Global production networks and local learning: The case of Ford in Hermosillo, Mexico[1]

Oscar F Contreras,
El Colegio de Sonora
ocontre@colson.edu.mx

and

Jorge Carrillo,
El Colegio de la Frontera Norte
carrillo@colef.mx

(English version)

To be presented at Gerpisa 14TH International Colloquium Paris, June 12-13, 2006.

Abstract

In July of the 2005 it renewed their operations the stamped and assembly plant of Ford Motor Co. in Hermosillo, Sonora, in the north of Mexico, after an ambitious expansion and reorganization process. By means of this expansion three new models were introduced (Ford Fusion, Mercury Milan and Lincoln Zephyr), the production capacity was increased from 120,000 to 300,000 annual vehicles, a new system of flexible manufacture were established, and the network of first tier suppliers was reorganized in order to manufacture the new models according with the modular system. All these aspects position this plant in the technology frontier of the vehicle industry.

The investment to enlarge the Ford plant and to build a new park of suppliers overcomes the 2,000 million dollars, the biggest investment in the car industry in North America in the last 5 years. Within, the Ford-Hermosillo becomes a plant of flexible manufacture able to produce up to 10 different models in the platform CD3 developed by Mazda G.

This paper has three objectives: (a) to show the characteristics of the new organization of production in Ford Hermosillo, (b) to analyze their consequences for the incorporation of local companies in the supply chain, and (c) to analyze the mechanisms of transfer of manufacture knowledge and managerial capabilities on the part of the leaders firms toward the local companies. The data used for this analysis comes from a study concluded in December 2005, based on a survey with Ford-Hermosillo's supplier companies, and interviews with managers' suppliers of first and second tier.

1 This paper is based on "The Study of the Impact of New Investment of Ford Motor Co. in Hermosillo, Sonora" COLSON, 2005.

1. The Platform CD3 and the New Opportunities

Ford established a plant in 1986, with the participation of Mazda, in the city of Hermosillo, Sonora, Mexico. It was the most modern plant in the country and of the Ford's plants in Latin American at that time. The project was part of the Ford's 'world car', with the goal of overcoming their deficiencies in order to reach the levels of performance of the Japanese industry. The development of the FH initiate with an investment of 500 million dollars in order to produced 130,000 vehicles anualy. Their production is full exported to United States and Canada and it has a twin plant in Wayne, USA. Their international competitiveness has been outstanding since the beginning (Carrillo and Montiel, 1998).

Over the next 20 years, the Ford plant in Hermosillo (FH) has undergone several expansions and reorganizations, always maintaining international standards of excellence as regards quality and productivity. The most important expansion of the plant began in 2004 and concluded in July, 2005. Said expansion introduced 3 new models (*Ford Fusion, Mercury Milan, and Lincoln Zephyr*), increased production capacity to 300,000 vehicles per year, established a new flexible manufacturing system that puts the plant at the leading edge of automotive technology worldwide, and reorganized the Tier 1 supply chain so new models can be manufactured according to the modular manufacturing model.

Among the most important aspects of the expansion are:

- More than 1.739 billion dollars invested in Ford plant expansion and development of Supplier Industrial Park
- It is the largest automotive industry investment in North America in the last 5 years
- 13,275 new direct jobs created (including new jobs at Ford, Tier 1 & 2 suppliers, and local suppliers). The estimated indirect employment impact is of 23,894 jobs
- The industrial park adjacent to the Ford plant hosts 20 Tier 1 and 2 turn-key suppliers and specialized services
- Ford Hermosillo becomes a flexible manufacturing plant capable of producing up to 10 different models based on the *CD3 Platform* developed by Mazda G
- The CD3 Platform as a key piece of Ford Motor Co.'s strategy against tough competition from models such as the Honda Accord and the Toyota Camry in the North American market
- The strategy contemplates reducing costs while increasing vehicle quality and recovering their subcompact market share, where Japanese brands continue to gain ground
- This investment consolidates the Hermosillo plant as a World Class Manufacturing Center, now at the core of one of Ford's most ambitious plans in the difficult North American market

Over its nearly 20 years in operation, the Ford Hermosillo plant has been the subject of several studies[2], some of the most important of which have been on investment, production and employment, and labor force characteristics at the Ford Plant. Below are some of the most relevant conclusions reached by these studies as to the impact the plant had had, not including its most recent expansion:

- In its 20 years, Ford Hermosillo has grown on several occasions, both in production and employment;
- Salaries at the plant have regularly increased;
- Its labor force has matured and diversified, making it more experienced and stable;
- The Ford plant has fostered new organizational practices that have been adopted by other local companies;
- The engineers who have worked at Ford represent a vehicle for the transfer of manufacturing and organizational knowledge in our region;
- There have been some success stories as to working in liaison with colleges and universities, although they have not always had continuity.
- Although local companies have not been part of the Tier 1 & 2 supply chain, there has been some success in incorporating small and medium-sized local companies in areas such as General Services, Industrial Maintenance, and Technology Services.

According to some businessmen and analysts, the reasons behind Ford Hermosillo not having developed a local supplier network in its nearly 20 years of operations are as follows:

- Local companies have lacked the technological and financial capacity needed to meet Ford's standards
- Non-existence of an innovation-focused industrial culture
- Regional businesses focus primarily on agricultural/farming activities
- Lack of leadership to bring the efforts of local businessmen and institutions together in order to create a local supply chain
- Government incentives focused on large nationwide suppliers and not on local ones
- Academic and Training institutions did not have a policy to link their programs with the needs of the productive sector.

The dimension, technological features and strategic relevance of the 2005 expansion, have led to great expectations from the business and government sectors. Ford's new manufacturing lines, together with a strong presence of transnational Tier 1 and Tier 2 suppliers, are expected to spark a new phase of regional growth and the incorporation of local companies into the automotive cluster supply chain.

[1] Shaiken , 1990; Sandoval, 1990 and 2003; Carrillo, 1995; Carrillo & Montiel, 1998, among others.

