Chapter 4

4. Proposal of a Technology Transfer Model for México.

Starting from the definition that TT is a knowledge, technology (person, machine, equipment) and information flow from a developer to a client, the TT model that best applies for this research is the ”Dissemination Model”. This model was already described in the previous chapter, so in this chapter, specific factors regarding the case of Mexico and its automotive industry will be incorporated.

4.1 The Mexican Automotive Industry.

Mexico’s economic liberalization has resulted in unprecedented growth of the Mexican auto and auto part industry, turning it into a world class-player for its quality, reliability and its flexible manufacturing methods. According to WTO Annual Report 2000, Mexico ranked sixth among the leading exporters of auto and Autoparts in the world from tenth in 1990, and third among foreign suppliers for the United States, Canadian and Japanese automotive industries. Currently, Mexico is the world’s ninth-largest producer of vehicles.

NAFTA boosted the modernization of Mexico’s auto industry through cross- border production partnerships. They have enhanced regional competitiveness and increased output. Intra-regional trade has reached almost 80 percent of total NAFTA’s exports of auto and autoparts. This industry continues to lead the region in increasing global

competitiveness, sales growth and market expansion. In 2001, the NAFTA partners exported more than US$ 160 billion (Naftaworks, [5]), representing approximately one third of the world automotive exports.

Nowadays, Mexico's automotive sector is transiting towards a new stage in developing sophisticated industrial processes. The opening of advanced research centers to provide technological innovations and automotive design has been possible thanks to the high=skilled labor force graduating from engineering programs at Mexican universities and technological institutes. Firms such as General Motors, Nissan, Volkswagen and Delphi have developed amazing capability of improving and creating new processes and products (Naftaworks, [5]).

4.1.1 Structure of the Automotive Industry.

The automotive industry supply chain is made up of four large product segments: the raw and basic materials supplied to both producers of major components as well as those of sub-assemblies and assembly plants. In addition to the supply chain, there are other segments such as research and development, marketing and post-sale services.

Currently, the Mexican Automotive Industry has fourteen vehicular firms within the assembly plants segment (Bancomext, 2004):

- BMW.
- DaimlerChrysler.
- Dina.

- Ford.
- General Motors.
- Honda.
- Kenworth.
- Nissan.
- Renault.
- Toyota.
- Scania.
- Volkswagen.
- Volvo.

Traditionally the production segments that have been considered as the most important within the Mexican Automotive Industry are the assembly plants and autoparts. The assembly plants produce complete units of vehicles for people or cargo. It is also common for these plants to produce components, as in the case of engines in Ford Cuautlitlán and Volkswagen in Puebla. These firms and plants maintain a high volume of employment and, above all, has achieved a significant concentration in production and export value. As for autoparts, this segment is comprised of many companies of varying sizes, technological levels, products and production volumes. This heterogeneity, along with a greater variety in terms of capital origin and position in the supply chain (tier 1, tier 2 etc. suppliers), leads to considering this to be a much more complex and heterogeneous segment with greater challenges and opportunities for achieving more balanced regional-production development. It is estimated that there are 600 autoparts companies in Mexico,

of which 34% are subsidiaries of foreign corporations and the remaining 66% is made up of national companies.

