

Individual Case Studies of Japanese Knowledge Transfer via Training in Mexico's Automotive Industry

Estudios de caso individuales de transferencia de conocimiento japonés a través de la capacitación en la industria automotriz mexicana

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Abstract

The automotive industry has been considered a source for achieving development in emerging economies. In an ideal setting, supplier firms and assembly plants work interconnected creating positive externalities, but it has been shown that this is difficult to achieve for developing countries. The case of Mexico stands out as a country that has successfully attracted major Japanese automotive assemblers but has struggled to include endogenous firms in the supply chains primarily due to the inability to meet technological and quality requirements. This study employs a qualitative case study methodology to analyze knowledge transfer processes to local firms that participated in a training project from the Japan International Cooperation Agency (JICA). The results show that through training, participating local firms improved quality and productivity measurements. The knowledge acquired was internalized and diffused within the firm allowing for industry-specific certifications, market growth, and market diversification.

Resumen

La industria automotriz ha sido considerada una fuente para lograr el desarrollo de las economías emergentes. En un escenario ideal, las empresas proveedoras y las plantas ensambladoras trabajan interconectadas creando externalidades positivas, pero para los países en desarrollo se ha demostrado que esto es difícil de lograr. El caso de México se destaca como un país que ha logrado atraer a las principales ensambladoras automotrices japonesas, pero que ha tenido dificultades para incluir empresas endógenas en las cadenas de suministro, principalmente debido a la incapacidad de empresas locales por cumplir con los requisitos tecnológicos y de calidad. En este estudio se emplea una metodología cualitativa de estudio de caso para analizar situaciones de transferencia de conocimiento a empresas locales en el marco de un proyecto de capacitación de la Agencia de Cooperación Internacional del Japón (JICA). Los resultados muestran que, a través de la capacitación, las empresas locales participantes mejoraron medidas de calidad y productividad. El conocimiento adquirido se internalizó y difundió dentro de la empresa, lo que permitió certificaciones específicas de la industria, así como crecimiento y diversificación del mercado.

Keywords: knowledge transfer, training programs, automotive industry, Japanese Foreign Direct Investment, Mexican automotive suppliers.

Palabras clave: transferencia de conocimiento, programas de capacitación, industria automotriz, inversión extranjera directa japonesa, proveedores automotrices mexicanos.

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Introduction

The automotive industry has been considered a source of development because of its impact on employment, knowledge transfer capabilities, and backward and forward linkages with other industries. However, only a handful of developing countries have achieved an internationally competitive automotive industry. Hosono (2015) argues that this might be attributable to the industry requiring skilled labor and a strong supporting industry able to provide from 20,000 to 30,000 parts and components. In an ideal setting, supplier firms and assembly plants work interconnected, creating positive externalities to each other. Still, for developing countries, it has been shown that this is difficult to achieve.²

The case of Mexico stands out as a country that has successfully attracted major automotive assemblers but has not been able to develop a solid supplier base. Despite the increasing presence of Japanese firms in Mexico, local firms have not been able to enter automotive chains primarily due to the inability to meet technological and quality requirements (Guzman-Anaya, 2016; Tokoro, 2006). According to JICA (2017), this has been in part due to labor shortages and technology gaps that hamper the possibility of Mexican automotive suppliers entering global production chains. On the other hand, there is also the argument that Japanese firms impose high entry barriers on local firms and favor procurement from suppliers that form part of the same business group or “*keiretsu*”. Irawati (2012) argues that Japanese *keiretsu* follow a global-local type of interlinked network or what is regarded as a network within the network that limits linkages with local firms.

In this sense, Japanese automotive assemblers have incentivized other Japanese companies to establish in Mexico primarily in the Tier-1 level of procurement, with an increasing presence in the Tier-2 level.³ This behavior is reflected in Japanese Foreign Direct Investment (JFDI) statistics, where almost 70% of manufacturing investment flows are concentrated in the automotive

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2. The case of Thailand stands out as a success story for the development of a competitive and inclusive automotive industry, where local firms acquired technological capabilities and there was an increase in the pool of skilled labor required for the industry. See Yamashita (2004).
 3. The automotive industry organizes suppliers in sequential levels called “tiers”. The automotive manufacturer (also called Original Equipment Manufacturer (OEM)) relies on parts, module, and system suppliers (Tier-1), who in turn receives components from manufacturers (Tier-2), who themselves must depend on suppliers of raw or close to raw materials (Tier-3).

industry. Also, there is a spatial concentration of automotive JFDI in the western region of Mexico including the states of Aguascalientes, Guanajuato, Jalisco, and Queretaro (Falck-Reyes & De la Vega Shiota, 2014). This region has provided favorable conditions in terms of competitive production costs, qualified labor, and infrastructure. Additionally, despite that production is established in the region for export purposes, the internal market has been expanding, creating an increasing demand for automotive products. Finally, Lugo-Sanchez (2018) mentioned that state and local governments in Mexico had set forward encouraging policies in the form of favorable labor conditions and fiscal incentives to attract Japanese firms to the region.

Despite the discouraging scenario for Mexican firms to enter the Japanese automotive production chains, there are opportunities for local firms to increase their presence in the Tier-2 and Tier-3 levels of procurement, since more than half of the inputs required in the country are imported. To achieve this goal, Mexican companies need to reduce the technological gap with their international counterparts by improving their quality and productivity indicators. This may be achieved by knowledge and technology transfer via training. For instance, government agencies can increase the technological levels of local firms at the micro-level using training. This study presents six case studies of Mexican Tier-2 firms and three case studies of Japanese Tier-1 firms that participated in a training project implemented by the Japan International Cooperation Agency (JICA) from 2012 to 2015. The interviews were carried out in 2018 to analyze the benefits achieved from training.

The paper is organized as follows: the next section cites the literature review regarding the effects of training programs at the macro and micro-level. Section three presents a contextual framework regarding Japanese training programs. The fourth section shows the methodological strategy implemented. The fifth section produces the empirical case studies of this study. The final section concludes.

Literature Review

Previous studies from Japanese FDI in the automotive industry have shown that Japanese industrial organization models are able to adapt to local conditions (Nonaka et al., 2000; Fujimoto, 2007). Also, it seems that Japanese firms equip themselves with more advanced technology when they settle in a developed country compared to developing countries. This, however, might

not be disadvantageous for developing countries since a wide technological gap might limit the absorptive capacity of local firms to internalize the new knowledge. In other words, if Japanese firms establish in a developing country with their cutting-edge technology, this may limit technological transfer to local firms due to the knowledge gap. However, Japanese firms also invest in developing countries to take advantage of lower labor costs and make use of labor-intensive technology; in some cases, this might be not entirely the firm's choice but also the process of agreements with local governments to comply with employment quotas and receive fiscal incentives.

