers to import the auto-parts even when there has been an improvement in some Mexican products (quality, price and punctuality in delivery times). To compete successfully it is needed to put some great efforts.
- The automotive industry preference for foreign auto-parts because of the joint ventures created.
- Most of the vehicles production is for foreign markets.
- Increase in the importation of vehicles for the domestic market.
- Commercial aperture + increase in the vehicles exportation = Attraction of new foreign auto-parts companies to Mexico. Some domestic companies are displaced.
- Auto-parts ´maquila industry´ (a factory run by a U.S. company in Mexico to take advantage of cheap labor and lax regulation) represents a great competitor because of the low levels production costs. This is more obvious because of the peso deflation.
- Mexican auto-parts industry technology considerably depends of foreign companies; USA. As a consequence, it is perceived that the products of foreign companies need to be better that those with national capital.

Opportunities

- The Mexican labor on this industry has a lot of chances to become more productive.
- The chains of production or links to the auto-parts enterprises from the suppliers, seems to be with a lot of opportunities to get in develop, particularly trough joint – ventures.
- The companies located in Mexico can reach international productivity levels by the people selection before hiring them, and an accurate training.
- The peso deflation represents for auto-parts Mexican industry to compete with other foreign same industries. The prices of the products must be more attractive now than before.

1.3 National tendencies of the auto-parts industry.

The Mexican auto-parts industry presents, according to some experts, the subsequently tendencies:

- The Mexican auto-parts industry is in a deregulation process with the proposal to be internationally competitive, creating some resist to imports and generating the currencies that the industry requires.
- About country imports, the Mexican assemblers introduce more auto-parts today than before, conducing to losses for the national auto-parts industry. Mexican exports of assembled vehicles and parts are going up. In 1994 were made more vehicles for export than domestic consumption.
- NAFTA gives Mexico the attractiveness for being the exporter country. This is particularly true for United States and Canada markets. The attractiveness consists in taking advantage of the low labor costs and the free access to the

markets listed above. This attractiveness goes all the way to the auto-parts sector, where Foreign Investments keeps growing (Olvera, 2007).

1.4 Profile of a Mexican Auto-parts producer.

To understand the impact of the environmental facts of this industry in a particular one, we present the case of Trailers de Monterrey, S.A., a factory that is part of the Grupo Industrial Ramírez. It started its operation in 1946; this means a 50 years experience in the auto-parts industry. Nowadays the main activities consist in manufacturing and trading of brake devices and the assemblage of pots concrete mixers.
Following, the core capabilities map of this enterprise is shown:

Core Business

Manufacturing and trading of brake devices for trucks are the activities that generate more incomes for the enterprise Trailers de Monterrey S.A. Another activity that generates important incomes is the installation and assemblage of pots concrete mixers on trucks, which are directly imported from USA.

Core Processes

The needed processes for manufacturing brakes devices are:

- To guaranty the product uniformity and elevate productivity it is necessary the acquisition of supplies like steel and aluminum in intensive devices use.
- Welding, with certify welders, new welding equipment and defined processes.
- Hermetic, with adhesives tapes on ground, running boards and frontal and lateral panels.
- Sealer in higher running boards. Insulated of polypropylene non-corrosive tape in 5 sections of steel and aluminum. Avoid electrolyte corrosion.
- Baked paint with cleaning process, first, paints over all the components.
- To facilitate the service and maintenance cleaned air with no paint lines.

These brake tanks are traded all around the country and in some Center and South American countries.
Assemblage of pots concrete mixers is the other activity that generates a lot of incomes.
The pots are imported from USA, are more expensive than those produced in China but with more quality. Also, the aluminum needed for the welding is imported from the same country. The switch to aluminum instead that steel is present in these processes and even these are more expensive supplies, the cost/benefit in the long term is more convenient to the carrier. The main suppliers of this metal are in the USA.
These pots are installed in trucks that belong to the clients (enterprises). The clients move the trucks to the Trailers de Monterrey workshop and there are made the mounting and welding processes of the pots concrete mixers.

Core Competencies

According to some clients, the quality of the supplies used generates more value to this enterprise and the assemblage process that this enterprise do, which one has the experience of 50 years with international certifications in assemblage.

Core Technologies

The enterprise Trailers de Monterrey, S.A. has a high flexibility level at the assemblage of different models. It has an intelligent bodywork assemblage system that guaranty high precision levels at the integration of the mixer pots at different trucks models.

The specialist firm in welding and paint automation processes of the mixer pots and of the tanks of the air brakes for trucks.

Differentiation Vector.
Trailers de Monterrey, S.A. has advantages over his competitors in two main aspects: First by of the international certification it has, because his competitors do not have it and this is an important characteristic valued by the clients (enterprises) that install mixer pots. Another big advantage is that the pots come directly from USA, a known country because of the quality on its products.

