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The Evolution of Automotive Clusters and Global Production Network in Thailand

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1. Introduction

Thailand was an agrarian economy and had virtually no industrial experience. Automobile production started in 1960s as a result of government policies inducement incentive. Foreign assemblers then entered into the country and started their production to serve domestic market. Local production and supporting industries have been developed and multinational car manufacturers gradually expanded their production and started export. Less than 40 years, in the mid-1990s, Thailand was dubbed as "Detroit of Asia." Although the country was affected by the 1997-98 economic crisis, several assemblers restructured their business and finally made a strategic decision to use Thailand as one of their global production bases. How could this development pattern happen and what are policy implications for developing countries that want to promote automotive industry?

This paper tries to provide description on the avenue to this development pattern and to postulate crucial factors accounted for such success. Although there are a number of studies discussing why Thailand became part of the global production network (hereafter, GPN) of multinational car makers, for example, Techakanont (2002), Takayasu and Mori (2004), Kohpaiboon (2005), this paper will attempt to provide a

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systematic explanation, particularly a discussion of government policies that not only favored Japanese car makers, but may have also been indirectly influenced by the multinational companies.

To exemplify the avenues which have allowed the Thai automotive industry to participate in the GPN of automobiles, the paper will discuss both the Thai government policies and global strategies of the multinational car. This study partially relies on the research approach of Dyer and Nobeoka (2000) and Liker and Wu (2000) in assessing economic benefits from being a part of GPN. Liker and Wu (2000) examine the secrets of the Japanese transplants' success and provide reasons why U.S. automakers are unable to keep up to the Japanese standard, despite they put effort to emulate lean manufacturing practices and supply-chain logistics, Moreover, the paper will also examine the role of the networks in facilitating inter-organizational learning (Dyer and Nobeoka, 2000).

In examining the development of automotive clusters, the author will first describe the development of the automotive industry in Thailand, based on the previous studies of Techakanont (2002) and Lecler (2002). Government policies and the economic factors are postulated on the premise that the choice of location of the firms, both assemblers and part suppliers, in automotive industry. Clusters are defined as geographic concentrations of firms and institutions that are interconnected in a particular location (Porter 1990). Agglomeration of firms in a particular area or region constitutes a cluster. However, clusters in different countries seem to vary in terms of the nature of production technology, inter-firm relational modes, and their historical development, i.e., whether or not supporting industries exist. Policy makers and private sector can have significant role in developing clusters or having close business relationship with suppliers.

In the automobile industry, globalization and advancement in information and communication technology (ICT) in the past decades were the main reasons for industrial restructuring of firms' strategies. Competition has become more intense and globalization has redefined the concept of distance and helped agglomeration and inter-firm relations to take place across distance, not only within a specific location in a country, but also across industries and countries (Guerrieri and Pietrobelli 2006). There are some links between the evolution of clusters and the technological change in production and management. With the diffusion of ICTs and internationalization of economic activities, technology becomes more codified and easier to transfer or share via globalization. Thus, this may change the way firms operate, share and create knowledge, and maintain inter-firm relationships with distant suppliers or customers.

According to Guerrieri and Pietrobelli (2006), clusters and industrial districts (IDs) may be grouped into three categories: (1) the *Marshallian* industrial district, which was first noted by Alfred Marshall about the external economies of co-location of small firms in a region. In this type, cooperation and inter-firm relationships among firms in the IDs are relatively strong, due to substantial specialization and bonded business relationships between business and economic activities; (2) the *hub and spoke district*, proposed by Markusen (1996), where a cluster occurs when one or more firms act as centers or hubs and their suppliers and supporting industries locate around them (such as a big company in a region, Toyota in Toyota city). This type consists of *leading firms* as cores of the enterprise networks. Leading firms can thus play a crucial role in providing strategic services as well as technical linkages to suppliers; and, (3) the *satellite platform*, which as described by Markusen, "consists of a congregation of branch facilities of externally based multi-plant firms" (Guerrieri and Pietrobelli 2006, p.13). In this type, firms in IDs or clusters may have little contact with local

institutions. They may operate with little linkage with other firms in the same area (geographically). However, indigenous firms may emerge out of technology transfers by universities or business relationships with anchored firms in the region, hence, local SMEs can be fostered as industrial activities develop.

Although clusters can be a blend of several types, they tend to share a geographical agglomeration along these three modes. They also depend on historical development of the economy, basic infrastructure and industrial experience, government policies, and firms' strategies. Comparing both definitions of production networks and clusters, one observes that clusters are, in fact, one form of governance style of the production networks, i.e., the industrial districts where there are strong agglomeration economies from the relationships among firms that are clustered in the same areas.

In addition to the secondary sources of information, the author also utilizes primary data, obtained from the questionnaires sent by mail to the parts suppliers. The questionnaires were sent to autoparts firms that supplies parts to the Toyota Motor Thailand (TMT), Auto Alliance Thailand (AAT) and Mitsubishi Motor Thailand. The targets were firms that located around the Eastern Seaboard (ESB), both in and outside industrial estates (IEs). Altogether, about 250 questionnaires were sent, but only 18 were returned, accounting for 7.2 percent of those sent. The questionnaires were sent in January 2007. Moreover, the author also utilizes information obtained from past interviews with some executives of car makers and parts suppliers.

The organization of this paper is as follows; after the introduction, Part 2 provides a brief historical development of the Thai automotive industry, emphasizing the issues of government policies and the multinational car makers' strategies. Part 3 discusses historical development of the automotive cluster in Thailand. This section addresses question differently from existing literature by focusing on the influence of

government policies on the production and location strategies of assemblers (especially, Japanese firms), which explains the agglomeration of firms in some areas. The main issue is the reasons for the emergence of clusters in the Eastern Seaboard area. In Part 4, characteristics of GPN of some assemblers in Thailand will be presented. This section will present research findings on the benefit of local firms being part of GPN and compare network governance between Japanese and non-Japanese automakers. Part 5 is the conclusion and implications.

2. The Historical Development of the Thai Automobile Industry

2.1 Brief history of Thailand's automobile

From the 1960s, the Thai automobile industry was among the first industries to receive an investment promotion from the Board of Investment (BOI) and was promoted in line with the country's import substitution policy. In 1961, there were only 525 cars produced locally, while domestic sale was 6,080 units. From 1970 to the mid 1980s, the domestic market grew gradually as well as production volume. This growth resulted from the change in government policy from import substitution to a more rationalized policy, aiming to increase the use of localized parts and components. Automobile production and sales grew significantly in the 1990s due to two major reasons. On the one hand, the appreciation of the Japanese yen in 1985 encouraged Japanese and part makers to expand their production in Thailand. On the other hand, the Thai government committed to liberalize the auto industry, e.g., the deregulation of the automobile industry in the early 1990s and the abolishment of the Local Content Requirement regulation in 2000. This significantly transformed the Thai automobile industry from a highly protected industry to a more liberalized one.

Asian Financial Crisis, triggered by the devaluation of the baht in July 1997, caused serious impact on manufacturing sector, including automotive industry. As

shown in Figure 1, the domestic sale of new vehicles dropped sharply, by 38.36 percent in 1997 and 60.33 percent in 1998. The decline in domestic demand made assemblers adjust their production plans. They adjusted by reducing their production, temporarily stopping production, and reducing the number of workers as well as operating and working time (BOT 1999; Poapongsakorn and Wangdee 2000; Terdudomtham et al. 2002). Despite the severe shock caused by the economic crisis, both production and employment recovered quickly as a result of rapid economic recovery. Also, many assemblers tried to increase their exports in order to offset the loss of the domestic sale. The industry has been resilient quickly. The economic aftermath has proved that Thailand has strong potential to be an export base. As a consequence, Japanese and U.S. automobile assemblers, such as Mitsubishi, Toyota, Auto Alliance (a joint venture between Ford and Mazda), GM, and Isuzu, have decided to use Thailand as their export base. Production capacity expanded considerably after 2000 (see Table 1). In 2006, annual production was 1,176,840 units and total export was 539,206 units (see Figure 1). After only 40 years of development, the Thai automobile industry is now becoming more export oriented.

The fact that assemblers could swiftly turn their excess production capacity into export indicates that Thai made vehicles could achieve international quality standard and competitive price. It can be argued that earlier government policies were successful in the process of industrialization of the Thai state, under the series of protection policies, which attempted to streamline the industrialization process incrementally. Japanese assemblers, which tried to adjust and comply with those higher policy requirements, have played crucial roles in the development of local automobile production and supporting industries in Thailand. These important roles go beyond

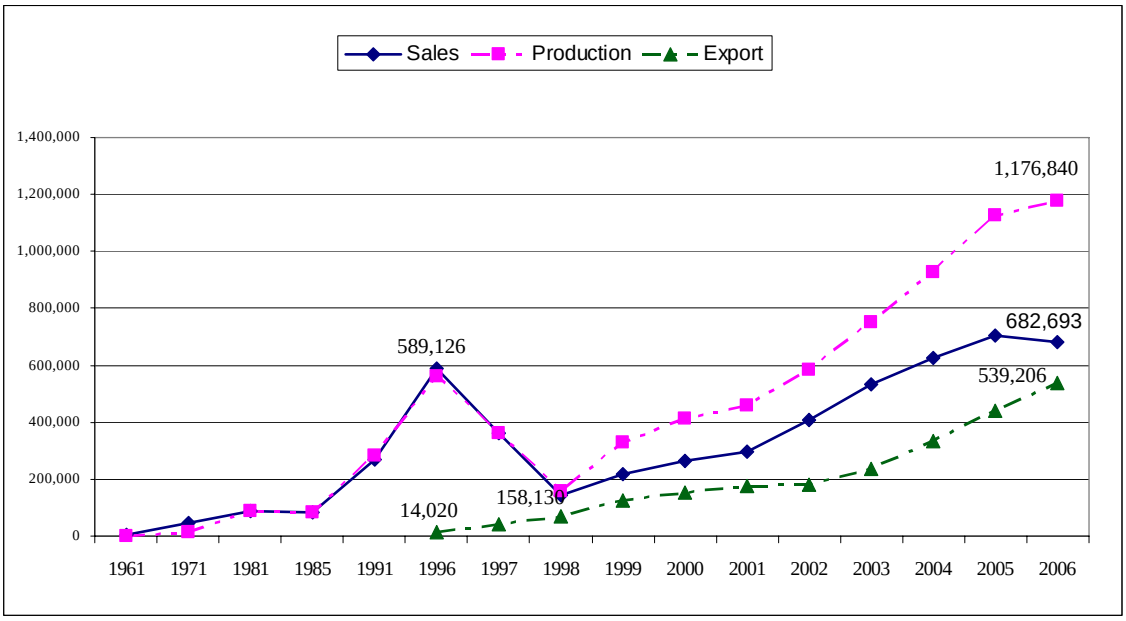
simply increasing the levels of localization of parts production for their operations in Thailand.