There are several factors that lead us to believe that Sonora's ability to take advantage of the opportunities the expansion of the Ford plant represent is greater today than it was 20 years (As can be seen in **Table 1**):

- There is more capacity for preparing specialized human resources, as well as for technological and scientific research. In addition, higher education and research institutions have revised their priorities, among the top of which now is the link with the productive sector.
- Some local companies have built their technological and business capabilities to a level that allows their participation in global supply chains. A good number of companies are already supplying services in areas such as janitorial services, security, foodservice, maintenance, etc. But, in addition to these conventional services, a handful of technology-based companies has emerged in the last few years, becoming permanent suppliers for Ford or its transnational turn-key suppliers. This is a reflection the technological and business capacity that has been built in the region.
- Ford's operations over these 20 years have created a significant spillover of technical and administrative knowledge in advanced manufacturing. Engineers who have worked for Ford in the past and have since moved to other companies or have set up their own businesses serve as a vehicle for spreading World-Class manufacturing practices throughout the region.
- The Sonora State Government and Mexico's Federal Government both have an industrial policy that stimulates the creation of knowledge-based companies and seek to strengthen productive chains. They also have specific instruments for supporting innovation and growth of local companies.

Table 1
FORD HERMOSILLO PLANT AND SOME IMPACTS

Indicators	1985-86	1995-96	2005-06
Investment, production and employment			
Ford Investment (millions US dollars)	500	300*	1,200
Production capacity (units assembly by year)	130,000	165,000	300,000
Direct employment in the Ford plant	700	2,200	3,800
Average wage (dollars per hour, level 5)	0.53	1.74	--
Percentage of automation	ND	70%	90%
Porcentage of national content (integration)	18%	33%	72%
No. of suppliers of First and Second tier in Hermosillo	7	7	20
Investment in suppliers (millions of US dollars)	57	ND	539.1
Direct employment in suppliers	ND	1,300	4,675
Temporary employments in construction	2,500	--	5,000
Urban Infrastructure			
Construction of roads and highways	21 Km	ND	72Km
Construction of houses	5,300	ND	5,000
Education centers	5	ND	--
Health centers	1	ND	1
Socio-economic profiles of Ford's workers			
Average age	20	28	--
Years of schooling	12	12	--
Percentage of migrants (born out of Sonora)	3%	16%	--
Percentage of males	100%	98%	--
Percentage of singles	88%	43%	--

* Data based on the period 1989-1994; ND = No data available.
Sources: SEDUE (1984), Ford (1984), Fimbres (1984), CIDESON (1984), Sandoval (1990), Carrillo (1995), Taddei (1999), Hualde (2001), Sandoval (2003), Sandoval y Wong (2005), SIUE (2004).

2. Antecedents on Organization at Ford Hermosillo

The North American auto production of Ford is concentrated in US (80%) and Mexico plays a smaller role (8%). In the case of Light Vehicles is even worst (**Table 2**). FH was designed to export, mainly to USA and Canada3. Like other car plants their history is based on the implementation of models: sub-compact Tracer in 1986 (first phase), Escort model in 1990 (second phase), Focus in 1995 (third phase) and now Ford *Fusion, Milán and Zephyr* (fourth phase). By 1990, the plant produced close to 89,000 units and in 2002, 180,000 units (**Table 3**). In 2003 it was announced the production of a new models, and the future production of 300,000 units in different models. The management at FH has been allowed a greater degree of involvement in the design and implementation since the beginning (for example, engineers and technicians were invited to Mazda-Hiroshima during three years.

The sources of FH's main components have changed according to the models produced. North America and Japan are the most important sources of components (in a range from 65% to 35%). By 1990 the plant maintained a national content higher than 30% involving 29 supplier firms. Nine of which were local exclusive specialized subcontracting firms and produce dashboards, carpets, seats, plastic parts, wheels and paints. With the actual increasing capacity the supplier sector is booming, as we will see later.

The adaptation of the Japanese Production System (JPS) has been very intensive since the beginning. To summarize -and using the terminology of Abo (1984)- the firm has the philosophy and practices of the JPS, one that prioritizes human and material methods. Even though the application of the JIT/TQC principles has been systemic at FH, the firm has had to adapt to existing labor relations within the plant and within Ford-Mexico.[4] As a result, they have an organization that searches for continued improvement, but that lags behind in certain key areas like the decentralization of responsibilities to work teams which is due to the decrease in worker involvement and, in general, to the greater presence of the union.

Nevertheless, various incidents have occurred during the plant's history that indicates continued distrust on the part of the firm. The excellent performance in quality and productivity in FH were not free of labor problems: Low wages, intense work rhythms, monotony and repetitive activities, lack of multi-task, and health risks. These problems impact negatively producing high rates of turnover and absenteeism during the first and second phases (Carillo and Montiel 1998). As a green-field site in a developing country, Ford attempted in Hermosillo to implement the use of the best available Japanese technology and organizational methods to produce high quality, low cost automobiles. Although low wages were an advantage they were not identified as the main attraction for the location of the plant in Hermosillo. Rather, Ford hoped that flexible and committed labor would be a greater competitive asset.

---

3 Before the development of FH, Ford-Mexico did not export autos.

[4] Ford's Mexican corporation is composed of a central administration in Mexico City, the industrial complex at Ford-Cuautitlán, the engine plant at Ford-Chihuahua and the assembly and stamping plants at FH.

Regarding with employment, Ford Hermosillo employed close to 2,000 persons in 1990. At the beginning were less than 700. The increase of production during the 90's give a important dynamism for the employment in this region. But since the new century, the US recession impact negatively the plant and Ford Mexico decided to cut 400 jobs and stop producing the Escort (Hermosillo), Cougar and luxury Lincoln Continental (in Cuautitlan plant). Nevertheless new investments (1,600 millions of dollars) were announced in 2003 in order to produce the new models on a Futura platform. It has been launched in 2005 and created 2,000 new jobs in order to produced 135,000 units for export to U.S. Also a new supplier park full linkage with FH will be constructed (FDI 400 millions) in order to attend 38 foreign plants with additional 3,000 jobs under JIT modular production. For Mexican government this investment represents a new industrial era in the region and the possibility to attract new OEMs.

Table 2
Ford North America Production (1995)

	U.S.A.	Canada	Mexico
Cars	1,385,710	207,249	139,350
Light Vehicles	1,225,782	326,194	6,960
Total	2,825,641	533,443	146,310
Plants	16	2	2

Sources: Automotive News; Market Data Yearbook;
Statistics Canada; Mexican Association of Auto Industry Bulletin

Table 3
Ford-Hermosillo: Employment and Production Evolution

Year	Total Employment (average)	Vehicle Production	Models
1987	700	51,773	Tracer
1990	1,998	88,604	Tracer/Escort
1994	2,020	162,777	Tracer/Escort
1998	2,800	124,000	Escort/Focus
2002	n.d.	185,874	Escort/Focus/Fiesta-Ikon
2003	n.d.	143,707	Escort/Focus/Fiesta-Ikon
2006	3,800	300,000	Fusion/Milan/Sephyr

Sources: Authors Elaboration base on AMIA and interview with the company.

