CHAPTER 4

INTER-FIRM TECHNOLOGY TRANSFERS BETWEEN JAPANESE AUTOMAKERS AND FIRST-TIER SUPPLIERS

In present, it is a situation of increasing global competition in the automotive industry. Demand growth and liberalization of the Thai automotive industry have encouraged MNE automakers to move their production bases to Thailand, which has been used as a hub for automobile exports. However, it is very costly to automakers if they expand production capacity to Thailand by relying raw materials and plants on home countries because of long distances and risks from currency fluctuations. Thus, automakers expect to utilize resources in Thailand to achieve their global sales.

Utilizing resources in Thailand tend to increase local part procurements. The context of locally assembled automobiles, automakers expect high capabilities from first-tier suppliers because they are expected to achieve automakers' requirements. If first-tier suppliers fail to do their jobs, they are likely relegated as lower tier suppliers or forced to be out of the businesses. Thus, in the next section local part procurements of both Japanese and Western automakers will be discussed.

4.1 Local Part Procurements by Automakers

In this section, it is intended to provide the role of automakers in local part procurements. The Japanese and Western automakers will be investigated whom plays a more active role in local sourcing.

4.1.1 Local Part Procurements of Japanese Automakers

For Japanese automakers in Thailand, they rely heavily on local part procurements. There are only some parts that are imported from Japan e.g. car engines, electronic systems, electronic control units, and fuel injection pump because all of these parts require high technologies in production and they cannot be produced in Thailand.

Because Japanese automakers rely on local sourcing, so they expect first-tier suppliers to be able to supply auto parts meeting their requirements, which are quality (Q), cost effectiveness (C), delivery (D), engineering (E), and management (M), or QCDEM (Charoenporn, 2001 and Nopprach, 2006).

Quality (Q)

Quality is the most important requirement of Japanese automakers. After the financial crisis, Thailand has been used as a regional hub for automobile exports. Thus, the quality of locally assembled automobiles must meet international quality standards. If any first-tier supplier fails to meet them, they will not be given new orders.

Cost (C)

Cost effectiveness is another important requirement of Japanese automakers. Although they strengthen on the quality, but they also have price target that first-tier suppliers have to achieve. In practice, Japanese automakers motivate first-tier suppliers by awarding them new orders for whom achieving cost target.

Delivery (D)

In the past, Japanese automakers relied on mass production and first-tier suppliers accounted for full-loaded deliveries. However, things have changed in recent years because Japanese automakers have relied on the lean production[1] and Just-In-Time (JIT). They work with first-tier suppliers and help them in developing production schedules. Typically, the duration between when Japanese automakers need parts and parts delivered by first-tier suppliers are very shortly. As a result, these can reduce cost by lowering inventory and quickly respond to changes in customer demand. All the right parts are delivered to the automakers at the right time.

So, the Japanese automakers have built close long-term relationships with first-tier suppliers and helped them enhancing their managements.

[1] Lean manufacturing is a philosophy of manufacturing focusing on delivering the highest quality product at the lowest cost on time. A key part of lean manufacturing is JIT delivery- getting the right part to the right place at the right time.

Engineering (E)

In recent years, first-tier suppliers are expected to be capable in concept generation, product engineering, and process design (Takayasu and Mori, 2004).

The concept generation is involved in a task of first-tier suppliers in a product development stage. They are asked to share Japanese automakers about new automobile development. The product engineering is involved in a task of first-tier suppliers in enabling two or three dimensional design, and it also includes interior and exterior design. And the process design is involved in a task of first-tier suppliers in planning production processes.

Management (M)

First-tier suppliers are expected to have well-managed system because it allows them to manipulate target price, quality standards, and on-time delivery. Besides, the well-managed system also includes collaborations to automakers and lower tier suppliers in assembly lines.

4.1.2 Local Part Procurements of Western Automakers

For Western automakers in Thailand, they rely on global sourcing and international standards. International standards play a crucial role in terms of lowering procurement costs and increasing their negotiation power. First-tier suppliers that supply them auto parts must qualify the most two important standards, which are QS 9000, and ISO/TS 16949.

QS-9000 is a quality management system developed by Daimler-Chrysler, Ford, and General Motors for material selections, part productions, and services in the automotive industry. QS-9000 was first published in 1994, and later re-issued in March 1998. It is based on ISO 9001:1994 and incorporates additional quality requirements expected by the Big Three.

ISO/TS 16949 specifies the quality system requirements for the design, development, production, installation, and servicing of automotive-related products. ISO/TS 16949 also specifies development of a quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain. This technical specification is applicable to

production and service part organization sites where customer specified parts are manufactured, and can be applied throughout the automobile supply chain.

In addition, Western automakers also rely on the APQP or Advanced Product Quality Planning, which is a structured method of defining and establishing the steps necessary to ensure that a product satisfies the customer. Effective product quality planning depends on a company's top management's commitment to the effort required in meeting customer specifications. As a result, they also expect first-tier suppliers have well management system.

So, Western automakers do not build relationships with first-tier suppliers as closed as Japanese automakers because of their larger scales of productions and longer experiences in Thailand (Charoenporn, 2000; Techakanont and Terdudomtham, 2004; and Nopprach, 2006).

4.2 Patterns of Inter-firm Technology Transfer between Japanese Automakers and First-tier Suppliers

It is very difficult to first-tier suppliers in achieving automakers' requirements without the supports in terms of know-how or technologies from the automakers. Specifically, the transition to export orientation of the Thai automotive industry, meeting international standards and competitive price of the automakers are very important. As a consequence, technology transfers from the automakers to first-tier suppliers are very essential.

According to Takayasu and Mori (2004) and Techakanont (2007), they study the processes of automotive production of Japanese automakers in Thailand. The production processes can be organized into three main stages, which are product development, process engineering, and production stage. If any production process takes place in Japan, it is assumed that technologies are not transferred to first-tier suppliers. On the other hand, if any process takes place in Thailand, it is assumed that technologies are transferred to firs-tier suppliers.