Table 1 Production Capacity (Units) of Assemblers in Thailand (1989 – 2006)

	1989	1994	1999	2003	2005	2006
Toyota	24,000	100,000	200,000	240,000	350,800	450,000
Mitsubishi	40,000	126,600	160,000	190,200	170,200	208,000
Isuzu	27,400	83,200	140,600	189,600	200,000	200,000
General Motor	n.a.	n.a.	40,000	40,000	100,000	160,000
Auto Alliance &Mazda	7,200	8,400	135,000	135,000	135,000	155,000
Nissan	23,520	96,500	113,100	124,000	102,000	134,400
Honda	8,220	39,000	70,000	80,000	120,000	120,000
Hino	9,600	9,600	9,600	28,800	28,800	28,800
DaimlerChrysler	2,340	4,600	14,900	18,100	16,300	16,300
YMC Assembly	12,000	12,000	12,000	12,000	12,000	12,000
Volvo	6,000	6,000	6,000	6,000	10,000	10,000
BMW.	n.a.	n.a.	n.a.	n.a.	10,000	10,000
Total	**160,280**	**485,900**	**901,200**	**1,063,700**	**1,255,100**	**1,576,500**
Average Annual Growth *	-	**24.8**	**13.2**	**5.7**	**5.7**	**19.9**

Source: Kohpaiboon 2006, Table 3, p. 13.

Figure 1 Thailand Production, Sales, and Exports of Automobile (1961 – 2006)



Source: Federation of Thai Industries and the Thai Automotive Industry Association

2.2 Historical Development of the Thai Automobile Industry: From Import Substitution to an Export-oriented Industry

Thailand began developing its automobile industry with very limited experience of automobile assembly. The industrialization process of the automotive industry can be traced back to the early 1960s. Although Thailand was at a disadvantage with respect to its manufacturing expertise, the Thai government promoted industrial development of finished products industries by giving investment incentives to foreign firms and setting high import duties to protect domestic industries. These incentives encouraged a number of multinational automobile manufacturers from Japan, the U.S. and Europe to set up joint ventures business with local firms and a common feature of the operations was the assembly of imported CKD parts and components for the domestic market. At the same time, various policy measures were implemented to promote the development of supporting industries directly and indirectly.

In the initial stages, most assemblers used imported parts and components and invited their suppliers to establish plants in Thailand. According to Doner (1995: 1546), by 1969, 12 Japanese part suppliers established production in Thailand at the request of assemblers with whom they had close relationships in Japan. Japanese automobile assemblers have developed their own supplier networks and they did this by developing the technological level of local part firms, usually Sino-Thai firms, by providing technical assistance to them. This was the first step in the development of supporting industries in Thailand.

The most important policy of the Thai state was the implementation of the local content requirement (LCR) policy in 1972, requiring car makers to purchase parts locally. This was not an easy task because at that time supporting industries in Thailand were virtually nonexistent. To comply with the gradual increase in local content

requirement while the quality of local parts was still poor, Japanese assemblers asked their suppliers to invest in Thailand (Siroros 1997, p. 15). Since 1978, the LCR was revised and became more aggressive in the level of localization. There had been extensive negotiations among the government officers, Japanese assemblers and local parts firms. The new LC formula was adopted to compel the assemblers to procure more import parts locally.

Although the rules were strict, the policy makers were quite flexible for assemblers to choose how to procure parts, either produce them locally or assembled components from imported part (Doner 1991: 199). Moreover, the government supported private sector by preparing and developing infrastructure for manufacturing activities. Industrial Estate Authority of Thailand (IEAT) was established in 1972 and many industrial estates (IEs) were constructed around Bangkok, such as Samut Prakarn, Bang Chan, and Lad Krabang, which were areas where assemblers had already established their production plants. Hence, the agglomeration of firms around these areas was observed during the 1970s.

In the 1980s, when the Japanese yen appreciated and the LCR regulation was revised several times to increase the local content ratio, Japanese firms had to expand their production, increase the use of local parts, and invite more part suppliers to establish plant in Thailand. However, they could not invite all suppliers from Japan because of the limited size of the domestic market. As the LCR policy was becoming more aggressive, turning to local firms for cooperation was inevitable. In addition to the internalization of part production, Japanese firms responded to the Thai Government policies with two other major strategies: 1) implementation of a satellite strategy and 2) collaboration among assemblers, especially for the diesel engine project.

With respect to the first strategy, the Japanese automobile manufacturers invited their parts suppliers to Thailand and locating them around their assembly plants (Doner 1991). Supplier networks in Thailand then developed, though, they differed from the *keiretsu* system in Japan. The automobile industry networks in Thailand are comparatively weaker. There are only two levels of subcontracting and the relationships between suppliers and assemblers are multiple, i.e., a supplier supplies parts to several assemblers (Maruhashi 1995). The main reason for this was the insufficient domestic demand, Hence, a strategy to procure parts from suppliers who also supplied parts to other assemblers proved more cost-effective.[1]

The other strategy of Japanese automobile manufacturers in response to the localization policy in Thailand has been an inter-assembler collaboration. This was one of the requirements of the BOI Engine Production Promotion scheme. It was compulsory for engine assemblers to utilize local engine parts that have undergone domestic casting and forging processes by a specified schedule.[2] Three engine assemblers under the BOI promotion projects, i.e., Isuzu Engine Manufacturing (Thailand), Siam Toyota Manufacturing, and Thai Automotive Industry, initiated cooperative production for these five compulsory parts. Collaboration among engine manufacturers is as follows: Isuzu Engine Manufacturing (Thailand) is responsible for

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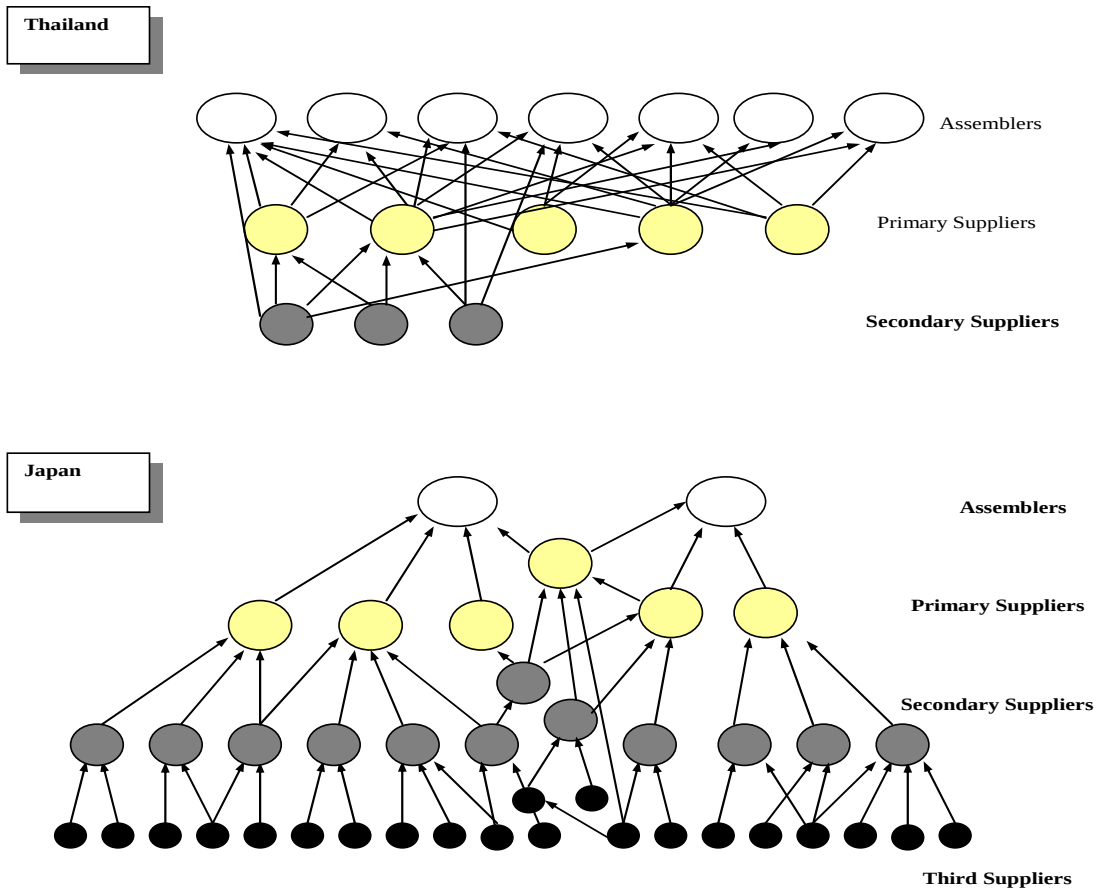
[1] However, the rapid growth of automobile production in Thailand and the fact that Thailand has recently been integrated into the global production network will certainly affect the structure and relationship of this supplier system in the future.

[2] The promoted engine manufacturers had to increase local content every year from 20 percent in 1989 to 70 percent in 1998. From 1994, engine manufacturers had to use local cylinder blocks (casting), and local connecting rods (forging) and camshaft (casting) from 1996, cylinder head (casting) from 1997, and crank shaft (forging) from 1998.

forging crankshafts and connecting rods; Siam Toyota Manufacturing for casting cylinder blocks; and Thai Automotive Industry for casting cylinder heads. Each assembler produces and supplies for the collaborative group.

