Mexico's Learning Process: interaction between transnational corporations and their supplier networks. The evolving role of industrial property in the 21st Century

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KDI International Conference

KDI Main Conference Hall, Seoul, Korea
18-19 February 2010

Intellectual Property for Economic Development: Issues and Policy Implications

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Key Question

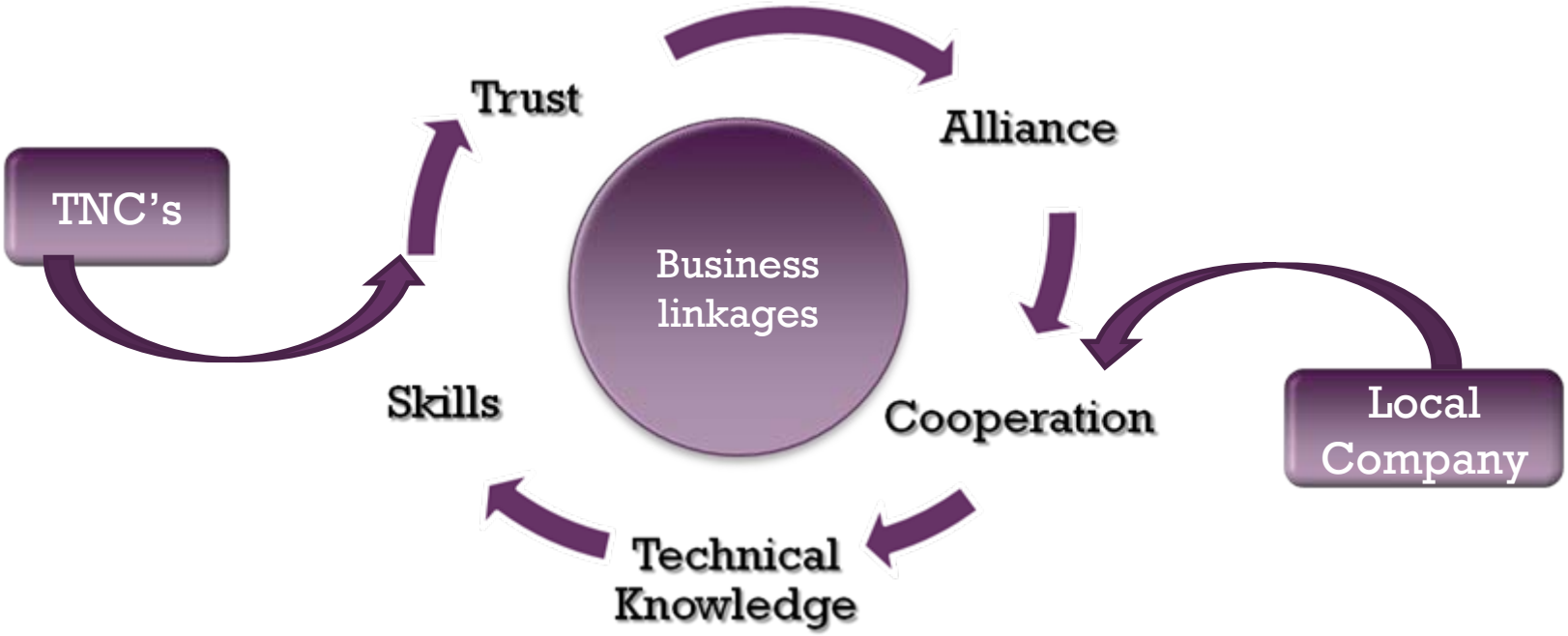
Key Question: is there room for patents in the supplier networks of TNC's?

Learning Process in local producers, TNC's and Innovation

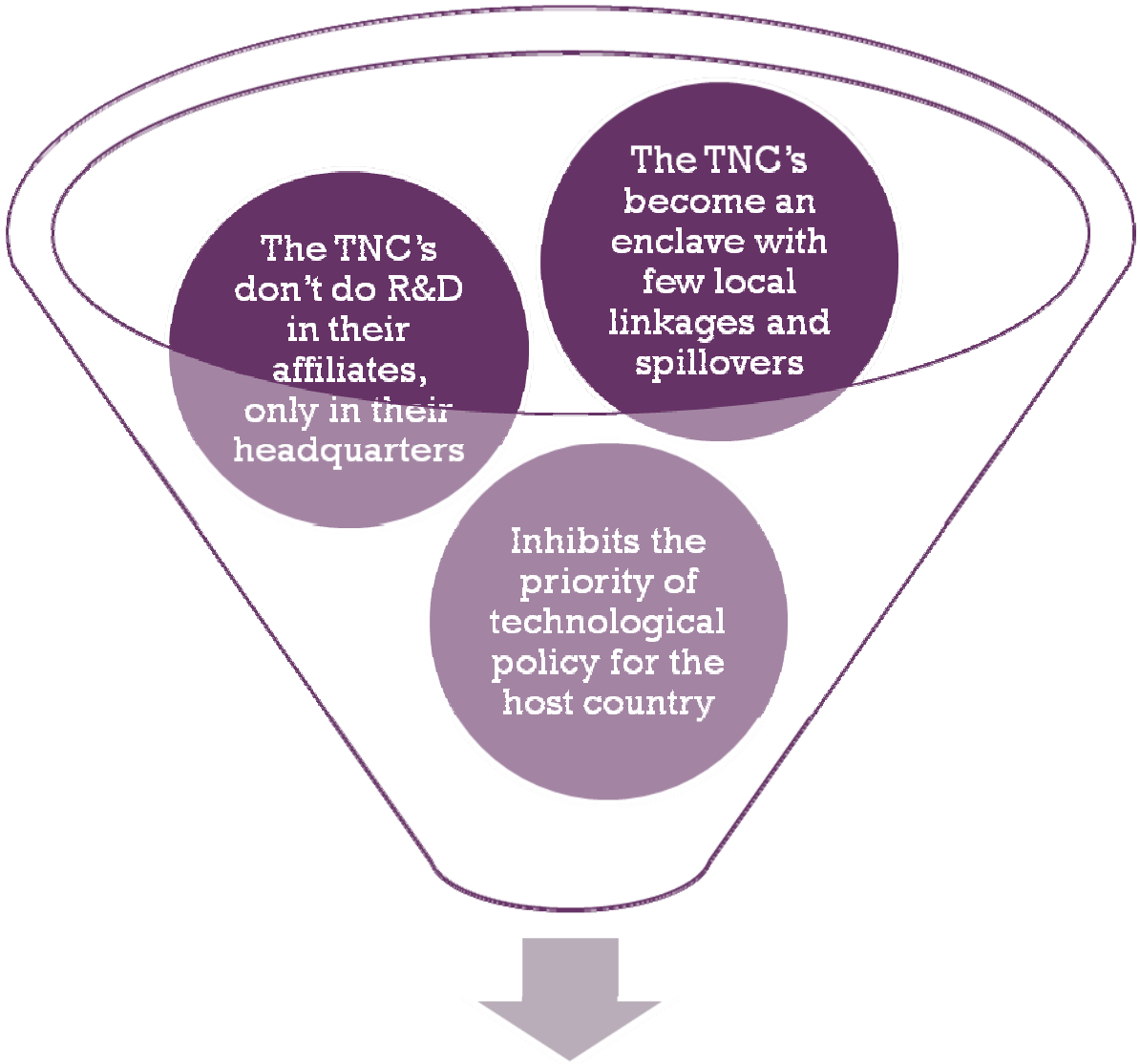
Learning Processes in local businesses, TNC's and Innovation

Transnational corporations (TNC's) have been an important mean through which local producers can access to new technologies and knowledge management.

Strong business linkages between TNC's and local producers can generate a relationship of trust, alliance, cooperation, technical knowledge, and skills.



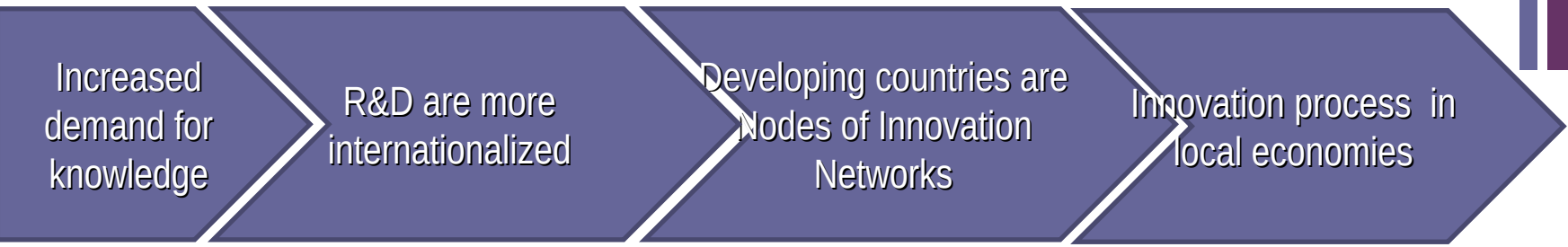
A potentially important source of competitive advantages for TNC's is the capacity of their foreign subsidiaries to generate innovations based on stimuli and resources encountered in the heterogeneous host country environments. In this sense, FDI may also be interpreted as a mechanism through which firms seek to develop new resources and capacities on a global basis (Kogut and Chang, 1991; Teece, 1992; Westney, 1990).