Core Business Opportunities
Nowadays Trailers de Monterrey, S.A. sells its products (tanks of air brakes for heavy equipment) in the domestic market and in some Center and South American countries. With approval of the NAFTA it is a big opportunity to get in to the market, which one it's very competitive and the necessity to establish joint ventures will be present. Firms may start to think in other markets like Europe when they stability in USA.

Core Strategic Vision
Trailers de Monterrey, S.A. focuses its strategic vision in two fundamental aspects: First, the substitution in the imports supplies levels and the second is to create collaborative supplies nets with Mexican auto-parts enterprises to make production costs cheaper and be more competitive internationally.

1.5. SWOT analysis Trailers de Monterrey, S.A.
The analysis of the strengths, weaknesses, opportunities and threats of Trailers de Monterrey S.A. presents this situation:

Strengths
- People with specialized knowledge and certified auto-parts experience are available.
- Supply requirements are quick responded.
- Production lines based on global levels industrial standards.
- Competitive abilities have been allowing a stable increase.
- National and International prestige.

Opportunities
- As a consequence of the market aperture, an increase of the potential clients will be seen.
- A motivating exports Country Economic Policy.
- A chance to get associated with international firms.

Weaknesses
- No website that allows buyers and sell online.
- Not much Technologies of information investment.
- Very low R&D investment.

Threats
- Global competitors.
- Market aperture and FTAs are running on that create global investments.

- Cheaper labor in some countries like China and India.
- Unions creation.
- Resistance to some changes and administrative innovations from some workers groups.

2. CONCEPTUAL FRAMEWORK

Nowadays, the Mexican auto-parts sector is integrated by a thousand of companies; 70% are foreign investment firms and 30% national investment. From all the companies, 345 of them are first level manufacturers and the others are suppliers and raw materials (second and third level) manufacturers.

About location, most of the companies are located around the vehicles assemblers, to accomplish supply exigencies and delivery that the automotive industry requires.

Hereby, Nuevo León, Distrito Federal and state of Mexico are the three major entities with presence auto-parts companies and concentrate almost 53% of the national manufacturers.

Inside the manufacturer industry, the auto-parts are the second exportation product in this sector, after the vehicles. Finishing 2004, the auto-parts sector contributed with 8.1% of the manufacturers exportations.

2.1 Current importance of the Mexican auto-parts sector.

About the total domestic auto-parts production value, the sector has demonstrate an important increase when it changed from US$ 13,893 to US$ 22,419 million between 1994 and 2004, meaning an increase of 61%. The production has increased on an annual average of 4.9% in the last 11 years, a higher increase that the one presented by the total economy. In 2005, the Mexican auto-parts manufacture, registered an increase of 3.9%, reaching US$23,300 millions. (Asociación Mexicana de la Industria: AMIA, 2006).

In the other side, finishing 2004 the auto-parts national producers' sale reached a total amount of US$22,569 millions. From this amount, sales in foreign markets were of US$12,805 millions and the remainder was sales in the domestic market. From the total domestic auto-parts market, the billing was 69% of the original equipment and the remainder 31% was to the spares market.

About the trade auto-parts balance, in 2004 the direct exportations were of US$12,865 millions, while the importations increase to US$15,486 millions, resulting on a US$2,981 million deficit.

Even though this negative result, the trade deficit keeps diminishing, decreasing in 17.2% in comparison with the 2003 result. In 2005, the auto-parts exportations increase to US$14,805 millions, while the importations have an amount of US$14,856 millions, resulting on a US$771 million deficit.

Finally, about exportations destination, the auto-parts sales in the foreign is concentrated in 3 countries: Unites States of America (76%), Canada (3%) and Germany (3%). It is important to mention that Mexico is the third auto-parts supplier for USA, after Canada and Japan but before Germany (fourth place).

During November 2006, the production value of the auto-parts sector increase to a little bit more than US$2,225 millions, there were billed US$48 millions more than in

November 2005, meaning an increase of 2.2%, being posicionated as the sixth month with highest production level in the history and as the best November.

In an accumulate way, the auto-parts production value finishing the penultimate month of the year elevates to US$24,183 million, representing an increase of 11.4%. Even one year before the year finish, the production level was the highest in the history, surpassing the US$23,451 millions produced in all 2005.

As the auto-parts production presented an increase, the manufacture of vehicles and trucks surpassed the 2004 and 2005 numbers.

The total production of vehicles in Mexico closed with a 1,978,771 unities volume, a record never reached before.

President of the AMIA (Mexican Association of the industry), César Flores, affirmed that even though the registered increase in the entire automobile automotive industry sector, especially in the domestic market, this is incongruent with the increase of the economy, this because the GNP increase 4.6%, the inflation closed in 4.1% (Asociación Mexicana de la Industria: AMIA, 2006).

In all the main motives of this moderate increase are the ups and downs that generated the sports and politics events, an extraordinary increase on the medium type dwelling build and the expectations about the fiscal change that correspondent to the tax deductibility of 300,000 to 150,000 pesos that finally stayed in 175,000 pesos from year 2007.