Figure 2 Structural Difference of the Supplier System between Thai and Japanese Automotive Industry



Source: Thailand case from Maruhashi (1995) and Japan case from Smika (1991)

There were three major reasons for this cooperation. First, all these parts require very high technology. Second, a large amount of investment is required to cast or forge all compulsory items, because they require high-cost machinery and equipment. Third, scale economies were still difficult to achieve if each firm decided to produce independently. As a result, a unique procurement system was developed first in Thailand (Wattanasiritham 2000, p. 65). However, this situation may be changing

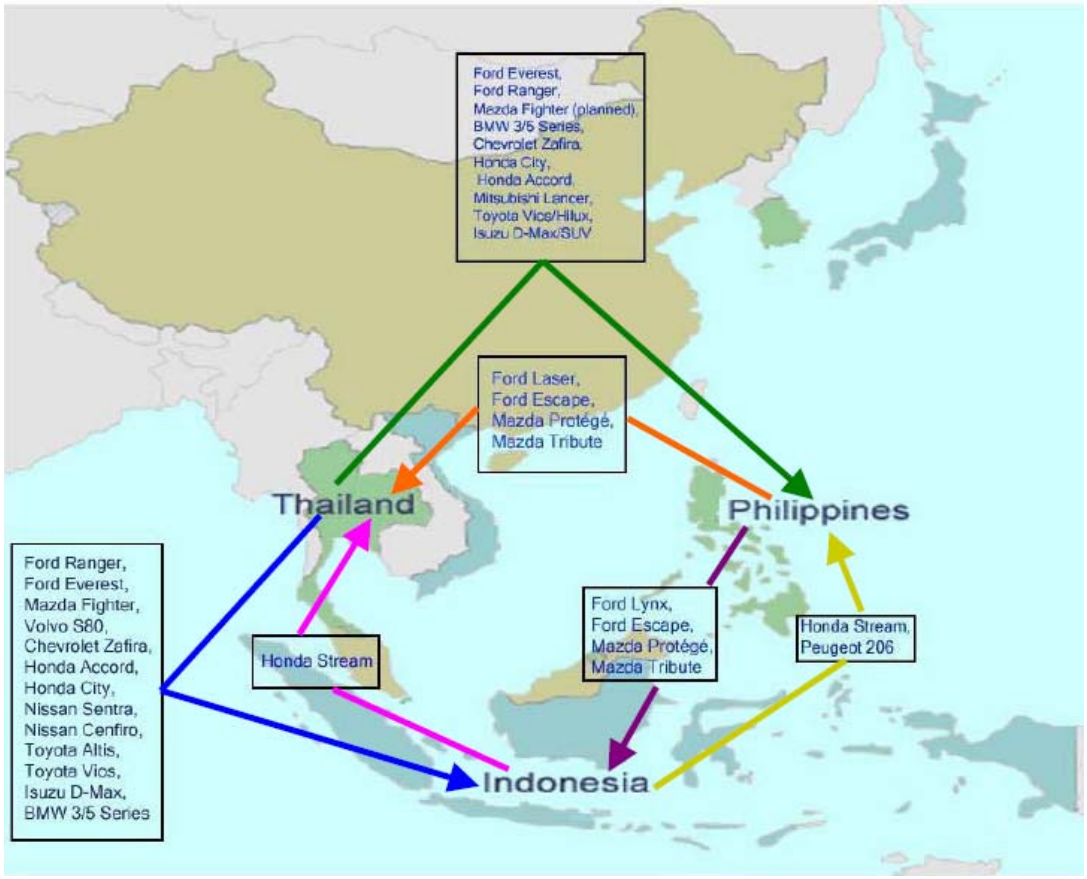
because of the export strategy of some major assemblers, such as Toyota and Isuzu. As production volume of each manufacturer grows, economies of scale might be achieved, and hence there would be less incentive to maintain cooperative relationship among these engine manufacturers.

Another milestone for Thailand's industrial policy was a shift from an import substitution toward export-orientation one. The export-oriented industrialization policy, proposed by a newly formed Industrial Policy Committee, received the cabinet's mandate in 1984, had automotive production as a primacy focus. The government worked hard in convincing the Japanese government and investors that it would definitely adopt the outward-oriented investment policy and avoided the nationalist policy against foreign investors. This shift was important because it help preparing to automotive industry for export production afterward. Most of the policies in the early 1980's were deliberated in the formal public-private cooperation committee (PPCC) before they were officially declared as the government policy. Mitsubishi and Nissan made decision early and started exported passenger cars from Thailand by the end of 1987 (Techakanont 2002, p. 47).

Since the 1990s, the world automobile industry has been facing increasingly global competition driven by excess capacity, trade liberalization, deregulation of trade and investment, and the revolution of information and communication technology (IT). Multinational firms view their operation as a global production network rather than as "stand-alone overseas investment projects" (Ernst and Kim 2002). Global competition became more dynamic and this made multinational assemblers reconsider their worldwide operations. In the case of automobiles, this phenomenon is clear in Southeast Asia, including Thailand, where Japanese firms dominate.

A recent trend resulting from such globalization was the consolidation of multinational firms' existing production network in this region (Figure 3). For example, Toyota uses Thailand as an export base for small-to-medium passenger cars and one-ton pickups, while Indonesia for SUV. Toyota exports vehicles to worldwide market. Mazda and Ford use the Philippines as production base for passenger cars, while Thailand's plant for pickup trucks. Honda manufactures and exports some models of passenger cars (Accord, Civic, and City) from Thailand while Honda Stream is produced and exported from Indonesia. These examples clearly indicate the presence of Thailand as a part of many assemblers' production network. Discussion above can thus confirm on importance of government policies and role of multinational firms in developing Thailand to become part of GPN.

Figure 3 Production and International Trade Network in Southeast Asia



Source: Kohpaiboon (2006), Figure 6,

3. The Automotive Clusters: Evolution, Characteristics and Benefits

Based on a recent work of Lecler (2002) and Techakanont (2002), this study will provide additional information on the industrial estate policy and the statistics on the automotive industry in the industrial estates. The main objective is to explain the evolution of clusters, their location and benefits of the industrial estates.

3.1 The emergence of industrial cluster in the eastern provinces

Perhaps the best way to understand the evolution of the Thai automotive production networks and the development of automotive clusters in the eastern region (which may be considered "the automotive belt" of Thailand) is to examine the sectoral share of gross regional products and the size of the automotive industry in the eastern region (defined as the eastern areas of Bangkok) and the six eastern provinces. Prior to 1990, manufacturing activities had been concentrated in Bangkok, because of location advantages such as an important sea-port and its capital city status. The chronic congestion problems in Bangkok, particularly congestion at its main port, and infrastructural bottlenecks had prompted the government to develop other potential areas for industrial sector.

The Board of Investment incentives were revised and granted privileges to firms according to their location in 3 General Industrial Zones (see Table 2). This investment incentive was the major driver of industrial decentralization towards the eastern provinces. Although there was a policy to develop the Eastern Seaboard (ESB) areas in the mid 1980s, it was not until the early 1990s that industrial activities began to spread to this region. As a consequence, the eastern region becomes the second largest manufacturing sector behind Bangkok. Industrial activities, in terms of Gross Regional Product (GRP), in these two regions increased significantly between 1995 and 2005 (see

Table 3). Manufacturing sector of the eastern region was the second highest, after the central region, and its manufacturing sector is also highly diversified. The largest sub-sector is the refined petroleum products, followed by the automotive, the petrochemical and the machinery sub-sectors, respectively.

Table 2 Investors' Privileges in accordance with BOI and Industrial Estates Authority of Thailand (IEAT) for location in 3 General Industrial Zones

	Zone 1	Zone 2	Zone 3
Corporate Income Taxes	100% exemption for 3 years	100% exemption for 7 years if location in IE	100% exemption for 8 years + 50% reduction for a further 5 years
Duties on Capital Goods (Machinery, parts etc.)	Pay 50%	Pay 50%	Free
Duties on imported raw material	Exemption for 1 year if exports at least 30%	Exemption for 1 year if exports at least 30%	5 year exemption if exports at least 30%; pay 25% for 5 years
VAT, Excise Tax, Surcharge (BOI), Import and Export Duty (IEAT)	Normal rates	Normal rates	Normal rates
Transportation, Electricity, Water	Not applicable	Normal rates	Double deduction from tax income for 10 years
Infrastructure Facilities	Not applicable	Not applicable	Deduction from taxable income 25%

Source : Lecler (2002), Table 2.2

Zone 1 = Bangkok (Bangplee IE, Lad Krabang IE), Samut Prakan (Bangpoo IE, Gemopolis IE), Samut Sakhon, Nakhon Pathom, Nonthaburi, Pathum Thani.

Zone 2 = Ayutthaya (Bangpa-In IE, Saha Rattana Nakorn IE), Chachoengsao (Gateway City IE, Wellgrow IE), Chonburi (Amata Nakhon IE, Chonburi Bo-Win IE, Pinthong IE). Special zone 3 privileges apply to Chonburi (Laem-Chabang IE), Ratchaburi (Ratchaburi IE), Saraburi (Saraburi IE).

Zone 3 = Rayong (Amata city IE, Eastern IE, Eastern Seaboard IE, Map-Ta-Phut IE, Padaeng IE, Thai Singapore 21 IE, Asia IE) Khon Kaen Mini IE, Northern Region IE, Pichit IE, Southern IE.