4.2 The Model.

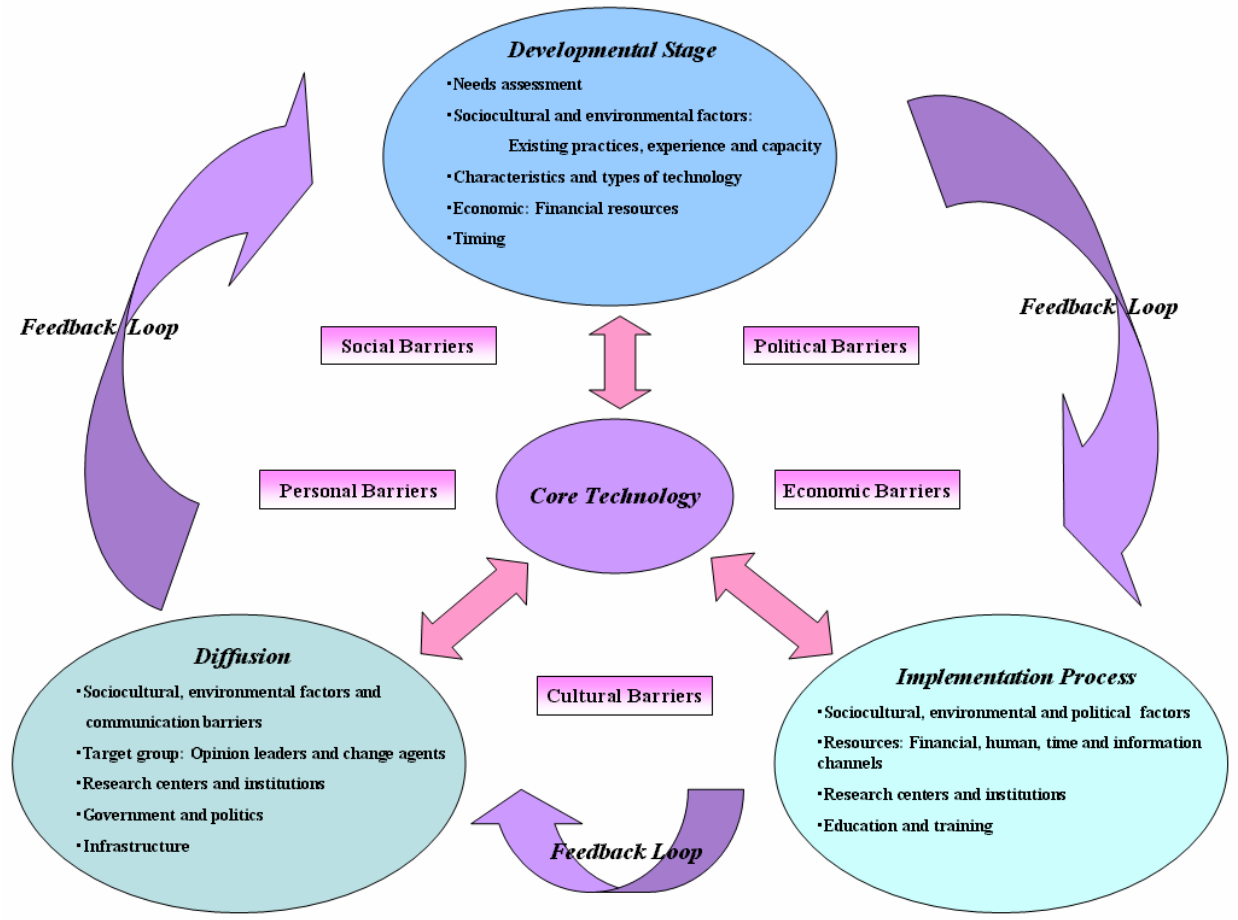

Figure 4.1 Model of technology transfer.

The TT model shown above is a modification of the one proposed by Walumbwa (1997). It was adapted for the purpose of this research work. The arrangement of this TT model is important because it gives the developer of the technology an opportunity to assess future strengths, weaknesses, opportunities and threats that might enhance or inhibit

successful transfer. This way, the developer is able to apply appropriate strategies for implementation and diffusion of the new technology (Feedback Loop). TT starts with a new idea, or a modification of an existing one. The double-sided arrows in the model infer that the variables in each of the three categories (developmental stage, implementation process, and diffusion) reciprocally affect the core technology being transferred, developed or modified. The elements found in each category will be described later in relation to the current situation of Mexico and its Automotive Industry.

Technology does not stand alone, but encompasses political, social, economic and cultural values that can serve as barriers that impede the transfer of the core technology. The barriers to TT exist for all innovations, but some transfers are more affected by the barriers than others:

Social barriers.

It is important to recognize that transfer occurs within a social system. The social system defines the boundary or limits within which the innovation will be transferred and diffused. Most transfers assume some sort of societal judgment. An individual will not recommend a technology to neighbors if it is detrimental to them or not of substantial benefit. Similarly, news of a new technology will not be printed in a scientific journal unless its benefit has been adequately proven.

Political barriers.

The influence of political barriers on transfer was evident in a problem that occurred in India, where a near-famine situation prompted the development of an agricultural research system and the reform of the bureaucracy that had driven the peasants to poverty (Parayil, 1992). Before the development of the new technology, the colonial government was interested solely in increasing the production of exportable cash crops. In this case, the political agenda largely ignored the needs of the citizens between 1947 and 1965. The political barriers to transfer were not broken until an influential change agent gained a high level position in the government. This change agent pushed the technology through the political barriers by creating partnerships between the government and research institutions that ultimately helped to avert the famine and created an infrastructure in which the technology could thrive.

Economic barriers.

The role of economic barriers in technology transfer is apparent in studies of the transfer and diffusion of technology to the American cotton-textile industry (Feller, 1974). The adoption rate of a new loom was slow in the North because the industry had a heavy investment in non-automatic looms. In contrast, the new looms quickly spread throughout the South due to a relatively new textile industry that had not yet committed financial resources to a particular technology.