Negative effects of FDI

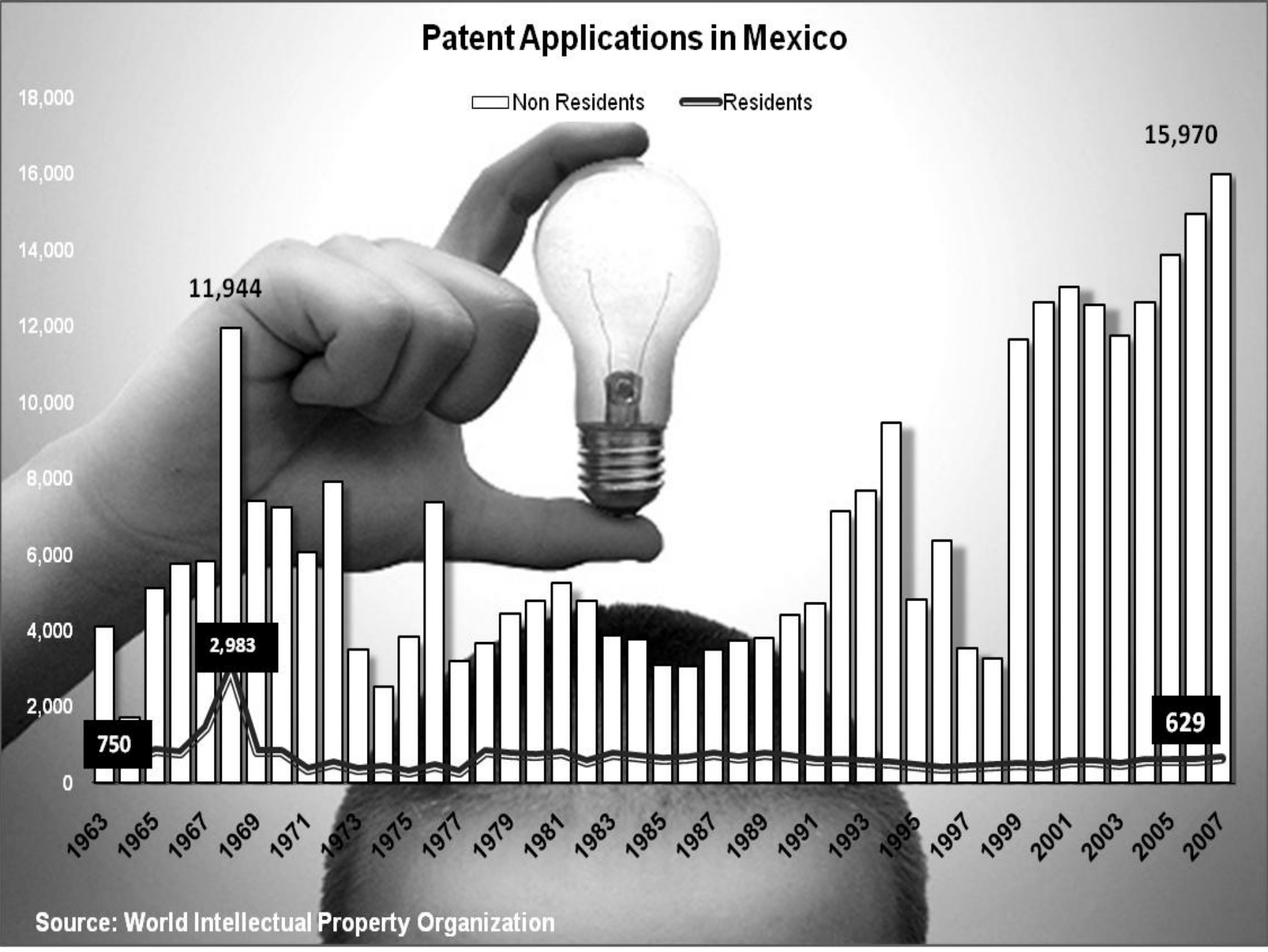
Positive effects of FDI

Current Trends in the Participation of the Global Value Chain, favors local producers and local economies.



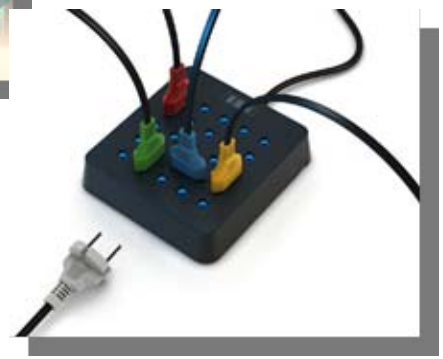
Although this has positive effects in host economies property rights are kept by TNC's, as innovation processes remain within the TNC's network (parent – subsidiary – innovation network).

There may be exceptions, but developing countries should develop better strategies for **Intellectual Property**, which take into account the development, ownership and use.


Patent Applications in Mexico
Non Residents
Residents
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
11,944
15,970
2,983
750
629
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
Source: World Intellectual Property Organization

Industrial Property in Mexico

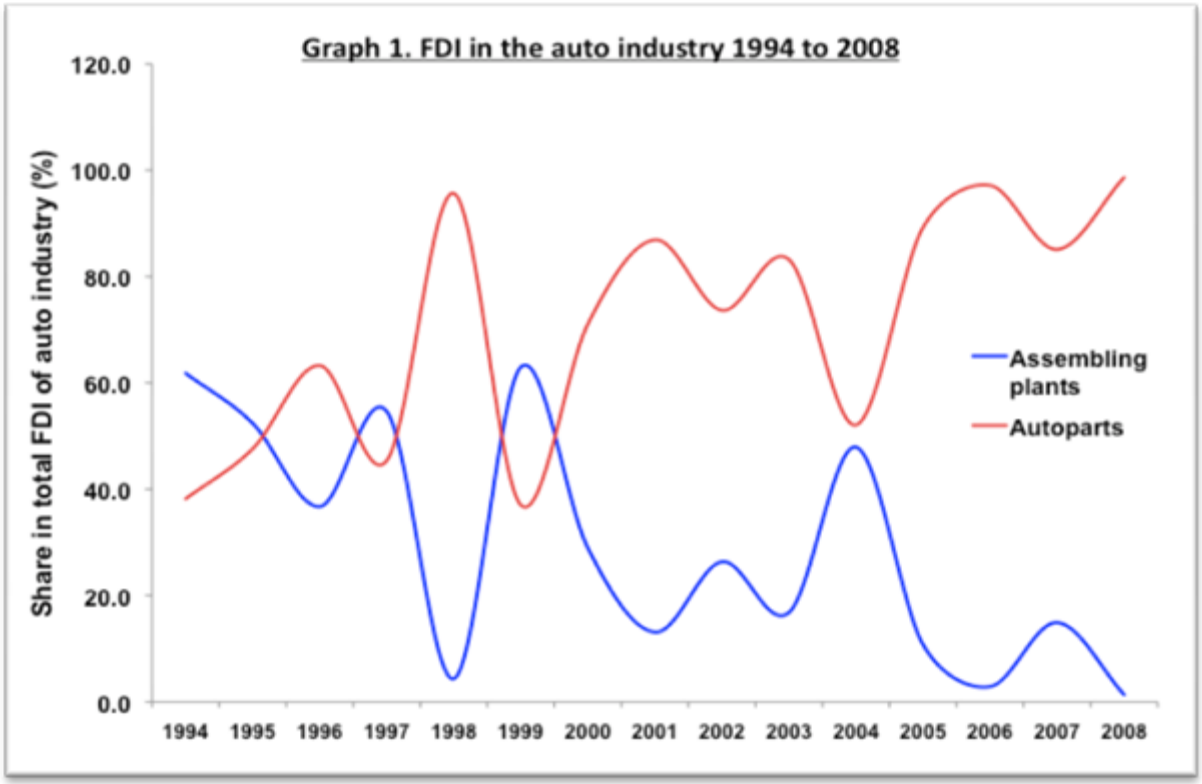
Category Application in Mexico 2007			
Property	*Residents*	*No-Residents*	*Total*
1 Industrial Design	943	1,939	**2,882**
2 Patent	629	15,970	**16,599**
3 Trademark	54,610	28,606	**83,216**
4 Utility Models	413	69	**482**
Source: Statistics on Patents, WIPO			



FDI in the automotive industry and local producers

FDI in the automotive industry and local producers

FDI becomes part of a more complex process when the relationship extends beyond the subsidiary structure, as supplier networks are developed. After NAFTA, the investment went from assembly plants to auto-parts production, to build the second and third tier supplier network to promote a solid hiring process in Mexico.




61%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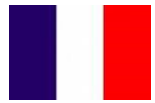
6%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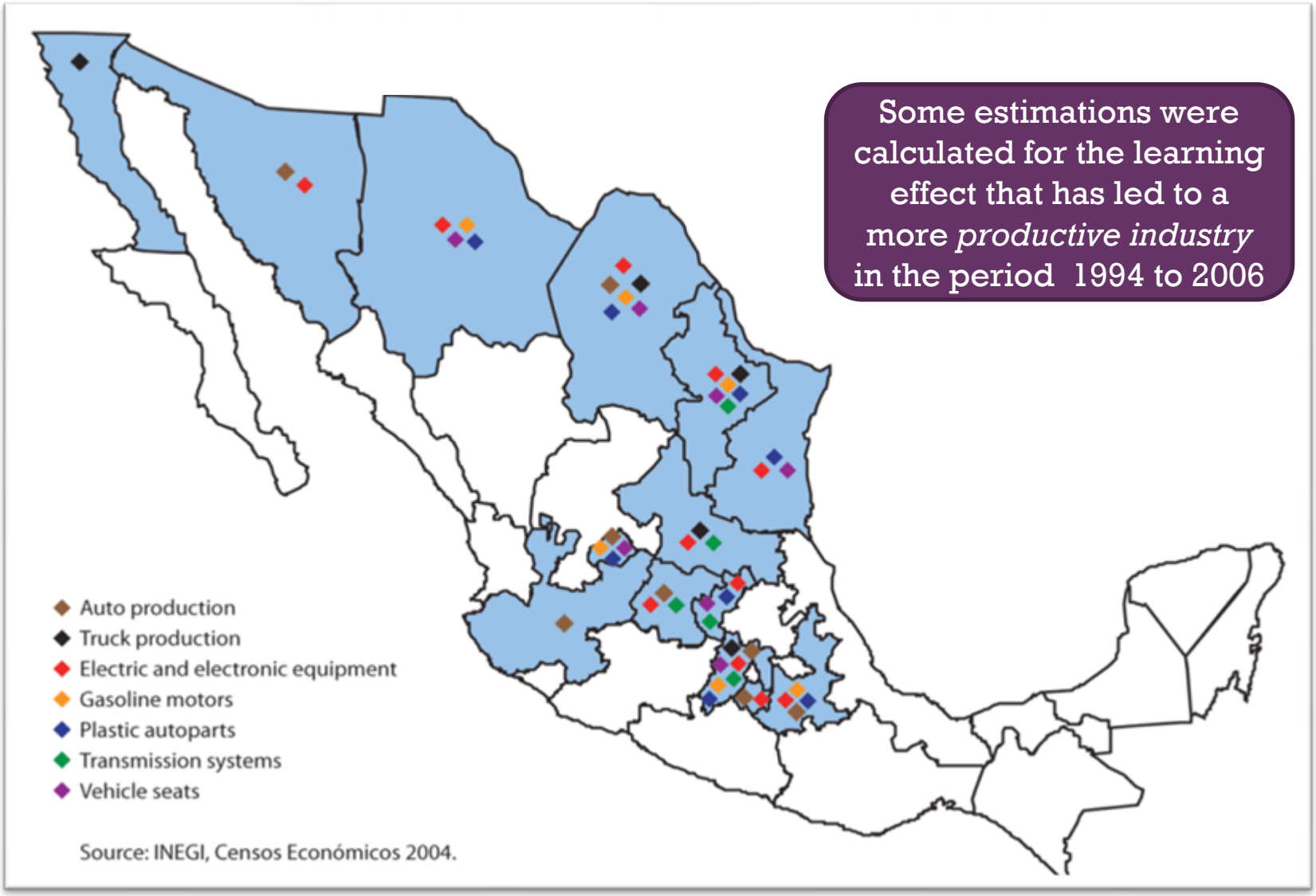
Source: Own estimations based on INEGI.