Table 3 Sectoral Share of GRP by Regions

(Percent)

Region	1995				2005			
	All	Agriculture	Industry	Services	All	Agriculture	Industry	Services
North	100	18.20	29.87	51.93	100	18.07	31.88	50.05
Northeast	100	20.69	24.13	55.18	100	18.45	24.21	57.34
Central	100	7.11	66.04	26.85	100	4.73	77.24	18.02
East	100	7.51	67.58	24.91	100	5.20	72.96	21.84
West	100	17.02	36.74	46.24	100	16.81	36.83	46.36
Bangkok and vicinities	100	1.00	44.86	54.15	100	1.31	45.57	53.12
South	100	33.17	23.13	43.70	100	33.18	22.62	44.20
Whole Kingdon	100	9.40	43.03	47.57	100	8.68	47.29	44.03

Source : National Economic and Social Development Board, GRP

Table 4 Value Added Share of Non-Agricultural Sector GRP by Regions

(Percent)

Sector/Year	year	North	Northeastern	Central	Eastern	West	Bangkok and vicinities	South	Whole Kingdom
Manufacturing	1995	22.77	15.18	62.36	65.29	32.65	36.72	22.87	37.64
	2005	30.83	21.26	76.29	70.16	33.10	40.85	24.70	45.34
Electricity	1995	2.69	2.50	4.55	4.00	3.49	2.60	3.19	2.97
	2005	3.24	3.24	3.65	5.08	7.96	2.92	4.36	3.67
Construction	1995	11.05	12.75	4.18	3.78	8.14	5.99	8.55	6.89
	2005	4.83	5.19	1.14	1.73	3.20	2.40	4.80	2.78
Wholesale and Retail	1995	24.88	30.89	11.64	9.85	23.41	18.95	22.78	19.38
	2005	20.08	26.90	6.20	6.43	19.10	16.61	19.07	15.33
Hotels and Restaurants	1995	2.16	2.17	0.49	2.32	1.94	5.37	4.68	3.96
	2005	2.30	1.75	0.43	1.70	3.13	5.34	9.02	3.87
Transport	1995	7.97	7.23	3.84	5.43	7.40	10.90	9.37	8.98
	2005	9.46	10.03	3.59	7.99	11.08	14.00	11.11	11.04
Financial	1995	13.79	12.43	5.98	5.18	11.22	14.12	11.15	12.01
	2005	12.31	12.34	3.98	3.28	9.38	9.15	10.45	8.29
Public Administration	1995	4.67	4.73	2.63	1.63	4.15	1.83	8.67	2.90
	2005	5.74	6.19	1.85	1.49	4.69	2.76	5.28	3.22
Education	1995	8.73	11.23	2.97	1.71	5.07	1.53	7.09	3.63
	2005	9.55	11.96	2.18	1.51	6.14	2.02	9.00	3.97
Other	1995	1.29	0.89	1.36	0.81	2.53	1.99	1.65	1.64
	2005	1.65	1.15	0.69	0.62	2.21	3.94	2.21	2.49
Total Non-agriculture	1995	100	100	100	100	100	100	100	100
	2005	100	100	100	100	100	100	100	100

Source : NESDB

This pattern can be considered as an evidence of benefits of agglomeration network. The manufacturing sector can function efficiently if there are adequate services, particularly transportation and financial services. The TDRI survey in 1998 also confirms that there was satisfactory level of social facilities for the workers in the eastern industrial estates (Poapongsakorn and Tangkitvanich 1999). The eastern and the

central areas have the largest manufacturing sector, and the necessary supply of supporting services. A number of industrial estates (IE) had been developed by government and private sector along the Eastern Seaboard areas and in the northern part of Bangkok. The location of those IEs, induced by industrial decentralization policy in the 1980s, was the critical factor for firms to locate in the same area, which enabled them to take advantage of the benefits of agglomeration.

3.2 Cluster roles and agglomeration of automotive industry in Thailand

During this early stage, in 1970s, automobile and auto parts producers located their plants in industrial estates in Bangkok (Bangchan, Ladkrabang IE) and the central area, such as Samut Prakan province (Samrong IE). It was the time that agglomeration of firms in automotive industry developed. This was due to the government policy to encourage foreign investors to locate in IEs. For example, Toyota, Nissan, Isuzu, and Hino opened their first plants in Samrong IE (Samut Prakan), Mitsubishi in Lad Krabang IE, and Mazda in Bangchan IE (Bangkok). Their suppliers were located nearby in order to minimize transportation costs. These IEs were the first IEs that the Thai government created to attract foreign firms to establish their production facilities. This was the first step of agglomeration of part suppliers in Thailand; however, the clusters were rather small at that time (Lecler 2002).

During the 1980s, the LCR had been revised and the requirements went beyond the assembly of automobiles. Policy makers imposed further restrictions such as the local sourcing of certain compulsory parts such as radiators, batteries, exhaust pipes, mufflers, tires and tubes, safety glass, drum brakes and disc brakes. Localization on diesel engines was imposed in 1989 at 20 percent and the localized ratio were set to increase to 70 percent in 1996. Because of this policy, the supporting industries in Thailand emerged and local firms were nurtured and subsequently went on to develop

their businesses. Nevertheless, the Thai government was quite flexible before enacting any regulation. Policy makers and assemblers normally discussed the possibility of increasing local content. In this way, Japanese carmakers could share their views with policy makers on the ratios for each part, to enable them to comply with changes in the LCR scheme (Siroros 1997).[3] As a result, from the latter half of the 1980s, the agglomeration of automotive firms in Bangkok and its vicinity (Samut Prakan and Pathum Thani) further increased.

In the 1980s, the Industrial Estate Authority of Thailand (IEAT) established regional IEs in the northern region and eastern provinces in line with rural area development objectives. This was because of the rapid expansion of manufacturing activities in Bangkok caused congestion problems and infrastructural bottlenecks. Highway and infrastructure were then developed, especially in the IEs. Moreover, the BOI began to provide differential tax incentives for promoted firms in three zones, with companies located in Zone 3 to receive the highest incentive of the three zones (see Table 2). Thus, new industrial and manufacturing projects were established in Zone 3, and many automobile and auto parts factories were set up.[4]

For the automobile industry, the IEs in the eastern provinces were quite successful in attracting car makers and part suppliers to agglomerate. In the 1990s, there was significant growth in automobile projects in Chonburi and Rayong because of the

[3] Though the assigned points, calculated using this formula, did not have a direct relationship with the value-added aspects of parts (given the Government's objective to reduce trade deficit), its clear definition and stated points made it much easier for assemblers to make localization plans (Techakanont and Terdudomtham 2004a).

[4] For more details about the explanation of industrial decentralization, see Poapongsakorn and Fuller (1996).

establishment of new IEs and incentives under the Eastern Seaboard Development Project. According to Lecler (2002), Japanese corporate investment became concentrated in Chonburi, with auto makers such as Mitsubishi and its suppliers in Laem Cha Bang IE, Denso, Siam Toyota, and other part makers in the Chonburi IE, while Western automakers (AAT, GM, and BMW) invested in Rayong (Eastern Seaboard IE), followed by western part suppliers such as Visteon, TRW, and Dana. Some Japanese part makers also invested in these IEs to supply parts to western manufacturers.

Geographically, the establishment of new car manufacturing factories has led to a change in the distribution of manufacturing activities over time. Before the 1990s, Japanese parts suppliers tended to locate in the central area, especially the Bangkok and Samut Prakan areas. Since the 1990s, there has been significant growth in newly established suppliers in the eastern provinces (see Table 5). However, if the distribution of firms in automotive-related companies is taken into consideration, Bangkok and Samut Prakan are still the most important locations (see Table 6). Nonetheless, recent expansion in production capacity by many assemblers, such as Isuzu, Mitsubishi, AAT, Toyota IMV project and Toyota's establishment of a third factory in Chachoengsao, it can be said that the eastern region of Thailand is becoming another major strategic location for Thailand automobile production. The agglomeration in this area can be explained by high-quality infrastructures (road, sea port, industrial estates), investment incentives, and its proximity to established supporting industries in the central part of Thailand (especially Bangkok and Samut Prakarn).

Table 5 Year of Establishment of Assemblers and Location

No.	Assembler	Year	Location
1	Nissan (Siam Motors)	1962	Samut Prakan
2	Toyota	1964	Samut Prakan
3	Hino	1966	Samut Prakan
4	Mitsubishi	1966	Bangkok (Lad Krabang)
5	Isuzu	1966	Samut Prakan
6	Mazda	1975	Bangkok (Bangchang)
1	Nissan (Siam Nissan Auto)	1977	Samut Prakan
7	Nissan Diesel	1987	Pathum Thani
8	Honda	1993	Bangkok (Minburi)
9	Mitsubishi	1992	Chonburi (Laem-ChaBang)
10	Toyota	1996	Chachoengsao (Gateway)
11	Honda	1996	Ayutthaya (Rojana)
12	Isuzu		Chachoengsao
13	Auto Alliance Thailand (Mazda/Ford)	1998	Rayong (Eastern Seabord)
14	General Motors	1998 (2000)	Rayong (Eastern Seabord)
15	BMW	2000	Rayong (Amata City)
16	Toyota	2007	Chachoengsao

Source : Lecler (2002), Table 2.4.

Table 6 Numbers of Automotive Companies in Thailand in 1999

Province	No. of companies	Share of companies
Bangkok	406	42%
Samut Prakan	188	20%
Pathum Thani	52	5%
Samut Sakon	45	5%
Nakhon Pathom	17	2%
Nonthaburi	13	1%
Central Thailand subtotal	721	75%
Chonburi	64	7%
Rayong	58	6%
Chachoengsao	30	3%
Eastern seaboard subtotal	152	16%
Ayutthaya	43	4%
Nakhon Ratchasima	17	2%
Others	25	3%
Others areas subtotal	85	9%
Total	958	100%

* Including non-production functions such as head office operations.

Source : Lecler (2002), Table 2.3.

* Including non-production functions such as head office operations.

Based on two important case studies, Toyota and Mitsubishi, Lecler (2002) found that the automakers' strategies in selecting new production locations would influence their suppliers to relocate or establish new plants in the same area. Both firms

chose the Eastern Seaboard area for their new plants in the 1990s; Toyota established its second plant at Gateway City IE in Chachoengsao, while Mitsubishi chose Laem Chabang IE in Chonburi. Such locations were selected for many reasons: investment incentives (because these areas are in Zone 3), their proximity to port facilities (Laem Chabang), the proximity to part suppliers that were established previously in old IEs such as Lad Krabang, Chonburi, or some firms located outside IEs but on the Bangna-Trad road which provides easy access to their facilities, the cheap price and availability of land for creating supplier parks, and an abundant workforce.

The two case studies confirm that assemblers have played important roles as *lead firms*. Their choice of location had a strong influence on suppliers to agglomerate around the assembling plant. This clearly shows the dynamic of an "agglomeration of firms in the new location" (Lecler 2002, p. 812). The location of major Japanese part makers in Table 7 is an evidence of the agglomeration of part suppliers in different location during each period. Before the 1990s, the parts suppliers were clustered in the central region of Thailand. Then, the new factories spread to the northern part of Bangkok and finally to the Eastern Seaboard area after the 1990s. This may be one reason that influences the decision of multinational car makers to choose Thailand, particularly the eastern region, as part of their global production network.