Table 4.1

A Study on Automotive Production Processes in Thailand

Process Stages	Individual Processes	Before 2002	2002 Onward
Product Development	Concept generation	J	J
	Product planning	J	J
	Product engineering	J	J/T
	Engineering change for local specification	J	J/T
Process Engineering	Process control	J/T	T
	Design and ordering of equipments and tools	J/T	T
	Work design	J/T	T
	Skill design	J/T	T
	Pilot runs	J/T	T
Production Stage	In-house production management	T	T
	Supplier management	T	T

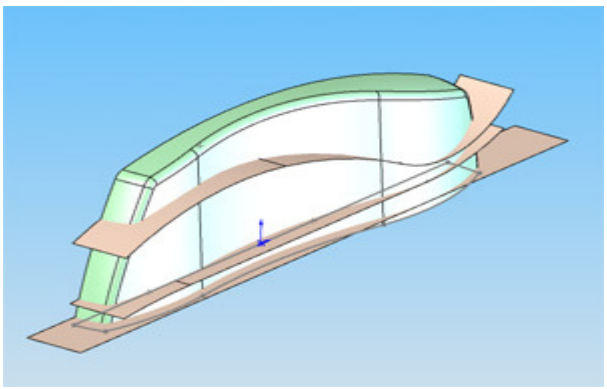
Source: Takayasu and Mori (2004) and Techakanont (2007)

Note: J and T are locations that each process is mainly operated; where J = mainly operated in Japan; T = mainly operated in Thailand; J/T = the process equivalently

Based on table 4.1, after 2002 technologies transferred by Japanese automakers to first-tier suppliers have not been only limited in the production stage, but they have also included product development and process engineering. In the past, the product development stage took place in Japan because locally assembled automobiles followed models manufactured in Japan and there were few part suppliers in Thailand at that time. However, in recent years Japanese automakers have employed Thailand as a hub for automobile exports. As a result, they have transferred technologies involved in some product development stages such as product engineering and engineering change for the purpose of local specifications to first-tier suppliers.

According to Techakanont and Terdudomtham (2004), first-tier suppliers in Thailand have invested in necessary software for detail design and prototyping in

product engineering[2]. For using the software effectively, groups of first-tier engineers work closely with the experts from Japanese automakers. Close supervision and technical advices by the Japanese experts help them to deepen in engineering capability (socialization). The most frequently used software in product engineering is SolidWorks[3], which is a 3D CAD (computer-aided design) program that runs on Microsoft Windows and developed by SolidWorks Corporation -a subsidiary of CATIA maker Dassault Systèmes, S. A. It was introduced in 1993 to compete with products such as Pro/ENGINEER, SDRC I-DEAS (now Unigraphics NX/SolidEdge), and AutoDesk's Mechanical Desktop (now Inventor). SolidWorks is a part of the midrange CAD market (Wikipedia: The free encyclopedia).



Screen shot captured from a Solidworks top down design approach (Wikipedia: The free encyclopedia)

[2] The process of detail design and prototyping in product engineering infer the capabilities in interior and exterior designs and it also includes two and three dimensional modeling.

[3] SolidWorks employs a parametric, feature-based approach to creating models and assemblies. Parameters refer to constraints or conditions whose values determine the size, shape, characteristics, and behavior of the model or assembly. Parameters can be either numeric, for example dimension values such as the diameter of a circle or the length of a line; or geometric, such as conditions like tangent, concentric, coincident, parallel, horizontal, and the like. Numeric parameters such as dimensions can easily be related to each other through equations to capture even the most complicated design intent (Wikipedia: The free encyclopedia).

Features refer to the building blocks of the part. They are the shapes and operations that construct the part. Shape-based features would include slots, holes, bosses and the like that either add or remove material from the part. Shape-based features typically begin with either a 2D or 3D sketch. Operation-based features generally don't have sketches. These types of features include operations like filleting, chamfering, shelling, or applying draft to a part (Wikipedia: The free encyclopedia).

In addition, Japanese automakers have intended to increase proximity of process engineering to actual production. So, they expect first-tier suppliers to be capable in process engineering. This study finds that first-tier suppliers have been assisted in terms of organizing production schedules in process control (socialization) and have been provided technical advices e.g. kinds of tools or equipments needed in part production by representatives of Japanese automakers (internalization).

So, technologies transfers involved in product development and process engineering occur in the form of the bilateral relationship, which know-how is transferred by Japanese automakers.

But for the production stage, according to previous literature (Techakanont and Terdudomtham, 2004), technologies transferred to first-tier suppliers occur in the form of the bilateral relationship through training visits by Japanese automaker's technicians. However, this study finds that one Japanese automaker, namely Toyota, has improved the pattern of technology transfer to be more effective. More precisely, Toyota has not only transferred technologies to its first-tiers, but it has also encouraged them to play a more active role in the learning process by sharing knowledge among members within the network (multilateral relationship).

In this study, Toyota Motor Thailand (TMT) is picked up as a case in examining knowledge-sharing network because TMT has been widely recognized as a leader in continuous learning and improvement (Dyer and Nobeoka, 2000). Besides, it has been recognized as having the most complicated pattern of technology transfer in the Thai automotive industry (Techakanont, 2007).

4.3 A Case Study of Toyota Motor Thailand (TMT)

4.3.1 History of TMT

Toyota was first established in Thailand in 1956, namely Toyota Motor Sales. It was not only the first affiliate in Thailand, but it was also the first affiliate in overseas, which imported CBU passenger and commercial cars. In early, TOYO-ACE, STOUT, MS 40, DA, and LAND CRUISER were imported to Thailand by Toyota.

In 1964, Toyota was given a privilege by the Board of Investment (BOI) to assemble automobiles. In that year, Toyota Motor Thailand was established by having

registered capital 11.8 million baht. The head office was located in Surawong Rd., and there were 13 distributors.

In 1966, the first assembly plant was established at North Samrong, and there were imports of finished parts (CKD) from Japan. In the beginning, Toyota models assembled in Thailand, there were Toyota DYNA JK 170, TIARA, STOUT, PUBLICA (UP 10), DA, and CORONA RT 40.

In 1977, the second assembly plant was established at South Samrong. In 1982, Toyota was the first assembly plant in Thailand, which had introduced Electro Deposit Painting and Swing Arm Auto Loading in assembly line. In 1988, Toyota has moved its head office from Surawong Rd. to Samrong Complex until now, and that year the third assembly plant was also established. During that time, Toyota was recognized as the most advanced assembler in Thailand and its target sales was more than 100,000 units.

In 1997, Toyota Gate Way was open, which was recognized as the most technological advance in South East Asia. Toyota Gate way firstly assembled 'Toyota Soluna', which was the model that had collaborations between Thai and Japanese engineers.

All 50 years operating in Thailand, TMT always offer customers by making them most satisfactory and serving them with highest technological advance. In recent years, TMT has established 7 assembly plants in Thailand and its capacity is around 240,000 units per year.

4.3.2 Knowledge-sharing in Toyota Network

Toyota has been in the mind of Thai customers for long-time and it has been the most widely used vehicles in Thailand. Even though, the economic crisis in 1997 hit Toyota domestic sales decreased a lot, and its domestic sales touched 42,661 units in 1998. However, it had continually increased after 1999 until 2006, which its domestic sales were 289,108 units, or taken account 42.40 per cent of domestic market share (see table 4.2).