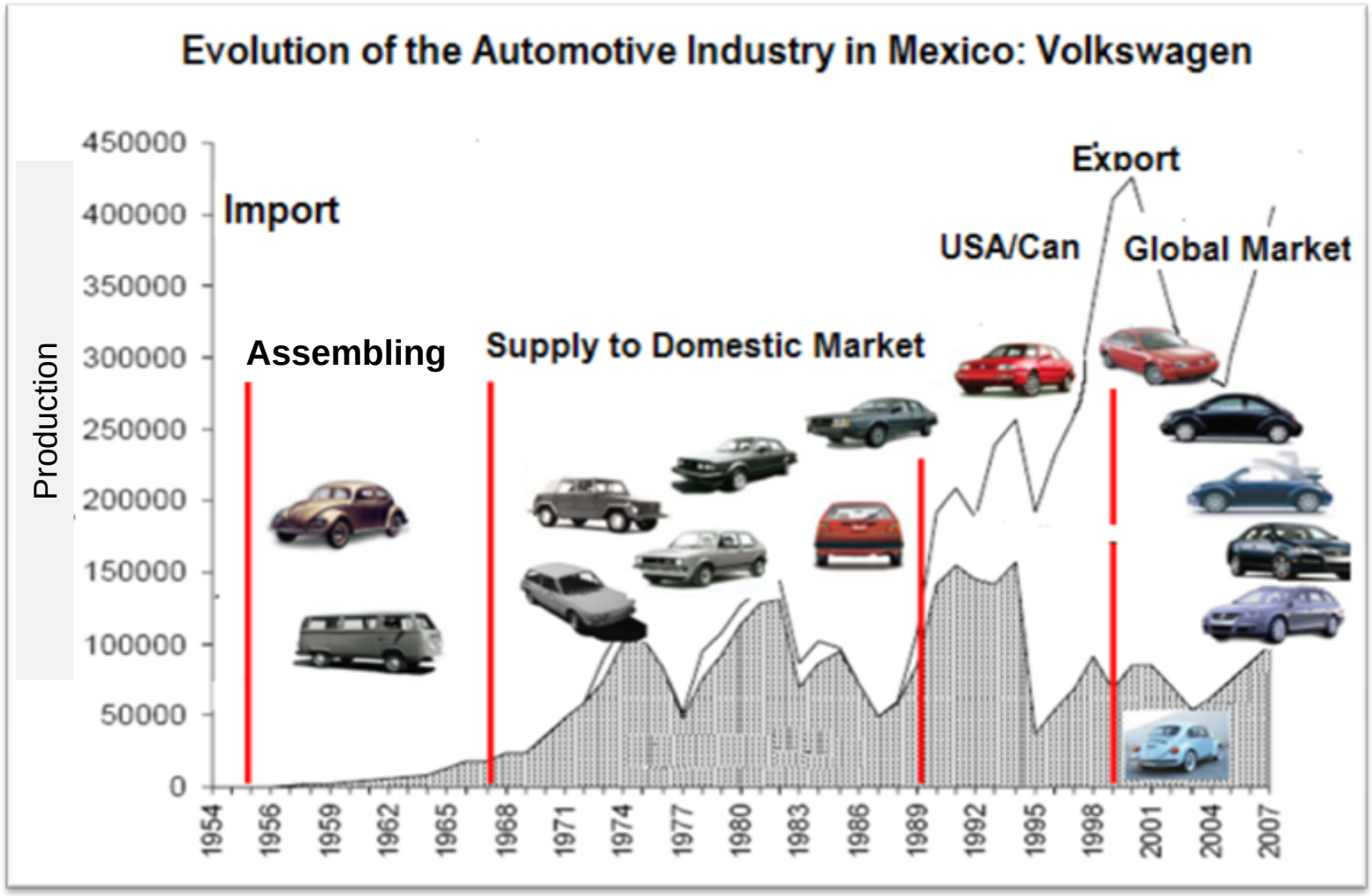
The Automotive Industry in Mexico



Automobile and Auto parts Industry Productivity

Year	Auto Industry (3841)	Cars Assembling Plants (384110)	Trucks Assembling Plants (384121)	Motor Production (384122)	Transmission Parts (384123)	Suspension Systems (384124)	Brake Systems (384125)	Other Components and accesories (384126)
1994	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1995	94.6	96.6	53.9	97.4	50.6	83.1	85.5	99.0
1996	129.7	142.6	67.9	107.5	88.1	106.1	109.5	131.6
1997	134.4	154.1	77.8	106.6	98.7	109.4	109.5	138.9
1998	127.8	146.0	84.8	100.2	109.6	100.4	120.3	125.2
1999	142.2	158.9	99.9	107.4	135.1	115.4	134.5	140.8
2000	169.9	195.7	142.6	113.1	142.4	121.1	157.0	167.4
2001	183.8	208.5	147.1	118.4	150.3	114.5	153.6	187.5
2002	189.0	217.4	137.3	122.1	147.2	127.6	159.5	190.3
2003	182.1	213.9	122.8	125.9	140.0	136.8	156.0	181.0
2004	194.8	231.7	145.7	149.9	157.8	156.7	165.4	189.0
2005	211.8	258.5	179.3	151.1	163.6	173.5	194.2	184.5
2006	229.7	275.8	214.4	145.7	167.9	209.0	191.6	192.6
2007	235.8	267.3	450.1	145.1	232.6	240.3	231.9	191.7
2008	203.2	228.2	407.4	121.5	208.0	185.7	191.7	160.7

Source: Own estimates based on data base of INEGI. Encuesta Industrial Mensual CMAP

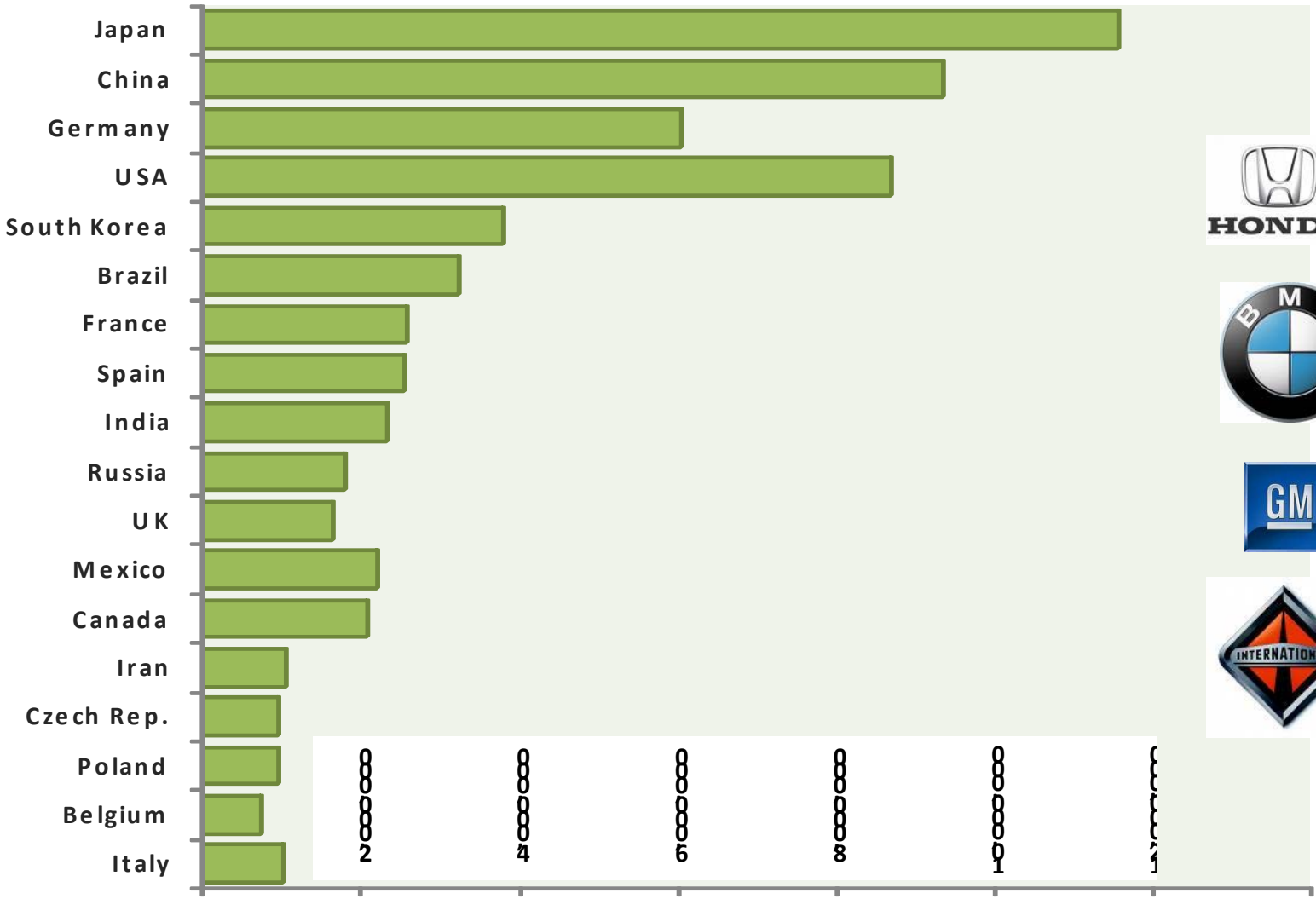


The redesigning of FDI led to an increase in the number of auto and auto parts establishments

1,978 Firms

Source: INEGI, 2004.