Table 7 Location of Major Japanese Parts Suppliers in Thailand

Location	1969	1970-79	1980-89	1990-95	1996-98	Total
Bangkok	3	6	6	9	8	32
Samut Prakan	4	7	11	4	4	30
Chonburi	-	1	1	12	6	20
Rayong	-	-	-	4	16	20
Pathum Thani	1	1	8	4	1	15
Chachoengsao	-	-	3	3	2	8
Ayutthaya	-	-	-	5	2	7
Others	-	-	2	3	6	11
Total	8	15	31	44	45	143

Source : Lecler (2002), Table 5**,** p. 808

3.3 Locations of automotive factories: Automotive belt in Thailand

The automotive industry is highly concentrated in a few provinces, particularly in the industrial estates in Bangkok and the eastern region of Thailand. These two regions have the largest number of industrial estates, 16 industrial estates in the ESB and 12 estates in the central region. According to statistics of IEAT, in 2006, there were in total 2,329 factories located in IEs, 95 percent of which were IE-based factories (49 percent in the eastern IEs and 46 percent in the central IEs). Consider automotive-related factories (both Non IEs-based and IE-based), Table 8 shows that most of the factories are in Bangkok and the eastern region. Bangkok has the largest number of automotive factories outside the IE, followed by the eastern region.[5] But the eastern

[5] Although there are more automotive factories outside the IEs, many of them are garage service operators and local parts suppliers. Most of the parts factories in the IEs are foreign owned and relatively larger than those outside the IEs.

region has the largest number of automotive plants in the IEs, followed by Bangkok. It should be noted that almost all automotive factories are located in only three regions: Bangkok, the eastern and the central regions. More than 90 percent of the establishments are concentrated in seven provinces: Bangkok, Samut Prakarn, the three eastern provinces (Chachoengsao, Chonburi, and Rayong) - and the two central provinces in the north of Bangkok (Pathum Thani and Ayutthaya).

Table 8 Number of Factories in and outside IEs by Regions

Region	Non-Industrial Estates (2005)		Industrial Estates (2006)	
	Total	Auto parts	Total	Auto parts
Bangkok & Metropolitan	50,510	1,203	859	123
Central	11,393	169	220	31
East	7,359	317	1,140	306
Northeast	41,163	42	1	0
South	9,823	14	22	0
North	15,021	22	87	3
Total	**135,269**	**1,767**	**2,329**	**463**

Source: Industrial Estate Authority of Thailand Department of Industrial Works

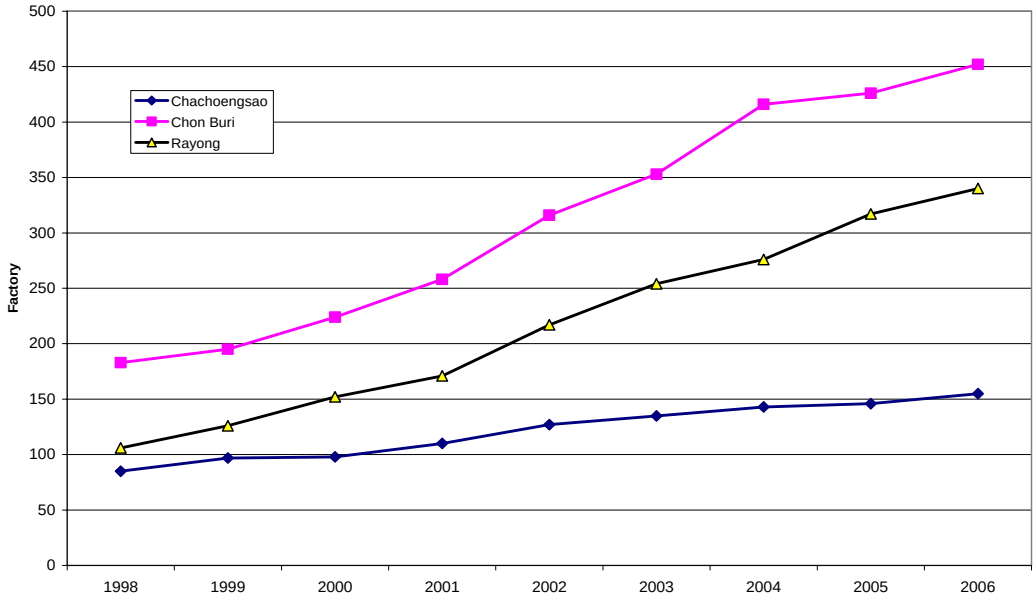
The increasing concentration of manufacturing sector in the central and ESB areas may be viewed as patterns of industrial clustering. Based on this information, a map of “the automotive belt” in Thailand can be created (see Figure 4). Most of the IEs and automotive plants outside the IEs tend to locate in the eastern areas of Bangkok (i.e. along the Bangna–Trad or eastern Highway), Samut Prakarn (a province to the east of Bangkok, Chachoengsao, Chonburi and Rayong. Since 1990s, a number of factories have been set up in Pathum Thani and Ayutthaya, which are to the north of Bangkok. For instance, Nissan Diesel factory is in Pathum Thani, while Honda has an assembly plant in Ayutthaya.

Figure 4 Map of the Automotive Belt in Thailand

Source: By the author

Since the completion of the ESB Development Plan I in 1990, industrialization in the Eastern Seaboard area (ESB, which includes Chonburi, Chachoengsao and Rayong) has been accelerated. Between 1998 and 2006, the number of factories in IE increased on average 19 percent per year (see Figure 5). Among the three provinces, Chonburi has the largest number of factories both inside and outside the IEs, followed by Rayong. This phenomenon, aside from the fact that the ESB area is now a major cluster of automotive factories, implies that there are strong agglomeration economies that attract all kinds of manufacturing establishments to locate in the same cluster.

Figure 5 Number of Factory in Industrial Estates in ESB Area



Source: Industrial Estate Authority of Thailand

3.4 Location choice and benefits from locating in the IEs

To explain the location choice and benefit of current location of autopart firms, this study conducted an enterprise survey in January-February 2007. Questionnaires were sent to 250 auto parts enterprises in five provinces: Bangkok, Samut Prakan, Chachoengsoa, Chonburi and Rayong. The autoparts companies that are members or affiliated with Toyota, AAT and Mitsubishi were also identified and provided with the questionnaires. The response rate was quite low despite the researchers' telephone follow-up. Only 18 questionnaires were received. They were asked about advantage and disadvantage of their current location(s),[6] either in IEs or outside IEs. Although the response rate is low, their answer can reveal some interesting results.

[6] Each supplier was asked to provide information about 2 most important factories and to answer about advantage and disadvantage of the current location(s). From 18 suppliers that replied questionnaires, 7 firms answered that they have two factories, while 11 firms have one factory.

The survey result on factors affecting the firms' choice of location is consistent with TDRI survey (Poapongsakorn and Tangkitvanich 1999). The most important reasons for companies' locating their factories in the current IEs are, in descending order, good public utilities services convenient transportation, and proximity to customers For companies outside the IEs, there are 8 firms answering this question, the most important factors are their original site, proximity to customers and convenient transportation as well as good public utilities services. However, in response to the question: "What is the biggest advantage of the existing location?", almost 56 percent of the companies reported that it was the low cost of transporting products to the customers, while 22 percent claimed that it was the cost of transporting raw materials. The main weakness of the current location is, not surprisingly, the public utility problems (31 percent), traffic congestion (25 percent), followed by inconvenience of transportation and electricity problems (12.5 percent), see Table 9.

Table 9 Advantage and Disadvantage of Current Location

Question	Percent
1. Why did you locate your plant in the IE? (13 out of 18 firms)	
- public utilities	42.8
- good transportation	21.4
- close to the customers	21.4
- easy to recruit labor	7.1
- cheap land	7.1
2. For non-IE factories : what is the most important reason to choose the current location? (8 out of 18 firms)	
- Original site	50.0
- close to the customers	25.0
- good transportation	12.5
- public utilities	12.5
3. What is the advantage of the existing location?	
- low cost of transporting products to the customers	55.6
- low cost of transportion for raw materials	22.2
- Eary to recruit skill labor	5.6
- Others	16.7
4. What is the major weakness of the existing location?	
- public utilities problem	31.3
- traffic congestion	25.0
- inconventient transportation	12.5
- electricity blackout/problems	12.5
- labor problems	6.3
- Other	12.5

Source: Survey of Autoparts firms in the ESB area during January and February 2007

The major benefits from locating in the IEs are, therefore, the low cost of transporting parts, raw materials and products (64.7 percent), lower communication costs (41 percent), and economies of scale from larger volume of production (23.5 percent). Surprisingly, very few companies reported the benefits of lower labor costs and lower machine repair costs. However, the distance between the firms and their suppliers has either no effect on the firms' production (27.8 percent) or only minor impact (61 percent). This finding suggests that supplier network tend to be scatter in a wider area.

Table 10 Benefits from Current Location

Question	Percent
1. What are benefits deriving from current location?	
o Communication costs	
(a) lower	41.2
(b) same	11.8
(c) uncertain	47.1
o trasportation costs of parts and materials	
(a) lower	64.7
(b) same	0.0
(c) uncertain	35.3
o Labor cost	
(a) lower	5.9
(b) same	35.3
(c) uncertain	58.8
o Cost of reparing machines	
(a) lower	5.9
(b) same	52.9
(c) uncertain	41.2
o Economies of scale	
(a) lower	23.5
(b) same	17.6
(c) uncertain	58.8
2. Does the location of the suppliers and your factory affect your production?	
(a) no effect beacause of proximity	0
(b) long distance, but no effect	27.8
(c) delaying production schedule	11.1
(d) minor impact on production	61.1

Source: Survey of Autoparts firms in the ESB area during January and February 2007

In sum, the choice of location of sample firms is largely influenced by the costs of transportation and communication. For factories outside IEs, they do not want to move from their original location because of its proximity to the customers. Proximity to customer seems to be more important than to locate close to suppliers. Based on

several field surveys with Thai suppliers, this author observes that part suppliers will consider establishing a new factory in the same industrial estate as their customer, if order volume is high enough. However, this observation is clear for suppliers that produce bulky parts, such as stamping or casting parts, where transportation costs are high and customer's requirements on delivery schedule are frequent and strict (i.e., just-in-time delivery). However, research findings found no labor and machine repair service benefits from locating the factory in the IEs. One possible explanation is that the agglomeration economies arise from the cluster of companies in a larger geographic area than one IE, which is along the "automotive belt" as shown in Figure 4. However, locating the factory in the same IE as the main customer certainly increases the factory's production, which in turn leads to economies of scale and reduces the amount of time in delivering the products to customers.