Furthermore, Thailand is very important to Toyota Motor Corporation (TMC) because it has been used as a hub for Toyota exports, specifically under the Innovative International Multi-purpose Vehicle (IMV) project in 2002 that

automobiles were exported more than 145 countries around the world. Besides, in April 2007, Toyota Motor Corporation (TMC) has established the new organization in Thailand, namely Toyota Motor Asia Pacific Engineering and Manufacturing (TMAP-EM), which has been used as a center of Toyota exports in Asia Pacific market. Thus, locally assembled vehicles under the name of TMT are expected to achieve very high requirements in terms of quality and competitive price in both domestic and overseas markets. As a result, knowledge-sharing with its first-tier suppliers is very essential in order to retain competitiveness over competitors.

Table 4.2

Toyota Sales Volume in Thailand Market

Year	Toyota sales (Units)	Total market sales (Units)	Toyota market share (Per cent)
1996	163,940	589,126	27.83
1997	107,121	363,156	29.50
1998	42,661	144,065	29.61
1999	74,619	218,330	34.18
2000	71,300	262,189	27.19
2001	83,514	297,052	28.11
2002	130,052	409,362	31.77
2003	188,748	533,176	34.40
2004	234,177	626,026	37.41
2005	277,955	703,432	39.51
2006	289,108	682,161	42.40

Source: Toyota Co-operation Club Annual Book (2007)

Table 4.3

Toyota Sales Volume Broken down by Models 2006

Model	Sales volume 2006 (units)
Camry	9,298
Corolla	20,900
Soluna	35,964
Yaris	18,466
Wish	3,753
Innova	1,344
Avanza	2,594
Other PC	247
Total PC	**92,566**
Vigo	166,356
Hilux	2
Fortuner	19,351
Total 1 Ton	185,709
Other CV	10,833
Total CV	**196,542**
Grand Total	**289,108**

Note: PC = Passenger car CV = Commercial car

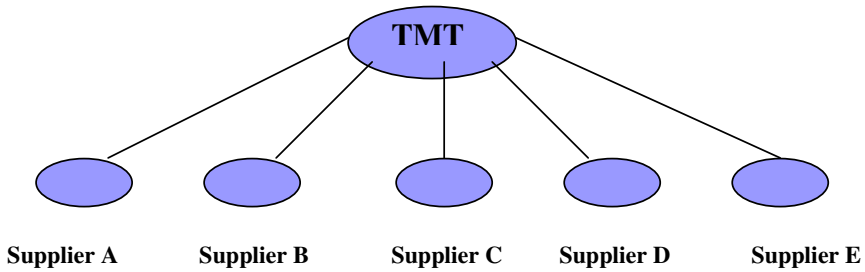
Source: Toyota Co-operation Club Annual Book (2007)

In the past, local suppliers did not understand Toyota Production System (TPS). So, all activities had to be organized through training visits to improve first-tiers' capabilities (socialization). From interviews an executive of Toyota purchasing department (2007), he explains that in the past TMT dealt with small groups of lower tier suppliers. So, TMT transferred know-how to its suppliers through the bilateral relationship[4] (see figure 4.1).

[4] Toyota sent technicians to visit first-tiers and teach them know-how involved in productions (socialization).

Figure 4.1

Knowledge-sharing of TMT in the Bilateral Relationship

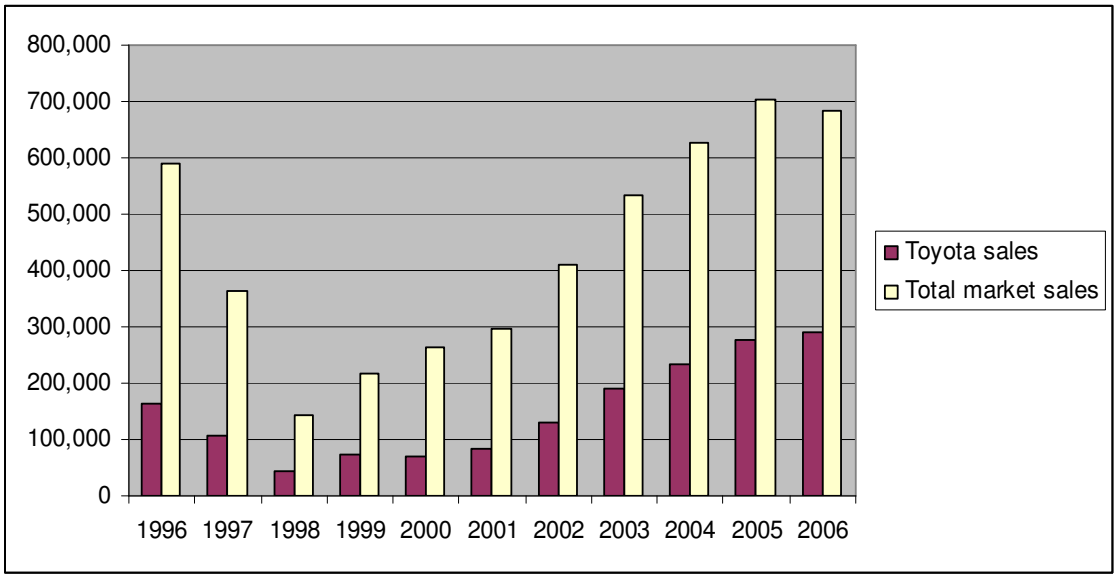


Source: From surveys (2007)

However, TMT has continually established its plants to serve increases in domestic demand (figure 4.2 shows increases in TMT sales and its market share) and its business relationships with first-tier suppliers in Thailand have been continually growing. In recent years, TMT deals with 300 first-tier suppliers. As a result, transferring know-how to first-tier suppliers through the bilateral form have been developed to be more effective. Furthermore, Toyota has also picked up Thailand as a hub for automobile exports, specifically after launching the IMV project in 2002 and establishing TMAP-EM in 2007. Consequently, first-tier suppliers are anticipated to be more competent. Thus, knowledge-sharing in the form of network has been introduced under the name of “Toyota Co-operation Club (TCC).”

Figure 4.2

Toyota Sales Volume in Thailand Market



Source: Toyota Co-operation Club Annual Book (2007)

4.3.3 Toyota Co-operation Club (TCC)

In 1981, TMT was a leader to take the representatives of local part suppliers to travel and visit TMC. In that opportunity, it aimed to enhance local part suppliers to learn, exchange, and increase knowledge with Japanese part suppliers. After this group came back from Japan, one Japanese staff from TMC, namely Mr. Y. Iida, agreed with 32 company members to establish TCC on February 6, 1982.

TCC is a voluntary program that allows Toyota suppliers can subscribe. Its objective is to emphasize on activities for strengthening co-operations among TCC members for enhancing knowledge, leveling up management skill, productivity, and technology exchange with no discrimination and no profit seeking (Toyota Co-operation Club Annual Book, 2007). In the beginning, the purchasing department of TMT was in charge of TCC. However, in recent years the purchasing department has been transferred to TMAP-EM, which recently has been in charge of TCC.

In present, Toyota has business relationships with 300 first-tier suppliers. However, there are 145 plants subscribing as TCC members or taken into account almost 50 per cent. There are three criteria set for first-tier suppliers who would like to subscribe as TCC members.