Knowledge transfer from Japanese subsidiaries seems to depend on the characteristics of the investing firm and if the investment is realized in a developing or a developed country. For the case of developed countries, the knowledge transfer phenomenon appears to be bidirectional (Branstetter, 2006); for developing countries, the transfer is regarded as one-directional, from the Japanese subsidiary to the local firm (Blalock, 2001).

The transfer of technology from a developed country to a developing country is also known as “the North-South model”, where the “North” (developed countries) are regarded as the originators of technical knowledge to the “South” (developing countries). However, a sharp increase in South-South Cooperation (SSC) has been observed in the last decades (Raslan, 2021). The SSC model argues that active partnerships from governments, regional organizations, civil society, academia, and the private sector among developing countries may develop individual capacities through the exchange of knowledge, skills, resources, and know-how. Multinational companies from China, India, Brazil, and South Africa are actively investing in Africa, Asia, and Latin America (Singh-Puri, 2010).

In the case of Mexico, previous studies indicate several factors related to knowledge transfer. For example, (Beltran-Morales et al., 2019) argue that Technology Transfer Offices (TTOs) play an important role in the transfer of technological skills to local firms. These efforts might help reduce the technological gap. However, the challenge to transition to new frontier technology and Industry 4.0 remains. As a result, the country's 2016 roadmap for industry 4.0 recommended identifying six states with the potential to implement industry 4.0 and develop clusters (Ministry of Economy of Mexico, 2016). For the automotive industry, this will require preparation for “smart factories” which are able to combine AI, open-source software, robotics, 3-D printing, cloud services, and big data analytics (UNCTAD, 2021).

Previous literature on knowledge or technological transfer has focused on FDI and its impact on local firms. It is believed that knowledge flows from foreign subsidiary firms located in the host country to local firms through imitation (learning-by-doing), competition (pressure on local firms to use their resources more productively), business linkages (relationships with local supplier firms “backward linkages” or flow of parts and components to local customer firms “forward linkages”). However, there is still no clear consensus on the existence of benefits or “spillovers” associated with FDI presence in a host country. Blomstrom and Kokko (1998) argue that the mere presence of foreign firms does not automatically generate positive impacts on the host country or local firms.

In this sense, knowledge transfer studies associated with FDI can be classified at the macro, meso, and micro-level. At the macro-level, it has been documented that national characteristics related to the absorptive capacity of the host country including education and human capital levels (Glass & Saggi, 1998), presence of developed financial markets (Carkovic & Levine, 2002), openness to free trade (Balasubramanyam et al., 1996) and relative backwardness or technological gap between host and home country (Findlay, 1978; Glass & Saggi, 1998; Romer, 1993) influence the knowledge transfer process. Meso-studies focus on industrial characteristics and the nature of the product (Lall, 1980; Dunning & Cantwell, 1986; Kokko, 1994).

For the case of micro-level studies, these can be divided in terms of characteristics of the foreign firm (source of the knowledge), features of the local firm (recipient of the knowledge), or the nature of the relationship. The qualities of the foreign firm have focused primarily on the corporate strategy and organizational structure of the multinational firm (Blomstrom & Sjöholm, 1999; Rodriguez-Clare, 1996). Regarding the features of the local firm, emphasis has been set on absorptive capabilities (Cohen & Levinthal, 1990). Finally, from the relationship perspective, studies have included time to build relationships (Aitken & Harrison, 1999; Kiyota et al., 2008) and the existence of transfer mechanisms between foreign and local firms (Branstetter, 2006).

Another body of literature has focused on training as a knowledge and technology transfer mechanism. It is believed that training may transfer both tacit and explicit knowledge; however, the Japanese production system favors the transfer of tacit over explicit knowledge (Urata, 1996). Also, Rivera (2002) mentions that technological and knowledge transfer takes place via formal and informal channels. Formal mechanisms include the leasing or

contracting of technology through licensing, patents, packages, trademarks, turn-key plants, and consulting or technical services. The informal mechanisms include reverse engineering, personal contacts, academic and private corporation study groups, involuntary leakage of technical information, and training of employees and local suppliers. In the case of developing countries, it is believed that informal mechanisms have larger impacts on local firms since formal mechanisms impose a series of financial restrictions and usage barriers that endogenous firms are not able to overcome.

Several empirical studies have evaluated the impact of training on local economies. According to Mikami and Furukawa (2014), the literature has followed an interdisciplinary approach from areas including labor economics, business administration, and development studies. From the labor economics approach, studies have emphasized employee-firm interaction and the general costs of training. There is a general agreement that workers increase their human capital stock via training impacting their productivity; however, a conflict of interest arises between the trained employees who are incentivized to leave the firm for better job positions after receiving the training, and the firm that paid for their instruction. In this sense, trained employees might be seen as a common good that creates incentives for free riding to competing firms. Labor economic studies seek to find the optimal training levels and equilibrium scenarios (Acemoglu, 1997; Acemoglu & Pischke, 1998; Boom, 2005).

From the development perspective, studies have focused on the donor-lending angle for developing countries. This literature attempts to evaluate the efficiency and effectiveness of training, especially of high-level technical and managerial skills in the public sector along with the brain drain problem of local and international trained civil workers (Tessema et al., 2012).

Business administration studies seek to explain training outcomes at the organizational level. A body of work focuses on the internal and external conditions that enable training to be effective (Nikandrou et al., 2008); another approach centers on the improvements after training in terms of firm performance and innovation (Bartel, 1994; Huang, 2001; Almeida & Carneiro, 2009; Dumas and Hachane, 2010; Chen et al., 2013).

Japanese Training Programs

According to the UNCTAD (2014), developed countries offer financing support, matching services, partnerships and alliances, support for purchase licensing and equipment, and training through their development agencies abroad. According to a survey of 41 agencies, 19 of them offered training programs and four of them implemented their training programs in developing countries to train local workers. In the case of Japan, the study mentions that the Japan International Training Organization offers international workers to undergo training in Japanese companies for up to one year.

Similarly, the Japan International Development Organization offers equity participation and loan facilities for joint ventures between Japanese and local firms. The projects supported are valued in terms of their long-term, social, and environmental impact. Newly formed firms are expected to use advanced and proven technology.

Also, the Japan International Cooperation Agency (JICA) is responsible for technical cooperation within Japan's Official Development Assistance (ODA) program. JICA has the goal to transfer knowledge and technology to developing countries seeking to stimulate socio-economic development by offering assistance programs in the form of technical cooperation, investment cooperation, and grants. Technical cooperation trains and transfers knowledge at the management, technical and academic levels in local countries.

JICA is considered the world's largest bilateral aid agency with a presence in 150 countries and ranks fourth in terms of net ODA contributions (JICA, 2017). A major part of JICA's ODA is offered in the form of technical cooperation training to developing countries. Since joining the Colombo Plan in 1954, JICA has trained over 310,000 people in 198 countries (JICA, 2016). According to Mikami and Furukawa (2014), JICA conventionally had the goal of influencing trainees at the individual level; however, since 2012, the agency has sought to impact via training at an organizational level.