4. Characteristics and Benefits of Production Network in Thailand

This part will discuss the characteristics of the production network in Thailand and its benefits. Multinational automobile assemblers changed their investment and production strategies and viewed their global production as a network rather than as stand-alone investment projects, thus, they need to improve their operation and management to be leaner and their supply chain network more consolidated. According to Ernst (2004, p. 93), a global production network (GPN) covers both intra-firm and inter-firm transaction and forms of coordination, hence, it increases the need for knowledge sharing among member in the network. Specifically, this will expand inter-firm linkages and create the need for technology transfer, at both 'intra' and 'inter-firm' levels. Locally based suppliers would have new opportunities to upgrade their capabilities. This section will report research findings on the characteristics of GPN from both assemblers' and suppliers' point of view.

4.1 Characteristics of GPN of some automakers in Thailand

Thailand's automotive industry has been gradually developed and ultimately become a part of GPN of many assemblers. Earlier discussion made clear that this is possible because of the well-developed supporting industries in Thailand thanks to government policies and Japanese firms in creating supplier networks, which enables assemblers to launch new models for both domestic and export markets.[7] A comparison of the export of automobiles from Thailand in 1997 and 2005 shows that Mitsubishi was the largest exporter, followed by Auto Alliance, Toyota, General Motors, and Isuzu (see Table 11). However, in 2005, Toyota became the largest exporter, with around 150,000 units of its new Hilux VIGO, a new model of pickup trucks. VIGO is a part of the Innovative International Multi-purpose Vehicle (IMV) project that was launched in 2004. Mitsubishi was the second largest exporter, followed by Auto Alliance (Thailand), General Motors and Isuzu, and Auto Alliance Thailand (AAT), see Table 11 and Table 12. The Thai automobile industry has become an export-oriented one, and has been integrated into part of the global production networks of a number of models by many world manufacturers.

[7] Since 2000, many new models of pickup trucks were firstly launched in Thailand, such as Ford (new Ranger), Mitsubishi (Triton), Isuzu (D-Max), Mazda (BT-50), Nissan (Frontier), and Toyota (Hilux VIGO under the IMV project),.

Table 11 Exports of Automobiles during 1997 and 2005

	1997	1998	1999	2000	2002	2004	2005
Mitsubishi Motor	40,072	63,797	60,986	63,541	75,581	88,033	88,152
GM	-	-	-	6,283	33,276	45,248	83,836
AAT	-	1,213	42,785	49,977	47,333	73,842	77,551
Toyota	1,563	1,819	12,151	16,031	11,882	52,682	151,824
Honda	570	2,910	6,361	6,183	10,371	44,564	45,216
Isuzu	-	20	516	5,689	1,348	26,954	42,938
Nissan	-	-	1,912	4,590	555	301	829
Others	-	48	380	541	n.a.	n.a.	n.a.
Total	42,205	69,807	125,091	152,835	180,553	332,053	440,715

Source: (1) Mori (2002;

(2) Prachachart Thurakij, February 10-12, 2003;

(3) Thai Automotive Industry Association.

Table 12 Production Capacity and Export Plan from Thailand in 2006

Company	Year of announcement to use Thailand as export base	Annual production capacity (units)	Export in 2005	Main export market
Toyota	2002	450,000	151,824	Asia, Australia, New Zealand, Ocenea
Mitsubishi	1990s	208,000	88,152	EU, Africa, Middle East
Auto Alliance (Ford & Mazda)	1996	155,000	77,551	EU , Australia, New Zealand, Ocenea
Isuzu	2001	200,000	42,938	Middle East and EU
GM		160,000	83,836	Australia, New Zealand, and Asia

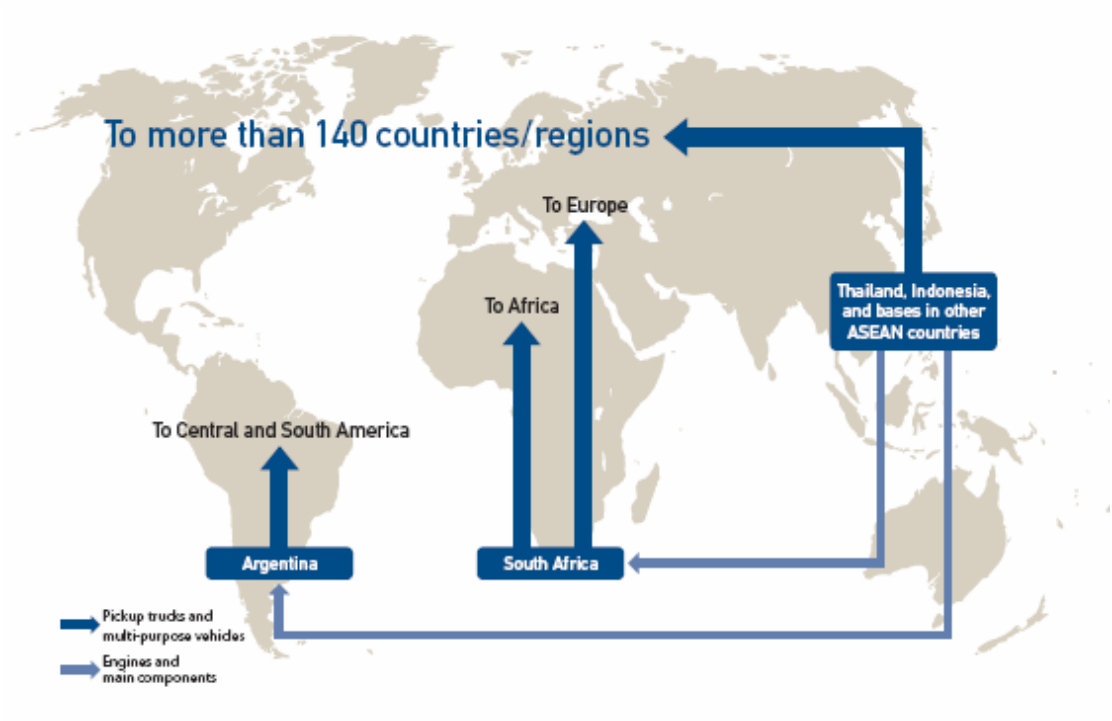
Source: Thai Automotive Industry Association

According to Techakanont (forthcoming), the Toyota's IMV project is perhaps the best example of a GPN because the production started almost at the same time at its four main production bases of Thailand, Indonesia, Argentina and South Africa, which will supply vehicles to countries in Asia, Europe, Africa, Oceania, Latin America and the Middle East.[8] In addition, the project also includes the production of some major components in various locations, such as diesel engines in Thailand, gasoline engines in

[8] Although other assemblers also uses Thailand as an export base, see footnote 7 on page 3, their operation is different from Toyota in the sense that they concentrate their production network in Thailand but do not assemble the same model in other countries.

Indonesia and manual transmissions in the Philippines and India, and their supply to the countries charged with vehicle production (See Figure 6). An important implication of this development is that it is necessary for assemblers, the lead firm of its network, to create and diffuse their organizational 'routines' to their suppliers.[9]

Figure 6 Toyota's Production and Supply Network (IMV project)



Source: Annual Report 2005, Toyota Motor Corporation

4.2 Nature of knowledge-sharing in production networks

There are two important characteristics of the emerging GPN, i.e., intensified global sourcing and adoption of the modular system (Sturgeon and Lester 2004). One of the consequences of the global sourcing and modular system is that suppliers, particularly those producing larger and bulky modules, need to develop closer

[9] Techakanont (forthcoming) report the roles of a global production network on technology transfer in Thailand. In that study, the roles of Toyota Motor Thailand in transferring management technology and knowledge-sharing activities among Toyota suppliers were reported.

relationship with or have to locate their plants near those of the automakers. Proximity to customer can help shorten shipping time and reduce transportation costs, this is particular true for ones producing bulky parts and most large modules that are more likely to be sequenced in the assemble line. The other consequence of the adoption of module systems is that many first-tier suppliers have begun to acquire or enter into the joint ventures with other related parts businesses as well as to establish new plants in the emerging markets. Such moves enable them to gain the ability to deliver parts and modules just-in time on a global basis.

The above description explains why there were American and European first-tier suppliers, for example, Delphi, Visteon, Lear, Johnson Controls, TRW, and Bosch, who followed their customers and set up new plants in Thailand in the early 1990s. To understand the characteristics of the automobile GPN in Thailand, the author tries to compare production network of two cases, Toyota Motor Thailand (TMT) and Auto Alliance Thailand (AAT). Toyota Motor Thailand has 144 first-tier parts suppliers[10], while Auto Alliance of Thailand (AAT), a joint venture between Ford and Mazda, had 112 suppliers in 2003.

The increasing utilization of global sourcing and module system in the motor vehicle industry has important implications for the Thai parts suppliers. After the economic crisis in 1997-98, a large number of Thai parts suppliers went bankrupt and some were taken over by the foreign suppliers. Consequently, there are now only a dozen of Thai firms which are the first-tier suppliers capable of providing some module systems for the automakers. The module systems they produce are mostly labor-

[10] It has another 526 suppliers of intermediate inputs (i.e., raw materials) and service providers (such as logistics).

intensive parts, such as seat, cockpit module and trim. The Thai suppliers do not yet have technical capability to assemble the knowledge intensive components such as ignition, chassis electrical system, drive train system (i.e., engine, axles and transmission), rolling chassis, etc. Most of them are the second- and third-tier suppliers and supply raw materials to first-tier firms.

