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Stakes in Common:
The APEC's Technological Co-operation

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1. Method of Survey and Historical Overview

This report mainly depends on two field surveys; a field survey in Thailand and Malaysia (from 28th January to 14th February 1998), and another author's field survey in Thailand (from October 1995 to March 1996). During the field survey this year, which was funded by the Institute of Developing Economies (IDE), the author visited seventeen factories and a few government agencies including the Department of Industrial Promotion (DIP) in Bangkok, and the Malaysian Industrial Development Authority (MIDA) in Kuala Lumpur. The author's major interest lies in technology transfer from Japan to Asia, especially in supporting industries, i.e. auto parts and electrical parts industries. As for the number of supporting industries in Thailand and its statistical analysis, the author used *The Directory of Supporting Industries in Thailand 1993* by SEAMICO. The result of the statistical analysis is attached in Table-1 and Table-2.

The author depended on historical overviews. Examples are Akamatsu Kaname, Yamanaka Tokutaro, Thorstein Vebeln, David Landes and Nathan Rosenberg. Standard Western economics (neo-classical economics) was found to be useless for the study of technology transfer in Asia[1]. Standard economics tends to neglect Asian cultures and states[2]. It also neglects technology because of a lack of suitable information sources concerning Asian technology transfer. A critical point is the fact that Western FDI has helped Asian

[1] Amsden, Alice H., *Asia's Next Giant: South Korea and Late Industrialization*, (New York: Oxford University Press, 1989)

[2] 吉田和男『日本経営システムの改革』読売新聞社 1995年

industrialisation far less than Japanese FDI, as has been claimed by Kojima Kiyoshi and Ozawa Terutomo. The fact that Western FDI did not help Asian industrialisation seems to be due to ignorance of the mechanisms of Asian technology transfer.

Before the war, Akamatsu Kaname studied the development pattern of Asian economies and developed the so-called theory of flying-geese pattern economic development[3]. After the war, the first issue of IDE's English periodical in 1962 introduced Akamatsu's theory[4]. In this article, Akamatsu claimed that trade with the West facilitated the development of Japan and other Asian (Chinese) economies. To our regret, however, WWII occurred and obstructed Asian development because the interests of the West and Asia clashed in Asia as Howe has described in his 1996 book.

> Another influential viewpoint was that of the great trade theorist Akamatsu and this was much more positive. It acknowledged the immediate trade problem but suggested that full development of the East Asia regional economy, with Japan as its advanced core, would enable the flying geese pattern of development to spread Japanese industrialisation to China and the rest of the region. This of course could be accomplished only by the expulsion of the western powers, who naturally wished to avoid the painful readjustments that Asian economic success would entail and therefore sought to impede the development of Japan-centred Asia and impose the trade and industrialisation patterns that suited them. (Howe, 1996[5])

As described above, the essence of Akamatsu's theory lies in the co-operation between developed and developing countries, which would inevitably facilitate the industrialisation of late-comers. The then Japanese leaders who contributed to reconstruction of the post-war economy considered that Japan, with few natural resources, could survive only in peaceful co-operation with the West and Asia. The underlying goal behind IDE's establishment in 1960 was to facilitate better understanding of neighbouring developing

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[3] 赤松要「我国羊毛工業品の貿易趨勢」『商業経済論叢』第13巻上 1935年; 赤松要「吾国経済発展の綜合弁証法」『商業経済論叢』第15巻 1937年7月; 赤松要「東亜貿易の歴史的類型」東京商科大学東亜経済研究所編『東亜経済研究年報　第一輯』日本評論社 1942年

[4] Akamatsu, Kaname, "A historical pattern of economic growth in developing countries", *The Developing Economies*, (March-August, pp. 3-25, 1962)

[5] Howe, Christopher, *The Origins of Japanese Trade Supremacy*, (London: Hurst & Company, 1996)

countries. In that sense, the role of the IDE corresponds to that of Mantetsu Toa Keizai Chosakyoku[6] or Tokyo Shoka Daigaku Keizai Kenkyusho[7] before the war. After the war, the IDE's contribution to the development of Asian study has been great.

As Akamatsu pointed out, late-comers catch-up with developed countries through borrowing[8]. The British government once prohibited the emigration of craftsmen and the export of machines in a vain attempt to protect its domestic textile industries. Recognizing the inevitable course of the flying geese development of Asian countries, the Japanese government did not prohibit Japanese FDI into Asia and even began to positively promote it in the 1960s. This encouragement was strengthened especially after the Plaza conference in 1985 as the Maekawa report shows.