1. The company has already started business with TMT & STM (Siam Toyota Manufacturing).
2. The sales volume is more than 50 million baht per year for new comer.
3. The company must be recommended by TMT, STM, and TCC.

The structure of TCC consists of 13 committees, who are responsible for each TCC activity and operation. There are one chairman, two vice chairpersons, and ten advisors. These thirteen committees (representatives from each company subscribing as TCC member) are chosen by TMAP-EM based on their specializations in each TCC activity. In addition, these thirteen committees must act as a leader and sub leader in each TCC activity.

Table 4.4

TCC Chairpersons 1982 – 2007

1	Mr. Chalit Pongvatnanusorn (1982 - 1990)	CH. Auto Parts Co., Ltd.
2	Mr. Kaoru Kawakami (1991 - 1992)	NHK Spring (Thailand) Co., Ltd.
3	Mr. Tadahara Kaneoka (1993 - 1999)	NHK Spring (Thailand) Co., Ltd.
4	Mr. Yoshinori Omori (2000 - Present)	NHK Spring (Thailand) Co., Ltd.

Source: Toyota Co-operation Club Annual Book (2007)

Table 4.5

TCC Committees 2000 – Present

Mr. Yoshinori Omori (Chairman)	NHK Spring (Thailand) Co., LTD.
Mr. Manoj Leegomonchai (Vice Chairman)	Thai Koito Co., Ltd
Mr. Kazuo Hiramatsu (Vice Chairman)	Thai Arrow Products Co., Ltd
Mr. Samphan Phanpanit (Advisor)	Yarnapund Public Co., Ltd.
Mr. Yoshihiko Yamada (Advisor)	Denso International (Thailand) Co., Ltd.
Mr. Shinichi Sato. (Advisor)	Thai Bridgestone Co., Ltd
Mr. Sunsern Jurangkool (Advisor)	Summit Auto Seats Industry Co., Ltd.
Mr. Suchai Pongvatnanusorn (Advisor)	CH. Auto Parts Co., Ltd
Mr. Ryutaro Abe (Advisor)	Toyoda Machine Works (Thailand) Co., Ltd.
Mr. Makoto Hanakuma (Advisor)	Siam Aisin Co., Ltd.
Mr. Kunio Tomura (Advisor)	Hino Motors Manufacturing (Thailand) Ltd.
Mr. Shunichi Natsume (Advisor)	Toyoda Gosei (Thailand)
Mr. Hiroshi Takano (Advisor)	Toyota Tsusho (Thailand) Co., Ltd

Source: Toyota Co-operation Club Annual Book (2007)

According to table 4.4, there is only the first chairman, who is from purely Thai-owned company. But for the last three chairpersons, they are from the same foreign company. Besides, based on table 4.5, there are only three representatives, which are purely Thai-owned first-tier suppliers as committees in TCC (Yarnapund Public Co., Ltd., Summit Auto Seats Industry Co., Ltd., and CH. Auto Parts Co., Ltd). So, it implies that the Japanese and Japanese joint venture first-tiers play a more crucial role in the Thai automotive industry because they have more advanced technological capabilities than purely Thai-owned suppliers. So, the purely Thai-owned first-tiers need to improve their technological capabilities; otherwise they are likely relegated as lower tiers suppliers.

In addition, according to table 4.6 there were eleven activities organized by TCC in 2006, which were Safety Activity, Quality Assurance (QA), Toyota Production System (TPS), Quality Control Circle (QCC), Lecture, Dealer Visit, Factory Visit, Overseas Seminars, Golf Tournament, Rally, and Sports Day[5]. These eleven activities could be broken down in two groups, which were production and social interactive activities.

Production activities (Quality Assurance (QA), Toyota Production System (TPS), Quality Control Circle (QCC), Lecture, Dealer Visit, Factory Visit, Overseas Seminars, and Safety Activity) aim to share knowledge among TCC members in order to enhance management, skill, productivity, and technology.

On the other hand, social interactive activities (rally, sports day, and golf tournament) aim to build long-term relationships between Toyota and suppliers. According to previous literature (Lee and Humphreys, 2006), building long-term relationships is very important because it generates trust between a leading firm and its suppliers. As a result, the leading firm is willing to invest its resources in suppliers.

Remarkable to table 4.6, there were 65 members in 1997. However, numbers of TCC members have been continually increased until 2007, which have 145 members. So, TCC has been developed significantly in the last ten years because Toyota has continually relied on local sourcing and used Thailand as a hub for automobile exports.

[5] For all details about TCC activities in 2006, please see Appendix A

Besides, based on table 4.6 some production activities such as cost reduction and cost improvement, they were organized in the past. Nevertheless, recently they have been unintended because these two activities overlap with the concept of TPS. Broadly speaking, they have been already implemented through TPS.

Table 4.6

History of Activities since the First Day until Now

Activities	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Quality Assurance (QA)	O	O	O	O	O	O	O	O	O	O	O	O	O
Cost Reduction	—	—	—	—	—	—	—	—	—	—	—	—	O
Toyota Production System (TPS)	—	—	—	—	—	—	—	—	—	—	—	—	—
VA	—	—	—	—	—	—	—	—	—	—	—	—	—
Cost Improvement	—	—	—	—	—	—	—	—	—	—	—	—	—
Localization	—	—	—	—	—	—	—	—	—	—	—	—	—
Quality Control Circle (QCC)	—	O	O	O	O	O	O	O	—	—	O	O	O
Lecture	O	O	O	O	O	O	O	O	O	O	O	O	O
Up-country Seminar	—	—	—	—	O	O	O	O	—	—	—	—	—
Dealer Visit	—	—	—	—	—	—	—	—	—	—	—	—	—
Factory Visit	O	O	O	O	O	O	O	O	O	O	O	O	O
Overseas Seminar	—	O	—	O	—	O	—	O	—	O	O	—	O
Golf Tournament	O	—	O	O	O	O	O	O	O	O	O	O	O
Walk Rally	—	—	—	—	—	—	O	—	—	—	—	—	—
Rally	—	—	—	—	—	—	—	—	—	—	—	—	—
Bowling Tournament	O	O	O	O	—	—	—	—	—	—	—	—	—
Sports Day	—	—	—	—	—	O	O	O	O	O	O	O	O
Safety Activity	—	—	—	—	—	—	—	—	—	—	—	—	—
Total activities per year	5	6	6	7	7	8	8	8	5	6	7	6	8
Number of membership	32	35	34	35	36	38	40	42	43	47	45	52	54