To enhance the productivity of their suppliers, both TMT and AAT provide technical assistance to suppliers. They both have invested in some important activities that help prepare its supply chain in Thailand up to the standards of the GPN. For example, Toyota began to introduce a Toyota Cooperation Club (TCC) and established a training center in 1982, when there were around 25-35 supplier members and the number increased to 109 members (as first-tier suppliers) in 2007.[11] The scattering of suppliers over the dispersed areas, Toyota cannot simply adopt its famous just-in time (Kanban) system which requires a prompt delivery of parts at the assembly parts. With 144 suppliers trying to deliver parts at specified schedules, there were serious congestion at the assembly plants. Toyota, therefore, has adopted the milk-run system for parts delivery. The Samrong plant, which is the pick-up truck assembly, can accommodate 360 trips per day, while the Gateway passenger-car plant receives 275 trips per day. An executive at Toyota claims that the performance of the Thai assembly plants is now as high as 98%-99% of the production plan.

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[11] At Toyota, suppliers are divided into several types; including parts suppliers (or first-tier suppliers, which is the focus of this study), facility tools, packing material, direct material (e.g., paint, oil), indirect material (for use in manufacturing site), and logistic (transportation service for parts and material). According to TCC Annual Book, in 2007, there were 145 TCC members. However, this number also includes other types of suppliers, see also footnote 10.

Toyota can achieve such high productivity because it has been successful in diffusing its efficient production management system, called Toyota Production System, to suppliers. Toyota's production network facilitates knowledge sharing among suppliers in the network, similar to what they did in the US. Dyer and Nobeoka (2000) identified three institutional innovations in the creation of the network and in facilitating inter-firm knowledge sharing, i.e., the supplier association, the knowledge transfer consultants and the small-group learning teams (or jishuken). Information obtained from interviews with Toyota executives confirms that Toyota Thailand has also adopted similar institutions in Thailand. The Toyota Cooperation Club (TCC) is responsible for the sharing of explicit knowledge. Not all suppliers can join and benefit from the club, however. Only suppliers who have maintained long-term relationship with Toyota will be admitted as the TCC members. For new comers, they have to have annual sales more than 50 million baht and must be recommended by Toyota Motor Thailand, Siam Toyota Manufacturing, or the TCC.

After becoming the TCC members, suppliers can receive consulting service on the Toyota Production System. This is a free-of-charge service but suppliers' top management must show their commitment in learning and improving their production management capabilities. Then, Toyota will send well-trained consultants to transfer tacit know-how regarding the Toyota Production System at the suppliers' plants. But knowledge transfer is not the only objective. The consultants are in fact acting at "the catalysts for creating a norm of reciprocal knowledge sharing, and a feeling of indebtedness and openness within the supplier network" (Dyer and Nobeoka, 2000). There are now a dozen of consultation projects in 2007. Currently the Thai staff is also responsible for providing the TPS training for the parts companies in other ASEAN countries.

The third institution is to carefully organize the small learning teams to maximize the willingness and the ability of suppliers to learn and to share the specific tacit knowledge with each other team members. The institution is very effective in developing strong ties among team members through the formal "core group" activities and informal social networks. This practice is quite unique for the case of Toyota. Other Japanese firms seem to have less active supplier development activities. The American (GM and Ford) and European (BMW) carmakers do not have similar institution of knowledge sharing. They provide necessary technical support required by the new car models.[12] Based on this observation, it can be argue that the Japanese automakers tend to rely extensively on multi-tiered supplier networks and have established a long-term relationship based on trust and rent sharing. Thus, in Sturgeon (2000) terminology, the Japanese supplier networks are more captive than the American car maker network.

4.3 Characteristics and benefits of production networks at the firm level

Based on questionnaire survey results, this section will discuss the benefits of automotive production network at the firm level. As explained earlier, only 18 questionnaires out of 250 sets were returned. Despite a small number of sample firms, their answer can represent some aspects of characteristics of production network, because they are currently supplying parts to major assemblers in Thailand.[13]

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[12] However, based on our interviews with Thai suppliers, AAT was more open and willing to provide technical support to independent Thai suppliers, who had no parent company to support, in the new model.

[13] Questionnaires result reveals that most all firms answered that they are a part in a GPN or a regional production network of some automobile assemblers or part suppliers. Because many of them did not disclose their partner, it is difficult to identify which network they are participating.

Some salient characteristics of the production network of the sample parts suppliers in our survey are shown in Table **13**. First, the main factor leading to their recruitment as partners in a production network is that the company produces quality products and reliability (38.9 percent), and trust based upon long-term business relationship with customers (22.2 percent). Second, 15 firms out of 18 (83.3 percent) of the sample firms are members of auto clubs set up by the auto makers or members of the parts producers association. Only 16.6 percent of the sample is neither members of the auto club nor members of the parts producer associations.

From 15 firms that answered being a member of assembler association, 12 firms are member of TCC, thus, research findings can reflect how Toyota utilize 'supplier association' or 'supplier club' as a method to share and diffuse knowledge among members. All suppliers stated that they received training; 11 out of 15 firms (83.3 percent) state that they receive regular training from the auto clubs, while 4 firms (26.7 percent) receive occasional training services. Interestingly, 3 firms reported that they had received on-site technical advice from automobile assemblers. A Thai supplier disclosed that, in 2006, Toyota had sent 2 experts to give technical advice at its factory for one month, and the result was very satisfying. This company can improve productivity as well as product engineering capabilities (such as VA/VE and engineering change). This fact thus confirms the willingness to transfer technology or to diffuse knowledge to supplier in its network, i.e., the Toyota Cooperation Club.

Suppliers can also benefit from study group activity and had visited the best practice factories to learn how to solve their production and other related problems more efficiently (86.7 percent) and to exchange knowledge about production, design and production processes with other club members (86.7 percent). If they could find ways to improve productivity or to reduce defect rate, they must share their findings with other

network members. If not, the measure would be expulsion from the club. However, because knowledge exchange is valuable for suppliers, especially the chance to receive consulting service or technical assistance from assemblers, they recognize the need to be reciprocity.

Table 13 **Some Salient Characteristics of Automotive Production Network**

Question	Percent
1. What are reasons that your company being selected as part of the network	
- Product quality and reliability	38.9
- Trust and long-term relation	22.2
- High potential production	5.5
- Efficient management system	5.5
- Not answer	27.7
2. Is there an auto club or parts association established by the car makers?	
- Yes, and the firm is a member (15 out of 18 firms)	83.3
- Yes, but the firm is not a member (1 out of 18 firms)	5.5
- Not answer (2 out of 18 firms)	11.1
3. Does the auto-maker regularly organize production-related activities with you (parts suppliers)? (15 firms that join association)	
- Training (a) regularly	73.3
(b) occasionally	26.7
- Sending advisors (a) yes	16.6
(b) no	83.3
- Executive meeting (a) yes	100
(b) no	0
- Visiting the best practice factories	
(a) Yes	86.7
(b) No	13.3
- Exchanging knowledge on production, design, process	
(a) Yes	85.7
(b) no	14.3
4. Penalty for free rider members	
(a) no free rider	40
(b) do not know	60

Source : Survey of the Auto parts Firms in the ESB area during January and February 2007

Finally, all firms reported that auto makers regularly hold executive meetings. Executive meeting activity is a forum for discussing future business as well as a mean for assemblers to observe and evaluate top management's commitment on knowledge sharing activities. These characteristics are consistent with a study of the knowledge network of Toyota in the U.S. (Dyer and Nobeoka 2000). This implies that the Toyota production system has been adopted both in developed and developing countries.

Table 14 identifies the benefits from the production network. As reported earlier, only 15 out of 18 firms belong to automobile production network. In Table 14, the major benefits from being a production network member are technical advice from auto makers (73.3 percent) and economies of scale from a larger volume of business (66.7 percent). This explains why the network membership can significantly enhance the productivity of 33 percent of the sample firms, and significantly reduce the defect rates in most companies (33 percent). The other benefits are improvement in product engineering capabilities, i.e., VA/VE activities (20 percent); and slight improvement in engineering changes and design capacity (46.7 percent). In sum, being part of assemblers' production network offers good opportunities for suppliers to learn and improve their technological levels. Findings of this study are consistent with the work of Techakanont and Terdudomtham (2004b) that described the existence of "inter-firm technology transfer" in the Thai automobile industry. Part suppliers can learn new technology or production method from having business relationship with assemblers. However, the present study gives a new look to the topic to technology transfer, i.e., knowledge-sharing among suppliers at the network level. This topic deserves further investigation.

Table 14 Benefits from being Part of Automotive Production Network

Benefits to suppliers (15 out of 18 firms answer these questions)		**Percent**
1 Benefits from being part of the auto network (multiple answer is allowed)		
	technical assistance from auto-makers	86.6
	economies of scale	73.3
	more clients/market diversification	26.6
2 How does the network membership affect you as the parts supplier?		
o	Productivity	
	(a) increase significantly	33.3
	(b) increase slightly	33.3
	(c) no impact	20.0
	(d) uncertain	13.3
o	Product engineering, VA,VE	
	(a) increase significantly	20.0
	(b) increase slightly	46.7
	(c) no impact	20.0
	(d) uncertain	13.3
o	Engineering change and design capacity	
	(a) increase significantly	13.3
	(b) increase slightly	53.3
	(c) no impact	26.7
	(d) uncertain	6.7
o	Production problem solving capability	
	(a) increase significantly	20.0
	(b) increase slightly	6.7
	(c) no impact	33.3
	(d) uncertain	40.0
o	Defect rate	
	(a) decrease significantly	33.3
	(b) decrease slightly	13.3
	(c) no impact	40.0
	(d) uncertain	13.3

Source: Survey of the Auto parts Firms in the ESB area during January and February 2007

5. Conclusion

This paper analyzed the factors that have influenced the decisions of major car makers to choose Thailand as one of the global production bases for commercial cars. It describes the development of the Thai automotive industry, which emphasizes the role

of government policies and the strategies of the auto makers. In retrospect, the Thai policy makers have always been flexible and aligned with the interests of multinational car makers. Admittedly, Thailand has been fortunate that the past bureaucrat-dominated governments took a series of gradual steps to liberalize the automotive industry at the right time.