The development of industries in the neighboring countries replaced some of the industries in Japan following the due course presented by Akamatsu. At first, Japanese textile industries declined, followed by the decline of machine industries as shown in Tables in Appendix A. In 1990 the number of machine industries and number of people engaged reached a peak (Table-13 and Table-14). Since then, the numbers have been declining. In contrast, the number of establishments in Asia is increasing rapidly. It should be noted that decline in Japan and growth in Asia are directly linked through trade and investment. Furthermore, the linkage is assisted by the concept of flying geese. The fact is clearly observed in the Maekawa Report and the government policy to support FDI.

2. Expansion of Supporting Industries in Thailand

Through trade and investment, i.e., through technology transfer, the shift of Japanese industries into Asia was observed firstly into NIEs, and then into Asean countries. By industry, the shift began first in textile industries and then progressed to machine industries. As Santikarn wrote, "Since 1960, direct foreign investment [in textile industries] in the form of

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[6] Manchurian Railway East Asian Economic Research Bureau; **満鉄東亜経済調査局**

[7] Hitotsubashi University East Asian Economic Research Institute; **東京商科大学東亜経済研究所**

[8] Landes, David, *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*, (Cambridge: Cambridge University Press, 1969)

joint ventures [with Japan] has become the most important means of technology transfer." [9] In the case of machine industries, assembly operation of electrical industries were the first to develop, encouraged by government policy for investment promotion through the Board of Investment (BOI). In the 1960s and 70s, some FDI also appeared in general electrical industries and automobile assembly. Ford, Benz, Fiat, and Sanyo Universal and National Thai (Matsushita) before 1961, Philips Electrical and Nissan in 1962, Toyota and Kan Yon Electric (Mitsubishi) in 1964 are typical examples. These were followed by other major and supporting industries.

Table-1 shows the number of cases of investment in the supporting industries up till 1993. Until 1984 more investment appeared in the auto parts industries than the electrical parts industry, 163 in auto parts and 93 in electrical parts, due to the government policy concerning local content. However, since 1985 more investment has appeared in electrical parts industries, 92 in auto parts and 217 in electrical parts, due to a policy change in which the government allowed even full ownership in FDI for export.

The classification of FDI in supporting industries shows that more investment came from Japan and Asia than from the West. In other words, the major technology provider to Thailand was Japan and Asia, not the West. Western investment tended to concentrate in petroleum, mining, food processing, chemicals, pharmaceuticals and toiletries as Suehiro showed. This is in sharp contrast with Japanese FDI in textiles, metal, steels, automobiles, auto parts, electricals, and machinery (Table-3).

As explained above, the development of textile industries and supporting industries in Thailand was supported mainly by Japanese and Asian FDI, not by Western. It is true that, after the war, Western automobile companies began CKD in Thailand first. However, when they were requested to transfer technology and to use more local content, they withdrew from the country. Meanwhile, Japanese automobile companies remained in Thailand. That inevitably assisted technological development in Thailand. Today's high level Thai automobile industry was facilitated and maintained by Japanese automobile industries. The same thing

[9] Santikarn, Mingsarn, *Technology Transfer, a Case Study,* (Singapore: Singapore University Press, 1981)

happened in India. Initial technology transfer in the automobile industry was done by the West albeit on a lower level. Latterly, more complete technology transfer at Murty began in the 1980s through co-operation with Suzuki.

Table-1 Three Main Group of the Supporting Industries (Years of establishment)

Industry	-59	60-69	70-79	80-84	85-89	90-93	(-84)	(85-93)	(-93)	n.a.	Total
1. Auto parts industry	5	36	78	44	62	30	163	92	255	77	332
2. Electrical parts industry	5	22	35	31	125	92	93	217	310	49	359
Sub-total	10	58	113	75	187	122	256	309	565	126	691
(Ratio)	1.8	10.3	20.0	13.3	33.1	21.6	45.3	54.7	100.0		
3. General parts industry	5	58	99	63	123	113	225	236	461	47	508
Total	15	116	212	138	310	235	481	545	1,026	173	1,199

Source: SEAMICO, 1993. By the author's data processing. The same applicable to below tables Table B-1, 2, 3 and 4 are re-classified and calculated by the author. The figures of the year 1993 are only partially included.

Table-2 Supporting Industries by Majority-ownership Country

	Thailand	Foreign Country						-(50%+50%)	Total
		Japan	Asia	West		na.	Sub-total		
-1984	406	13	5	24	42	37	485	8	481
		(31.0)	(11.9)	(57.1)	(100.0)				
1985-1993	329	106	65	35	206	16	551	12	545
		(51.5)	(31.6)	(17.0)	(100.0)				
Year na.	87	4	15	4	23	63	173		173
Sub-total	822	123	85	63	271	116	1,209		
-(50% +50%)	9	4	4	3	11			20	
Total									1,199

Source: SEAMICO, 1993. The country classification is by majority ownership. The 10 firms of 50%+ 50% ownership are double counted as majority. Therefore, sub-total (1,209) includes the 10 cases of double counting and hence requires a deduction of 10.