This means that, 2006 finally was an atypical year that did not permit the expected increases to reach the sale of 1,200,000 vehicles.

On the production and exportation topics, Flores forecast increases of 30% and 35% respectively, for year 2007.

In the other side, the accumulated volume in 2006 was of 1,139,718 and marked a new record on sales in the domestic market, it means, 0.7% higher than in 2005, when it was registered 1,131,768.

The result in 2006 also marked a record on this industry, with 1,536,768 cars light trucks sent to foreign regions. 2006 represented a difference of 29.5% larger than in 2006.

The result on December 2006 was not larger than the one in the year before and it did not affect at the finish of the year.
As it was mentioned, the total production volume in 2006 is another record in the automobile industry when it reached 1,978,771, meaning 23.3% more than in 2005. In this area, the production for the market contributes 78.7% and for the domestic market 21.3% from the total produced in 2006.

The production numbers reached 2,063,484 vehicles, when all the following production was summed; heavy trucks, tractors-buses and buses.

2.1 Problem definition.

The Mexican auto-parts industry nowadays has a high dependency from the importation of raw materials and auto parts made in USA, China and Japan and some other countries from which it get supplied for the development of productive processes. Many of this importations can be substituted is the necessary mechanisms to produce in a national level get established, bringing an increase of the auto-parts industry and more competitiveness from Mexico in global scenarios. For this, it is necessary to create the better environment that generates the adequate production conditions. Some factor that may contribute is the creation of joint ventures to integrate productive chains that help to diminish the importations level and increase exportations at the same time.

Specifying the observed situation, we can see the problem as follows: The current production level in the Mexican auto-parts industry is very underneath from the optimum production which can be reaching if the adequate conditions, that allow the production level increase and the existent dependency of raw material importation to decrease, are created.

The objective we proposed in this investigation is:

Modeling the current situation of the Mexican auto-parts industry, designing scenarios that allow observe how the produced changes in sensible variables affect the behavior of the generated model.

This model could help to test some hypothesis:

- The creation of the adequate conditions that let increase the national auto-parts production levels and diminishes the existent dependency of raw material importation from other countries.
- The quality levels increase of the auto-parts industrial production in Nuevo León and diminishes the supplies importation.
- The production costs reduction on the auto-parts industry in Nuevo León is very important for the supplies importations substitution.

3. CAUSAL LOOP DIAGRAM

This diagram showed below intents to represent all the facts mentioned before, trying to capture the essence of the situation. The Table 1 shows the definition of the whole set of variables.

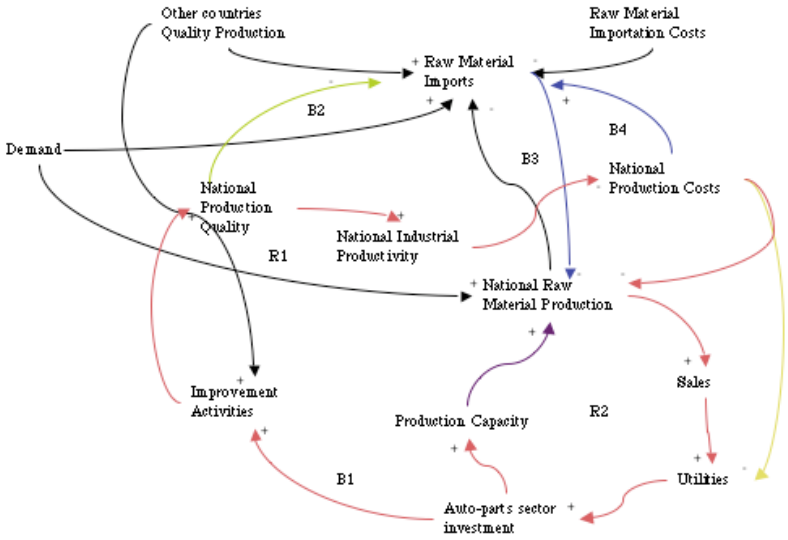

Fig. 1 Causal Loop Diagram

Variable	Description
Importations demand	Desire of consumers of raw auto-parts material to acquire products (raw material) imported from foreign countries.
Demand surplus production	The difference between the national demand and the production capacity, in other words is what the country is not able to produce and the consumers demanded.
Production capacity	The maximum reachable production using all the resources available.
National demand	Desire of consumers of raw auto-parts material to acquire national products (raw material).
Raw material national production	The quantity of finished goods that are made in the auto-parts sector from the country.
Raw material importations	The quantity of supplies that the Mexican industry imports for the auto-parts production.
Importation costs	Total costs that are needed to paid to bring a product (raw material) to the country. Example.- taxes, products costs, etc.
National Industrial productivity	Is the relation between the products quantity that are made versus the resources that are available to manufacture them.
National production costs	Financial resources used to produce finished goods.
Incomes	Profits that manufacturers receive from the products when the costs are discounted.
Sales	Raw material acquire by the sector produced domestically..
Auto-parts sector investment	The relation between one year incomes and the planned to be invested in the sector.
Sector investment rate	Factor that determines when it is planned reinvest in the industry.
Other countries production quality	Measurement quality of the global productive processes parameters.
Quality Gap	The difference between the national production quality and the foreign countries production quality, these variables also works as pressures in the sector to motivate to be better.