Personal barriers.

An individual's particular concerns about a given technology seem to be an influencing factor in the degree of acceptance (Hall & Loucks, 1978). Hall and Loucks stress that individuals have different concerns about innovations and proceed through various stages before they fully accept the change. Rogers (1995) also asserts that transfer depends on certain characteristics of the end user. He contends that a very small percentage of the population, called innovators, constantly seek out new innovations. This group is followed by a larger group called early adopters who are generally eager to test new technologies. This group influences those around them and is often sought out for advice. This is a key group for change agents working to transfer a technology because they can have a strong impact on their peers. Following this group is the early majority who tend to wait until they receive positive feedback from the early adopters about the technology before they become interested in adopting. Nearly half of the population trails behind these groups and has been classified as late majority and laggards.

Cultural barriers.

Cultural barriers also play a key role in technology transfer. In many cases, the culture in which a technology is designed is different from that where it is ultimately used. Thus, it is important for designers to communicate with and understand the receiving culture (Pacey, 1986). This communication will help assure a solution that is appropriate for the culture and acceptable to social norms and values. Baranson (1963) stressed that designers should consider the characteristics of the labor force and the resources available in the receiving country. In developing countries, equipment should be small-scale, rugged,

and require minimal training for successful operation. These features should not be limiting, however, as the technology should have the potential to expand as a country's needs and resources expand. He explains that "little attention has been paid to accommodating technological design to cultural traits; instead emphasis has been placed upon adjusting societies to machines". As systems become more automated, those in charge of technology tend to believe that more computer power will make their processes more efficient. In pulling manufacturing and design toward automation, the tendency is to give as much power as possible to the machine and leave the remaining job tasks to the worker. This automation philosophy discounts the knowledge and intuitive capabilities of workers and pushes them to resent the technology. A better approach is to design systems around the workers, which offer the workers a change from mechanistic job tasks to higher-level tasks.

4.3 Elements of Technology Transfer Model in Mexico.

4.3.1 Needs Assessment.

We can achieve assessment for both co-development and follow-up applications through a series of questions about the technology starting with more general topics (Is the technology a potential product?) to more specific (Can this technology penetrate the market?). Each technology needs to be evaluated independently. Each technology will have a different list of questions and answers. Those doing assessments need to rank their questions by determining the most likely problems in transferring or commercializing a

particular technology. Because of the extent and costs of a technology assessment, the Mexican Automotive Industry needs to do a preliminary evaluation of its technology. Basically, all the automotive technologies are available for transfer. So it is necessary to asses only those technologies that have a higher potential for a successful transfer.

In a preliminary assessment, the first aspect to evaluate is whether the technology is something specific a company wants or needs. To find out one needs to ask:

- Is it a potential product? Can the company manufacture, package and sell it at profit?
- Are there some potential partners that have similar technology needs?
- Is it a product or a process technology? Commercial activities may use process technologies to manufacture or test products or as research tools/methods for developing new products.
- What is the need for this technology?
- What are the potential applications for the product?
- Can a process improve a product?
- How significant is the need?
- What is the intellectual property position? If information about the technology has been published (before a patent), is it in the public domain?
- How mature is the technology? How much development is required before fielding the technology?
- Is it an enabling technology?
- Does this have co-development potential?
- Is it needed for survival purposes?

- Is it imposed by the market?

The answers to these questions may be found from a variety of resources: The company's knowledge and experience, initial information supplied by the developers of the technology, other people within the organization, and if necessary, databases, literature or participation in technical societies. The goal of this preliminary evaluation is to decide whether or not to invest the time and resources to evaluate the transferability of a technology. If the technology turns out to be transferable, a proper technology assessment process can be undertaken. This assessment can be done by a consultant company or by a team comprised of engineers from different areas of the company. While evaluating the candidate technologies a market analysis is required.

4.3.2 Sociocultural Factors.

Culture is the set of knowledge, beliefs, values, practices, conscience and organizational forms of a society (De la O, 1997). This model of TT suggests that the practices and experiences of the intended end users need to be considered in determining the appropriateness of new technologies.

In this study, the most relevant aspect of the Mexican culture is the work culture. Work culture is how each person does his everyday job, what sets of rules are to be followed; how people react to company imposed goals; what people value the most and the least at the workplace (García Blásquez, 2003).