Activities	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
QA	○	○	○	○	○	○	○	○	○	○	○	○
Cost Reduction	○	○	○	—	—	—	—	—	—	—	—	—
TPS	—	—	—	○	○	○	○	○	○	○	○	○
VA	—	—	—	—	—	—	—	○	—	—	—	—
Cost Improvement	—	—	—	—	—	—	—	—	○	—	—	—
Localization	—	—	—	—	—	—	—	○	—	—	—	—
QCC	○	○	○	○	○	○	○	○	○	○	○	○
Lecture	○	○	○	○	○	○	○	○	○	○	○	○
Up-country Seminar	—	—	—	—	—	—	—	—	—	—	—	—
Dealer Visit	—	—	—	—	—	—	○	○	—	—	○	○
Factory Visit	○	○	○	○	○	○	○	○	○	○	○	○
Overseas Seminar	—	○	—	—	—	—	—	○	—	—	○	○
Golf Tournament	○	—	—	—	—	○	○	○	○	○	○	○
Walk Rally	—	○	○	—	—	—	—	—	—	—	—	—
Rally	—	—	—	—	—	—	—	—	○	○	○	○
Bowling Tournament	—	—	—	—	—	—	—	—	—	—	—	—
Sports Day	○	○	—	—	○	○	—	○	—	○	—	○
Safety Activity	—	—	—	—	—	—	—	—	—	—	—	○
Total Activities Per Year	7	8	6	4	5	6	6	11	8	8	9	11
Numbers of Membership	59	60	65	76	89	90	92	96	100	117	138	142

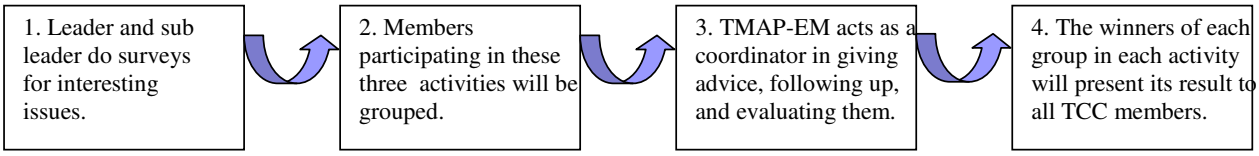
Source: Toyota Co-operation Club Annual Book (2007)

The study finds that Quality Assurance (QA), Toyota Production System (TPS), and Quality Control Circle (QCC) are production activities that facilitate knowledge-sharing in the form of network. A leader and sub leaders being responsible for each of these activities will study which topic being most interesting and helpful to members. Then, all these three activities are organized to members in the form of group competition[6]. Notably, direct competitors will not be in the same group.

During the competition, TMAP-EM would act as a coordinator. The members are able to ask for advices from TMAP-EM. Then, TMAP-EM would send technicians to give advices (socialization), follow up and evaluate a progression of each member at its plant. Then, the winner of each group in each activity has to present its result to all members in the TCC meeting. The processes of knowledge-sharing network of those three activities are shown in figure 4.3. As a result, all the members participating in the meeting can learn from others' successes and apply that know-how to their plants (internalization).

Figure 4.3

The Processes of Activity Facilitating Knowledge-sharing in TCC Network



Source: From surveys (2007)

In section 4.4, it provides details in knowledge-sharing network in Quality Assurance (QA), Toyota Production System (TPS), and Quality Control Circle (QCC).

[6] From surveys (2007), there are many criteria used in grouping members e.g. location and technological capability of suppliers.

4.4 Knowledge-sharing Network in Quality Assurance (QA), Toyota Production System (TPS), and Quality Control Circle (QCC)

Quality Assurance (QA)

QA is an activity aiming to provide confidence over quality of a product satisfying given requirements by Toyota. In other words, all the things in product design, process engineering, the production stage, purchasing, sales, and service need to be guaranteed. Besides, it also includes the purchasing regulation of the quality of raw materials, assemblies, products and components.

QA has been introduced to TCC members since 1982. However, the policy in 2006 was to promote QA improvement mainly concerned push & strengthen packing quality, quality gate, changing point management, and QA network to members. The targets of implementing QA in 2006 were to achieve quality receiving target 7 PPM (pieces per million), zero safety part defect, and in process defect down 50 per cent. Table 4.7 shows the final QA contest result in 2006 and figure 4.4 shows the pattern of relationship in QA.

Table 4.7

Final Quality Assurance (QA) Contest Result in 2006

Group	Rank	Company
A	The Winner	Pioneer Manufacturing (Thailand) Co., Ltd.
	The 1st Runner up	NHK Spring (Thailand) Co., Ltd.
	The 2nd Runner up	Inoue Rubber (Thailand) Public Co., Ltd.
B	The Winner	Thai Arrow Products Co., Ltd.
	The 1st Runner up	USUI International Corporation (Thailand) Co., Ltd.
	The 2nd Runner up	Thai Automotive Seating & Interior Co., Ltd.
C	The Winner	CH. Auto Parts Co., Ltd.
	The 1st Runner up	Sanko Gosei Technology (Thailand) Co., Ltd.
	The 2nd Runner up	Yarnapund Public Co., Ltd.
D	The Winner	Thai Koito Co., Ltd.
	The 1st Runner up	AAPICO Hitech Public Co., Ltd.
	The 2nd Runner up	CH. Industry Co., Ltd.
E	The Winner	Siam Aisin Co., Ltd.
	The 1st Runner up	Kallawis Auto Parts Industry Co., Ltd.
	The 2nd Runner up	Thai Engineering Products Co., Ltd.

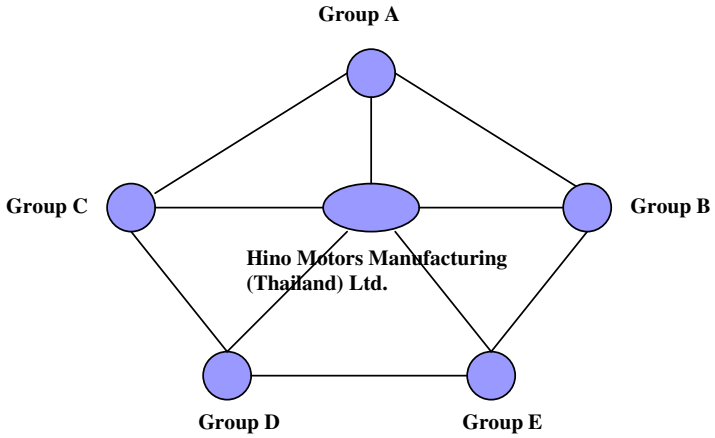
Leader: Hino Motors Manufacturing (Thailand) Ltd.

Sub Leader: Yarnapund Public Company Limited.