Empirical studies have documented the impact of Japan's ODA on developing countries. Sahoo and Bishoni (2016) study the impact of Japanese transport infrastructure investment in India. The results show that Japanese ODA investments have changed the urban landscape and improved living standards by reducing trade costs and increasing employment and income. Similarly, studies have analyzed JICA's training program effectiveness. Nakano et al. (2015) measured the productivity gains from JICA training in rice

cultivation technologies in Tanzania. The overall results indicate productivity enhancements from trained farmers and knowledge spillovers to non-trained farmers through social networks, observation, and imitation, resulting in further productivity gains. Kijima (2018) analyzed short and long-term spillover effects from lowland rice farming training in Eastern Uganda. The analysis found short-term technological and knowledge spillovers to trainees that were transferred in the long-term to the community resulting in a net increase in total rice production of trainee and non-trainee households. Mikami and Furukawa (2014) studied the impact of JICA training of public servants on their dispatch organization. The results indicate that efficient bilateral communication between the public servant and their organization during the training plays a key role in achieving the transfer of individual-level learning at the organizational level.

JICA implemented a training program in 2015 for Pakistan's automotive. The project sought to develop local suppliers needed for the industry by offering technical support and training from Japanese experts. The results show that local trained firms were able to improve their quality, productivity, and competitiveness as auto part suppliers. Similar results are shown for a JICA project launched in conjunction with South Africa's "Automotive Industry Development Centre".

Mexico has ranked among the top ten countries receiving JICA training assistance since 1970 (JICA, 2016). The Mexico-Japan Economic Partnership Agreement (EPA) sets industry promotion as a top priority area within the country assistance program set forward for Mexico, where JICA plays a key role. JICA's ODA assistance program in Mexico has focused on increasing the pool of skilled engineers required for the automotive industry and improving the quality, productivity, and competitiveness of automotive supporting industry local firms (JICA, 2017).

JICA has promoted several projects to strengthen the Mexican automotive industry since 2012. Among these, are the "Project for Human Resource Development for the Automotive Industry in El Bajío of Mexico", the "Project for Automotive Cluster Promotion in Mexico" and the "Project for Automotive Supply Chain Development in Mexico" (hereafter PASCDM). The PASCDM was conceived to develop local automotive suppliers by improving their quality, productivity, and competitiveness through training. These benefits were expected to allow trained firms to become suppliers of Japanese automotive companies established in Mexico.

The PASCDCM was carried out from November 2012 to November 2015 in the states of Queretaro, Guanajuato, and Nuevo Leon. The states were selected since they represent key locations for Japanese automotive production. Japanese Tier-1 firms were consulted to determine the 30 tier-2 participating local firms. The project trained local suppliers in *Kaizen*⁴ philosophy to improve their quality costs and delivery times. Also, the training extended to government officials in charge of industrial policy to help them understand Japanese production systems, business practices, and particularly *Kaizen* philosophy.

Methodology

The study follows a qualitative research method to analyze the knowledge transfer obtained from training. In this sense, case studies are employed to understand the knowledge transfer mechanisms observed during the training process. The case study approach is adequate when the topic at hand is too complex to understand through quantitative research methods. Case studies allow us to better understand the knowledge transfer process using descriptive details of the firms that participated in the PASCDCM.

Nakano et al. (2015) mention that the impacts of training programs should be analyzed in the medium or long term, in other words, a few years after the implementation, to fully capture the spillover effects from training. The case studies were conducted three years after the completion of the PASCDCM.

Specifically, six local firms that participated in the PASCDCM were chosen from the state of Guanajuato. Also, three Japanese firms with business relations with the trained firms were included in the study. The fieldwork consisted of semi-structured face-to-face interviews with key actors in each firm (owners, directors, managers, engineers). The firm visits were carried out from January 22 to January 25, 2018. All visits were conducted in the production plants of the firms to observe the production layout changes made after training. Of the six local firms, five were plastic injection oriented, and

4. The term "*Kaizen*" refers to a continuous improvement process that involves all of the organization. It is considered a concept that reflects the best Japanese management practices that helped boost Japanese firms after World War II to world class competitiveness levels during the 1980s. For further information see Imai (1986).

one produced bolts, screws, and special fasteners. To comply with privacy requirements, the names of the firms were changed.

The interviews were centered around four main topics: positive changes observed after the PASCD, negative aspects after training and knowledge transfer acquisition channels, and knowledge internalization appropriation and diffusion methods. The results from the case studies are presented in the next section.

Empirical Case Studies

Firm A

The interview to firm A was conducted with the company's Chief Executive Officer (CEO). The firm may be considered a family corporation since the CEO's father is the business' founder and family members are in management positions throughout the company. Firm A was originally established as a supplier for the medical industry, ten years later the firm transitioned to the automotive industry as a Tier-2 plastic injection supplier of a Japanese Tier-1 firm that we shall name "J1".

According to the CEO, the JICA project gave the firm tools to implement 5's methodology and helped them reduce their Parts per Million defective rate (PPMs) and the time needed to change their molds (known as "Single Minute Exchange of Die" 'SMED'). The company acknowledges that the JICA training gave them the knowledge to understand the expectations from Japanese firms and better utilize their existing resources before major investments. The firm, before the project, thought that its processes and quality were acceptable but realized that they were not competitive on international terms. The firm had difficulties internalizing the TP's knowledge since they experienced high labor rotation, and workers that benefited from the training left the company. The firm decided to correct this shortcoming by documenting all its processes and by seeking several certifications.

After the training, the firm expanded production to three production lines (before there were only two) and went from four to twelve plastic injection machines. Currently, two production lines are for the automotive industry and one for the medical industry. They also increased the number of work shifts from two to three and from a five-day to a seven-day workweek. They are now suppliers of not only J1 firm but also of another Taiwanese Tier-1

automotive firm. The firm also changed the organizational structure by introducing middle-management positions and by modifying the production layout to allow a better flow of information.

The exponential growth of firm A is unquestionable, especially in the automotive industry. In 2016, this market represented 87% of their total sales and in 2017 the figure increased to 94%. The firm originally produced parts for only one OEM through the J1 firm, but now they make parts for five OEMs (four through the J1 firm and one through the Taiwanese firm). In terms of production molds, in 2012, they worked with only one mold, in 2013, they had two, in 2014, they increased to four, and between 2015 and 2016 they worked with seven molds.

Despite the positive outcomes, firm A mentioned that they are also facing fierce competition and several challenges. They point out that labor shortage and high labor rotation are major issues since resources are wasted in training new workers. Also, they point out that their main client, J1, has pushed them for excessive cost reductions and implemented the “peso policy”, where fluctuations in the exchange rate that result in increments of production costs must be absorbed by firm A.