Generally speaking, the Mexican labor force is characterized by an empirical learning process in which a newly hired worker starts doing his job without clear instructions, first through observation, then doing on his simple tasks until gradually he acquires the mastery necessary to become an officer (De la O, 1997) This is a methodology in which the worker is expected to acquire specific skills by pure imitation. No analyses are made, no questions are asked, and only the job is done the way it was first learned. There can not be any kind of systematic improvement of the workplace expected. The Mexican worker is often described as a person with deep inferiority feeling which is constantly nurtured by the comparison with other countries and directly derived from the dominance Mexico has been subjected to for hundreds of years now (Guadarrama, 1988). This feeling leads him to not trust himself, what he does and those who surround him, thus making him susceptible, aggressive and macho. The result of considering separately the difficult social and economical positions that the country's situation over the past years had forced him to live in, is a worker with serious adaptation problems to modern, simplified and organized working systems. Workers newly hired by local companies will be expected to immediately get to work. Most certainly he will be assigned easy tasks that let him learn from what the others are doing. On the other hand, in a multi-national company, the worker is going to attend to a series of training sessions in which the philosophy of the company is explained along with the safety, quality and productive expectations.

When comparing the Mexican workforce with that of some of the most industrialized countries, the Mexican worker severely lacks willpower to change what surrounds him; is barely reflexive and even less analytical. He has absolutely no sense of time, is never previewing and definitely not devoted to work. He obviously has to work

otherwise he will starve, but he would rather stay at home, enjoying a life devoted passionately to his family, traditions, religion and party (Guadarrama, 1988).

Catholic in their vast majority, the Mexican workers somehow adopt from their religion a rather fatalist position that discourages and leads him to laziness, most of them will never even try to improve their situation in life. He is sensitive and romantic in nature, which makes him avoid awkward negative and/or conflictive situations, which result in a rather difficult process of open discussion of the issues that arise in the shop floor; for him, giving direct answers is not really necessary and there is nothing wrong with little lies. Add up the fact he owns an aesthetic and dreaming mentality that makes it hard for him to understand the practical needs of the modern entrepreneurial world. He sees his job as something that only gives him the means to enjoy much more relevant things such as sharing time with family and friends. What almost all Mexican workers are looking for is a nice and comfortable environment to spend a few hours a day, without planning and for instance without any commitment to deadlines (Guadarrama, 1988).

It is not surprising that when it comes to working for a foreign company that asks for precision and efficiency, the Mexican worker reacts with an attitude of distrust and suspicion because his paradigms are simply stronger than reason. Globalization at the workplace is looking for the development of absolute identity with the company, involvement values regarding the job and commitment feelings and loyalty to the company. Once this is accomplished, the beginning of radical positive changes will be on its way. But if a company is expecting flexibility, quality and productivity from its workers, it must be willing to give something in exchange, and that something is not exactly money.

Motivation is about making the employee feel that his work is highly appreciated and that it highly contributes to achieve the goals set by the company and that his work has impact on the company's overall performance. This motivation will develop a sense of ownership and pride that will keep on going as a virtuous circle that benefits both parts (worker and company) equally. This kind of philosophy will definitely contribute to build a friendly, challenging and rewarding work environment (García Blásquez, 2003).

4.3.3 Environmental Factors.

Mexico is located in Middle America, bordering the Caribbean Sea and the Gulf of Mexico, between Belize and the US and bordering the North Pacific Ocean, between Guatemala and the US. Its total area is of 1,972,550 km^2, of which 1,923,040 km^2 are land and 49,510 km^2 are water. Its climate varies from tropical to desert. Its terrain varies from high, rugged mountains, passing through low coastal plains and high plateaus to dessert. The lowest point in Mexico is Laguna Salada with 10 m below sea level and its highest point is the volcano Pico de Orizaba with 5,700 m. Among the most important natural resources found in Mexico are petroleum, silver, copper, gold, lead, zinc, natural gas and timber. The current issues regarding the environment are that natural fresh water resources are scarce and polluted in the north; inaccessible and of poor quality in the south; raw sewage and industrial effluents are polluting rivers in urban areas; deforestation; widespread erosion; desertification and serious air pollution in the national capital and urban centers along US-Mexico border. (www.geographic.org)

4.3.4 Characteristics and Types of Technology.

The transfer of technology is greatly influenced by the nature and type of technology being transferred (Rogers, 1995). The Automotive Industry has specific technology needs in different areas including but not limited to: product design and development, logistics, production processes, marketing/engineering roles, outsourcing, costing and pricing, strategic management, alliances, and customer relationship management.