Improve activities	Actions taken in the industry to promote productivity (be more efficient) based on the quality factors.
National production quality	Reached quality by national companies in the auto-parts sector.

Table 1 Variables Definition

3.1 Histories behind the feedback loops.

Next, the description of the different feedback loops that comes from the causal diagram is shown:

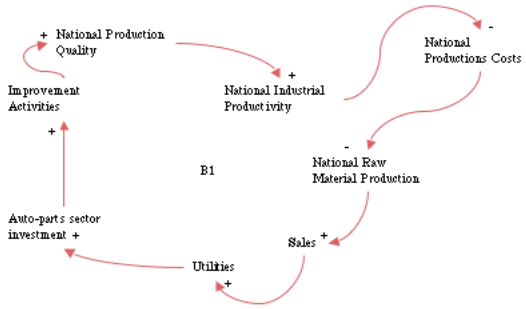

Fig. 2 National Raw Material Production Loop

This loop indicates that if the national raw material production rises, the sales will increase. More sales will generate more incomes allowing an increase on the auto-parts sector investment prompting more activities of improvement. If the activities of improvement increase, the national production quality will be larger. A larger national quality, an increase on the national industrial productivity will be seen. If a big industrial productivity exists, costs will diminish, and finally will cause an increase on the national production.

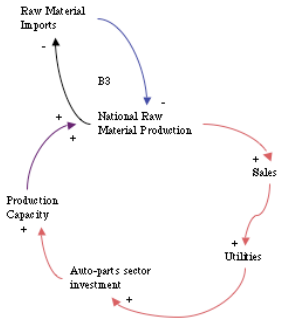

Fig. 3 Raw Material Importations Loop

Raw material imports diminish if the Mexican raw material production increases. In this way, if the production increases, sales will increase, and this will generate bigger incomes number. If incomes increase, more investment in the sector will be generated.

The investment increases the production capacity, affecting positively the national production.

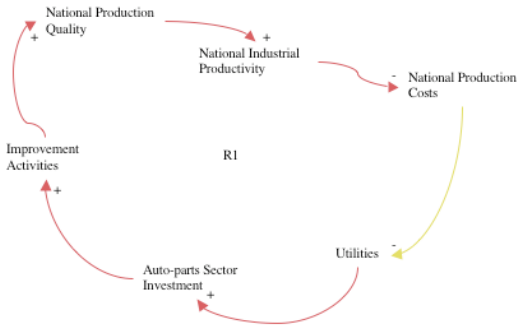

Fig. 4 National Production Quality Loop

If the National Production quality rises, the national industrial productivity will be affected positively. If the industrial Productivity increases, the National Production costs diminish. If the costs diminish, then incomes rise. If incomes are high, the auto-parts sector investment increase. This generates an increase in the activities of improvement; more activities of improvement, national production quality gets better.

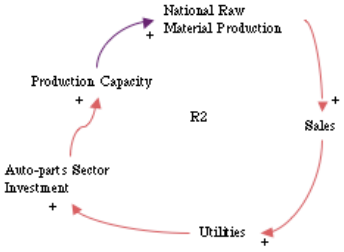

Fig. 5 Production Capacity Loop

When the Production Capacity increases, the national raw material increases too. If the production is larger, national sales will rise. This generates larger incomes, prompting the investment in the sector. If the machines investment increases, as a consequence the production capacity increases too. If the production capacity is larger, then the raw Material production increases.

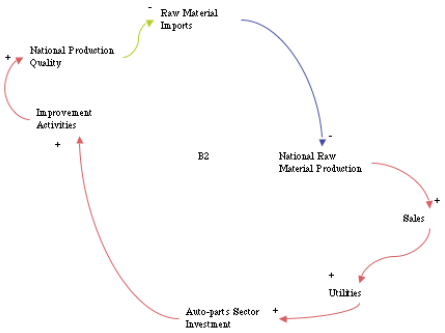

Fig. 6 Importations versus National Quality Loop

If the National Production quality rises, the importations diminish. If importations diminish, the national raw material Production increases. When the national production

is large, sales increase. More sales, more incomes will be. This last thing causes more investment in this sector; if the sector investment is high the activities of improvement increase. Finally, if there are a lot of activities of improvement, production quality will rise creating the cycle.