Production Statistics: Worldwide Automotive



Source: OICA, 2009

Research Methodology

Research Methodology

- The aim was to identify producers who developed innovation processes and register patents.
- This methodology was carried out in three phases:

Phase 1. Identification of Information Sources

National Auto Parts Statistics provided by INEGI

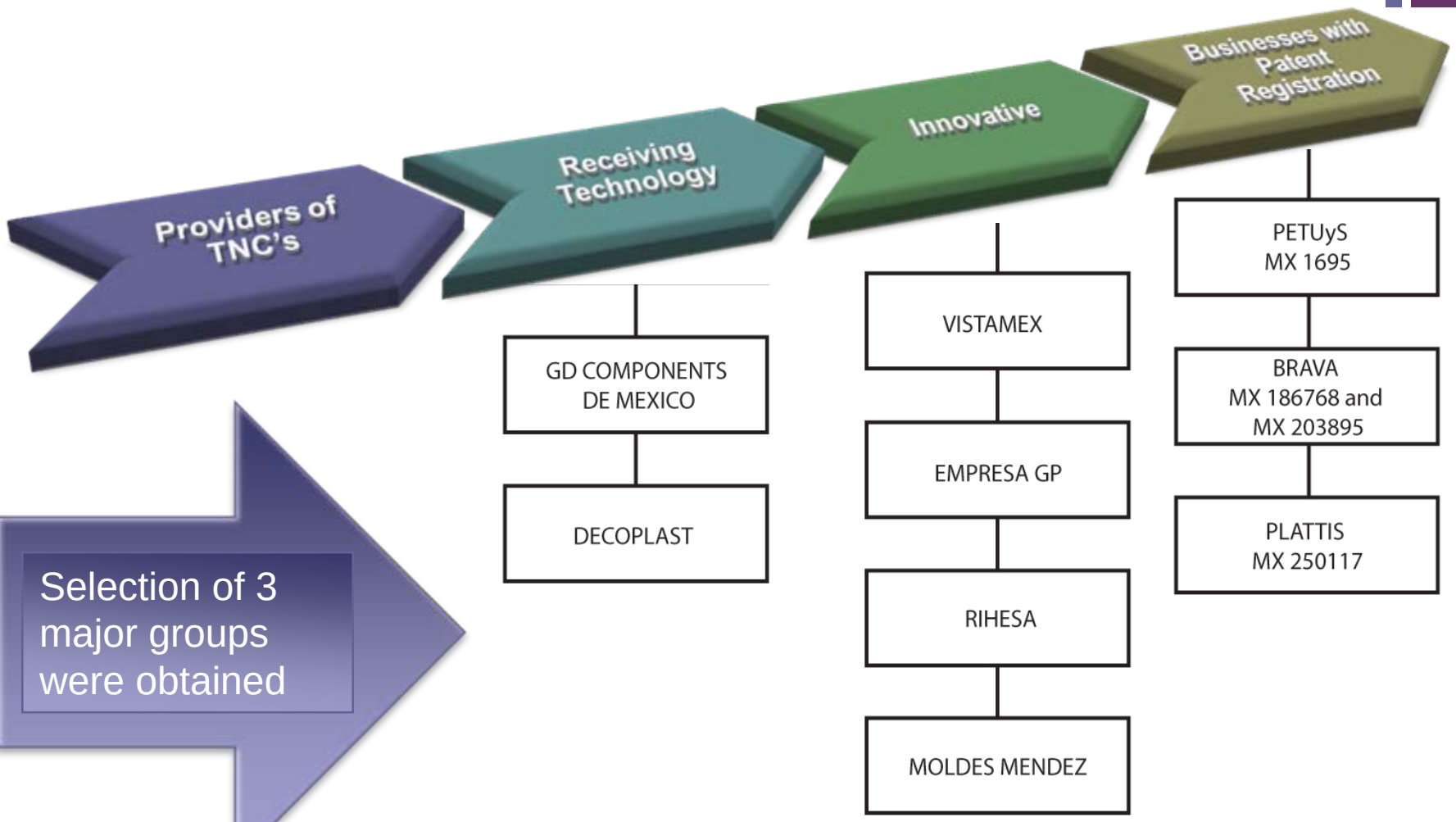
Mexican Institute of Intellectual Property

World Intellectual Property Organization

Phase 2. Use and management of information

Phase 3. Companies surveys

. Firms surveys



Identification of Learning and Innovation

Identification of Learning and Innovation

The first group of enterprises have technology transfer by customers, they do not have innovation and hence no possibility of patenting.

The second group of companies receive technology transfer by their clients, have a significant degree of innovation, design and development, focusing on innovative design, however, despite the development, they do not have patent filing.

The third group of companies, is characterized by innovation and development of patents.

Lessons learned, policy recommendations and future perspectives

+ Lessons learned, policy recommendations and future perspectives

Technology Learning in Local Business

Company	Acquisition and use of technology (machine)	Troubleshooting		Quality control systems	Use of external knowledge			
		Individual	Team		Suppliers	Customers	Competitors	R&D Center or Design Center
Group I. Technology transfer								
Gd Components de Mexico	X		X	X		X		X
Decoplast	X		X	X		X	X	
Group II. Innovation without patents								
Vistamex	X		X	X	X	X	X	
Empresa Gp	X	X		X	X	X		X
Rihesa		X			X	X	X	X
Moldes Mendez	X	X		X	X	X	X	X
Group II I. Innovation with patents								
Brava	X		X	X		X	X	
Petuys	X		X		X	X	X	
Plattis de Mexico		X						X

The root of innovation was the initial training in other corporations

Entrepreneurship by itself might not be the key, since accumulated knowledge is necessary to transform and design new products; previous jobs in larger firms were a key factor for innovation.

Vistamex
Acquisition of technical knowledge and technology

Mouline x

General Motors

PETUyS
Develop their engineering capacities

CASA

IRIZAR

Subcontracting Suppliers and Innovation

In subcontracting, innovation processes become complex, since generally the TNC's define almost everything: capital goods, training, engineering requirements, inputs, final goods and quality controls.

The suppliers are selected and they receive some technology transfer (TT) in molds or patterns.

The TT is updated and continued near a real time basis, enabling suppliers to effectively support worldwide production.

Local producers recorded an increase of production scale and hence of their productivity

Good Practices

Teamwork

Constant training

Bad Practices

Once innovation is obtained, **property** becomes a critical factor, generally, the innovation is appropriated by the subcontractor.

Suppliers aren´t outsourced

The firms began to subcontract after they were already producing their own products, so the relationship was not as restrictive as for firms established specifically to supply some sort of parts to TNC's, and this gave them more flexibility.

Bargaining was easier for the latter, as they discussed the type of product they would be interested in supplying to the foreign company, i.e. Volvo and Irizar.

Patenting was a by product; the main incentive was competition among suppliers rather than interest in acquiring patents

AUTO CASTELAR PARTES

Recommendations

Policies should be oriented toward linkages and innovation, otherwise TNC's operations will continue to be based on short term operations.

The government should discuss with TNC's the role it is expected them to play in developing innovation, and how they must help to develop an innovation environment through best practices that include training, supplier development, problem solutions, quality control systems, and the development of research and design centers within the industries.

Further research is required, but IMPI database must be revised and updated. The files of companies are incomplete therefore is complicated to contact companies.

Mexico has a long way to go in promoting IPR. Businesses do not fully recognize the usefulness of patents, and how they can become an asset for their development.

Conclusions

Innovation and patenting seem difficult in a country dominated by TNC's, since FDI policies focus on attracting large quantity of FDI without paying much attention to the type of investment.

TNC's usually attempt to obtain all the rights of any innovation that takes place, thus the innovation process among suppliers is inhibited.

Interviews reveal that supplier firms established without the help of TNC's have more flexibility and are able to be engaged in innovation and obtain patents.

The question that remains unanswered is how to make contracts between TNC's and supplier firms, with the appropriate contracts, innovations can also be held by supplier firms.

There is a perception that there is no enforcement of the law in Mexico, so firms feel that even if they follow the process to obtain a patent, benefits will be marginal or even non-existent.

Mexico learning process: the interaction between transnational's corporations and its supplier network. The evolving role of industrial property in the XXIst Century

Clemente Ruiz Durán[1]

February 16, 2009

Abstract

The growing role of TNCs in world production and trade, their increased tendency to source production inputs internationally and the rising number of local producers included in international chains of production suggests that much of the future local producers activities will be situated within or around TNC production systems. The ability of local producers to compete in the global market place depends on their access to certain critical resources the most important of which are finance, technology and managerial skills. TNCs have been an important means for local producers go gain access to new technologies and management know-how. Strong business linkages between TNCs and local producers generating a relationship in terms of trust, alliance, co-operation, knowledge, technical knowledge, and skills as well as they can even facilitate access to finance. In the overall, there has been a learning process for local producers as they have adapted to global best practices and have been forced to get global certification. Some local producers have gone one step beyond adapting to the global challenge, innovating and patenting. This paper traces how local producers in Mexico auto parts industry has been able to get into innovation and patenting.

Keywords: Mexico, TNCs, Learning, Supplier Development
JEL Classification: O31, O32, O33, O34

[1] I would like to thank IMPI for the support given for patent retrieval in particular to Ingeniero Mauricio Pérez Martínez; research was conducted with the help of Misael Sandoval that was the key man to get the interviews realized with the help of Alan Apodaca. Ingeniero Fernando Gutierrez helped us to get access to businesses, and we want to thanks the businesses their time and effort to fill up the survey and for the interviews.

1. Innovation, TNCs, local producers and learning processes.

Innovation has long played a central role in theories of foreign direct investment (FDI) and the transnational corporations (TNCs), first introduced by Vernon (1966) with his product life cycle model, where he points out that TNCs have the ability to exploit proprietary advantages (knowledge, innovations) generated in the home base by the parent firm. Frost (2001) in his review of the literature points out that in the nineties there was a reformulation of the argument by some scholars (Bartlett and Ghoshal, 1989; Cantwell, 1992, 1993; Dunning, 1998; Nobel and Birkinshaw, 1998) focusing on the knowledge-creating potential of firms with value chain activities that span borders. According to this alternative perspective, a potentially important source of competitive advantage for multinational firms is the capacity of their foreign subsidiaries to generate innovations based on stimuli and resources resident in the heterogeneous host country environments in which they operate. In this sense, foreign direct investment may also be interpreted as a mechanism through which firms seek to develop new resources and capabilities on a global basis (Kogut and Chang, 1991; Teece, 1992; Westney, 1990).

Within this discussion, UNCTAD (2005) argue that many developing countries use foreign direct investment (FDI) as one among several avenues to integrate their economies into global production chains. A pressing question is whether such incoming FDI serves to stimulate the host economy and to raise its competitiveness in world markets. Critics argue that FDI is isolated in enclaves and that where it does develop local linkages; these are mainly in the form of ruinous competition among would-be supplier firms. Conversely, supporters of FDI point to the potential usefulness of backward and forward linkages between affiliates and local firms, the transmission of technology from high-tech TNCs to the local economy, and the upgrading of workplace skills in industries receiving FDI inflows. In some cases, TNC affiliates have transferred new technology and skills and built strong linkages with local enterprises, leading to improved industrial structures and new exports. This is the case with the color-TV industry, where Malaysia, Thailand and Mexico have established themselves as the world's major suppliers. In some cases, restructuring by TNCs has led to the denationalization of local enterprises, as occurs when TNCs bring in their first-tier suppliers from overseas or acquire domestic SMEs. This was the case with the automotive industry in Argentina, Brazil and Mexico. While it has enabled some developing countries to attract FDI and enter global production chains, it has also made them vulnerable to shifts in trade rules and to footloose behavior by investors in response to changing relative production costs. For instance, the role in the global production chain that TNCs assign to affiliates in a particular economy determines the kind of technology they transfer and the kind of sourcing they do, and this has become related recently to the discussion of the globalization of research and development (R&D) by transnational corporations (TNCs) and its implications for developing countries. The topic reflects a growing recognition in developing countries of the role played by innovation and R&D in development. Innovation and R&D are essential for upgrading technologies, moving up the development ladder, and catching up with developed countries. In technology generation, transfer and diffusion, developing countries are involving TNCs that are major players in global R&D.