The technological frontier in Mexico started a profound change in the early seventies. Until then, designs, specifications and techniques in diverse areas were transferred from the transnational companies to their local subsidiaries. The change was seen in different OEM companies throughout the world, who started a transformation process in their manufacturing systems making them more flexible. These new systems were based in simultaneous engineering, total quality management and just in time. Among some examples of these radical changes in the production methods and processes were:

- CAD/ CAM systems
- Process automation
- Robotics
- Flexible manufacturing systems
- Just in Time logistics
- Process integrated supervision
- Statistical quality control
- Total quality management

- Standardization of parts.

These technological changes affect the subsidiaries of transnational companies established in Mexico, because they have to adapt and adopt all these concepts to their processes (Brown, 1998).

For example, in November 2003 a survey was applied to 20 companies in Puebla related to the automotive branch, in the plastics sector, metal-working and machine-tooling. All these companies are suppliers to Volkswagen and are involved in the plastic injection, tooling and stamping processes. 40% of the companies do not develop their own dies. The companies that do develop their dies in their plants in Puebla need skilled personnel; CAD/CAM, modeling and prototyping systems. 45% of these companies think they have their equipment needs covered. Other companies; need CAD/CAM and simulation systems such as: general simulators; assembly-line simulators; equipment for development; equipment to design new dies; specialized software for production, maintenance, electricity, electronics, mechanics, hydraulics and pneumatics. These are the specific technology needs of the companies surveyed (KIMA, 2003). Each company in the Automotive Industry has different technology needs, that is why it is not possible to discuss the characteristics and types of technology in general.

4.3.5 Economic: Financial Resources.

Foreign investment flows received by Mexico have contributed to the transfer of new technologies and the modernization of the automotive industry. The auto industry's

remarkable performance has promoted the creation of new and better paying jobs in Mexico, which have led to better living standards required for the population. The auto and autopart industry has played a vital role in Mexico's economy, with its 19% share in total exports, 24% of the country's manufacturing GDP, and employing more than 1.9 million people. It is now serving as the engine for increasing economic activity and providing prosperity (Naftaworks [5]).

Table 4.1 Companies with foreign direct investment in the Mexican Automotive Industry

Type of activity	Number of companies	Part. %
Total	**575**	**100.0**
Production of:		
Parts and accessories	417	72.5
Engines	48	8.3
Assembly	47	8.2
Braking systems	19	3.3
Suspension systems	18	3.1
Body Assembly	15	2.6
Transmission systems	11	1.9

*/ Until September 2003. Source: Secretaría de Economía. Dirección General de Inversión Extranjera.

4.3.6 Education, Training, and Human Resources.

Education is considered as merely one more input for production, and schools as the places where "added value" in students is generated. But, the Mexican government is

incapable of providing this education for all, at the depth and scale necessary to build an economy based on knowledge and innovation. The average years of schooling for adults in the year 2000 was 7.2, this are the years of formal schooling received, on average, by adults over age of 15. The duration of compulsory education in the year 2000 was 10, this is the number of grades (or years) that a child must legally be enrolled in school. The duration of primary education is 6 years and secondary education is also 6 years. The net enrollment ratio, at secondary level, was 59.7 in the year 2000; this is the ratio of the number of children of governmental secondary school age enrolled in school to the number of governmental secondary school age in the population. Literacy (age 15 and over can read and write) is 89.6% of the total population (est. 1995). (UNESCO Institute for Statistics, 2003, [6])

Nowadays, job training has grown significantly in importance in all companies. Several studies on the sector show that training is associated with productivity and company size. In general, training needs have risen in all of the establishments; but the increase has been greater within export companies, followed by those that maintain dual – domestic and export- markets. The intensity of the training varies depending on the origin of capital and the product chain, with the foreign companies focusing more on training. They assign a higher budget and take advantage of their connections with other companies or within the same firm. Several companies have implemented individual training programs with the aim of covering cells of knowledge and skills, and they have established evaluation and ranking norms for acquired qualifications, among other aspects. Teamwork in many of them is the foundation upon which the continuing education model is built,

whereas external training is basically geared to higher occupational categories (Carrillo, 1998).