Table-3 Industrial Distribution of MNCs in Thailand (1980)

	USA	Europe	Japan	Total
Petroleum	12	5		17
Mining	1	2		3
Food	7	2		9
Chemicals	8	6	6	20
Pharmaceuticals	4	7		11
Soap, toiletries	8	1		9
Textiles	1		7	8
Metals, steels	3	2	7	12
Automobiles, auto parts, tyres	4	1	18	23
Electricals, machinery	6	4	17	27
Others	3	1		4
Total	57	31	55	143

Source: Suehiro, 1989: 198, 318-22. Figures show the number of direct investments by the World Top 85 MNCs in Thailand from 1932 to 1980, surveyed by Suehiro.

Table-4 Oligopolistic Market in Thailand

Industry	Oligopoly	US	Europe	Japan	Thailand	Share(%)
Oil refinery	O	x	x		x	99
Tin smelting	O		x			99
Condensed milk	O		x x		x	83
Condiments	O			x	x	96
Soft drink	O	x			x x	93
Sanitary paper	O	x x			x	81
Detergents	O	x	x	x		89
Polyester staple	O		x	x		100
Tyres	O	x x		x		94
Sheet glass	O			x	x	100
Tin plate	O			x		100
TV sets	O			x x x		44
Refrigerators	O			x x x		55
Ics	O	x x				91
Passenger cars	O			x x		64
Trucks(ten wheels)	O			x x x		94
Motor cycles	O			x x	x	95

Source: Suehiro, 1989: 205. Modified by the author.

Notes: "O" on the left hand side = the market share over 90% by top three firms, "O" in the middle = over 80%, "O" on the right = less than 80%.

x denotes the distribution of oligopolistic firms (top three or less).

A chief economist at Morgan Stanley Japan and Gregory Clerk[10] requested that Japanese companies should stop investment in unprofitable projects and stop competition for expansion. They proposed that, in order to improve this wrong decision making in Japanese management, strict corporate governance and a system of checks and balances should be introduced. However, they do not understand that latecomers had to struggle for survival. The struggling behaviour facilitated the industrialisation of Asian countries after the war. If only businesses with higher profit rates were allowed to remain and unprofitable businesses were forced to withdraw as Ford and GM did in Thailand, how could Thailand have possibly continued with industrialisation. If we consider the present situation of many small and medium scale industries (SMEs) in Asia and Japan, many of them are in loss. Neo-classical economists may simply say that they have to disappear. However, they have a right to struggle for survival. Government regulations and protection in Japan are part of Japanese culture and will facilitate Asian economic development through the flying geese model.

3. Interview Surveys in Thailand and Malaysia on Technology Transfer

In machine industries, the industrial shift occurred first in assembly processes. The range of technology transfer was then extended to engineering processes (upper stream processes). It is a well-known fact that the industrial shift from developed to less-developed needs not only the introduction of machines and materials but also human technology transfer from developed to less-developed.

Technology has multiple meanings. Technology covers production management, sales management, financial management, labor management and production technology (product technology and process technology). Production technology itself is also multifaceted as shown in Chart 1, 2 and 3. Hence, technology transfer is carried out in many ways, from simple products or processes to complicated ones, from operation technology to development and design technology (Chart 3). As shown in Table-5, the author has classified production technology into ten categories; operation, maintenance, QC, production

[10] Comments in a TV program "Hodo 2001" on Channel 8, 7:30-9:00, 15th March, 1998.

management (or operational technologies), process improvement (kaizen), moulds/dies and jigs development, equipment development (or improvement technologies), new technology, design technology, and R&D for new products (or creative technologies). Levels of technology in eleven Thai firms and six Malaysian firms were surveyed by the author through discussion with managing directors (in some case they are called president).