One important aspect of the industrial development is the role of automotive industrial clusters. This paper tackles this question different from existing literature by focusing on the influence of government policies on the production and location strategies of assemblers (especially, Japanese firms), which explains the agglomeration of firms in some areas. This study argues that Thai government administrations have always given high priority to the development of the automotive industry in the industrial estates since the early stages of the import substitution industrialization regime. However, an important milestone occurred in the mid 1980s when Thailand began to plan and develop the Eastern Seaboard areas, which are now the most important locations of the automotive industry. The government also provided a wide range of social services such as education, health care and the development of recreational facilities in the coastal areas.

As a result, the eastern provinces were rapidly industrialized in the past 20 years. The manufacturing sector has become the largest sector in the eastern region. Such agglomeration of industries has attracted more and more factories to locate in industrial estates in Chachoengsao, Chonburi and Rayong. This explains why the main reason that companies choose to locate their factories in the IEs is convenience of transportation and communication. The main benefit is proximity to their customers. However there seem to be no agglomeration economies for firms outside the IEs especially in terms of labor recruitment and machine repair costs from being in the industrial estate per se.

This study also offers new findings about the economy-wide and the firm-level benefits that locally-based suppliers enjoy from being a partner in global automotive production networks. The firm-level benefits are based on an establishment survey of the parts suppliers in five provinces which are Thailand's "automotive belt". Although the number of questionnaires returned was small, the findings are interesting and consistent with previous studies on the benefits of the adoption of the Japanese production system in developed countries. The major benefits are improvement in productivity, economies of scale from being integrated into the world market, and a reduced defect rate resulting from knowledge-sharing within the network.

Some limitations remain with this study. This paper neither deals with the issue of the weaknesses of Thai parts suppliers, most of which have been downgraded from first–tier to second- and third-tier suppliers after the 1997-98 economic crisis, nor does it discuss the issue of knowledge development and innovation of firms in the IEs. Also, the small number of questionnaires returned made it difficult to perform statistical analyses and hypothesis testing. However, some important implications can be drawn from this study. First, the liberalization policies that are market-friendly and aligned with the interests of private companies are important conditions to attract long-term foreign direct investment. Second, the sound macroeconomic policy and active infrastructural development are critical factors affecting the cost of doing business. The active development of the industrial estates—both state-run and privately owned – can bring about huge agglomeration economies which are a critical factor affecting the companies' choice of factory location. More studies are needed to expand our understanding of the complexity of clustering and global production networking.

References

Abdulsomad, Kamaruding. (1999), "Promoting Industrial and Technological Development under Contrasting Industrial Policies: The Automobile Industries in Malaysia and Thailand", pp. 274-300, In *Industrial Technology Development in Malaysia.* Edited by Jomo K. S., Greg Felker, and Rajah Rasiah. London: Routledge.

Buranathanang, Noppadol. (1995), "Multinational Enterprises, Global Division of Labor and Intra-firm Trade: A Case Study of the Thai Automobile Industry". Ph.D. Dissertation, Faculty of Economics, Kyoto University.

Busser, Rogier. (1999) "Changes in Organization and Behavior of Japanese Enterprises in Thailand: Japanese Direct Investment and the Formation of Networks in the Automotive and Electronics Industry", Ph.D. dissertation Universiteit Leiden.

Charoenporn, Peera. (2001). "Automotive Part Procurement System in Thailand: A Comparison of American and Japanese Companies", Unpublished Master Thesis, Faculty of Economics, Thammasat University, Bangkok: Thailand.

Doner, Richard F. (1991), *Driving a Bargain: Automobile Industrialization and Japanese Firms in Southeast Asia* Berkeley: University of California Press.

Doner, Richard F. (1995) "Weak State-Strong Country? The Thai Automobile Case", In The Political Economic of East Asia Vol. 3 Singapore, Indonesia, Malaysia, The Philippines, and Thailand Volume II. Edited by John Rarenhill (1995) Great Britain: Cambridge University Press.

Dyer, J.H. (1996) "Specialized Supplier networks and a Source of Competitive Advantage: Evidence from the Auto Industry." *Strategic Management Journal* Vol. 17, pp. 271-291.

Dyer, J.H. and Nobeoka, K. (2000). "Creating and managing a high-performance knowledge-sharing network: the Toyota case. *Strategic Management Journal* Vol. 21, pp. 345-367

Ernst, Dieter and Linsu Kim (2002), "Global Production Network, Knowledge Diffusion, and Local Capability Formation." *Research Policy* 31, pp. 1417-1429.

Ernst, Dieter. (2004). "Global Production Networks in East Asia's Electronics Industry and Upgrading Prospects in Malaysia," pp. 89-157, in *Global Production Networking and Technological Change in East Asia* Edited by Shahid Yusuf, M. Anjum Altaf, and Kaoru Nabeshima, Washington; World Bank.

Guerrieri, P. and C. Pietrobelli. (2006), "Old and new Forms of Clustering and Production Networks in Changing Technological Regimes: Contrasting Evidence from Taiwan and Italy," *Science, Technology & Society*. 11(1): 9-38.

Higashi, Shigeki (1995). “The Automotive Industry in Thailand: From protective Promotion to Liberalization”, In *The Automotive Industry in Asia: The Great Leap Forward?* Tokyo: IDE Spot Survey, Institute of Developing Economies.

Kohpaiboon, Archanun. (2005). “Industrialization in Thailand: MNEs and Global Integration.” PhD Thesis, Division of Economics, The Australian National University.

Kohpaiboon, Archanun. (2006). “Thai Automotive Industry: Multinational Enterprises and Global Integration.” Report submitted for World Bank Office (Thailand).

Lecler, Y. (2002), “The Cluster Role in the Development of the Thai Car Industry,” *International Journal of Urban and Regional Research.* 26(4): 799-814.

Liker, J.K. and Y. Wu. (2000), “Japanese Automakers, U.S. Suppliers and Supply-Chain Superiority,” *Sloan Management Review* Fall: 81-93.

Markusen, A. (1996), “Sticky Places in Slippery Space: A Typology of Industrial Districts”, *Economic Geography.* 72: 293-313.

Maruhashi, Hiroko. (1995) “Japanese Subcontracting System in Thailand: A Case Study of the Thai Automobile Industry”, Unpublished Master Thesis, Faculty of Economics, Thammasat University, Bangkok: Thailand.

Mori, Minako (2002). “The New Strategies of Vehicle Assemblers in Thailand and the Response of Parts Manufacturers”, *Pacific Business and Industries RIM (Japan Research Institute),* 2(4): 27-33.

Poapongsakorn, Nipon (1997), *“ASEAN Automotive Industry in the Emerging Economic Integration Environment: Corporate Strategies and Government Policies”*, Paper prepare for the Second Expert Meeting on the Interregional Project on “Transnational Corporations and Industrial Restricting in Development Countries”, TDRI: Thailand Development Research Institute.

Poapongsakorn, Nipon and Belinda Fuller. (1996), “Industrial Location Policy in Thailand Industrial Decentralization or Industrial Sprawl?” *A paper presented at the AT-10 Researchers Meeting. Tokyo Club Foundation for Global Studies,* Nomura Research institute, Japan. February 1-2.

Poapongsakorn, Nipon and Somkiat Tangkitvanich. (1999), “Post Evaluation for Eastern Seaboard Development Program.” Submitted to The Overseas Economic Cooperation Fund (OECF), Thailand: Thailand Development Research Institute (TDRI)

Porter, Michael. (1990), *The Competitive Advantage of Nation* New York: Free Press.

Siroros, Pacharee (1997), *Thai State and Business in Automobile industry*, Bangkok: Thammasat University Press. (in Thai)

Smitka, M.J. (1991), *Competitive Ties: Subcontracting in the Japanese Automotive Industry.* New York: Columbia University Press.

Sturgeon, T.J. and R.K. Lesler. (2004), "The New Global Supply-Base: New Challenges for Local Suppliers in East Asia." pp. 35-87, in *Global Production Networking and Technological Change in East Asia* Edited by Shahid Yusuf, M. Anjum Altaf, and Kaoru Nabeshima, Washington; World Bank.

Sturgeon, Timothy J. (2000), "How Do We Define Value Chains and Production Networks?" *MIT IPC Globalization Working Paper* 00-010, MIT.

Takayasu, Ken'ichi and Minako Mori. (2004). "The Global Strategies of Japanese vehicle Assemblers and the Implications for the Thai Automobile Industry," pp. 210-253, in *Global Production Networking and Technological Change in East Asia* Edited by Shahid Yusuf, M. Anjum Altaf, and Kaoru Nabeshima, Washington; World Bank.

Techakanont, Kriengkrai (2002), *A Study on Inter-firm Technology Transfer in the Thai Automobile Industry*, Unpublished Ph.D. Dissertation, Graduate School for International Development and Cooperation, Hiroshima University: Japan

Techakanont, Kriengkrai and Thamavit Terdudomtham (2004a), "Historical Development of Supporting Industries: A Perspective from Thailand". *Annual Bulletin of the Institute for Industrial Research of Obirin University No. 22*, pp. 27-73.

Techakanont, Kriengkrai and Thamavit Terdudomtham. (2004b) "Evolution of Inter-firm Technology Transfer and Technological Capability Formation of Local Parts Firms in the Thai Automobile Industry", *Journal of Technology Innovation* Vol. 12, No. 2, pp. 151-183.

Techakanont, Kriengkrai. (forthcoming). "Roles of Japanese Assemblers in Transferring Engineering and Production Management Capabilities to Production Network in Thailand." Working paper series of Faculty of Economics, Thammasat University.

Wattanasiritham, Supawan. (2000). "The Impact of Local Content Requirement Policy on the Development of Thai Auto-Parts Industry: Case of Engine Industry", Unpublished Master Thesis, Graduate School for International Development and Cooperation, Hiroshima University, Japan.

Yusuf, Shahid. (2004). "Competitiveness through Technological Advances under Global Production Networking," pp. 1-34, in *Global Production Networking and Technological Change in East Asia* Edited by Shahid Yusuf, M. Anjum Altaf, and Kaoru Nabeshima, Washington: The World Bank