One of the main problems within this discussion has been that TNCs do not generally conduct basic research abroad, R&D and innovative activities *have generally been confined to the home countries* of TNCs much more than manufacturing activities have been. The standard explanation refers to the complexity of R&D activities and the need for geographical proximity. Still, in recent years R&D activities have become more internationally mobile, and developing countries are starting to become nodes in global innovation networks. In fact, some experts indicate that complexity may no longer constitute a barrier to the internationalization of innovation, highlighted examples of highly complex R&D-related work –such as chip design –. It was also noted that the markets for knowledge workers and technology are becoming increasingly international as well. Some experts have stressed the importance of distinguishing between different phases in the internationalization of R&D. Until the 1960s, R&D tended to be very "sticky" and stayed in home countries. Starting in the 1960s, the first wave of R&D internationalization involved mainly asset-exploiting R&D aimed at *adaptation of products for local markets*. The second wave began in the 1970s, and was primarily directed towards adapting specific new products to particular local markets. In the third wave – starting in the 1980s – R&D internationalization was driven by the need for firms to find complementary expertise abroad, notably in other developed countries. This trend was intensified from the 1990s onwards, and in the fourth wave there was increasing demand for scientific expertise of a scale and scope that could not be easily met without expanding internationally. In this phase, "asset- augmenting" R&D has also grown in importance. While most R&D activities remain in developed countries, experts concluded that developing countries are becoming more important as both host and home countries of FDI in R&D. In recent years, China and India have become the leaders of the developing world in FDI in R&D, partly because of their large and fast-growing markets and their large supply of low-cost engineers and scientists. While noting that important examples of R&D by foreign affiliates could be identified in all parts of the developing world, the experts indicated that these two countries have been particularly successful in attracting "asset-augmenting" R&D conducted with a view to developing processes and products for global markets.

In Latin America and the Caribbean, R&D activities of TNCs are relatively limited, especially when compared to Asia. One of the reasons for this is that in most Latin American and Caribbean countries, FDI policies focus on attracting large quantities of FDI and do not pay much attention to the nature of FDI. R&D-related FDI in the region is of an adaptive type, with some degree of new product development for local or regional conditions. More recently, however, some countries such as Brazil have begun to attract increasing FDI in R&D oriented towards global applications (for instance in the case of R&D in automobile components) and in Mexico, FDI has set up some R&D departments in the automotive aftermarket (i.e. Delphi in Juarez with local researchers). This has speed up the innovation process in local economies, with lower costs for FDI. Although this has positive effects on host economies (creation of well paid employment for scientists and engineers; better use of locally available materials; technology transfer inculcation of an R&D culture in local firms; the development of new disciplines and specializations at local universities; the

development of R&D clusters; and spin-offs of by-products that TNCs do not want to develop themselves), innovations rights are kept by FDI, as innovation process remains to be within the TNC network (parent – subsidiary – innovation network).

FDI becomes part of a more complex process when the relation goes beyond the subsidiary structure, as suppliers' networks are developed. In this case suppliers are selected and if accepted, they get some technology transfer (tT) in molds or patterns according to the industry. But as Moran (2005) has pointed out, this TT could be not updated if TNCs are willing that this supplier would focus on domestic market operations, rather than getting into the export market. A second case is where technology transfer is updated and continuous near real time basis so suppliers could support effectively worldwide production, as General Motors (GM) export plants in Brazil were designed to be interchangeable with engines produced at the Pontiac plant in New York, or Ford export plants in Brazil are perfect substitutes for engines manufactured in Ohio and received the company's highest quality rating. In Mexico in the last fifteen years since NAFTA was enacted this is the type of relation that has developed, most Chrysler, Ford and GM production are perfect substitutes for USA plants.

As local producers become part of the TNCs procurement operation scale increases, as was the case with Hewlett Packard in Jalisco, where the launch of the MIPO (Mexican International Procurement Program) increased the demand from local suppliers and with it their productivity. Haskel, Pereira and Slaughter (2002), realized an analysis in England at plant level and found an increase in total factor productivity, backed by the development of best management practices, and supported by domestic policies.

As local producers become worldwide competitive as part of a TNC network, and some of them become engaged in innovation, the question that rises is that of intellectual property rights (IPRs). This has not been clear out, as supplier of networks develop and some of them wants to go beyond technological transfer and innovate, who will be the owner of the innovation, tradition will say that TNC will hold the rights, but some cases supplier would be willing to patent and obtain a benefit from it, if that it is the case a conflict could develop, threatening the supplier network. But this will be an exception, as there is a general lack of awareness in developing countries that intellectual property represents assets that can be registered and used to generate income, and that the utilization of intellectual property as assets is important for development in an increasingly knowledge intensive economy. Some experts had argued that developing countries should develop better intellectual property strategies covering the creation; ownership and commercial leveraging of locally developed research. This would involve, among other things, helping individual researchers and scientists to better understand the importance and value of intellectual property, as well as creating the appropriate incentive structures for them to protect new innovations. It has been argued that, by becoming better at using their IPR regimes, developing countries would also become more interesting as partners to TNCs (Maskus 2002). As there is little evidence of how this type of relationships had developed among TNCs, subsidiaries and local producers,

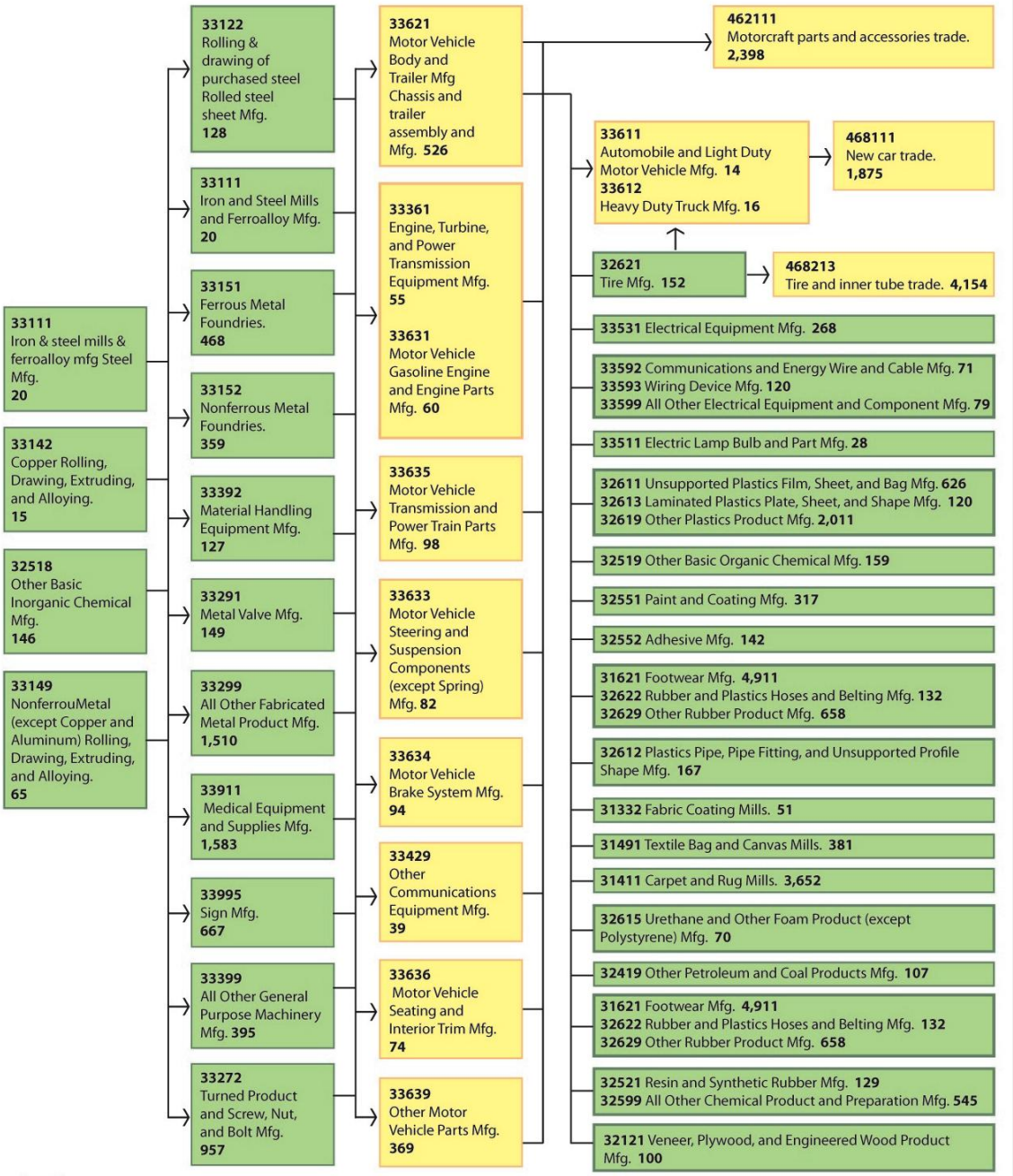
this paper try to fill the gap, focusing on how different type of relations has been developed within the auto supplier network in Mexico, that goes from simple technology transfer, to innovations and how some of them has been able to patent and develop a new pattern of relations within the industry, as they exploit their proprietary advantages.

2. Local producers and foreign investors in the auto industry

The auto industry has a long history in Mexico. Assembly plants were opened in the 1950s and since then, it has been one of the key businesses in development policy. One of the aims of public policy has been to increase domestic content, through the development of auto parts producers. Auto parts production was policy induced, since the government decided in the 1970s and early 1980s to promote value chains to increase the domestic content of cars. The most successful policy tool was the foreign exchange budget that forced auto producers to achieve a balanced budget in their operations. At the time the restriction was enacted, firm exports were limited so the only way to get the required balance was through the promotion of auto parts production. The value chain has continued to develop, and today auto parts value added is at 28 billion dollars. [2] Diagram 1 shows the auto value chain, with almost 50 economic activities engaged, while electric and electronic equipment and motor production are the most important modules, with 3.6 billion in the former and 1.2 billion in the latter.

[2] INA Webpage on January 22, 2009.