3. SME's Capabilities and Regional Development

A survey of Hermosillo micro, small, and medium-sized companies (MSMEs, or MPyMES, in Spanish) in four sectors was done in July of 2005. The four sectors chosen were those identified by specialized literature as those who are most likely to be part of the local supply chain of transnational companies in Mexico: Metal Industries, Industrial Maintenance Services, Specialized Technical Services (including automation and

software development), and "other industries", which includes activities such as wood/plastic products and uniform manufacturing.

General Characteristics of SMEs

- The survey discovered that the great majority of companies in these 4 fields are micro enterprises, particularly in the case of Metal Industries and Industrial Maintenance. Specialized Services includes a greater number of small and medium-sized companies.

- In the case of Metal Industries, two thirds of the companies invoice less than one million pesos per year, while almost 40% of the Specialized Services companies invoice over 10 million pesos/year.

Competitiveness and Participation in the Supply Chain

- A third of the companies had been direct or indirect suppliers of Ford Hermosillo prior to its 2005 expansion. This includes both those that had only temporary contracts and those with long-term participation in the supply chain. Specialized Services companies have had the greatest participation as suppliers, and "Other Industries" have had the least participation.

- A little more than 80% of the respondents indicated that they felt the Ford expansion would benefit their company either directly or indirectly. Specialized Services companies indicated the highest expectation of directly benefiting from Ford's expansion, while Industrial Maintenance companies had the highest expectation of indirect benefits. According to size, a third of micro enterprises expect direct benefits, as do two-thirds of small and medium-sized companies.

Skills Profile

- Less than 20% of the companies have some sort of quality certification documenting their capabilities. Metal Industries had the smallest percentage of certified businesses, with less than 10%, and at the other end of the spectrum are Specialized Services, with 35% of the companies having certification.

- Just under a quarter of the companies have technology that could be considered cutting-edge. Specialized Services companies exhibited the highest technology level, while Metal Industries showed the lowest.

Human Resources

- Two-thirds of the personnel working at MSMEs are unskilled labor, with the remaining third made up of professionals, technicians, and administrative employees. Metal Industries have the highest percentage of unskilled labor and lowest percentage of professionals, while the opposite is true if Specialized Services.

- Specialized Services companies find it the hardest to fill the positions they need. The greatest difficulty is the lack of qualified personnel in the region. This is a problem faced mainly by Specialized Services and Industrial Maintenance companies.

Academic Liaison

- Three-fourths of the companies have had no liaison work with the region's institutions whatsoever. The most notorious cases of this lack of liaison work have been those of Industrial Maintenance and Metal Industry companies. In contrast, Specialized Services companies have or have had the most constant contact with regional higher education institutions.

New Technology-Based Companies

- In spite of the adverse environment facing MSMEs, the last few years have seen the emergence of a small group of technology-based companies (automation, robotics, software development, precision machining, and industrial maintenance services, among others) that have become permanent suppliers for Ford or its Tier 1 suppliers.

- Such companies have been created by engineers who have worked directly for the Ford plant or who were somehow involved in the company's local socio-professional networks. These companies were created through an interactive learning process, born out of service & supply needs identified by the Ford plant or its suppliers, and maturing through the gradual delegation of technical and organizational capacity to local suppliers by the large companies. Once the local companies have built capacities, this increased capability becomes an incentive for the large company to transfer knowledge and more sophisticated processes to local suppliers, including aspect such as engineering and process development.

Figure 1.
LOCAL COMPANIES. STRATEGIES OF INTEGRATION TO THE SUPPLIER NETWORK.

Mayor intensidad tecnológica y de conocimiento

→ ***Industrias metálicas***
Maquinados, estructuras metálicas, herrerías, productos metálicos, etc.
* Bajos costos, flexibilidad y capacidad de adaptación

→ ***Servicios de mantenimiento industrial***
Instalaciones eléctricas, hidráulicas, de refrigeración; instalación y mantenimiento de maquinaria y equipo, etc.
* Calidad, bajos costos, capacidad de adaptación

→ ***Servicios técnicos especializados***
Desarrollo de software, automatización, robótica, etc.
* Calidad, competencias técnicas

Mayor intensidad tecnológica y de conocimiento

Figure 2

SIX CASES OF SUCESS LOCAL COMPANIES

Asesoría Integral de Ingeniería S.A. de C.V. (AIISA)
Fundad en 1991
Emplea a 20 Ingenieros
Se dedica a procesos de Automatización y diseño de redes.
Factura 12 millones de pesos anuales
Origen del vínculo con Ford: Relación de mercado: solución de contingencia técnica mediante dispositivo de automatización

Cinemática Industriales
Fundada en 2000
Emplea a 65 personas, la mitad ingenieros
Se dedica a la fabricación de manipuladores
Proveedor de Ford desde 2001
Factura 40 y 50 millones de pesos anuales (todo el grupo de Control e Integración de Sistemas)
Origen del vínculo con Ford: red socio-profesional de Ford

Integración Robótica y Mantenimiento Industrial, S.A. de C.V.
Fundada en abril 2003
Emplea a 40 ingenieros y 195 técnicos
Se dedica a procesos de automatización, mantenimiento de equipo, servicios industriales y programación
Proveedor de Ford desde 2003
Factura 24 millones de pesos anuales
Origen del vínculo con Ford: empresa fundada por ingenieros que trabajaron en Ford

Ingeniería y Servicios Profesionales E.M. de Sonora
Fundad en 1989
Emplea a 100 técnicos y 15 administrativos
Se dedica a procesos de automatización, montaje de robots, de tubería contra incendios, energía de alta y baja tensión.
Alumbrado, montaje de estructura y dispositivo neumáticos e hidráulicos
Proveedor de Ford desde 1989
Factura entre 20 y 25 millones de pesos anuales
Origen del vínculo con Ford: Relación demercado: solución de contingencia técnica

Proyecto y Manufactura Industrial (PROMAIN)
Fundada en 1988
Emplea a 15 ingenieros y técnicos
Se dedica a servicios de diseño, desarrollo de la ingeniería y manufactura de una amplia gama de producto y equipos metálicos dirigidos a la industria de la construcción, eléctrica, del transporte, alimenticia, agrícola y minera.
equipo, servicios industriales y programación
Proveedor de los grandes proveedores de Ford desde 1995
Factura
Origen del vínculo con Ford: Red-socio profesional