Source: Toyota Co-operation Club Annual Book (2007)

Figure 4.4

Knowledge-sharing network in Quality Assurance (QA)



Source: By the author based on Toyota Co-operation Club Annual Book (2007)

Toyota Production System (TPS)

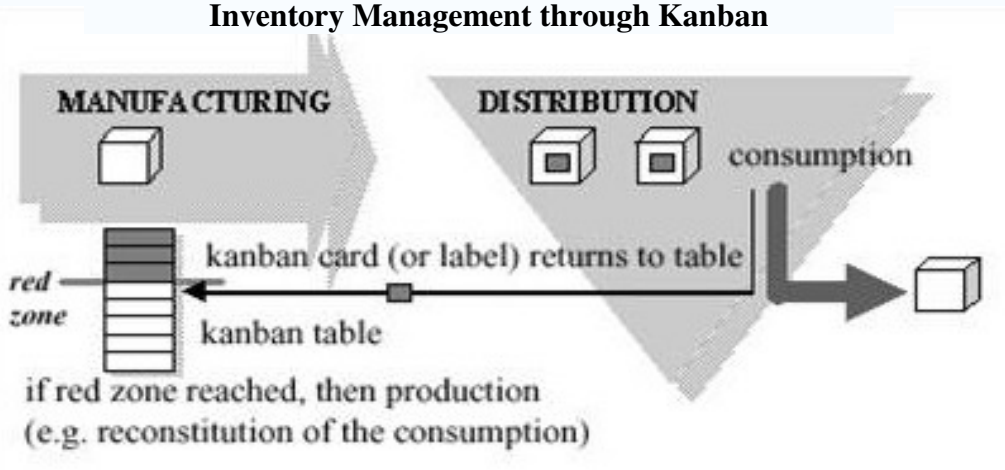
Toyota Production System (TPS) has been introduced to TCC members since 1998. It is a system that is used to identify and minimize non-value adding activities. TPS is not a static system; rather it promotes continuous change and improvement. TPS consists of three main commonly used terminologies, which are Just-In-Time (JIT), Jidoka, and Kaizen.

Just-In-Time (JIT) is an inventory management strategy that is used to reduce in-process inventory which in turn associates cost effectiveness. The philosophy of JIT, inventory is seen as incurring costs and wastes. In other words, JIT is all about having all the right part at the right place and at the right time with exact amount. JIT does not implement each process independently, but it rather views an entire system as linkages. So, viewing in this way leads to a broad view and seeing all the processes as a whole.

Besides, JIT is driven by "Kanban" that help to manage stock effectively. Kanban is signals for the existence or empty of inventory in a warehouse. Maintaining inventory levels; a signal is sent to produce and deliver a new shipment. These signals are tracked through the continuous replenishment. So, replenishment is implemented when stock decreases. As a result, JIT saves warehouse space and costs.

Figure 4.5

Inventory Management through Kanban



Source: Wikipedia (The free encyclopedia)

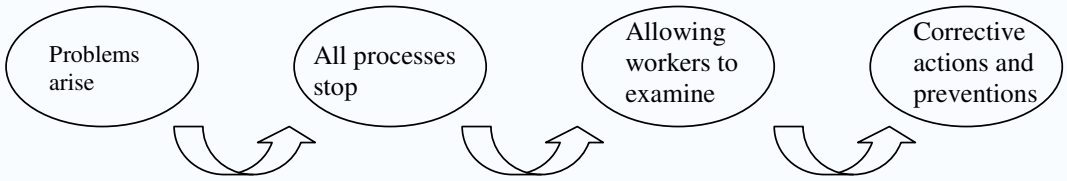
Jidoka[7] usually means understanding problems, eliminating, and ensuring that they will never occur again. Specifically, if an uncommon situation arises, the production line and machines will stop and allow the workers to examine and solve the problems. As a result, defective products are not allowed to come out. The benefits from implementing Jidoka are as follows:

- Helping to detect a problem earlier.
- Applying human intelligence into automated machinery.
- No defected product manufactured.
- Improving productivity.

[7] According to Fujimoto (1999), jidoka is shutdown of the machines that force human intervention in the process, which in turn leads to process of improvements.

Figure 4.6

The Processes of Jidoka



Source: By the author (2007)

Kaizen is a system that encourages every Toyota employee from top management to workers to come up with continuous improvement in quality, technology, and productivity. Kaizen is based on making changes in anywhere that improvements can be made. In other words, it expects every employee do it better and improve because if Toyota does not do it, it cannot compete with other automakers.

In addition, Kaizen involves setting standards and then continually improving those standards. As a result, Toyota always provides close supervision and training to workers for achieving higher standards. The benefits from Kaizen are as follows:

- Improving productivity, quality, and faster delivery.
- Implementing cost effectiveness.
- Improving greater customer satisfaction.

The policy in 2006, it was organized to strengthen cost kaizen by building up more leaders and promoting to new comers who participated in this activity for the first time. Table 4.8 shows the contest result in 2006 and figure 4.7 shows the pattern of relationship in TPS.

Table 4.8

Final TPS Contest Result in 2006

Group	Rank	Company
Sub-Leader	The Winner	Aapico Hitech Public Co., Ltd.
	The 1st Runner up	BVS Manufacturing Co., Ltd.
	The 2nd Runner up	Hino Motors Manufacturing (Thailand) Co., Ltd.
Experience 1	The Winner	YS Pund Co., Ltd.
	The 1st Runner up	Ampas Industries Co., Ltd.
	The 2nd Runner up	Bangkok Spring Industrial Co., Ltd.
Experience 2	The Winner	Marukami Ampas (Thailand) Co., Ltd.
New Member 1	The Winner	Thai Summit Auto Parts Industry Co., Ltd.
	The 1st Runner up	Enkei Thai Co., Ltd.
	The 2nd Runner up	Inergy Automotive System (Thailand) Co., Ltd.
New Member 2	The Winner	Thai Arrow Products Co., Ltd.
	The 1st Runner up	CH. Watanayont Co., Ltd.
	The 2nd Runner up	Usui Internation Corporation (Thailand) Co., Ltd.

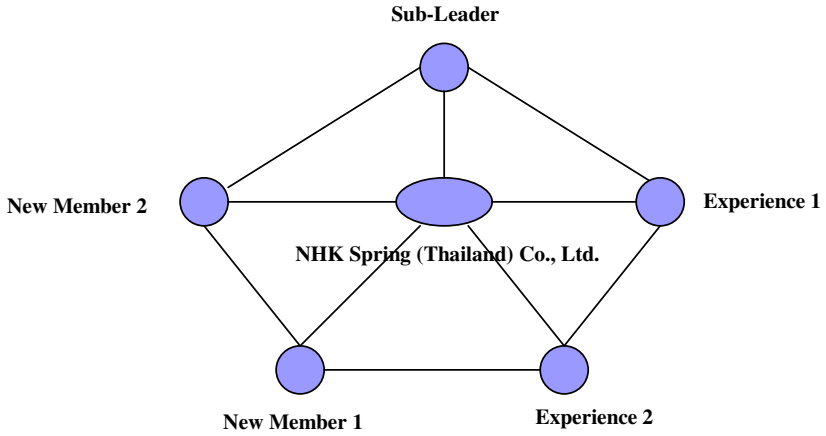
Leader: NHK Spring (Thailand) Co., Ltd.