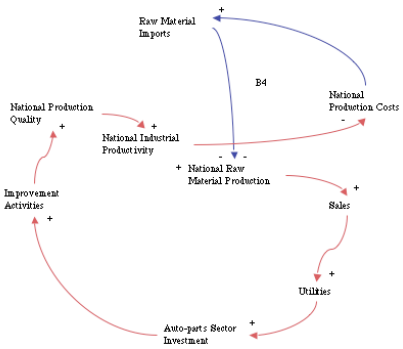

Fig. 7 Importations versus National Production Costs Cycle

If the national Production Costs rise, the raw material importations rise too. When the importations increase, the national production decreases. If the production diminishes, sales will diminish too producing a decrease to the incomes. If utilities decrease, the auto-parts sector investment will be less, producing a decrease on the activities of improvement. If the activities of improvement are few, the national production quality falls down producing that the national industrial productivity diminishes. If the industrial production diminishes, costs rise closing this loop.

4. SIMULATION MODEL.

Stock and flows diagram allows representing physical flows accumulations that can be measure directly. The levels report the system conditions in a time point (Sterman, 2000). Next, the auto-parts diagram is presented.

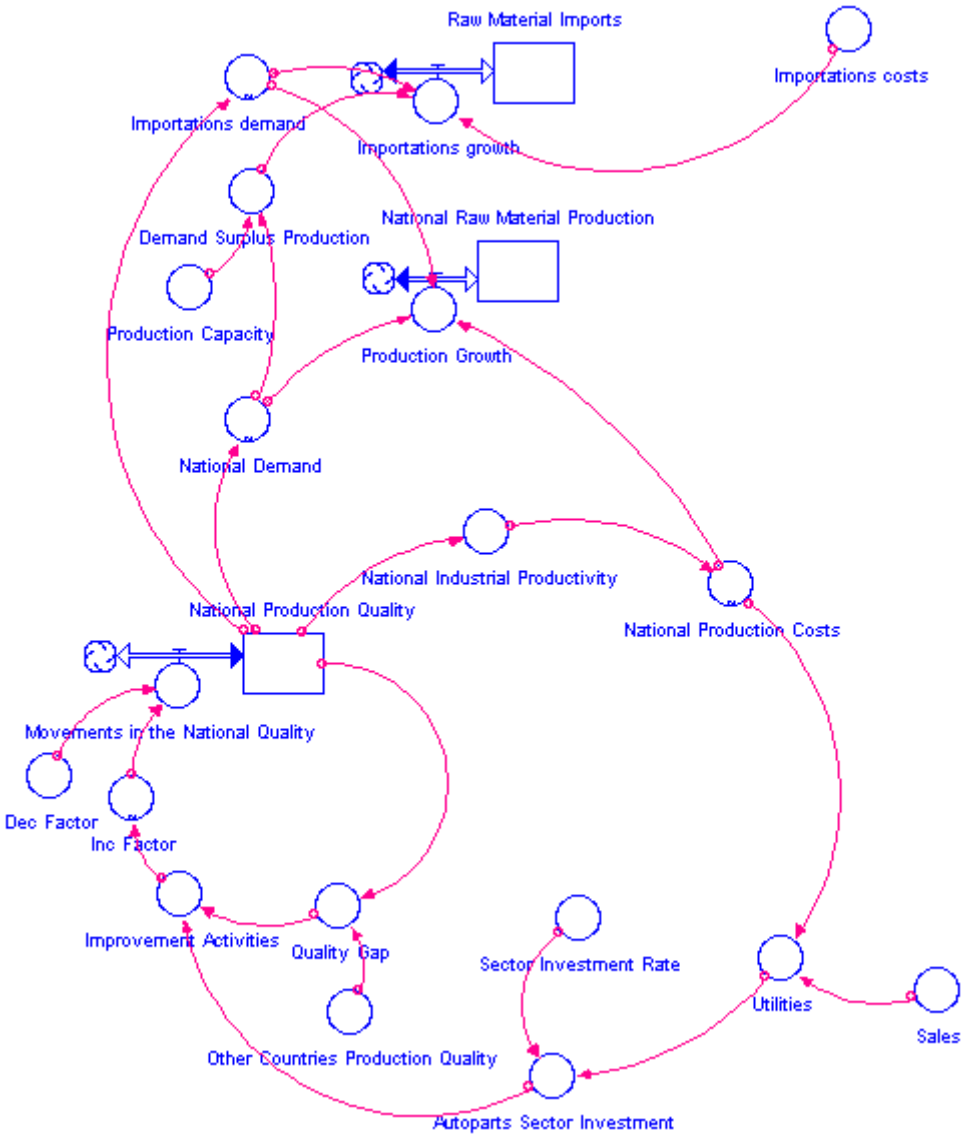

Fig. 8 Stock and flows Diagram

4. MODEL BEHAVIOR.

In this part of the investigation some equations will be introduce to the variables that conform the model to be able to see the generated behavior. The first model run is represented trough some graphs. The definition of the equations is presented in the appendix one.

4.1. Base Run.

Once all the equations are in the model, the results can be observed in the Fig. 9. and table 2.