Gear Industrial Service
Fundada en 1996
Emplea 61 técnicos y 14 administrativos
Se dedica a control de calidad
Relación de Ford aproximadamente desde 1996
Factura 3 millones de pesos anuales
Origen del vínculo con Ford: empresa fundada por ingenieros que trabajaron en Ford

4. Technology and Entrepreneurship of Ford Hermosillo's Engineers

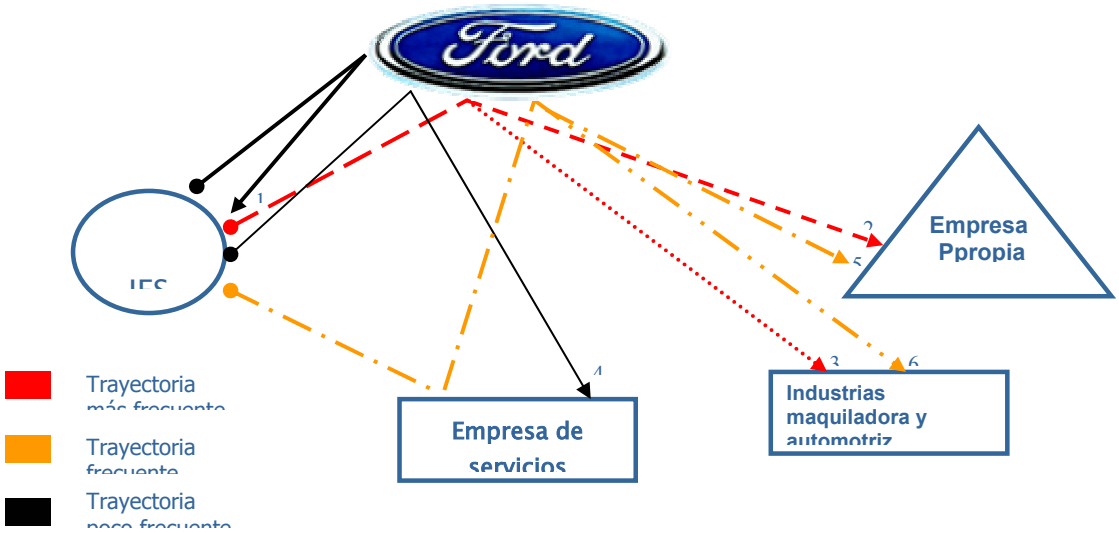
Between June and July of 2005 a list of former Ford employees was created using a "snow ball"-type procedure. A total of 42 engineers who were employed at this plant at one time or another were identified; in-depth interviews were then done from the list, focusing on their occupational career path and its relation to the technological and entrepreneurial learning process.

- Engineers hired by Ford are normally very young, with an average age of 26 years at the time of hire.
- Their average length of service at Ford is of 6.1 years. Over the last 20 years, approximately 400 engineers left their position at Ford to delve into other activities.
- At the time the 2004 expansion began, about 250 engineers were employed at the Ford plant, making up around 12.5% of the total personnel.
- As of the time the interviews were held, the engineers had had an average of 3 jobs in their careers, and an average of 16.1 years since their first formal job.

- 85% of them are Sonora natives, and only 15% are women.
- Most of the professionals interviewed have engineering degrees. Half have had postgraduate studies, generally while working for Ford and often with the support of the company itself.
- Ford was the first job for nearly half of the interviewees, and the second formal job for over 30% of them.
- The majority of engineers who joined other companies after leaving Ford did so at *maquiladora* or automotive companies in the region.
- The most frequent career path observed was going directly from higher education institutions to the ford plant and from there to either *maquiladora* or other automotive industry companies, or to a company of their own.

Figure 3

COMMON TRAJECTORIES OF ENGINEERS THAT HAVE BEEN WORKED IN FORD HERMOSILLO



- Frequently, engineers leaving Ford both take on a new job as employees *and also* set up their own companies.

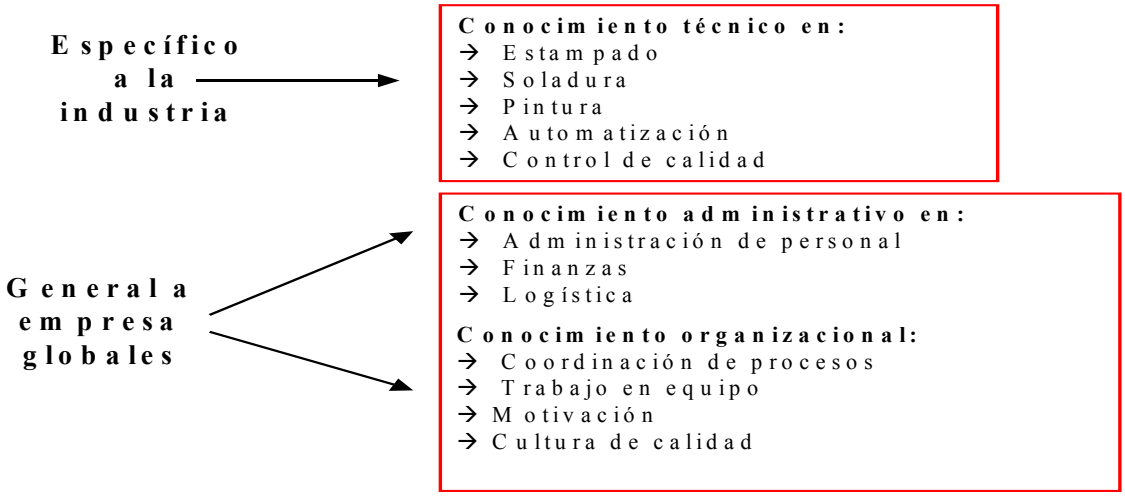
- Two main reasons were given by these professionals as to why they decided to leave Ford, the most common being having gotten an attractive offer for an administrative position (generally management) at another company. A second reason, albeit a less frequent one, was the desire to move to an activity that demanded less of their time and effort.

- In general terms, the knowledge acquired by engineers through their work experience at this automotive assembly plant can be divided into three main areas: technical, administrative, and organizational knowledge.

- In general, the companies created by former Ford employees are characterized by being small companies with a high added value, whose origins are linked to the experience of working for Ford, who is often their main customer.