Sub Leader: Denso International (Thailand) Co., Ltd. & Thai Koito Co., Ltd.

Source: Toyota Co-operation Club Annual Book (2007)

Figure 4.7

Knowledge-sharing network in Toyota Production System (TPS)



Source: By the author based on Toyota Co-operation Club Annual Book (2007)

Quality Control Circle (QCC)

Quality Control Circle (QCC) has been introduced to TCC members since 1983. It aims to increase efficiency, enhance productivity, reduce cost, enhance knowledge & technique of QCC, and develop people and systematic problem solving by QCC method for Toyota Motor Thailand (TMT) and Siam Toyota Motor (STM) suppliers. Table 4.9 shows the result contest in 2006 and figure 4.8 shows the pattern of relationship in QCC.

Table 4.9

Final QCC Contest Result in 2006

Group	Rank	Company
Group 1	The Winner	Thai Engineering Products Co., Ltd.
	The 1st Runner up	Denso (Thailand) Co., Ltd.
	The 2nd Runner up	Thai Automotive Seating & Interior Co., Ltd.
Group 2	The Winner	Thai Stanley Electric Public Co., Ltd.
	The 1st Runner up	Siam AT Industry Co., Ltd.
	The 2nd Runner up	AGC Automotive (Thailand) Co., Ltd.
Group 3	The Winner	The Nawaloha Industry Co., Ltd.
	The 1st Runner up	Siam Aisin Co., Ltd.
	The 2nd Runner up	Pioneer Manufacturing (Thailand) Co., Ltd.
Group 4	The Winner	Tokai Rika (Thailand) Co., Ltd.
	The 1st Runner up	CH. Watanayont Co., Ltd.
	The 2nd Runner up	Molten Asia Polymer Products Co., Ltd.
Group 5	The Winner	Musashi Auto Parts Co., Ltd.
	The 1st Runner up	Inoac Tokai (Thailand) Co., Ltd.
	The 2nd Runner up	CH. Radiators Co., Ltd.
Group 6	The Winner	Takata-TOA Co., Ltd.
	The 1st Runner up	Nichias Rungruang Co., Ltd.
	The 2nd Runner up	Echo Autoparts (Thailand) Co., Ltd.

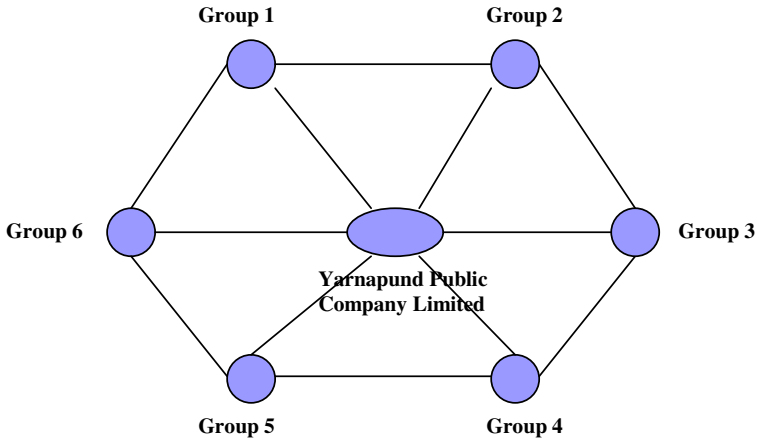
Leader: Yarnapund Public Company Limited.

Sub Leader: CH. Auto Parts Co., Ltd. & Siam Aisin Co., Ltd.

Source: Toyota Co-operation Club Annual Book (2007)

Figure 4.8

Knowledge-sharing network in Quality Control Circle (QCC)

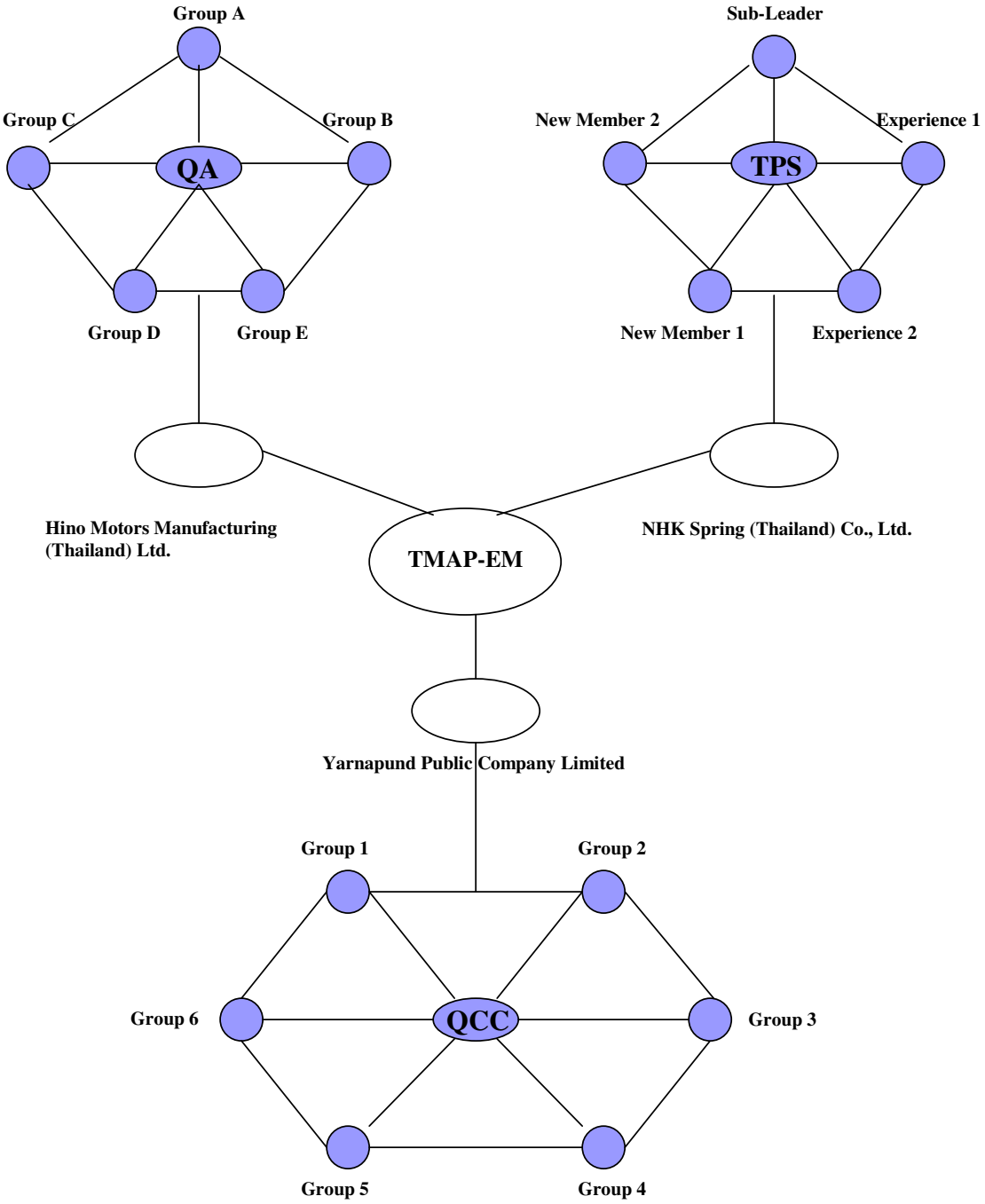


Source: By the author based on Toyota Co-operation Club Annual Book (2007)

So, the relationships of those three activities, Quality Assurance (QA), Toyota Production System (TPS), and Quality Control Circle (QCC), can be shown in figure 4.9. There is TMAP-EM acts as a center, and there is a leader in each activity.