4.3.7 Communication Channels: Research Centers and Institutions.

The main research centers in Mexico are universities, public and private, the national research council on science and technology (CONACYT) and a great number of sectorial research centers, such as the Mexican Institute of Petroleum, Institute of Electrical Research and the Engineering Institute (UNAM) among others. The mission of CONACYT is to encourage and fortify the scientific development and the technological modernization of Mexico, by educating human resources of high level, promoting and supporting specific research projects and diffusing scientific and technological information. In general, Mexico has low national expenditures rate on science and technology (0.5% GDP). The government sector concentrates most of the resources, human and financial (75%), dedicated to scientific and technological activities. There is no unified capacity for planning, programming and assessing S&T expenditures. There is a great distance between science and technology and social and productive goals. There is a small scientific and technologic community, but it is a highly qualified group. There is a lack of trained personnel to work on science and technology, especially in research and technological development areas, and particularly in the productive sector. There is a low and decreasing number of registered patents (Sbragia, 2003). Some figures will be given to create a general view of the status of science, technology and research in Mexico.

Table 4.2 Main Science and Technology Indicators (www.inegi.gob.mx)

Indicator	Measurement Units	Values		Annual Variation
		2001	2002	
Patent Applications	Number	13 566.0	13 062.0	-3.7
Granted Patents	Number	5 478.0	6 611.0	20.7
Human Resources in Science and Technology	Thousands of People	7 799.5	8 228.5	5.5
Population occupied in the Science and Technology areas	Thousands of People	4 634.2	4 768.8	2.9
Proporción de la Población Económicamente Activa Ocupada que Labora en Actividades de Ciencia y Tecnología	%	11.9	11.8	-0.4
University Graduates	Persons	215 431.0	221 328.0	2.7
Post-Graduate Programs	Persons	1 078.0	1 249.0	15.9
Government Budget for Science and Technology	Millions Pesos	23 993.0	25 374.0	5.8
High Technology Exports	Millions U.S. Dollars	33 965.4	32 073.5	-5.6
High Technology Imports	Millions U.S. Dollars	36 882.9	28 597.4	-22.5

4.3.8 Target Group: Opinion Leaders and Change Agents.

A change agent is an individual who influences clients' innovation-decisions in a direction deemed desirable. Change agents face two main problems: (1) their social marginality, due to their position midway between a change agency and their client system, and (2) information overload, the state of an individual or a system in which excessive communication inputs cannot be processed and used, leading to breakdown. Seven roles of the change agent are: (1) to develop a need for change on the part of clients or technology recipients, (2) to establish an information-exchange relationship, (3) to diagnose problems, (4) to create an intent towards change in the client, (5) to translate an intent into action, (6)

to stabilize adoption and prevent discontinuance, and (7) to achieve a strong relationship with clients.

A change agent's relative success in securing the adoption of innovations by clients is positively related to: (1) the extent of change agent effort in contacting clients. (2) a client orientation, rather than a change agency orientation, (3) the degree to which the diffusion program is compatible with clients' needs, (4) the change agent's empathy with clients, (5) his or her homophile with clients, (6) credibility in the client's eyes, (7) the extent to which he or she works through opinion leaders, and (8) increasing clients' ability to evaluate innovations (Rogers, 1995).

Such a change agent could be a supervisor within a company, with whom workers are familiar. This change agent must speak Spanish and it is better if he is local, because foreigners are distrusted. Generally, there is a different treatment for foreigners and locals within most companies. Given this difference in the way people is treated, it is easy to figure out that everything that comes from someone who is not a part of their rather closed local sphere will not be easily assimilated or accepted, although it is clear that given the situation and work subordination, workers will have no other choice than doing the things they are told to, but the way they will behave can affect the results of the TT (García Blásquez, 2003). Therefore, it is important to establish some form of connection with the local leaders who understand the culture in which the new technology is to be introduced.

4.3.9 Government and Politics.

In the last decade, there was a substantial change at the macro level in Mexico. NAFTA was signed, establishing a gradual and differentiated reduction on tariffs for the auto and autoparts industry. This allows the participation of foreign capital in the autoparts sector. And on the other hand, significant governmental efforts are made to develop suppliers to these industries. The second half of the nineties has meant the start of more active policy to promote production linking. Of particular relevance was the establishment in May 1996 of the Industrial Policy and Foreign Trade Program, which proposes as one of its strategic lines: inducing the development of highly competitive industrial, regional and sectorial groupings with a high level of participation by micro, small and mid-size companies (Carrillo, 1998).

Today, Mexico is the country with the largest network of Free Trade Agreements (FTA's) in the world. Mexico's network of FTA's with 32 countries, on three different continents, represents a unique opportunity for foreign investors, offering preferential access to a potential world market of more than 870 million consumers.

Mexico's strategy is to continue expanding its network of FTA's to diversify its export markets and to attract Mexican and foreign enterprises to invest and reap the benefits of joint production in a strategic location.