Figure 4

TYPE OF ACQUIRED LEARNING IN FORD AND DISSEMINATED TOWARD THE REGIONAL ENVIRONMENT AND TOWARD THE LOCAL ENVIRONMENT



5. Managerial Capacities for the Development of Companies of Technological Base

Three mechanisms were identified as the main factors in this capacity-building:

- *Socio-Professional Networks***.** The day-to-day activities of large transnational companies present locally foster the creation of social and professional networks. Over the years, these networks created by the employees of these companies and the different local stakeholders, institutions, and companies form a web of relationships through which information flows, experience is transmitted, and knowledge is amassed. The incorporation of local companies into the large companies' supply chain is often achieved through contacts in this socio-professional network.

- *Former Ford Employees.* Among the most often seen cases of local companies that have successfully become part of Ford's supply chain is that of companies founded by engineers who used to work at Ford and left to create their own company. Having worked at Ford has proven very useful to these new entrepreneurs, thanks to the extensive knowledge acquired within the plant, in addition to the fact that the relationships forged with other plant employees, executives, and suppliers become crucial later on for establishing business relationships.

- *Market Relationships*. Transnational companies seek local suppliers capable of offering low costs, flexibility, and quality. Being part of the socio-professional networks or being former Ford employees facilitates becoming part of this chain, however, sometimes the relationship is establish outside of the social networks through conventional market relationships. Most of these market relationships are developed out of some contingency in which the local company managed to offer services such as installations, equipment repair, programming, and automation, among other services, quickly and flexibly.

Capacity-Building Process

The participation of local suppliers in Ford's supply chain implies the occurrence of a capacity-building process through interactive learning. A conventional model of this process, based on the analysis of success stories, would have the following four phases:

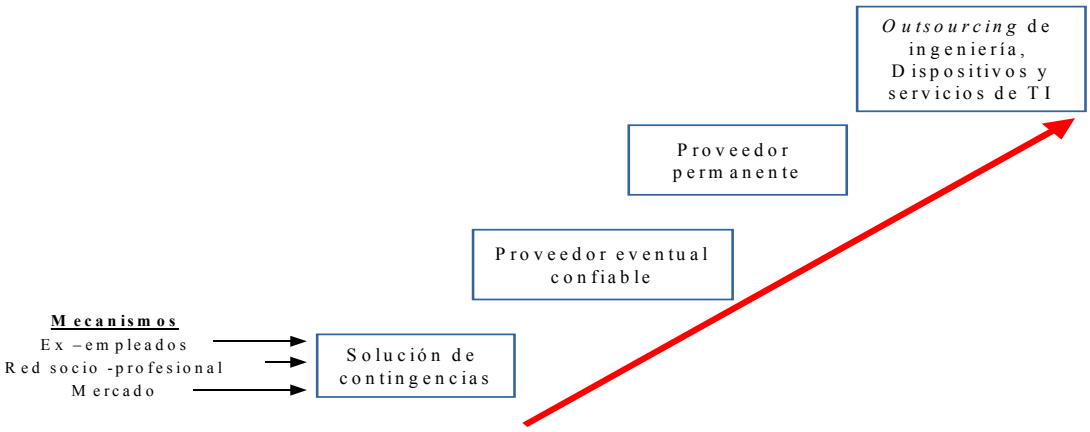
- *Emergency Resolution:* In this phase, the local supplier takes the first step in its relationship with Ford or one of its suppliers by resolving some issue that suddenly arose at the plant. The problems are normally associated with system compatibility, equipment failures, or changes in production lines. The local supplier, by solving these issues, begins to build a relationship based on reliability with Ford.

- *Reliable Temporary Supplier:* After the local supplier has resolved different problems at the plant on several occasions, there is a more solid relationship, based on the local company's reputation with decision-makers at the plant. Because of this reputation, this same supplier is always called upon whenever there is such an emergency.

- *Permanent Supplier:* In this phase, the local company has become a permanent service supplier. The supplier also begins to work in other areas within Ford.

- *Engineering and Process Development Outsourcing:* In this phase, the local supplier evolves into an outsourcer, and establishes a very close, permanent relationship with the leader company, sharing a great deal of information and getting involved in different internal processes, such as logistics, robotic programming, engineering work, etc.

Figure 5
PROCESS MODEL OF LOCAL SUPLIERS



6 Supplier Chain and Local Suppliers in Ford Hermosillo

The new industrial park for suppliers is located next to the assembly plant and hosts 20 Tier 1 and Tier 2 suppliers. With the new modular manufacturing system, the suppliers are responsible for providing modules, instead of parts, to the production line, which makes the vehicle assembly process faster and more efficient.
Tier 1 and Tier 2 suppliers are mostly transnational companies with a close relationship with Ford as global suppliers, with the exception of two Mexican Specialized Services companies. These companies have invested about $539,000,000 altogether, i.e., an average of $45,000,000 per company. These investments – mostly from U.S., Canadian,

and European capital – are equivalent to 3.6% of Sonora's GDP for 2003, and 22.2% of the Manufacturing industry GDP. These companies have created 4,675 new direct jobs, or an average of 234 jobs per company.

Table 7.
FIRST AND SECOND TIER SUPLLEIRS AT FORD IN SONORA

Supplier Company	Investment (million US dollars)	No. of workers	Products and services to Ford	Others operations in Mexico
Magna Sonora Forming Technologies, S.A. de C.V.	250	1000	Carrocería completa (piso del auto, cofres, puertas, techos y cajuelas)	Puebla y Coahuila
Collins and Aikman	150	700	Tablero de instrumentos, consola central, forros puertas, vestiduras plásticas, alfombras, tapetes, aislantes de ruido.	Saltillo y Querétaro
Faurecia Exhaust Services Mexicana, S.A. de C.V.	16	280	Sistema de escape complete	
Grupo Antolín (Kiekert, Kuster)	35	180	Elevalunas, toldos	Silao, Querétaro
Martinrea	11	48	Tanque de gasolina, chasis metálico, arnes interno del tanque.	Saltillo
Flex and Gate	13	200	Molduras de plástico, logotipos, parte de las defensas	
Hella Bher Plastic Omnium (HBPO)	0.6	40	Modulo Frontal (Radiador, ventilador, manguera de fusión, etc).	
Delphi - Carlisle	12.7	93	Sistemas de refrigeración, sistema de enfriamiento para el radiador y soporte de sujeción para radiador y sistema de enfriamento automotriz	
Decoma International Decoplas, S.A. de C.V.	3	60	Facia (defensa) y brackets	
National Material	n.d.	30	Acero en rollo	Monterrey
Seglo	2.8	103	Manejo de material	Edo. México, Ramos Arizpe, Silao, Mariscala y D.F.
TWB	n.d.	37	Corte de hojas de metal para posterior estampado, soldaduras.	
Benteler de México S. A. de C. V.	n.d.	60	Suspensión, amortiguador y ejes	
Lear Corporation de México S. A. de C. V.	10	800	Asientos	
Autopartes de Precisión de Santa Ana S. R. L. de C. V.	n.d.	530	Tubos de nylon, conectores de plástico, tapones de aceite	
Thyssenkrupp Budd	35	309	Chasis complete	
Metokote	n.d.	29	Pintan mofles, recubrimiento de E-Coat	Monterrey