Diagram 1. Mexico: auto industry value chain (number of establishments)



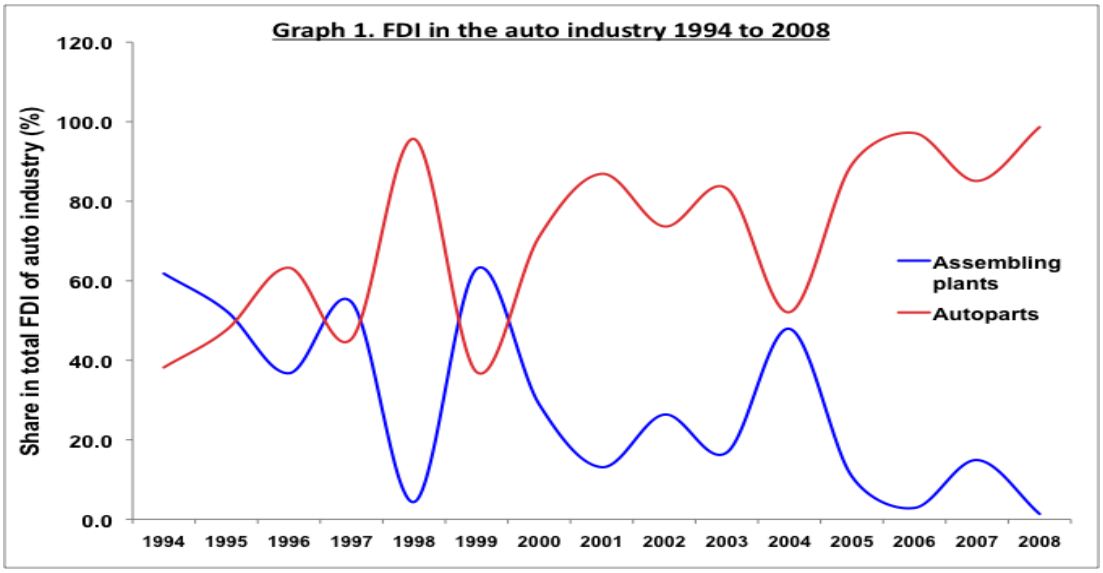
Source: Secretaría de Economía, SIEM web page, february 2009.

Auto industry supplier development has been one of the most challenging tasks for Mexico; it has been a long way to get to a semi integrated auto industry. In the 1950s Mexico enacted an industrial policy of import substitution strategy, to promote the assembling of final goods in the country. Assembling plants immediately began to emerge, some foreign factories immediately began operations, General Motors, Chrysler and Ford, in a second round Nissan, Renault and VW got into the project.

First stage was successful and led to a second stage of production the development of some basic supplies for the plants; it took a long time before that was realized. Public policy did not elaborate value chain integration guidelines; government's assumption was that on their self interest business were going to develop backward linkages, and with them, a learning process. To foster the process in the late seventies the government developed what was called *foreign exchange budget* for auto producers, the main goal was that producers should get a balance budget by the early eighties. Under this regime producers would have to get foreign exchange earnings in order to import intermediate goods for production. There were two routes to obtain balance budget, the first was to develop local producers that could substitute imports, the second one was to develop an export platform that could allow getting foreign exchange earnings that could match the import requirements. Auto corporations were pushed to develop an export platform and at the same time develop local suppliers. This was not an easy task to do, as local producers did not have the required quality and their capacity was reduced to match production requirements. In the eighties and nineties as global sourcing became the rule of the game auto producers invited some of the firms that were supplier for them at their home countries, to become involved in the procurement operation in Mexico to introduce just in time (JIT), total quality control, just in sequence (JIS), and zero inventory were the new standards in production. Under the North American Free Trade Agreement, Mexico, United States and Canada set up some parameters of regional content, which were included in the Rules of Origin Chapter, which specifies that at least 62.5 percent of final production must be produced in the NAFTA region. That has become an incentive to develop suppliers in Mexico, as that opens the market to Canada and United States and to MERCOSUR.

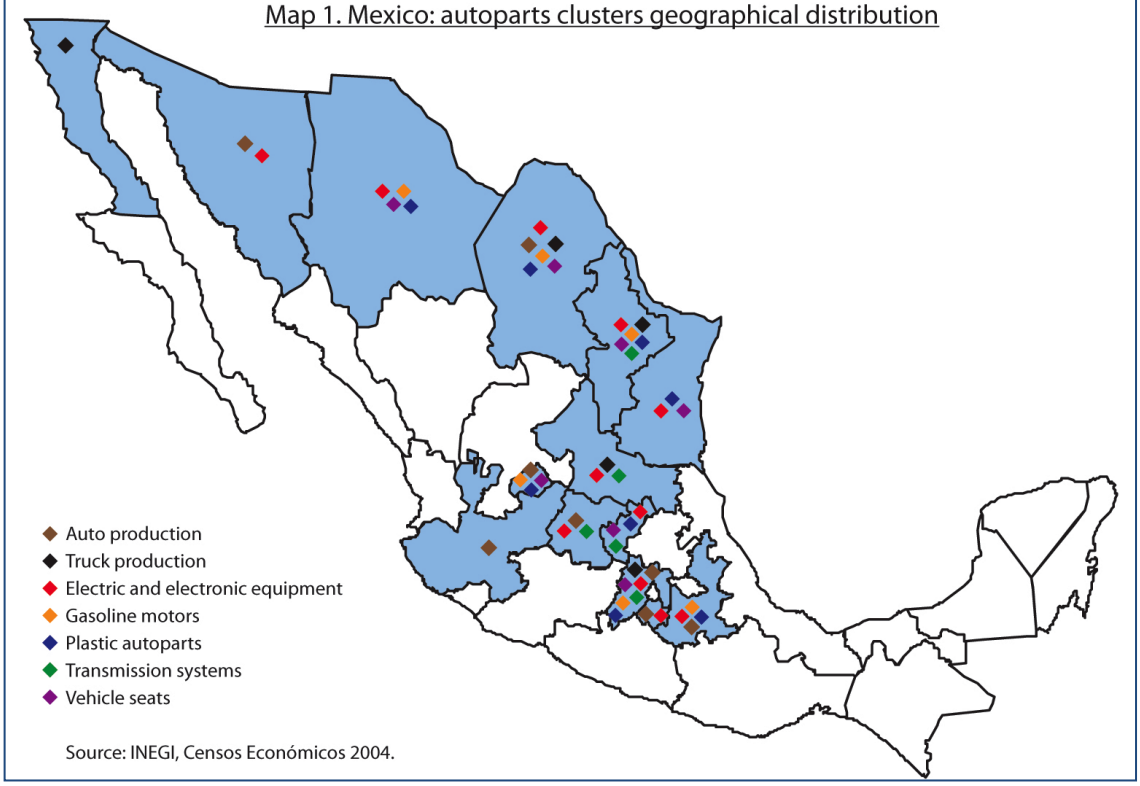
3. FDI and the learning process for Mexican producers

Key to the learning process was the change of flows of FDI in the auto industry, after the enactment of NAFTA, investment moved from assembling plants toward auto parts, to built up the second and third tier supplier network required to produce a solid procurement process in Mexico, as shown in graph 1.



Redesign of FDI led to an increase in the number of auto and autoparts establishments, reaching 1,978 at the end of 2004[3] from 1,401 ten years earlier. Geographical distribution of the expansion followed assemblers and now is located mainly around their plants; main locations are for electronic equipment (49.3%) Chihuahua; for gasoline motors Coahuila 25,9% and Puebla 18,8%; plastics auto parts Tamaulipas 28,8% and Nuevo León 23,6%; transmission systems Guanajuato 47,9% and Querétaro 24,3%; and seats in Coahuila 31%, Chihuahua 23,6% and Nuevo León 20,1%. This geographical distribution has led to specialization, mainly in the border and central Mexico, that are thee main clusters of auto parts production, as shown in Map 1. [4]

Map 1. Mexico: autoparts clusters geographical distribution



Source: INEGI, Censos Económicos 2004.

Supplier development has led to a more competitive auto industry, has enhanced productive capacities and has led to a learning process that has reduced costs. Following Ahn (2003) some estimates were realized around the learning effect that has led to a more productive industry in the period 1994 to 2006. Estimates were realized based on a sample collected by Instituto Nacional de Estadistica, Geografía e Informática, that shows that average productivity increased more in the assembling plants, than in the auto parts industry as shown in table 1.

[3] INEGI Censos Económicos 2004. Web Page.
[4] INEGI Censos Económicos 2004. Industria Automotriz Panorama Censal

Table 1. Auto and auto parts industry productivity

	Auto Industry (3841)	Cars Assembling Plants (384110)	Trucks Assembling Plants (384121)	Motor Production (384122)	Transmission Parts (384123)	Suspension Sytems (384124)	Brake Systems (384125)	Other components and accesories (384126)
1994	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1995	91.9	92.9	68.6	91.5	66.2	81.9	86.2	95.5
1996	111.5	116.7	69.1	112.0	81.9	101.3	86.0	109.0
1997	112.4	123.9	76.6	101.2	95.1	98.6	87.8	105.1
1998	109.5	123.3	89.3	92.9	96.9	85.6	81.8	100.4
1999	122.1	137.2	90.4	97.7	101.2	96.8	94.0	116.9
2000	140.2	160.0	110.8	104.2	111.8	104.0	111.7	133.3
2001	154.2	172.8	115.9	112.5	117.7	118.4	120.2	143.4
2002	164.0	189.8	101.4	118.9	122.0	133.3	136.3	146.0
2003	154.9	183.8	97.8	117.5	120.8	114.7	135.5	143.1
2005	115.9	178.6	112.9	105.5	171.1	154.4	138.5	165.2
2006	125.3	196.2	120.2	110.7	152.8	160.4	149.3	178.0

Source: Own estimates based on data base of INEGI. Encuesta Industrial Anual.

Learning process has to be measured not only by the increase of productivity in the different segments of auto industry as shown in the above table, but simultaneously has to comply with a reduction on the gap of productivity in the various segments with the main trade partner, that in this case is US. For that purpose an estimate was realized for the same period with surveys in Mexico and US economies. Results were not very encouraging as the gap became larger through time; there are different effects that could be outlined:

- Technology transfers effect. Increase in the overall productivity of the industry involved, in this case auto industry.

- Learning process effect. Increase in the productivity by segments of the industry involved.

- Inter industry effect. Reduction of the gap between the different segments of the industry involved between countries.

Learning has been positive for the two first effects, but negative for the third, that could be related to economies of scale. The transfer of technology of FDI is positive, learning is positive but the size of the production seems to be too small to close the gap between countries. Transfer of technology in this case has to do, not only with production itself but also with a package of best practices that improves productivity, as just production practices, quality control, and certification process.