Firm A mentioned that certifications such as ISO 9001:2015 and VDA 6.3 have helped them maintain competitiveness, and this has opened doors to other clients. Also, they have increased (or worsened) their PPMS with their expansion; they used to have them at zero but increased to 50 after 2015, when they started introducing new molds, changed the organizational structure, and production layout, requiring new training methods. The executive mentioned that with growth, they had to face new difficulties.

The firm argues that due to the “peso policy” and other demands from the J1 firm, the long-term relationship might be in jeopardy, so they are currently expanding their relationship with the Taiwanese firm and searching for new customers. They also see their medical business line as a backup business in case of future difficulties within the automotive industry and are seeking to further expand in this market. The firm mentioned that diversification is an important strategy and that they are trying to evolve from the Tier-2 to the Tier-1 level of procurement where they see larger profits.

The overall result from the visit to firm A was that the company benefited from JICA's TP. The firm is growing and expanding its business relations in the automotive and medical industry. The firm has internalized and appropriated the knowledge by documenting its processes and has obtained certifications

such as ISO 9001:2015 and VDA 6.3. Interestingly, the knowledge acquired has spilled over to their medical lines where they also report improvements in their production process. The firm A executive had kind words and fond memories from the training facilitator and was eager to continue training from JICA in the future. They indicated that the firm is very different now from the one that was trained in the PASCDM and therefore faces new challenges.

Firm B

Firm B is a joint venture firm with global partners (mainly Taiwan), but the company is family-owned. The firm has two divisions, the first division arrived in Mexico via FDI to sell machinery and produce shoes in Mexico. The second division was a transition from the production of shoes to auto parts since they already had the plastic injection machinery and from an invitation from the J1 firm to become a supplier back in 2007. The interview was conducted with the company's human resource manager, a family member of the owner of the firm; the manager mentioned that despite the Taiwanese origin of the capital, the firm is considered a Mexican company. The manager mentioned that this firm was the first local supplier of the J1 firm, and after observing its success, the J1 company decided to continue developing local suppliers.

The manager mentioned that participating in the PASCDM gave them appropriate training to improve their quality control systems. The 5s and *Kaizen* philosophies have been applied within the firm. Similar to firm A, this firm has appropriated the knowledge with the use of information diagrams and manuals to avoid losing information with employee rotation. The knowledge acquired has diffused throughout the firm to all their business operations. In the beginning stages of their automotive industry venture, they used to receive audits and revisions every four months, along with technical support from the J1 firm; however, after the training program, this was no longer required. They maintain their internal and external PPMs at less than 1% and are pursuing to reduce them; however, high production volumes and external factors (mainly dealing with the J1 firm) have impeded them from achieving this goal.

Despite the positive results from the PASCDM, total sales and profits dropped between 2014 and 2017 by almost 50%. The manager mentioned that this is due to an increasingly difficult relationship with the J1 client. They argue that the company outrivals competitors in service and quality of

production, in internal and external PPMS, and in the time needed to react to problems, all skills developed through the training program. However, they believe that their customer (the J1 firm) is no longer valuing these traits and are pressing only for low prices. Originally, they started with only three molds for the automotive industry and in 2014 they were working with 23 molds; however, by 2017 the figure dropped to only 16 molds, all for client J1. The main reason is the closing of projects from the J1 customer due to molds being sent to competing firms. The manager mentioned that the J1 firm invested in a joint venture with a Tier-2 Korean firm in 2015 that shifted the procurement chain and reduced the number of orders. Also, according to firm B, there is high pressure from the J1 firm for cost reductions that are seen as unfair and that hamper their possibilities for growth. This firm has also been affected by the “peso policy” where they suffer losses for exchange rate fluctuations. Firm B mentions that the “peso policy” is set directly from the J1 firm and not from the OEM. The firm considers itself as one of the main suppliers of the J1 firm but is evaluating ending its business relations.

Firm B mentioned that they are currently facing other challenges. The main obstacle is fierce competition among local Tier-2 firms; for example, the manager mentioned that in 2014 there were only three suppliers for the J1 firm, and by 2017, there were ten suppliers; currently, within a 1 km radius of the firm B there are now four suppliers of the J1 firm. There are also worries that other foreign Tier-2 firms with more advanced production technologies are planning to invest in the region, and this might further increase competition.

The firm mentioned that their main mistake was concentrating all their business efforts on the automotive industry, and client J1. For example, their shoe production sales only represented 3% of total sales in 2016. They are currently trying to revert this trend; the firm is working on developing their plastic injection household products market; in 2017 they acquired a major customer in this segment and automotive parts now represent only 60% of total sales. They expect shoe and household products to represent 90% of sales and the remainder for the automotive industry in the next two years. They are searching for new customers in the automotive industry but have failed to close any orders due to quality and cost requirements. Also, firm J1 has demanded supplier exclusivity, but firm B no longer feels loyalty to this customer.

In terms of further training, the manager mentioned that they are currently receiving technical support and new machinery from a Taiwanese firm. This firm is also family-related to firm B. The firm did not express any interest in participation in further JICA training programs.

Firm C

Firm C was established in Mexico City and after a period of growth, the company decided to start plastic injection activities first in Queretaro and afterward in Guanajuato. The company is 100% nationally owned and the Guanajuato branch is solely focused on producing auto parts for one Japanese customer (the firm J1). The interview was conducted with the production manager and the operations manager of the Guanajuato plant, both were not part of the company when the firm participated in the PASCMD. The managers mentioned that the training participants were no longer employed in the firm.

According to the production manager, JICA's training gave them the skills and expertise to reduce the time needed to change their molds. They now use magnetic platens in two of their four machines, and this has reduced the time needed to change molds by 50%. There are plans to extend this technology to another machine in the future. Also, from the PASCMD, they became apt to increase their business ventures with the J1 firm. Unlike firms A and B, firm C seems to have a growing and healthy relationship with firm J1. The managers mentioned that they have an annual 3% cost reduction target established by the firm J1 and seem confident in achieving this goal. They also mentioned that they used to operate with an external PPM target of 30% before the PASCMD and they now have this figure under 10%, complying with J1's requirements. The firm appropriated the training program's knowledge via manuals, operation sheets, and checklists. The managers interviewed were not employed in the firm during the PASCMD but were clear in the learning and results achieved from the project. They also mentioned that incorporating the knowledge within the firm is important, but they highlighted the issue of transmitting it to their personnel and having trained workers leave the firm 20 days later.

During the last five years, firm C has seen important growth. The firm went from two to four plastic injection lines. Five years ago, the firm worked from 10 to 15 molds, currently, they work with 35 molds. Sales have been

steadily growing at a 15% annual rate during the last three years. This growth gives them high expectations for the future.

The company mentioned that they face fierce competition in the plastic injection industry. To cope with the competition, the company's strategy has been to invest in cutting-edge technology that improves the quality of its products. Also, they expect to further improve their productivity by maintaining the 5s and *Kaizen* principles in the firm. Furthermore, firm C is thinking of diversifying to other customers by investing in a new plant that would allow them to increase their production capacity and increase their participation in the automotive industry. The company has acquired the land for this new plant and expects to be at its new location by the end of 2018; the plant will host 10 additional plastic injection machines. The firm also is planning to enter the aerospace industry in the Queretaro plant.