System Technologies	n.d.	1	Arnés completo desde el tablero de control al sistema de iluminación completo.	
Brown Corporation	n.d.	60	Soporte del tablero (estructura metálico), Esqueleto del asiento y soportes del asiento	Saltillo
Ingeniería y Servicios Profesional de Sonora	n.d.	115	Montaje de maquinaria de robots, tubería contra incendio, estructura, automatización y maquinado.	Chihuahua, Saltillo, Aguascalientes y Monterrey

Source: Authors elaboration based on plant manager interviews

This transnational suppliers are basically global companies, big enterprises, technology intensive and with important experience in the automobile industry.

The network of local suppliers

From data provided by Ford Hermosillo's Tier 1 and Tier 2 turn-key suppliers, a total of 129 local suppliers with ties to the automotive cluster were identified.

Table 8

GENERATED EMPLOYMENT BY FORD' SUPPLIERS IN SONORA

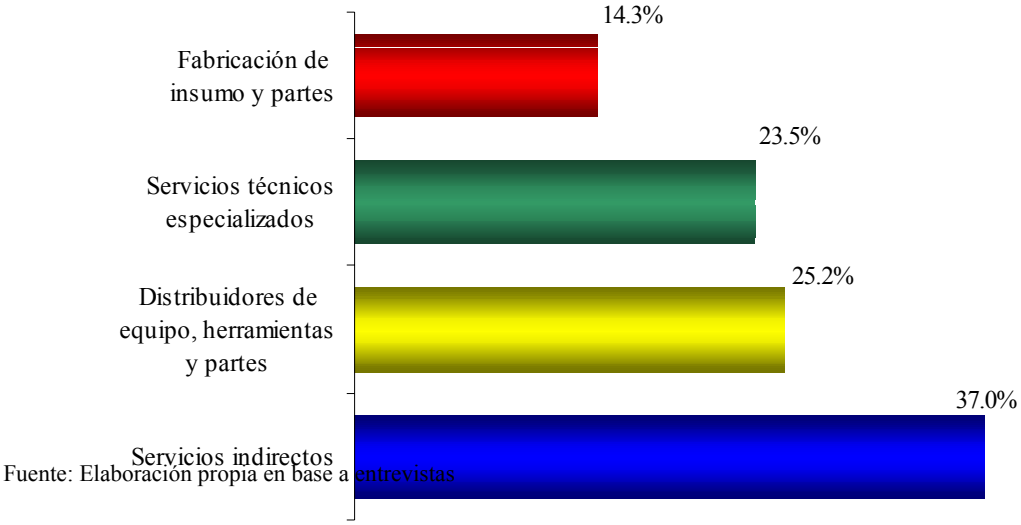
First and second tier big size suppliers	4,675
Local SMEs of Ford and theirs big size suppliers	4,800
Total	**9,475**

SOURCE: Author elaboration based on interview with plant managers.

As can be seen in the table above, the employment generated by local automotive cluster suppliers is of 4,800 employees, slightly more jobs than those created by Ford's transnational suppliers.

They are mostly service companies and tools and equipment distributors. Of all the companies identified, 37.8% are specialized technical service companies and parts/inputs manufacturers, while the rest (62.2%) are services indirectly related to production, such as foodservice, janitorial, security, and trash collection services, among others.

Graphic 1.



Fuente: Elaboración propia en base a entrevistas

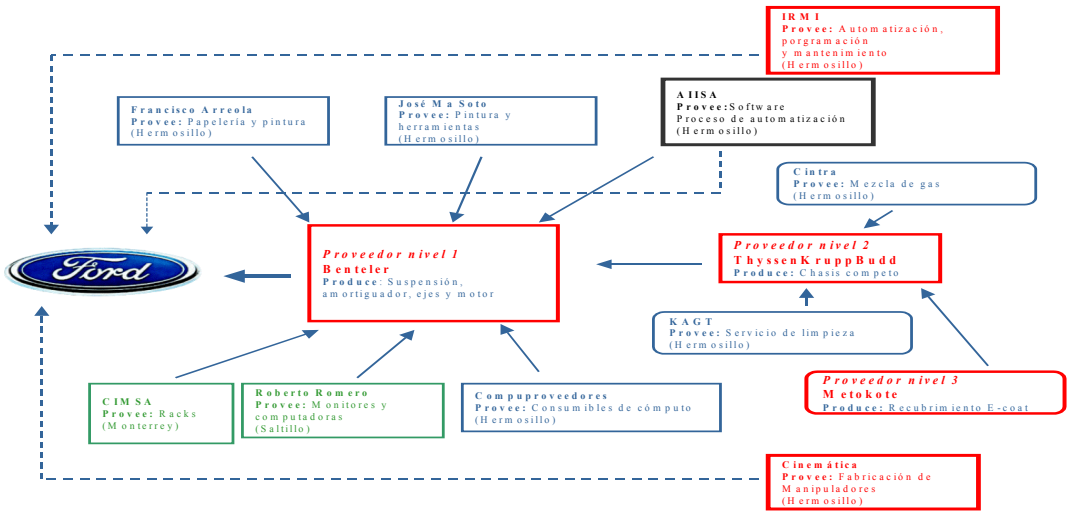
Although most of the local companies provide indirect goods and services, there is a good number of technology-intensive companies extremely capable of providing high-quality, internationally competitive services. These companies are direct suppliers for Ford and most of its turn-key suppliers. The do automation processes, manipulator manufacturing, software manufacturing, programming, robotics, equipment maintenance, electrical system installation, structural assembly, precision machining, logistics & engineering, and other activities.

Figure 4 shows an example of the integration of this kind of local supplier into the supply chain, in this case using the example of technology-based companies:

AIISA, IRMI y CINEMÁTICA.