Figure 4.9

Knowledge-sharing Network in Quality Assurance (QA), Toyota Production System (TPS), and Quality Control Circle (QCC)



Source: By the author based on Toyota Co-operation Club Annual Book (2007)

4.5 Key Successes of Knowledge-sharing Network in Quality Assurance (QA), Toyota Production System (TPS), and Quality Control Circle (QCC)

According to the analytical framework in chapter 2, in order to facilitate the most effective knowledge-sharing network, a leading firm has to deal with the three dilemmas; which are (1) motivate members to participate and openly share knowledge (2) prevent free rider problem (3) efficiently transfer knowledge. So, in this section, all the three dilemmas will be discussed.

The study finds that TMAP-EM deals with the first dilemma by strengthening good relationships with its first-tier suppliers. Free advice, provision of specialists, and financial supports are activities that TMAP-EM has chosen to build good relationships with the first-tiers. One of the most impressive stories is financial supports provided by Toyota to its suppliers during the economic crisis in 1997. Toyota provided loans to its suppliers, who were in financial difficulties. As a result, many suppliers could survive until present. So, the way that Toyota has built good relationships with the suppliers make them appreciate to have relationships and be willing to work for Toyota with minds.

In addition, Toyota has rooted the mind of co-operation to its first-tier suppliers for a long-time. It has made all suppliers felt that they are in the same family. If suppliers have problems, Toyota will help suppliers with minds. However, in return they must also view other suppliers as alliances and they must be willing to help others as well. So, suppliers have been encouraged to view if a network is efficient, every member can survive.

To the second dilemma, prevention of the free rider problem, TMAP-EM has set the entry and exit cost for new members. Every supplier having business relationship with TMAP-EM must allow TMAP-EM purchasing staffs to audit and evaluate its plant[8]. As a result, all operation and production of every supplier cannot be hidden because every process must be investigated by the TMAP-EM purchasing staffs. Furthermore, all members participating in TCC are charged for member fees by having annual paying 20,000 baht. So, the entry cost is inevitable to new members.

[8] See more details about TMAP-EM supplier evaluations in Appendix B

Besides, there is also exit cost for the members, who expect to gain proprietary freely and then leaves from a network because members joining to TCC must have business relationships with TMT or STM. If they enter and exit in a short run, they will lose opportunities to receive orders from Toyota and they will lose connections with other members in a network. As a result, they will lose business opportunities.

To the last dilemma, TMAP-EM facilitates the most effective knowledge-sharing in TPS, QA, and QCC by organizing members into the group competitions. The competitions facilitate the most effective knowledge-sharing because a leader and sub leader of each activity will study and choose the topic, which is the most interesting and beneficial to members. As a result, members participating can learn the result presented by the winners and they can precisely apply it to their plants.

More importantly, organizing the group competitions also encourage members participating in each activity would like to be the group winner because it will have to present its success to all members. Thus, the presentation is the opportunity for the winner to show its potential and create its business opportunity. So, the group competitions will generate a competitive environment contributing to the most effective knowledge-sharing.

4.6 Benefits of Knowledge-sharing in a Network

4.6.1 Enhancing Learning Capabilities of First-tier Suppliers

Because these three production activities, TPS, QA, and QCC are organized into group competitions, as a result each member expects to be the winner. Even though most of the prizes rewarded to the winner are traveling tickets, but members do not expect them as the most important thing. They rather expect good corporate image through presentations as the winners in TCC meeting because they will be credited as potential suppliers and they are likely given new orders by TMAP-EM. Furthermore, having good corporate image and reputation are their business opportunities because other members would like to have business relationships with them.

Thus, group competitions directly encourage members to enhance themselves and be willing to learn technologies from TMAP-EM. This is the benefits to both TMAP-EM and its suppliers. On the one hand, TMAP-EM would be supplied auto

parts with high quality and effective cost. Consequently, Toyota would gain competitive advantage on both domestic and export markets. On the other hand, members are able to enhance their productivities and efficiencies in auto part productions.

4.6.2 A Variety of Knowledge

TPS, QA, and QCC are activities that members are organized into group competitions in which the winner of each group in each activity has to present its result to all TCC members. As a result, the learning process can be carried out in many aspects because every member has a chance to observe and learn others' successes in order to improve its performance. It is different from the bilateral relationship that each member rarely observes others' successes.

4.6.3 Building Long-term Relationship

The relationship is very important to the business unit because having a good relationship will increase marketing channels and opportunities in getting to know other firms. Because TMAP-EM has business relationships with 300 first-tier suppliers, so it is hardly possible to each first-tier to get to know other firms. So, TCC is an integration of the members in order to share knowledge within a network. It encourages members to contribute their proprietary to a network that is legitimate for members to access. As a result, each member tends to build long-term relationship with others in order to have co-operation in research & development (R&D), which is the source of competitive advantage.

4.7 Concluding Remarks

In this chapter, technology transfers between Japanese automakers and first-tier suppliers get involved in product development, process engineering, and production stage. For product development and process engineering, they occur in the form of bilateral relationship, which technologies are transferred by Japanese automakers. Close supervision and technical advices by the Japanese experts help first-tier suppliers to deepen in product development and process engineering (internalization and socialization).

Based on a previous study (Techakanont and Terdudomtham; 2004), technology transfers involved in the production stage occur in the form of bilateral relationship, which know-how is transferred by Japanese automakers. However, this study reveals that one Japanese automaker, namely Toyota, has improved the pattern of technology transfer involved in the production stage to be more effective. More precisely, technology transfers in a network (multilateral relationship) have been introduced under a voluntary program, which is Toyota Co-operation Club (TCC). The study finds that TMAP-EM has not only transferred technologies to its first-tiers through training visits to first-tiers' plants (socialization), but it has also encouraged its first-tiers to play a more active role in the learning process by sharing knowledge among members (internalization) in a network through the TCC meeting.