Another problem mentioned in the interview was personnel shortage and high employee rotation. The managers mentioned that this same problem was experienced at the Queretaro plant 20 years ago and that in Guanajuato, due to the shoe industry's traditional system of production and piecework labor, it has been difficult for workers to learn and adapt to the automotive industry's style of production.

Currently, they are only receiving training and technical support from their machinery suppliers and the J1 firm. Their J1 firm customer helps them with benchmarking courses and developing new projects. As mentioned earlier, the workers that participated in the training program were no longer employed in the firm, and this hampered the possibilities of expansion of the benefits from training. Unlike firm A and B's results, firm C appears to not have been able to diffuse the knowledge to other business ventures. There are still vestiges of JICA's training in the firm, but since the current managers did not experience the training firsthand, they do not seem interested in acquiring further training benefits from JICA. The new plant is expected to be functional with an adequate layout but not necessarily following the *Kaizen* or 5s philosophy.

Firm D

Firm D was established in the late 1980s as a family-owned company dedicated to plastic bottle production. After a period of growth during the 1990s and 2000s, the firm decided to expand its operations to plastic injection for

manufacturing industries. The firm currently produces plastic parts for the food, automotive, and general industry. The interview was conducted with the CEO and owner of the firm and the engineering and quality managers.

The firm mentioned that the PASCAD sought to implement continuous improvement, reduce the time needed to change their molds, and increase equipment efficiency through the *Kaizen* philosophy. The results obtained from the training program were the adoption of the 5s methodology in all areas of the firm. They now have standardized their workflow instructions and have hourly reports that feed their quality control alerts. The firm values the benefits of continuous training and has designed worker-specific training using a skills matrix. Firm C also has internal and external audits of their processes and products and preventive maintenance that has impacted their quality standards. They have achieved time reductions in changing their molds. Overall, the firm improved its Key Performance Indicators (KPIs) and seems committed to further improvements and growth of the firm. The knowledge has been internalized in manuals and by documenting all their processes using checklists and measuring their internal and external PPMs; similar to other firms, the knowledge acquired has impacted all their business areas (food containers and general industry products).

The firm mentioned that the *Kaizen* impact is undeniable. They were able to implement 30% of improvement proposals in 2015, 68% in 2016, and 93% in 2017. The time needed to change their molds in their plastic injection production went from 240 minutes in 2014 to 67 in 2015, 5 in 2016, and 4 in 2017. For their blow molding operations, the time employed improved from 480 minutes in 2014 to 210 in 2015, 105 in 2016, and 90 in 2017. The knowledge has been transmitted to all areas of the organization, especially in their other business ventures, such as plastic bottle production.

Firm D mentioned that they are currently searching to diversify their customer portfolio. They are starting production of auto parts for another foreign Tier-1 company and have been contacted by another Tier-1 Japanese firm through referrals of other customers. The CEO mentioned that when contacted by the new Japanese Tier-1 firm, the company highlighted their participation in JICA's project, and this increased the confidence in the potential customer. They are now in the process of developing the first product trials. *Kaizen* is a central part of their diversification strategies, where the tools, skills, and knowledge acquired has spilled over to their different busi-

ness ventures. The firm affirms that the *Kaizen* philosophy is now ingrained in the company's culture.

Despite the positive results, firm D also faces some challenges. The quality manager pointed out that they are working with the firm J1 and receive their production molds from this company; however, due to bad planning, there is a lack of maintenance for the molds which causes defects in the final products and directly affects their quality standards. According to the manager, there is a great business opportunity area in the mold maintenance activity in Mexico, including the technicians that can provide the maintenance. The CEO mentioned fierce competition in the automotive industry, notably with the arrival of Tier-2 firms from the U.S., Spain, Germany, Korea, and Taiwan. This has pushed the firm to diversify its component production in the automotive industry; they produce interior and exterior parts, suspension, and illumination components for six clients (four Japanese, one Canadian, and one from Mexican and Spanish capital). In other industries, they lost a client that negatively impacted their sales and number of employees. For example, the number of employees in 2014 was 165 workers and this figure dropped to 107 in 2016. Firm D also mentioned that its relationship with the J1 firm is currently "tense and stressful". They have grown their business relations from one to eleven molds since the PASCMD; however, the cost reduction requirements are unrealistic according to the managers.

Firm D is looking ahead to confront its challenges through market diversification. They value employee training and see the importance of their human capital to optimize resources and improve their production processes. They are planning to extend their facilities, acquire new equipment, and increase their production capacity. Also, they are pursuing the ISO 9001:2015 certification. The PASCMD gave the firm confidence to establish business ventures with Japanese firms, currently; a Japanese firm has contacted them to be the suppliers of their U.S. operations. They believe that despite the cultural and language barriers, their products, hard work, and quality allows them to further grow their business linkages with Japanese Tier-1 firms.

Firm E

Firm E was founded in 1960 as a family-owned and operated manufacturing company dedicated to plastic injection activities and the design and fabrication of molds for this industry. The interview was carried out with the owner

and CEO and his two sons, one in charge of sales and public relations, and the other is the company's general manager. Due to their ISO certification, the company originally produced plastic parts for other industries but transitioned to the automotive industry.

This company seemed better organized and more technologically advanced than the previous firms reported. The company is not only a producer of plastic injection goods but also designs, develops, and produces molds needed for the industry. During the visit, they were working with over 150 molds (seven for the automotive industry) and with 37 employees. According to the general manager, some Japanese Tier-1 companies use their mold maintenance and repair services. Company E is certified in ISO 9001:2008 and is currently transitioning to the 2015 version, and it is also certified by International Automotive Task Force (IATF). They believe that their main strength is precision in their manufactured parts and innovation activities.

JICA's training helped firm E improve the time needed to change their molds and materials, which enabled them to accept small orders. Before the PASCDM, the firm had an average time of one to four hours for mold change and from six to twelve hours for machine cleaning; after the PASCDM, the time was reduced to 90 minutes for mold change and only one hour for machine cleaning. Similarly, before the PASCDM, the time needed to change materials was registered at over 200 minutes for simple materials and over 700 minutes for complex materials. This was improved to 24 minutes for simple materials and 54 for complex materials after the training. The firm divided all its processes into several stages as part of JICA's recommendations; they introduced checklists for these processes that helped them have uniformity and better control. The introduction of these tools boosted firm E's ability to maintain its external PPMs at 0. Their sales increased by 2.3 times between 2012 and 2017, and the share of the automotive industry in total sales increased from 6% to almost 20% by 2017.