Mexico's network of FTA's include:

- 1992 – Mexico-Chile FTA: This treaty was Mexico's first FTA. In 1999, the original agreement was complemented with additional topics including trade in services, government procurement, dispute settlement procedures and intellectual property. By 2001, as a result of the FTA, total trade between Mexico and Chile had increased eight-fold since 1991, reaching over US$1.5 billion.
- 1994 – NAFTA between Mexico, United States and Canada: Since it came into force in 1994, the North American Free Trade Agreement (NAFTA) has been a key instrument in increasing trilateral trade. Between 1994 and 2001, total trade between the three countries grew by 115.7 percent to reach US$622 billion. Today, the North American region is one of the most dynamic and integrated economic areas in the world. Since NAFTA began, trilateral trade has grown at an annual average rate of almost 10 percent, while Mexico-United States trade has more than tripled. In 2001, bilateral trade between Mexico and the US amounted to US$245 billion, while total trade during the same period between Mexico and Canada amounted to US$12 billion.
- 1995 – G3 FTA between Mexico, Venezuela and Colombia: This FTA has helped to build stronger ties between Mexico and South America. Trilateral trade has increased by 51 percent since 1994. Such results have helped Mexico to strengthen its position in those markets, with the result that, today; it is the fifth most important supplier of goods for both Venezuela and Colombia.

- 1995 – Mexico-Costa Rica FTA: This was Mexico's first FTA with a Central American country. The FTA has yielded significant results. Total trade more than tripled between 1994 and 2001, reaching US$566 million.
- 1995 – Mexico-Bolivia FTA: This FTA has helped to increase Mexico's presence in the Andean market. With this agreement, total trade between Mexico and Bolivia increased by 54 percent between 1995 and 2000.
- 1998 – Mexico-Nicaragua FTA: Immediately upon the entry into force of this agreement, 45 percent of Mexico's total exports to Nicaragua entered duty free, while 77 percent of Nicaragua's exports to Mexico entered duty free, (recognizing the differences between the economies of each country). By 2001, total trade between both countries had reached US$167 million.
- 1999 – Mexico-Uruguay Economic Cooperation Agreement: This partial-scope trade agreement was signed by Mexico and Uruguay under the Latin American Integration Association (ALADI). It provides for the elimination of tariffs in 90 percent of the common tariff lines and also covers other topics such as market access regulations, rules of origin, customs procedures, technical and phytosanitary norms and dispute settlement.
- 2000 – Mexico-EU FTA: This treaty created the first free trade area between Europe and the American continent. This FTA is a forward-looking and comprehensive agreement that offers increased opportunities for Mexican and European enterprises to create links, through the establishment of strategic alliances and the promotion of investments. In 2001, total trade between Mexico and the EU amounted to US$21.5 billion. This FTA gives Mexico the opportunity to increase its trade with a potential market of 370 million people.

- 2000 – Mexico-Israel FTA: Israel has concluded free trade agreements with the EU, US and Canada. In order to capitalize on this commonality with Mexico, both countries agreed to a further FTA between themselves. In 2001, total trade between Mexico and Israel reached US$297 million.
- 2001 – Mexico-European Free Trade Association FTA: The Mexico-EFTA treaty, signed with Norway, Iceland, Switzerland and Liechtenstein was negotiated on the basis of the Mexico-EU FTA. This FTA makes Mexico the only country in Latin America to have concluded free trade agreements with the vast majority of the world's highest income countries. In 2002, total trade between Mexico and EFTA countries reached US$1.4 billion.
- 2001 – Mexico-Triangular del Norte FTA between Mexico, El Salvador, Guatemala and Honduras: This treaty has helped to increase Mexican exports to Central America. Today, Mexico's total exports to these three countries are superior to exports destined for Argentina and Brazil combined.
- 2004 – Mexico-Japan Economic Partnership Agreement (EPA). After 16 months of often tough negotiations, Mexico and Japan reached a free trade accord on 12 March, to be signed in June and set to enter into force in January 2005. Mexico is the second country with which Japan has signed a free trade agreement (FTA); the first being Singapore. This agreement will raise the Mexican GDP in 1%.

Mexico also plays a central role in several important multilateral forums. Mexico's network of FTA's has helped to strengthen its position in these forums and to play an increasingly leadership role (Naftaworks, [5]).

The policies and actions by which the Mexican government, through CONACYT, intends to promote the scientific research and the technological development are contained in the “National Science and Technology Program 2001 -2006”. This program consists of an institutional organization of the Mexican science and technology system. The country will be investing 1% of its GDP in S&T instead of the actual 0.4%.