Figure 4.

EXAMPLE OF LOCAL SUPPLIER INTEGRATION TO FORD' SUPPLIER CHAIN



Niches Opportunities in the Ford supplier chain

Investments made by Ford and its suppliers have sparked new initiatives for the continuous development of innovation projects, both related to products & processes, and to services. These opportunities can be taken advantage of by current suppliers as well as by new participants able to build knowledge-based companies. The pace of innovation will quicken, given the specializations required by the Ford venture and the requirements demanded by the biannual technology change in assembly lines and the incorporation of new advanced manufacturing platforms.

The areas of innovation will be based on the trends marked by the plant's expansion:

Best practices in process/manufacturing design for a CD3 platform aimed at a Fusion model that represents the state-of-the-art in automotive features:

- Improved style and features
- Labor specialized in automation
- Low Emissions
- Cutting-edge drive train technology
- Latest-generation audio and navigation equipment
- Noise, vibration, and roughness level improvements
- Advanced Safety

Recognized superior manufacturing quality versus other Ford plants (at start up)

- Development of frame flexible tooling
- Advanced robotized assembly lines

Automated installation with locally designed and manufactured manipulators (windshield, instrument panels, rear window)

- Advanced technology for integration of subassemblies, modularization
- Implementation of new robotic support systems
- Virtual Construction Technology

The above-mentioned trends have led to a quicker development of process, product, and service technologies in the region by existing companies and have sparked interest in others to get involved, as well as fostered liaisons with universities and research centers for the opportunity to offer educational programs and high-tech specializations.

In order to get to know the issues and needs faced by large transnational and small local suppliers, to focus groups were held on November 3-4, 2005, at the facilities of the Ford Hermosillo plant.

Total attendance for the two sessions was 10 managers from transnational companies, 11 local company managers/owners, as well as 16 public officials and

academics. A description of the main issues and needs detected, as well as the areas of opportunity for strengthening the automotive cluster can be found below.

Tables 9 and 10 summarize the main issues and needs identified for local and transnational suppliers. Most of the issues are due to: (a) difficulty of local companies to meet delivery deadlines and quality levels required by Ford and its turn-key suppliers; (b) lack of coordination/communication tools between large companies and local suppliers, and (c) scarce local supply of specialized services that meet global standards.

Table 9.

Main Problems. First and Second Tier Suppliers

Problem	Description
Escasez de servicios locales especializados que cumplan con estándares globales.	✓ En general, problemas con los tiempos de entrega. ✓ Incluso los servicios más básicos como los comedores no cumplen con requisitos de calidad. ✓ No hay oferta de servicios de calibración. ✓ No hay talleres de maquinados de precisión. ✓ Falta capacidad de análisis de ingeniería par a hacer cambios de modelo. ✓ Faltan empresas con enfoque en el desarrollo de servicios de automatización. ✓ Falta de talleres de corte y soldadura láser.
Escasez de personal calificado y falta de actualización de las IES.	✓ Las IES utilizan herramientas obsoletas. ✓ Hace falta más conocimiento práctico. ✓ Las IES tienen que adecuarse a las necesidades de las empresas. ✓ Planes de estudios obsoletos. ✓ Cultura pesimista, sobre todo en las escuelas públicas. ✓ Falta personal capacitado en software de ingeniería de diseño robusto.
Pocas empresas locales con certificación y capacidades.	✓ Se cuenta con algunas empresas certificadas pero por lo general son servicios no ligados al producto final. ✓ Capacidad para acelerar las certificaciones de procesos, equipo industrial y equipos de medición (incluye torque manual y certificación de *gauges*), así como TS, ISOs y Q1.
No existe oferta de componentes en el mercado local	✓ Productos metálicos. ✓ Troqueles. ✓ Herramentales. ✓ Fabricación local de partes y componentes.
Áreas de oportunidad	**Descripción**
Diseño y desarrollo de moldes, troqueles y partes plásticas	✓ Diseño, simulación, desarrollo, fabricación y reparación de moldes, matrices y troqueles. Así como también partes para radiador, varillas y otros elementos. ✓ Análisis y diseño de elementos finitos de partes plásticas, inyección, termoformado y

	extrusión. ✓ Programación en robótica. ✓ Desarrollo de software para aplicaciones informáticas de la planta y administrativas para control de procesos, materiales y equipos.
Información sobre las capacidades y oferta de las empresas locales.	✓ Se requiere información acerca de empresas locales que pueden ayudar a resolver problemas. ✓ Información sobre las necesidades de Ford y sus grandes proveedores. ✓ Empresas que analicen viabilidad de proyectos de inversión.
Servicios de mantenimiento a líneas de producción	✓ Electrónica ✓ Herramentales ✓ Sistemas ✓ Centro de pruebas de equipos sistemas y software.
Servicios de metrología y calibración	✓ Muchas requieren de necesitan estos servicios. ✓ Se corren riesgos al mandar el equipo a otras ciudades a calibrar. ✓ Hacen falta laboratorios acreditados de calibración.
Apoyo gubernamental a las empresas locales	✓ Se requiere apoyo para procesos de certificación. ✓ Facilitar trámites. ✓ Sistema de certificación acelerado.
Actualización por parte de las IES	✓ Que aprendan a usar software avanzado. ✓ Técnicas avanzadas. ✓ Conocimientos prácticos. ✓ Hacer residencias en las plantas para que conozcan las necesidades de la empresa. ✓ Adaptar plan de estudio a las necesidades de las empresas.
Especialización según marcas de equipos.	✓ Los proveedores de primer nivel exigen que no solo manejen sistemas en general, sino en particular los de su empresa.
Información sobre los proveedores locales	✓ Hace falta un sistema de información para promover a las empresas locales.