Firm E pointed out that *Kaizen* training enabled them in the first stage to improve their quality and processes, which in turn helped them to reduce costs. In the second stage, they improved their know-how in the usage and operation of difficult resins, helping them cover a wider array of markets. In the final stage, they received support on the mold workshop, improving their elaboration, maintenance, and repair activities, which has provided them with firmness for their internal needs and has allowed them to offer these services to other firms.

The knowledge acquired from the PASCDM was replicated and diffused in other areas of the organization. The company has documented its processes in all its areas. This allows the information to be available to be transmitted to existing and new workers. Overall, errors were reduced, and the firm considers itself open to outside revisions and self-critical for further improvement. The firm has invested in newer and more precise machinery for the automotive industry to maintain competitiveness.

Firm E also mentioned that it faces fierce competition. They mentioned that foreign Tier-1 firms have a misconception of Mexican Tier-2 firms, believing that local firms will not meet their quality and capacity requirements. For this firm, convincing Japanese Tier-1 suppliers that they may be reliable suppliers has been a difficult task. Specifically, they had an encounter with a Japanese firm (J2) five years ago, and it took them three years to establish their first orders. Firm E was not able to establish major orders until they were contacted to resolve a problem J2 was facing with one of their plastic injection machines. Firm E delivered and a solid business relationship among the firms flourished. They have gained J2's trust and have been introduced to and worked with a J2 sister company in the U.S.

Firm E is also a supplier of the J1 company. They have received an on-time delivery and quality award from the J1 firm and expect to receive it again in the future. However, the relationship with the firm J1 was recently brought to a halt when they lost almost all the molds they were working with without any apparent reason. The instability with firm J1 has pushed E firm to try to diversify. They were contacted by another Japanese Tier-1 firm in 2016, and it took them almost two years to develop a working relationship; at the time of the interview, they were completing their first orders for this new client.

Another problem mentioned during the interview was employee rotation. They pointed out that it is difficult for them when employee rotation is present at the Tier-1 client firm, especially in key areas such as purchasing. It was mentioned that the treatment with Japanese firms is cordial, but it takes a long time to develop these relationships, and when a new employee arrives at the purchasing department they seem to have to start from scratch (new quotations, new processes, and new quality verifications).

Since the PASCDM, the company has expanded to several industries such as construction, food, and cosmetics; also, there is currently a project with a Japanese OEM to produce specific plastic parts for a truck. They have invested in five new plastic injection machines and have refurbished another

2. The interviewees acknowledged that profits are larger for the commodities industries rather than the automotive industry but see the latter as a more stable and long-term business that provides them with financial stability. Nevertheless, they plan to maintain market diversification and not depend solely on automotive sales; they have seen important growth in their other business ventures and expect to enter new markets such as shoe machinery support and maintenance.

Firm F

Firm F is a family-owned and operated company dedicated to producing bolts, screws, and special fasteners. They have been in the market for 45 years attending different industries, including electrical, appliances, and automotive. The interview was conducted with the sales director, the production coordinator, and the planning manager of the company. Interestingly, the planning manager is also the son of the company's founder and the father of the production coordinator.

The firm is a supplier of the J2 company. The interviewees mentioned that the relationship was complicated at the beginning of their business ventures since it took time for firm F to understand J2's work philosophy. The firm received the on-time delivery and zero defects awards from J2 company for the years 2016, 2017, and 2018.

Before the PASDCM, the firm had internal PPMs registered at 20 and after the project, this was reduced to 1.92. Currently, they report it at 0.2. JICA's project changed the company, and through the training, they have acquired higher flexibility allowing for the distribution of their products within a 300 km radius in the nearby states of Guanajuato, Puebla, Jalisco, and Mexico State. They argued that they are 100% committed to *Kaizen* learning and have transmitted this knowledge to other companies from the same business group. They mentioned that after the project, they increased their commitment to quality and now have both ISO 9001:2015 and IATF16949 certifications and are compliant with Japanese, U.S., and international quality standards. They said to be very proud of participating in JICA's project.

According to the sales director, the knowledge acquired from the training project was horizontally transmitted to their other product lines. They pointed out that the *Kaizen* philosophy is engraved in the firm and has been internalized and disseminated to all the workers across the company. They also

have worked with adopting the 5s methodology and expect to further develop this knowledge soon, improving the time needed for tool changes. They are working on an internal personnel training program to better transmit the knowledge to new workers. The firm sends its managers to visit their client companies to better understand their requirements and receive feedback that may further improve their quality, productivity, and time delivery.

Firm F is facing some challenges. They have seen the arrival of a German competitor that has patents for specific special fasteners that their Japanese clients use. Since firm F is not an owner and may not lease the patents, they must rely on “threads” or proxies that may be functional and adequate to their client’s specifications. They also mention that most business negotiations with prospective Japanese firms are done from Japan, limiting their possibilities of finding new customers. However, they point out that after 2017, the supplier localization policies of Japanese firms have changed with the inclusion of local Mexican suppliers in the production chain with possibilities of long-term business relations.

To face its challenges, firm F has tried to expand its client base through referrals. The firm relies on the quality of its products and has a firm policy of a 3% annual cost reduction for the next three years. They quote their inputs and their products in U.S. dollars to avoid exchange rate fluctuations. The firm has also invested heavily in new machinery (new die rolling machines, product certifiers, electrical sorters, and a four-stage machine) and their product development department. Firm F acquired the adjacent land (almost twice the size of its current layout) and is planning to expand the company. They are seeking market diversification, and alliances with foreign firms, and are also searching for technological transfer from local cluster associations. The firm attempts to stay current by visiting suppliers’ auto-shows and learning about new products, technology, and machinery.

Currently, Firm F has seen a drop in production between 2016 and 2017, but it was indicated that this decrease is due to a shift to production focused on projects that result in higher profits. They are producing at 35% of their installed capacity with 40% of total production in the automotive industry, 20% in electrical, 19% in appliances, and the rest of production is shared among several other industries.

Overall, it was mentioned that the Mexican automotive industry presents business opportunities in die casting and stamping. Different than previously visited firms, this firm argued that personnel rotation is not a major issue.

The reason is that most workers live in a community near the company location and they have treated their labor force as part of the family; in some instances, they have seen a grandfather, father, and son working for firm F.

Firm J1

Firm J1 is a Japanese Tier-1 company that was established in Mexico in the late 1990s. It is currently a supplier for three automotive assemblers in Mexico. It employs over 1,600 workers, and the company expanded by opening a second plant to cover increasing demand in the sector. The interview was conducted with the company president, the plant director, several managers in charge of engineering, quality, purchasing, and sub-directors of human resources and purchasing.

From the interview, it was noted that the Firm J1 also faces the problem of employee rotation; however, the human resource manager mentioned that monthly employee rotation for the company is registered between 1.4% and 2.5%, while the region experiences an average monthly rotation rate of 9%. The company explains its relatively low rotation rate by its long tradition in the state, strategic location, and special care for its employees.