4.3.10 Infrastructure.

Mexico, a country the size of Western Europe with a booming economy, needs a thorough and reliable transport system. But the transport infrastructure in Mexico is patchy, excellent in some areas but undeveloped and congested in others. The Mexican government has privatized most of the transport industry and left it to the private sector to raise the capital needed for improvements. And improvements are happening all the time.

Roads are the major source of transportation in Mexico. Almost all passenger traffic and about 90% of freight traffic is by road. 96,221 km of paved roads exist in the country. A network of modern highways exists linking major centers. These highways were built largely by the private sector in the early 1990s. They have however encountered serious financing difficulties following the 1994 currency devaluation which upset the concession pay back timetables set by the federal government. The government is privatizing the operation of the toll highways. The toll highways are generally in excellent condition. Tolls are extremely high with the result that most traffic uses the congested, limited "libre" or free federal roads. About US$ 700, 000 is spent annually on maintenance of roads in Mexico.

Railways have been privatized successfully in Mexico. The railways have been sold in individual packages, mainly to US backed operators. Virtually all passenger traffic has ceased. Railways instead concentrate on freight. Mexico's booming exports to the US and Canada provide a profitable market. Freight volumes are growing every year.

The Maritime sector is privatized, allowing significant private and foreign capital to participate, and a degree of private sector management control. According to official figures, from 1993 to 1999, even allowing for the economic crisis of 1994-95, total cargo handled by Mexico's 90 ports grew by 26%, to 231million tons. Oil and by products account for some 40% of this traffic. Container traffic more than doubled between 1995 and 1999, to 8.4 million tons. Overall, there are 180,000 meters of docks in Mexico, of which 44% is devoted to tourist traffic, 16% to fishing and 15% to ocean-going commercial freight traffic. Coastal traffic, the Mexican navy and docks owned by the state oil company, PEMEX, account for most of the rest.

Each of Mexico's 24 major ports or port groups is managed by its own Administración Portuaria Integral (API). Each API is a free-standing, publicly-owned, chartered corporation, granted a renewable operating concession by the Federal Government for up to 50 years. In turn, APIs may award partial concessions to the private sector to operate terminals and related services. Additional revenue is raised from docking fees. APIs may eventually be privatized, with up to 49% of shares available to foreign investors. One API - Acapulco, whose traffic is almost entirely limited to cruise liners - has so far been privatized, as an experiment.

In 1999, the 24 APIs together registered total pre-tax profits of 199 million Pesos (approx US$20 million), a drop of US$18 million over 1998. However, they invested a total of 689 million Pesos (approx. US$70 million) in 1999, up 39% on 1998. Some 90% of this investment was from public funds.

Passenger air traffic is growing in Mexico at a rate of 8% a year, according to the Director-General of Civil Aviation. In 1999, Mexican airports handled almost 60 million passengers (20% international). The congested Mexico City international airport accounted for over one third of these. Mexico has the second largest fleet of private aircraft in the world (after the USA). Air cargo traffic is also expanding fast, with airports increasingly seeking to encourage high-value, hi-tech cargo (e.g. computer components) over the more traditional bulk cargo (e.g. tropical fruit).

The operation of 34 of Mexico's largest regional airports was privatized between 1998 and June 2000, under the Ley de Aeropuertos (1995), which allowed for initial private capital participation of up to 15%. Most remaining government shares in the first group to be privatized - ASUR, centered on Cancun - were floated on the international market in September 2000, leaving only 11% in government hands. It is probable that the new government will continue this process with the other two groups, GACN and GAP, which are centered on Monterrey and Guadalajara respectively. (UK Trade and Investment, [7])

Telecommunications are growing fast with the opening of the state monopoly to foreign investment. Mexico has become one of the five leading nations in wireless

communication. Second generations of satellites have been launched and computer networking has increased connectivity.

Domestic telephone systems: Adequate telephone service for business and government, but the population is poorly served. Many Mexican communities in remote locations do not have an extensive phone network or other telecommunication networks. Phone service is usually limited and expensive, and high-speed technologies such as ISDN or DSL are not widely available; domestic satellite system with 120 earth stations; extensive microwave radio relay network; considerable use of fiber-optic cable, coaxial cable, and mobile cellular service.

International telephone systems: satellite earth stations - 32 Intelsat, 2 Solidaridad (giving Mexico improved access to South America, Central America, and much of the US as well as enhancing domestic communications), numerous Inmarsat mobile earth stations; linked to Central American Microwave System of trunk connections; high capacity Columbus-2 fiber-optic submarine cable with access to the US, Virgin Islands, Canary Islands, Morocco, Spain, and Italy. (www.nationmaster.com)