Table. 10. Main problems and local supplier necessities

Problemas	Descripción
Financiamiento	✓ Para hacer inversiones en equipo y maquinaria. ✓ Para capacitación de sus trabajadores. ✓ Para obtener certificaciones. ✓ Para invertir en nuevos proyectos y trabajos. ✓ Factoraje: las empresas transnacionales tardan mucho en pagar.
Falta de confianza por parte de Ford y sus grandes proveedores	✓ Falta confianza por ser pequeños proveedores y no estar certificados.
Falta de certificación	✓ No cuentan con recursos para pagar certificación. ✓ Trámites muy para certificaciones son tardados y complicados.
Falta de IES que se dediquen específicamente a la capacitación de técnicos	✓ Existen pocos técnicos especializados. ✓ Las IES imparten conocimientos demasiado teóricos.
Costos	✓ No pueden competir con empresas que ofrecen sus productos a precios muy bajos y con baja calidad.
Necesidades	**Descripción**
Información sobre la demanda de las empresas transnacionales.	✓ Seguridad sobre la demanda para poder hacer proyectos de inversión. ✓ Conocimiento de las áreas de desarrollo futuro para orientar su propia especialización. ✓ Crear una base de datos que sirva de vinculación y para conocer áreas en las que se pueden hacer innovaciones.
Financiamiento	✓ Participación de las empresas transnacionales en la capacitación del personadle proveedores locales para reducir costos en el largo plazo. ✓ Por parte del gobierno para poder hacer inversiones.
Técnicos especializados	✓ Las universidades preparan más en la parte teórica, se requiere formación practica.
Alianzas entre empresas locales	✓ Para abaratar costos. ✓ Para ofrecer servicios integrales. ✓ Para poder especializarse en diferentes áreas y complementarse mutuamente.

7. Perspectives and Recommendations

The new Ford Hermosillo manufacturing lines, and the presence of 20 turn-key global-scale suppliers, represent a renewed opportunity for the State of Sonora. Not only because of the significant economic spillover and the creation of direct employment, but above all because these investments – along with the maturing and learning achieved by companies and institutions in the state – can lead to the birth of an emerging economy based on knowledge.

The feasibility of this alternative is evidenced by the fact that in recent years several technology-based companies have been created and consolidated, capable of successfully joining the Ford Supply chain, and some have even diversified into other global markets. This shows that we are witnessing a new business sector, one with a technological vocation and global capabilities.

In order to take advantage of the new opportunities, we need organization and interaction approaches that strengthen and position this business sector, which in addition to creating high-added-value jobs also serves spearhead the development of the capacities of the future:

- Innovation-based competitiveness,
- Organizational design that is open to globalization,
- High interaction with local, regional, and international knowledge networks,
- Strengthening of the Ford value chain
- Foresight as to changes in new models, systems, and components of Ford vehicles, as well as new services and adaptations the plants will require.

It is also necessary to consolidate an industrial policy that includes the following conditions:

- To bring together the efforts of State and Federal innovation promotion programs so as to speed up the development of high-added-value projects, identifying them from this moment as investment opportunities and opportunities to have a positive impact on the sector and the region;
- Provide continuity to the identification, promotion, and development of innovation projects, with continuous evaluations of its economic and knowledge contributions, and documenting results based on the critical mass of the initiatives detected;
- To adapt the world's best practices for the design, implementation and operation of an *Innovation Automotive Cluster* in the region beginning in 2006, under an approach that will make it self-sustainable thanks to the value of the services it provides its members and to the new innovation-promoting projects.

Bibliographic

Abo, Tetsuo (Editor) (1994). *Hybrid Factory*. New York, Oxford University Press.

Carrillo, Jorge (1995). "Flexible Production in the Auto Sector: Industrial Reorganization at Ford-Mexico" in *World Development*, Vol.23, no.1, Pergamon, Oxford, pp.87-101

Carrillo Jorge and Montiel, Yolanda (1998), "Ford's Hermosillo Plant: The Trajectory of Development of a Hybrid Model" en Boyer, Charron, Jurgens and Tolliday (Ed.). *Between Imitation an Innovation. The Transfer and Hybriditazion" of Productive Models in the International Automobile Industry,* Oxford University Press, 1998, pp.295-318.

CIDESON (1984), *Estudio del impacto económico de la planta FORD*, Hermosillo, Sonora, (mecanoescrito).

Contreras, Oscar (coordinador) "Estudio del Impacto de la Ampliación de Ford Motor Co. en Hermosillo, Sonora" COLSON, Hermosillo, 2005.

Fimbres Montijo, Raúl (1984), *Viabilidad Social y Económica para el establecimiento de una planta ensambladora en Hermosillo Sonora*, México D.F. (Tesis de licenciatura, Facultad de Economía, UNAM).

Ford Motor Company, Contrato Colectivo de Trabajo 2004-2006 de Ford Motor Company, Planta de Estampado y Ensamblado de Hermosillo.

Hualde Alfaro, Alfredo (2001), "Del territorio a la empresa: conocimientos productivos entre los ingenieros del norte de México" en *Región y Sociedad*, Revista de El Colegio de Sonora, Vol. XIII, Núm. 21, enero-junio.

Lung, Y. y Van Tulder, R. (2004), "Introduction: In Search of a Viable Automobile Space" en Carrillo, Lung y Van Tulder (Editors), Cars, Carriers of regionalism?, Palgrave-Macmillan/GERPISA, London/New York.

Sandoval, Sergio (1990). "Los equipos de trabajo en la planta Ford" en *Revista de El Colegio de Sonora*, El Colegio de Sonora, Hermosillo.

Sandoval, Sergio (2003) *Hibridación, modernización reflexiva y procesos culturales en la planta de Ford Hermosillo*, Ed. Plaza y Valdez/COLSON/CIAD, Hermosillo.

Sandoval Godoy, Sergio y Pablo Wong González (2005), "Especialización regional, Integración de proveedores e impactos locales: el nuevo proyecto de expansión de Ford – Hermosillo", *Región y Sociedad*, *Revista de El Colegio de Sonora* (en prensa).

Secretaria de Desarrollo Urbano y Ecología (SEDUE) (1984), *Los impactos a corto plazo de la instalación de la planta FORD en el Desarrollo Urbano, la Vivienda y la Ecología*, Hermosillo, Sonora (mecanoescrito).

Secretaría de Infraestructura Urbana y Ecología (SIUE) (2004), *Infraestructura para el nuevo desarrollo de la planta Ford*, Hermosillo, Sonora (archivo electrónico JPG).

Shaiken, Harley (1990). *Mexico in the global economy. High technology and work organization in export industries*, Center for U.S.-Mexican Studies, Univesrity of California, San Diego, La Jolla, 136p.

Taddei, Jorge (1999) "Proyecto Ford– Unison y maestría en manufactura (BAMMEA)", en Blanca Lara, Cristina Taddei y Jorge Taddei (compiladores), *Globalización, industria e integración productiva de Sonora*, COLSON-CIAD-UNISON, México.

Womack, James, Jones, Daniel and Roos, Daniel (1990) *The Machine that Changed the World*, Ed. Rawson Associates/Collier Macmillan/Maxwell Macmillan, New York/Toronto/Oxford.