The company recently inaugurated a labor training center to transmit the *Kaizen* philosophy to their workers. It was argued that recently hired workers use the tools that they know, but not the ones they need and that without a full understanding of their work they will not be able to implement the *Kaizen* knowledge. The problem that arises is that fully trained operators are sometimes offered higher wages from U.S. companies and leave the firm. They have found better results in employing a higher proportion of women in the production line, because of their motor skill abilities and their loyalty to the company.

During the interview, there was an emphasis on the high Tier-2 local content of 82% in J1's products. However, this calculation has no clear distinction between endogenous or foreign Tier-2 suppliers. The company ranks all its suppliers on an A-to-Z scale, where quality is evaluated throughout the process with regular visits to plants, audits, quality supplier development programs, defective parts measurement, and KPIs. Another important criterion for the supplier rank is the QCDDM (Quality, Costs, Delivery, Development, and Management) indicators. Overall, the perception from the firm J1 is that there are still improvement opportunities for local suppliers. The

company sets a target of 10 external PPMs for all its plastic injection suppliers of interior and exterior parts. One executive mentioned that sometimes companies with over 100 PPMs are used but they require them to be lowered. Each supplier receives a scorecard every month and this information is used for future orders. There are also targets set for cost reduction for each supplier, continuous production-line walks and benchmarking between suppliers to set individual targets from the J1 firm.

Firm J1 has employed Tier-2 firms B, C, D, and E. According to JICA officials, the Japanese company J1 was a deciding factor for these firms to participate in the project. As mentioned earlier, firm J1 ranks its suppliers on an A-to-Z scale. According to the president of the company, the supplier firms that participated in the training program experienced the following change in their internal rank:

Table 1
Supplier Rank from firm J1

	<i>Mexican Supplier Firm</i>							
	B		C		D		E	
<i>Japanese Firm</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>
1	C	D	C	B	D	D	F	C

Source: Author's elaboration from firm interviews.

The president also gave some specific feedback on several firms. Firm A has grown from a small to a medium-sized firm by taking advantage of government financing. Also, they are open to adopting new technology and have seen a turnover growth of over 40% between 2015 and 2016. Firm B is regarded as a small supplier that is used for smaller orders. The firm is developing with the assistance of the firm J1 and has seen a growth of 15% in orders since beginning its business ventures. It was mentioned that the firm has overall good QCD levels and that with extra training it can further improve. Firm C is considered a reliable and good supplier that exhibits reasonable costs; it has seen its business increase due to improvements in its competitiveness. Despite this, business with this firm has stagnated due to the firm's production capacity; there is an expectation for growth in orders.

For the case of firm D, it was argued that this firm is reluctant to technological change, it is working with old machines and the firm is not competi-

tive due to high fixed costs. This same issue was experienced in the case of another local firm, as stated by the purchasing director; these suppliers are no longer used by firm J1.

According to the firm's president, in 2012 they employed from 15 to 20 suppliers; however, this has been reduced to only 12. The firm has kept those firms willing to grow, most Mexican companies. Firm J1 says that it is committed to developing its suppliers by providing technical guidance and support in several areas, for example:

- They work with their suppliers to help them investigate the root cause of quality issues.
- The company organizes an annual supplier meeting to bring to light the suppliers' previous results in QCDDM and start planning upcoming projects.
- Firm J1 routinely implements *Monozukuri* and production-line-walks to help suppliers keep on track; this is emphasized with suppliers that require special attention.

The firm mentioned that the firms participating in PASCDDM improved their understanding of *Kaizen* and 5's philosophy. However, it was noted that despite the need for specific types of suppliers to develop 5's, they are required to be trained in *Monozukuri* and more advanced tools than 5's. This firm considers 5s to be basic and somewhat antiquated to the industry's present needs. The firm expects to change its local procurement strategy to increase the supplier base and sees local firms with technological, financial, and cost-competitive traits as future partners. Overall, firm J1 seems committed to local supplier development, and the firm mentioned that there is an interest in suppliers to transition to "partners" of the firm, with opportunities in the fabrics and clothes industries as well as internal paint and chrome plating industries.

Firm J1 mentioned that it expects to continue working alongside JICA in upcoming projects and there is particular interest in participating in the "Project for Automotive Cluster Promotion in Mexico" and the "Project for Human Resource Development for the Automotive Industry in El Bajío of Mexico". The Cluster Project will take place from 2018 to 2023 in the states of Aguascalientes, Guanajuato, Queretaro, and San Luis Potosi with the participation of Mexican companies and the training of consultants in automotive-related industries. The Human Resources Project is promoted alongside the National College of Professional Technical Education (Conalep in Spanish) in

the states of Aguascalientes, Guanajuato, and Queretaro from 2015 to 2020; it attempts to deal with the labor shortage problem while training workers with the skills and abilities demanded by the industry.

Firm J2

Firm J2 is a Tier-1 Japanese supplier firm that established its operations in Mexico in 2008. The firm employs 22 domestic suppliers from the Tier-2 and Tier-3 levels of procurement. The firm registers 75% of local content and plans to establish strategies to increase the figure to 90%. The interview was conducted with an employee in charge of purchasing and translations.

According to Firm J2, the PASCDM has improved its dealings with Mexican companies that participated in the project. They have business relations with firms E & F. Firm F is considered a “major” supplier, and firm E is a “regular” supplier. In terms of quality, costs, delivery, and overall ranking, both firms are considered “A” or highest-level suppliers. The main advantage for the Mexican suppliers is the geographical distance, where closeness plays an important role in the usage of both companies.

There is a long relationship with firm E, and they are currently the suppliers of 50% of the parts and components produced by this firm. The other 50% is supplied by a Japanese supplier that has been gaining ground on firm E, according to the interviewee due to “nationality”. It seems that there is a preference for the Japanese supplier over firm E, due to factors not necessarily related to the competitiveness of both firms. The interviewee signaled that firm E has invested in improvements in their installations, but this has not been reflected in quality advancements. For example, their external PPMs are close to zero, but the goal is to be at zero.

For the case of firm F, this is the only plastic injection supplier of firm J2, and the business relationship extends for three years; however, there has been a decline in the volume of orders from this company. In part, firm J2 mentioned that this was because firm F failed to deliver an important order arguing that it was during the holiday season. This reduced the confidence in firm F. Also, there is a tendency from the firm J2 to move to the in-house production of all the plastic injection parts, attempting to eliminate outside suppliers.

The firm mentioned that it maintains a close relationship with all its suppliers. Audits and cost reduction requirements are set yearly. They set a 2% cost reduction goal on all their projects for an average lifespan of five years.

It was mentioned that for firm J2 their clients demand yearly cost reduction schemes that range from 2% to 7%. Supplier firms that struggle to meet demands face monthly audits and evaluations in terms of quality and costs with strict requests for solutions to avoid recidivism.