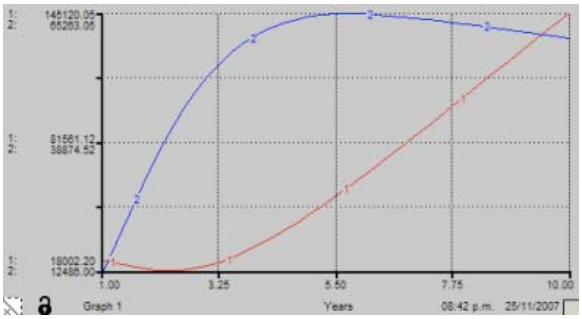

Fig. 9
Behavior of the Raw Material National Production and the Raw Material Importations

Years	Raw Material Importations	Raw Material National Production
Initial	12.486,00	22.419,00
1	35.512,43	18.283,37
2	52.276,42	20.428,27
3	61.013,12	30.612,10
4	64.681,43	45.873,40
5	65.194,76	64.298,17
6	64.360,91	84.075,09
7	63.085,06	104.295,86
8	61.648,05	124.678,45
9	60.152,29	145.120,05

Table 2 Base Run

In the current model, simulated to 10 years, reflects a decrease on the national production for the first year, while the imports increase doubling-up in the same period. From the third year, the national production gets better and keeps its constant increase for next years. In the last two years suffers an accelerated increase compared to the other periods increase. Importations keep increasing slowly to the fifth, from the sixth year importations decrease slowly.

The supported causes for this behavior are that in the first year, the quality of the national products is 0.8 versus 0.99 of the international standards. This generates a national productivity decrease impacting the productions costs in the country. Even though, sector investments increase for the next year, impacting positively in the implementation of activities of improvement, diminishing the Quality Gap.

If the Mexican products have similar quality that the international standards and the costs production can get optimized, the Mexican auto-parts demand will considerably go up, doing Mexican being positioned in preferred demand places, reducing considerably the imports. Even though Mexican market is recuperated, imports are an important factor that stimulates the auto-parts industry developments, making impossible to disappear them completely. Importations prompt competence and clear doubts about the national products quality, generating the necessity of sector investment, beneficiating the Mexican society.

About costs, it is really important to let know that when conditions in the industry get better (conditions: national productivity, sector investments, quality, production

capacity), national production costs diminish substantially, creating higher competitiveness in the national products. If importation costs are larger than the production costs, the number of importations will increase, in the contrary case, the national products demand will be bigger.

Finally, the conclusion that the model throws is that importations are needed for the national industry development; nevertheless, if Mexico creates conditions to improve auto-parts raw material production, it will be able to obtain a higher market participation in this sector, creating enough incomes to fortify the national industry and be known internationally.

5. SCENARIOS DESIGN.

In the policies analysis some sensible variables from the model were identified, policies were defined, related variables to such policies were identified, values and parameters to test with the variables were selected, the model were run again with the parameter definition and finally the obtained results were analyzed and documented.

5.1 Sensible Variables Definition.

There have been defined three exogenous variables as sensible because when its values are modified, they affect the model trough the time in a really radical way. The variables are listed below.

Raw Material Importation costs: Represent the total raw material importation cost from a foreign country. The costs of buying the raw material outside the own country affect directly the model because if there are no tariffs and this makes that the foreign raw material being cheaper, there will be a tendency to acquire it instead of consuming the produced inside the Country.

Sector Investment Rate: Factor that determines when it is planned to reinvest in the industry. More investments in the sector will produce results more evident and directly related to quality trough the activities of improvement.

Production Capacity: The maximum reachable production in the industry with the current resources and infrastructure. This variable gives exogenous value and is considered as sensible because it can be affected by events that affect production conditions in the country like political problems like strikes.

5.2. Scenarios Design.

Four scenarios were generated considering to dimensions: Earnings (vertical axe) and Quality (horizontal axe).

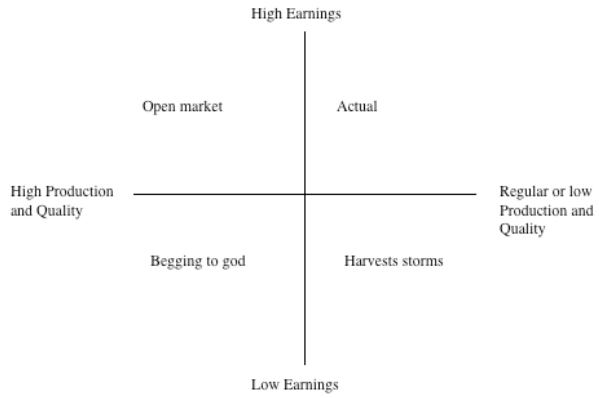

Fig. 10 Scenarios Design

Scenario 1 (Open market):
With the international agreements creation like TLC, tariffs can be eliminated producing a way down on importation costs, resulting in an increase of importations.
Scenario assumptions: Imports tariffs elimination on the auto-parts raw material sector.
The results are showed in the Fig. 11, considering a time horizon of ten years and Table 3 shows the generated values because of the tariffs elimination.