Although it could be considered that all FDI in the auto industry were bringing the same package, origin of foreign investors made a difference, as some of them were more suited to develop a learning process than others. In the period 1999 – 2008, investment reached 16 billion, coming mainly from US (61 percent), Japan (15 percent), Canada (7,5 percent), Germany (6 percent), and France (4 percent). US, Japan and Germany were more willing to invest in auto

parts to develop a network of suppliers, through clusters around their assembling plants i.e. Ford in Hermosillo and Chihuahua, Chrysler in Coahuila, GM estado de México and Guanajuato, Nissan in Aguascalientes, Honda in Jalisco and VW in Puebla.

Factors critical to investment have varied over time. Mexico became an interesting market for the world in the period from 1950 to 1981, as it became one of the leading developing economies, with an average growth rate of 6.6 percent. This allowed a seven-fold expansion of productive capacities, and this expansion led to the diversification of the productive platform, induced by the interaction of major public and private investment, and the interaction with foreign direct investment. Market conditions improved substantially during the period; the population increased from 26 to 68 million persons; the real Gross Domestic Product per capita was US $577 and reached US $5,435 dollars, and this attracted foreign investors to new activities, mainly the auto and household appliance industries. When expansion came to an end with the debt crisis, a new development model was adopted with an outward orientation. In this case, labor costs became a key variable for foreign investment, and a large *maquila* expansion took place, attracted by low wages for semi-skilled labor. This model has been jeopardized with the emergence of China and the slowdown of the US economy. The low-cost model has been unable to lower prices at the rate observed in Asian economies, so some *maquila* factories have been taken out of the country. Currently, a new, more knowledge-intensive model is emerging, attracting some FDI into higher technology areas such as software and biotechnology.

Location is embedded in all FDI decisions. In the first stage of FDI expansion in which the domestic market was the driving force, the central region of Mexico became the ideal location for foreign investors, since almost half of the population is concentrated in eleven of the thirty-two states of Mexico, with a total of 47 million people. Public expenditures developed infrastructure networks around the region, enhancing investment conditions. And therefore, the first FDI wave was located in that region, with production clusters developed in specific areas.

The second wave of FDI, which was focused on developing an export platform, was located in the border states, pushing development into the northern states, but unable to develop linkages with former operations in central Mexico. Consequently, linkages were developed mainly with the US, rather than with the domestic market. This created segmentation not only with the domestic market, but also with some of the early operations developed by FDI in central Mexican states.

4. Innovations and patent database.

Analysis of how learning take place among local suppliers requires data bases that could help find producers that innovates and patent their discoveries, there are two sources for the auto parts industry. The first comes from auto parts business association created in 1962, as Asociacion Nacional de Fabricantes de Autopartes, during the period of import substitution, as part of the national

strategy to increase domestic content in auto production, becoming later Industria Nacional de Autopartes. Association keeps a directory of their affiliates, bringing out a report on the volume of production, but does not collect information regarding the process of the different systems, so is a general database of enterprises that does not allow to give a follow up analysis of how innovation take place and which of the firms patent their innovation.

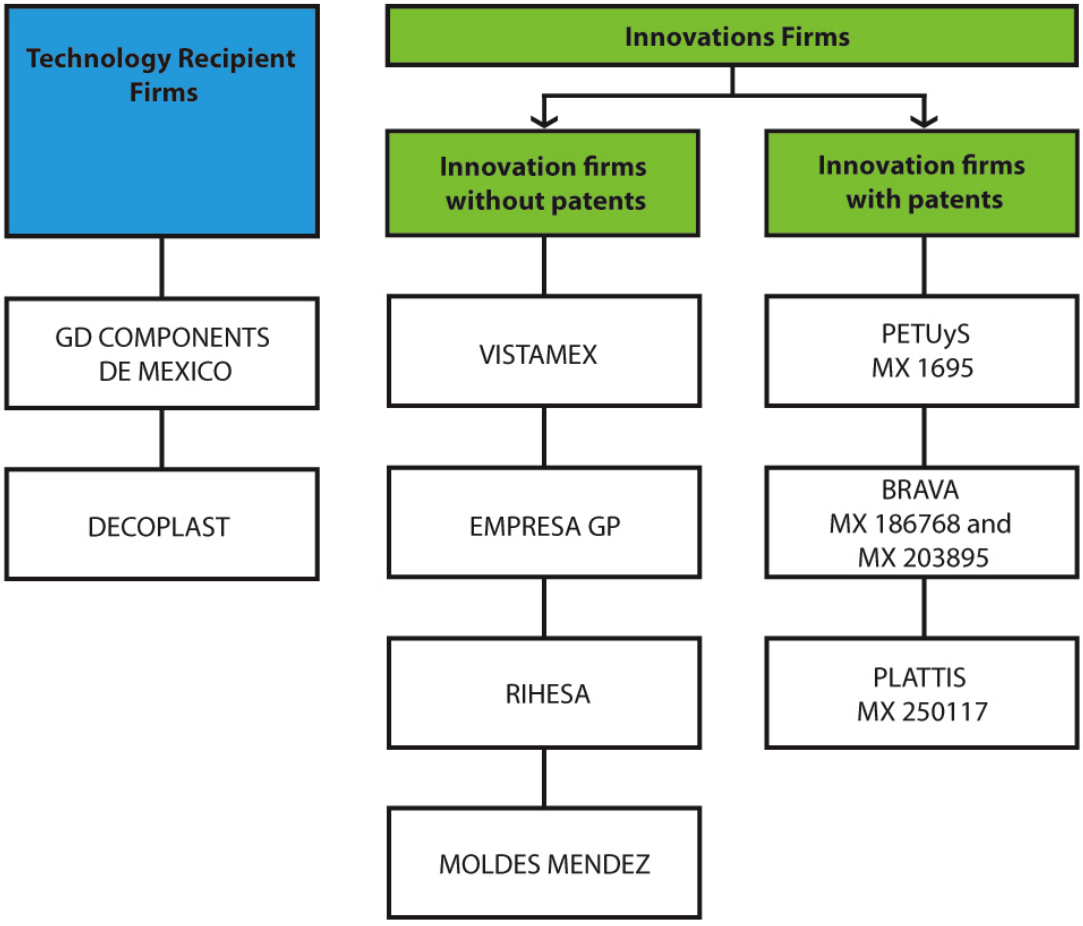
A second source of analysis comes from IMPI[5], (Instituto Mexicano de la Propiedad Industrial), which has records of all patents that are registered in Mexico. Electronic search can be realized based on the IMPI web page (http://www.impi.gob.mx), which allow you to get to their Banco Nacional de Patentes (http://www.impi.gob.mx/banapanet/main.jsp) where the program Experta allows you to get to the records of patents, applications number, international classification, date of application, priority, date of publication, person that holds the patent, inventors, agent, title, and a summary of the patent, where they specify the novelty of the case. Through this mechanism and with help of the international classification of patents B60 it was possible to identify the auto parts producers that have a register in the IMPI database. Information obtained through B60 classification is too general, it was recommended by IMPI officers the sub classification PYMETEC, that is a web place for small and medium enterprises, that allows to limit the search to get subgroups that fits your interest. In this case the records used were of section B, that allows to get to transport systems (Tecnicas Industriales Diversas: transportes). Section B is divided in 99 classes, so the search procedure was to get to class 60 (vehículos en general), which at the same type is divided in sub classes. Unfortunately records as registered do not allow making a difference among ownership by citizenship, as there is no specification or keyword that could direct the search into national or foreigners. Information obtained through BANAPANET brought serious problems to contact the auto part businesses, due to the fact that in most cases what you get is intermediary agents data that are not updated, without a telephone or address of the inventor or of the business that applied for the patent.

An alternative search procedure was to use WIPO database, where browse and search allows identifying country of origin – that in this case, was key to understand the learning process in local firms. With this procedure was possible to get 56 cases of patents in the auto parts industry in Mexico, from here a selection of patents to interview was based on those registered by Mexican enterprises, as it was easier to get contact data through telephone directory. Third stage procedure was to contact businesses; in some cases firms did not allow interviews (DINA and VITRO).

[5] In 1987 the Inventions and Brands Law is reformed and in 1991 it was published the Law for Promotion and Protection for the Industrial Property and on the 7th. Article creates an institution specialized on giving technical support from the Economics State Department on the industrial property system administration. The Technological Direction General Direction (DGTD), is a sub-division from the Commerce and Industrial Promotion Ministry and predecessor of the Mexican Institute for Industrial Property (IMPI). The DGDT's mission was to promote technological development through the deregulation policy and technology transfers. However, implementing deregulation policies at the Federal level brought important changes on the institutional structure of the industrial property. On December 10th of 1993 it was published on the Official Journey of the Federation the decree on which it was created the IMPI. The IMPI has the mission of giving technical support from the Economics State Department.

To surpass the lack of information, a new search process was designed, getting the names from the IMPI database and trying to locate them through Internet search, or visit the agent. As results were limited, contacts were obtained through business associations and suppliers of raw materials to the auto parts producers. [6] After the above procedures were completed it was possible to define a sample of enterprises that could be interviewed, with the following criteria, three recipients of technology from transnational corporations, three with innovations but without patent, and four with innovations and registered patents (diagram 2).

Diagram 2.
Firm selected: learning and innovation



5. Success stories: learning, innovation and patent registration

In order to get an insight view of how learning process and innovation parameters works in the auto part industry, interviews were realized among three different types of businesses were chosen. Interviews were conducted according to a questionnaire (Annex I), where the main aim is to understand

[6] Help was granted by Fernando Gutiérrez from Resinas TB, S.A. de C. V., who contacted some of his suppliers to request some interviews.

how the links with foreign firms varies and how they assume different attitudes toward innovation. All firms interviewed were related to transnational corporations in an indirect form, in the second or third tier of organization in the auto industry. Producers interviewed were related to fabricated plastics products (32619), and fabricated metal products (33299) where learning process takes place in the second tier levels of supplier, which does not require sophisticated inputs, but is mainly associated with the expertise you can get from injection, thermo molding and bearing assembly.