New suppliers are analyzed following strict selection criteria; when a company reaches the minimum requirements, there is a physical visit to the plant to confirm prerequisites are met. Statistics are gathered and analyzed showing installed capacity, inventory days available, quality control, and distance. Firms must also be certified in IATF. Afterward, quotations and samples are sent to Japan; if they are approved there is a transition to the negotiation phase.

Firm J2 mentioned that it faces several challenges. Although there was a steady sales growth between 2012 and 2017, during the first months of 2018, there was a significant drop of 10% that is attributed to the “Trump Effect”, where several of their major clients are reducing production expecting a drop in demand from the U.S. and Canada and a slowdown of the internal market. According to the interviewee, several OEMs have suspended production lines or moved them to other countries in South America. Another problem is related to employee rotation that is affecting the region. It was mentioned that there seems to be a lack of commitment and loyalty from local workers that are on the lookout for higher wages; on average, 20 new employees are hired daily, and after a few weeks, only two or three remain.

The firm is interested in continuing projects with JICA, especially in the joint work of human resource development. It is suggested that there are cultural differences between Mexico and Japan and this gap must be reduced by teaching trainees about Japanese business and work philosophy. This is regarded as a fundamental base to establish *Monozukuri* techniques, reduce rotation problems, and improve worker loyalty.

Firm J3

Firm J3 is a Tier-1 company that was established in Mexico in 1998, and it recently opened a second plant in the Bajío region. The interview was conducted with the general director and the engineering and sales director.

Regarding the PASCMD, the firm mentioned that the project helped them trust local suppliers and increase their local content as required by their OEM client. Firm J3 mentioned that their Japanese customers are currently

demanding higher local content of parts and components. Before, the firm worked with a U.S.-based automotive manufacturer that did not have these requirements. In this sense, the JICA project was of great help for them, since local suppliers are increasingly important, they were able to increase from 50% to almost 70% of local content in their products after the PASCMD.

The company currently works with a nucleus of 4 local Tier-2 companies, where one is a Mexican-owned firm. This Mexican firm did not participate in the PASCMD but seems willing to learn through training. Firm J3 worked on a one-year project to develop this supplier by teaching it about mold maintenance and improvements in the production floor that had significant changes at all levels. They currently hold four planned visits to the plant to plan new activities for improvements. These programs are only for the Mexican company since the other three are mature firms that do not require this support. The firm was regarded before as a level C-D supplier and moved up to a B-level supplier with major improvements in quality and delivery but with still room for advancement in costs. The firm understood that it had to evolve to survive; it adopted *Kaizen* philosophy and became a “thinking” entity.

The company is facing several challenges. Firm J3 is currently searching for additional local suppliers to increase local content but believes that Mexican firms still need help developing the required levels to fit their needs. For prospective suppliers, the company takes into consideration aspects such as production facilities, equipment, PPMS under 100, production capacity, company policies, and the overall functioning of the production system to avoid stoppage times. It is also experiencing a human capital shortage problem, especially in highly qualified workers with knowledge of the Japanese culture and language. The company director mentioned that assemblers are breaking the harmony in the labor market in the region by offering high monthly wages of \$50,000 pesos (about \$2,500 U.S. dollars) to highly qualified workers. There are plans to develop a human resource platform to attract highly qualified Japanese workers. A JICA representative mentioned that through their volunteer program they have identified over 300 Japanese workers that might be matched with Japanese Tier-1 companies in Mexico with specific human resource needs. The representative proposed to help this company by funneling prospective candidates to them.

There was also a mention of the Mexican education system, where the professors and researchers seem to have no real knowledge of the demands of the industry. Specifically, how the production floors work and operate.

According to the company director, Mexican workers and companies need to understand the principle of “*Genba shugi*” which portrays the idea that no work is beneath anyone and that all workers of the company must work sometime in the production line to fully understand the production process through direct experience, this, in turn, will help build camaraderie and burst new ideas for improvements.

Conclusions

Knowledge transfer is a process that depends on several factors, especially when there is a considerable knowledge gap between recipient and donor entities. This is noticeable for emerging countries that have struggled to develop their supporting industries due to a lack of skilled labor and technological deficiencies. In this sense, training may serve as a direct line to transfer knowledge in developing countries. Training has the virtue of transmitting tacit and explicit knowledge. For the automotive industry, tacit knowledge transfer and learning-by-doing are crucial for organizational development.

Japanese automotive firms may have limited linkages with local firms due to their organizational characteristics that favor a global-local interlinked network with supplier usage from companies from the same business group. This may become more evident when there is a considerable knowledge gap, and when quality, costs, and delivery times are unsatisfactory. This issue seems to be currently observable in Mexico, where local firms still face entry barriers to establishing business relations with their Japanese counterparts. This study argues that training may help Mexican firms improve their endogenous capabilities in the short run and if this knowledge spills over to other firms, it may impact the industry or institutional levels in the long run.

Interviews were carried out with six participating Tier-2 firms and three Tier-1 Japanese firms of the PASCMD. The case studies were carried out using semi-structured face-to-face interviews to analyze the impact of the training project and the mechanisms employed within the organization to internalize and diffuse the acquired knowledge.

The current analysis provides evidence that government agencies may ease the knowledge transfer process at the micro-level via training. The evidence shows that the PASCMD successfully transferred knowledge to local firms. Particularly, the project was able to transmit tacit and explicit knowledge

relevant to quality, production, and organization systems. The *Kaizen* “know-how” improved quality and productivity indicators.

Explicit knowledge for all cases was internalized, absorbed, and diffused; however, only half of the firms internalized tacit knowledge due to high employee rotation. In general, firms observed intra-firm knowledge spillovers and one firm was able to transmit the *Kaizen* knowledge to a sister company. This has allowed firms to expand production to new customers, industries, and countries. A better understanding of Japanese production systems and the JICA training certification also increased the confidence of potential customers in future business transactions.

However, despite the benefits, local firms are facing several challenges. The main external threat is the increasing competition in the industry by the expanding presence of local and international firms. This has brought disruptions in the labor market, increasing employee rotation and higher labor costs. Internally, although the training program allowed the firms to improve key quality, costs, and delivery indicators, there is still the need for further training in more advanced techniques such as *Monozukuri*. Firms should also explore the inclusion in other markets including plastic mold maintenance services, fabrics, internal painting, chrome plating, die casting, and stamping. Further development must include activities with higher value-added related to design and innovation.

On a final note, the covid-19 pandemic brought a disruption to supply chains around the world. As a result, car manufacturers are interested in exerting larger control over their production process. This will result in near-shoring or re-shoring processes for the industry, shifting to a preference for in-house production. The vertical integration of the industry may reduce supplier importance, especially for SME endogenous firms. This will be more noticeable as the industry moves to electric vehicle production. These challenges will require SMEs to evolve and acquire new technological skills to successfully insert themselves into future value chains. Training programs such as the one analyzed in this study will be critical for the transmission of knowledge, technology, and know-how needed in the reshaping of the automotive industry.

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