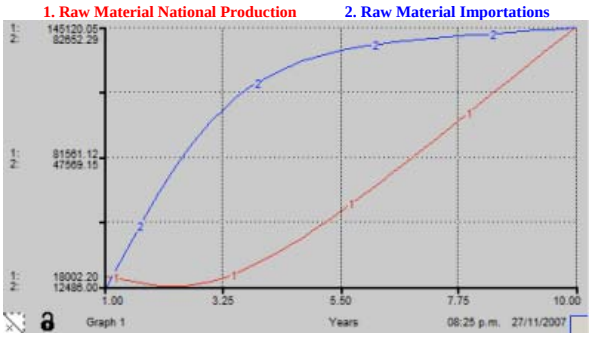

Fig. 11
Scenario 1 “Open market”

Years	Raw Material National Production	Raw Material Importations
Initial	22.419,00	12.486,00
1	18.283,37	35.512,43
2	20.428,27	52.276,42
3	30.612,10	61.013,12
4	45.873,40	64.681,43
5	64.298,17	65.194,76
6	84.075,09	64.360,91
7	104.295,86	63.085,06
8	124.678,45	61.648,05
9	145.120,05	60.152,29

Table 3

Tariffs elimination

From this graph we can see that the first year, importations are less than the national production, nevertheless, next year there is a considerably increase, generating that the Mexican production falls down approximately an 8%. Next years, importations dominate the national market but for sixth year importations start to get stabilize and decelerate their increase, allowing the Mexican market to recover some part of the market. Nevertheless, importations keep growing.

As a conclusion of this scenario, it is important to let know that open market policies do not represent a barrier for the national growing, to the contrary, they generate the necessity of create the needed conditions in the industry, allowing to keep the production numbers to maintain without going down some year. Presence importations keep in the country even though the national market conditions get better.

Scenario 2 (begging to God).

If the Mexican auto-parts sector gets investments, the resources will increase, such as activities of improvement to rises the quality in the national products, generating an increase in the national production. Nowadays there are investments rates of 40%.

Scenario assumptions: The programs development that prompt the foreign and national investment in the auto-parts sector to generate an increase on the investment in an 80%. The obtained results for scenario 2 are shown on the Fig. 12 and Table 4 shows the obtained results by prompt on foreign investment.

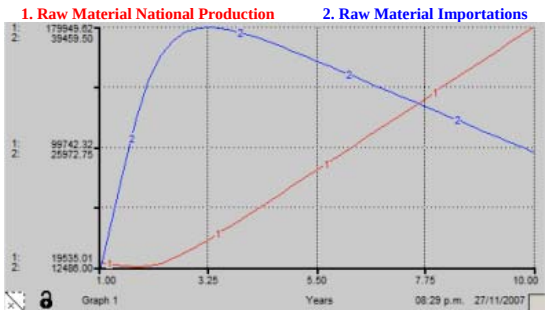

Fig. 12
Scenario 2 “Begging to God”

Years	Raw Material National Production	Raw Material Importations
Initial	22.419,00	12.486,00
1	20.075,86	33.725,19
2	33.377,64	39.349,82
3	52.898,86	38.770,71
4	73.874,91	36.745,46
5	95.070,34	34.504,15
6	116.288,46	32.240,49
7	137.508,71	29.974,72
8	158.729,15	27.708,77
9	179.949,62	25.442,79

Table 4

Results from prompting on the Foreign Investment.

In this situation it is observed that raw material importations increase less than in the previous scenario, causing a control over the national production. It can be seen an evident and accelerate increase on the national production, while the importations grow very slowly and for the year number 8 start to decrease.
It is concluded with this scenario that the support by the government is crucial to prompt the auto-parts national increase. If there are programs that finance the industry development, a significant increase can be obtained in the auto-parts industry, taking some market from the importations.

Scenario 3 (Harvests Storms):
In the Mexican auto-parts sector there are constant problems related to strikes or economic instabilities that affect the national production. In this scenario it is modeled the impact generated by strikes and the national production capacity. Nowadays it is estimated a production capacity of 26,903 Millions of pesos.
Scenario assumptions: The strikes in the sector produce a decrease on the production capacity, reducing it to its half current capacity.
The obtained results with the Scenario 3 design are represented in the Graph 4 and table 5 shows the results obtained by the rise of strikes in the Mexican auto-parts sector.