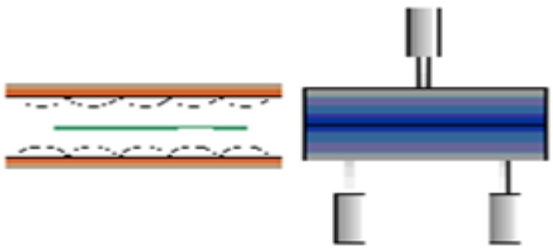
- In the first group "***technology recipients***" two Mexican owned companies were interviewed: GD Components and Decoplast, which are suppliers of original equipment auto parts. All of them are specialized in injection processes and basic learning is obtained from technology transfer directly from OEM; company provides molds or the design in 3D so they build the mold or outsource the mold production, so what they learn is how to process plastic injection. There is little margin to innovate, as plastic injection design is quite complicated and innovation will require a research department that is quite expensive for medium and small suppliers in the auto industry. Firms in this segment become experts to provide 2D and 3D dimensional analysis services for parts ranging in size from 10 x 10 mm up to 1,000 x 1,000 mm and produce conventional and critical parts for static and dynamic applications. They have developed quality control parameters by processors and electronic systems. These systems detect and compensate any minimum variance in the process, making it stable and continuous. The three companies have installed a local area network and several PC's for ERP information management system, which operates in conformance with the general industry norms and allows the record, control, processing and analysis of the related operational information of the company. Transfer of technology is mainly embedded in capital goods that come mainly from US, Australia, Canada, Switzerland and France, the difference among the three companies is the elaboration of the molds, while GD and Decoplast relies on outsourcing None of them modify the molds; there are no incentives to move to the design activity, as demand from TNCs is large enough to satisfy the estimated growth of profits. Learning is centered on the development of engineering abilities, GD and Decoplast have a group of high trained engineers 20 and 25, that insure certification within the higher standards of the industry.

- In the second group "***innovation without patents***" four Mexican owned companies were interviewed: Vistamex, RIHESA, Moldes Mendoza and GPs. Their roots are completely different; the first three are involved in plastic injection processes and the fourth in fabricated metal. Vistamex is a spin-off of Moulinex the French household appliance maker, it continues producing appliances, but became involved in auto parts production with design capacities. One of the benefits of being nurtured by Moulinex was personnel training that allowed the company to become a global player. In the auto industry its design facilities allows not only to receive external orders, but also to design and repair molds, assemble cells, develop new products and test new products for clients as Mabe, Norgren, Hutchinson, Automotive Lighting y Kasay. RIHESA is also a plastic injection business

that could design and repair molds and Moldes Mendoza has set up a design department in charge of developing the molds. Key difference with the first group of plastic producers is their interaction with clients in product design and the manufacturing of molds, up to now they have manufactured components for OEM, but they have not registered them as patents. The fourth case is EGP located in Queretaro, Mexico, that has specialized in bearing assembly and gearshift levers for trucks, their main clients are: Nissan, Toyota, John Deere, Desc Automotriz, VW and CNH. Facilities have specialized equipment such as: 3d modeling, Rapid prototyping, Testing (Fatigue, Performance, temperature, etc.), that has allowed to design special levers for different auto companies (i.e. Nissan). It has an engineering area, with four engineers and three practitioners, this has allowed EGP to develop new products and improvements to different components, but as specified in the contract with the OEM, all innovations that take place will be property of the clients. So there is no room for patents to develop, as the clients mainly design all the goods, and goods are not for sale to the general public. Innovations sometimes are tested at local universities or research centers (Centro de Ingeniería y Desarrollo Industrial (CIDESI) but most of them are in-home processes.

- The last groups of interviews were to businesses in the auto industry with ***innovation and patenting***. Two of them in the field of thermoforming to develop applications in the automotive interior trim area: Brava S.A. de C.V. and Plasticos y Ensambles Termoformas Universales y Servicios S.A. de C.V. Typical applications are hatch, headliner, carpets, trunk covers, parcel shelves, door panels and many more. Depending on the application they use machines with different dimensions and press forces, as well as manual simple systems or full automatic molding lines (as shown in figure 1)

Figure 1. Thermoforming machine



Source: ocdvreinforcement, web page

Thermoforming requires less expensive equipment that the one used in injection, so is easier for Mexican businesses to get into that type of manufacturing. Companies have specialized in vehicle hatch for passenger vehicle, but their path to innovation was different in both cases. In the nineties *Brava* became Volvo client, discussing with them the factors that led the vehicle hatch to broke down. From this dialogue its engineering department designed a heavy-duty hatch. This invention relates generally to devices known as hatches, and more specifically to

safety devices of the type used in multi-passenger public transportation vehicles to allow passenger escape in emergency situations. As an emergency exit, such hatches are typically located at the roof of such vehicles. To protect against competition, they decided to apply for a patent (PCT/IB1999/001327), the inventor Armando Cauduro Costaible with IPC ***B60J 7/16*** (2006.01), ***B60J 9/02*** (2006.01). Brava argues that although they have patented, law enforcement is low in Mexico, so they have not gotten the benefits of patenting, so they are not interested in getting new patents for their products.

Competition increased in thermoforming, companies as Plasticos y Ensambles Termoformas Universales y Servicios S.A. de C.V was one of the new comers, and decided to improve hatch related to motor vehicles, with the aim to provide a vehicle hatch different from those that were on the market, thanks to a new building, whose main characteristics was to incorporate the use of ultra-sonic process in the joints of plastics, metal reinforcements and fasteners. Two mechanisms were integrated opening made with extruded aluminum profiles, compression springs, anti-friction nylon bolts and steel pins. To get into production of this hatch, they decided that it was better to get a patent before producing to avoid any legal problem with competitors. The inventor in this case is Nadia Ramírez Maldonado, with international application number PCT/MX /1695 and IPC B60R21/00 (2006.01), B60J7/00 (2006.01). In this case they got support from IMPI (Instituto Mexicano de la Propiedad Industrial) to register the patent.

A third case of innovation and patenting interview was Plattis de Mexico S.A. de C.V that is related to a method of producing solid flexible inner tubes for tires and resulting products. The invention, which are made from polyurethane elastomer material and which are characterized in that they can recover the original shape thereof, with the self-sealing of punctures, and to inner tubes thus obtained. The registered name of the inventor is Ignacio Alvarado Escalante, under international application number PCT/MX2006/000099 and IPC*B60C 5/04* (2006.01), *B29D 23/24* (2006.01), *B29K 75/00* (2006.01), *B29L 23/24* (2006.01), *B60C 19/12* (2006.01). In Plattis innovations have been related to the entrepreneurship spirit of its owner and manager, and to a close relation with OEMs.

6. Lessons learned, policy recommendations and future perspectives

Interviews showed that although auto industry has systematized different patterns of behavior, and adapted some best practices, daily activity is still very heterogeneous. Data obtained from the questionnaire (Annex I), shows that technology transfer in most cases come from the acquisition of foreign capital goods, exception were Rihesa and Plattis where entrepreneurs were able to design their own capital goods. Teamwork for problem resolution is not a generalized practice; still manager or company owner decision-making seems to be as important; quality controls seems not to be generalized among

producers, systems varies from company to company, and is related to their relation with TNCs.

Technological knowledge seems to be in the market place, intensity of exchange seems to be the roots of new knowledge; it comes from clients, suppliers and from competition. Design or research centers are not yet a best practice among auto producers are too expensive to maintain.

Table 2. Technology Learning in Local Business

Company	Acquisition and use of technology (machine)	Troubleshooting		Quality control systems	Use of external knowledge			
		Individual	Team		Suppliers	Customers	Competitors	R&D Center or Design Center
Group I. Technology transfer								
Gd Components de Mexico	X		X	X		X		X
Decoplast	X		X	X		X	X	
Group II. Innovation without patents								
Vistamex	X		X	X	X	X	X	
Empresa Gp	X	X		X	X	X		X
Rihesa		X			X	X	X	X
Moldes Mendez	X	X		X	X	X	X	X
Group II I. Innovation with patents								
Brava	X		X	X		X	X	
Petuys	X		X		X	X	X	
Plattis de Mexico		X						X

As mentioned by Usselman (1999) engineering capacities seems to be the pipeline of innovation; initial training in other corporations was the root of innovation. Entrepreneurship by itself might not be the key, it requires accumulated knowledge to transform and design new products; previous jobs in larger firms were a key factor for innovation. PETUyS owners were employees of bodywork CASA where they were able to develop their engineering capacities; the same is also true for Vistamex with Moulinex. Acquisition of technical knowledge was key for owners of the businesses to open their own businesses.

In subcontracting in the auto industry process of innovation becomes complex, as in most cases TNC is the one that defines almost everything: capital goods, training, engineering requirements, inputs, final goods and quality controls. Margins are very narrow, but still there are some spaces for innovation, where we find some practices that have been critical, as is the case of team work. This sort of organization allows dialogues among them that led to detection of manufacturing problems, and the emergence of innovations to solve the problems. Detection requires training, and an organization that will be suited to compensate problem solvers. Once innovation is obtained, property becomes a critical factor, that in most cases is solve through the appropriation of the innovation by the subcontractor, as was the case in GP, GD components, Vistamex, Rihesa, Moldes Mendoza, and Decoplast.

In Brava and PETyUs we found a different path for subcontracting and innovation, they subcontracted once they were producing their own products, so

relation was not as restrictive as the one found in firms established specifically to supply some sort of parts to TNCs, that gave them more flexibility. Bargaining was easier for them, as they discussed the type of product they will be interested in supplying to the foreign company i.e. Volvo and Irizar. Patenting was a by-product; the main incentive was competition among suppliers rather than the willingness to do so. Brava declared that they have some patents, but they are not willing to have new ones, as they believe that there is no rule of the law in Mexico, and no one really cares about.

Innovation and patenting seems difficult in a country dominated by TNC, as FDI policies focus on attracting large quantities of FDI and do not pay much attention to the nature of FDI. Policies should be oriented toward linkages and innovation, otherwise TNC operation will continue to be based in short term operations. Government should discuss with TNCs the role they are expecting them to play to develop innovation, and how they are going to help develop an innovation environment through best practices that include training, supplier development, problem solution, quality control systems, and the development or research and design centers within the industries.

The problem found in the interviews was about the property of innovation, TNCs usually try to get all the rights of any innovation that take place, so they block the innovation process among suppliers. The question that remains open, is how to make contracts among TNC – S firm to have a margin open so innovations could also be hold by S-firm. Interviews show that S-firms that were established without the help of TNC have more flexibility and are able to innovate and patent. It seems that TNC will allow patenting as far as it is related to components that will fit into a final product.

S-firms require strengthening its bargaining position, and that could only be done if they diversify their production, and rely less on the TNCs. That will enhance innovation, but not necessarily the possibilities to patent, there is the perception that in Mexico there is no rule of the law, so they feel that even if they go all the way through, benefits would be marginal and they will not obtain the expected benefit. Business environment requires that government give clear signs that they will prosecute any violation to patents.

Further research is required, but for that to take place it is required that the IMPI data base has to be revised and updated, companies files are incomplete and makes difficult to get in contact with the businesses. IMPI data base has to be restructured in such a way that it allows filtering by different sort of indicators, today data base allows to get information at a more general level. If government is willing to redesign it will very useful to have a working group that could help them to set up an improved database. Mexico has a long way to promote IPR business still does not acknowledge what is the use of patents, and how they can become an asset for their development, diffusion of the benefits has to directed to business rather than to the general public, it has to have a positive message so business could see the benefits they could get from getting involved in patent registration.

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