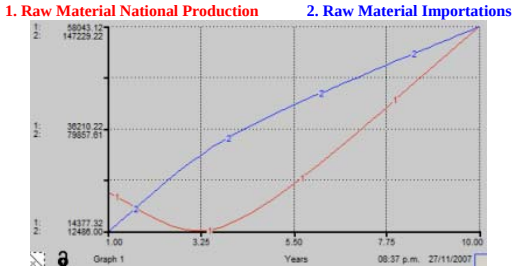

Fig.13
Scenario 3 “Harvests Storms”

Years	Raw Material National Production	Raw Material Importations
Initial	22.419,00	12.486,00
1	17.430,43	36.365,37
2	14.433,64	58.271,05
3	16.090,36	75.534,87
4	21.280,15	89.274,68
5	27.889,44	101.603,49
6	35.171,38	113.264,62
7	42.718,96	124.661,96
8	50.363,38	135.963,12
9	58.043,12	147.229,22

Table 5
Results produced by the rise of strikes in the Mexican auto-parts sector

The information obtained with the implementation of this policy indicates that the reduction of its production capacity impacts on the national production. In the information it is easy to observe that the production gets reduced to a half of what

would have in normal conditions, while importations rise as a consequence of the disregarded demand.
As a conclusion it is observe that the social problems that this sector faces in Mexico influence directly and in a negative way on the national production, causing a big increase in imported products and a slow advance on creating the necessary conditions to create a competitive sector and generate more profits to the country.

6. CONCLUSSIONS

The investigation developed allows us formulate the conclusions shown below:
The auto-parts industry is a sector that gets affected directly and indirectly by some diverse variables that make a complex simulation model. Specifically in Mexico, the industry gets affected directly by three reasons: Quality standards, Productions Costs and the Production Capacity that respond to the auto-parts demand. Around these variables, are related some other aspects that need to be in consideration to realize a more close to reality simulation.
The simulation of the industry demands a deeper knowledge of the sector, in a domestic and global level, nevertheless, to generate a close to reality model implies a lot of time (more than the time implied to make this document). As a result, the presented model and simulation in this paper just represents a minimum approximation to the Mexican reality, and some adjustments on the variables definition need to be done to achieve a more close to reality model about the industry situation.
So far, we can conclude that the Mexican auto-parts industry situation in the next 10 years needs to increase the quality of their products in order to reduce the importations. The good news are that, since the importance of this industry in de Mexican economy, the government is willing to support this development.

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APENDIX 1: Equations definition

Importations Demand: It is the relation between the demand and quality, traduces the percentage to pesos trough the graph.

Demand surplus Production: Is the production capacity minus the national demand that produces a demand surplus (what's impossible for the country to produce limited by the production capacity).
Production capacity – National demand

Production capacity: Is the limit that a country can produce with the current characteristics, if there is 100% productivity it would produce at the production capacity.

National Demand: Converts the quality of national production (percentage) to pesos trough the graph.

National Raw Material Production: Accumulates the production, to be able to observe it trough the time and apply increases and decreases by the bi-flow valve. According to INEGI information, in 2004 the production was of 22,419 Millions of pesos.
Initial value= 22,419 Millions of pesos.

Raw Material Importations: Accumulates the importations with objective of being able to observe it trough the time and apply increases and decreases by the bi-flow valve. According to INEGI, in 2004 importations were realized for the amount of 15,486 Millions of pesos.
Initial value= 15,486 Millions of pesos.

Importation costs: Total costs for paying the right to bring a product (raw material) to the country, for example: taxes, products costs, etc. According to some information found on the republic presidency the importations were for 2,500 millions of pesos.
Value= 2500.

National Industrial Productivity: Shows the reached productivity by the sector in the observed year.

National Production Costs: Converts the productivity in percentage to costs, showing the relation that exists in the costs reduction by the productivity.

Incomes: Shows the profits obtained by the sector, once the costs are already reduced.
Sales – National production costs.

Sales: Total raw material sold in the sector. According to INEGI information, in 2004 there were sold 22,569 Millions of pesos in the sector. 22,569 Millions of pesos.

Auto-parts sector investment: It is the quantity in pesos that is invested in the sector.
Incomes*

Sector Investment Rate: Factor that determines when it will be a reinvestment in the industry.
With data collected from INEGI a comparison were made between the production versus investment in the sector, where the Investment is divide by Production.
Value= 0.4

Other Countries Production Quality: Parameter for quality measure of the productive processes in the world. This factor is obtained as the result of the national production standard Six Sigma, which shows that for every 10,000 products, 3 can be deficient.
Value= 0.999997.

Quality Gap: The difference between national production quality and the other countries production quality, this variable works too as pressures to motivate to sector to be better.
Other Countries Production Quality – National Production Quality.

Activities of Improvement: By multiplying the Gap with the Investment it is possible to see the existing pressure in the sector as a Gap consequence, while more extensive the Gap is, more investment will be in Activities of Improvement.
Auto-parts sector investment * Quality Gap.

Production Quality: The current quality in presented in the sector, this block the main part o the goal-seeking archetype.

Importations increase: Determines the increase or decrease of importations produced by the demand, costs and production that the country was not able to reached.
Importations Demand – Importation Costs + Demand Surplus Production

Dec. Factor: Shows the sector tendency that it is impossible to reach 100% in quality. According to INEGI the quality in the processes has been in increase like the shown below (using the year 1993 as a base to compare increase). Average= 0.8%.

Inc. Factor: Converts the activities of improvement to increase percentages in the national quality.

Movements in the National Quality: Blind the growth and decrease factor, producing alterations in the National quality. (National Demand – Importations Demand) – National Production Costs.