Chart 1 Production Technology

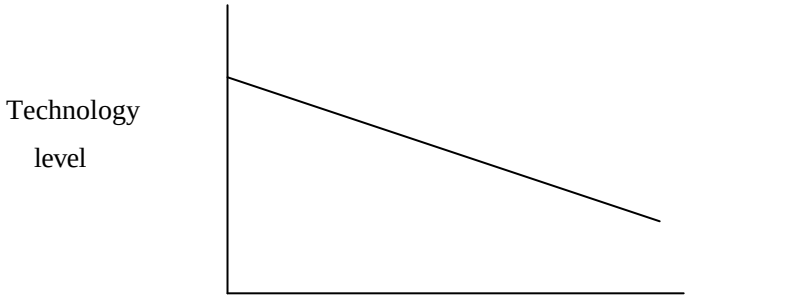


Chart 2 Technology Transfer in Different Products

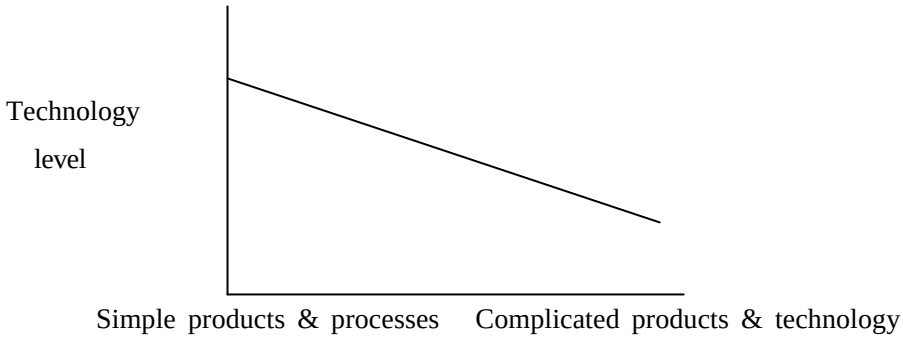
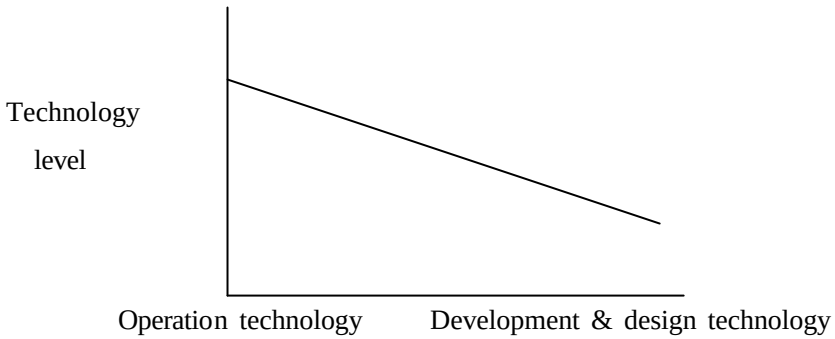


Chart 3 Technology Transfer in One Product



Source: Author

In interviews, the following eight questions were asked (see Appendix B):

1. Company profile: year of start-up, capital amount and capital shares by country, yearly sales, export ratio, a brief history of the company
2. Number of workers: workers in production, experienced workers, inexperienced workers, workers in sales and administration, number of foreign expatriates
3. Technical training in Japan and foreign experts/trainers: turn-over, number of trained workers in Japan
4. Origin of purchased parts and materials
5. Parts and components which are difficult to purchase in Thailand and the cause of the difficulty
6. Manufacturing processes assigned to local suppliers or OEM
7. Measuring technology transfer in ten categories of technology
8. Degree of staff localization

Table-5 Three Strata and Ten Categories of Technology

3 strata of technology	10 categories of technology	
(i) Operational technologies	1	Operation
	2	Maintenance
	3	QC
	4	Production control
(ii) Improvement technologies	5	Minor process improvement (kaizen)
	6	Development of dies and jigs
	7	Improvement of machines
(iii) Creative technologies	8	Process design technology
	9	Designing of parts and products
	10	R & D of new products

Source: Fransman, 1984: 10; Ogawa, 1993a: 304-7; 1993b: 36-7; Nikkei Sangyo Shohi Kenkyusho, 1992; etc.

Question No. 7 and No. 8 are concerned about technology transfer. No. 7 concerned the level of technology or technology transfer for 10 categories of technology shown in Table-5. The standard for the scoring is shown in Table-6. In addition, the level of staff localisation was assessed in Question No. 8.

Question No. 7.

How far has technology transfer been completed for each of the 10 categories below? Please evaluate using grades from 0 to 5. 0 refers to the level of no

technology before the start-up and point-5 refers to completed technology transfer in which local staff reach the same level as foreign experts.

Table-6 Standard for the Grading of Technology

Grading	Japanese and the Western subsidiary firms (Learning degree)	Thai firms (Combination of learning degree & sophistication degree measured by markets)
5	Nearly finished the learning of technology	Excellent, comparable to those of industrialized countries' leading firms
4	Reached a considerable level but still needs more efforts	Very good, comparable to industrialized countries' average firms or to leading firms (including foreign firms) in Thailand
3	Learned half of the technology	Good, better than the average Thai firms
2	On the first stage of learning	The average Thai firms, the low-end local market
1	A minimum level of technology	Very low, unacceptable to markets
0	No technology	No technology

Source: The author; The standard for the local firm (TDRI, 1989: 3-31; Sumeth, 1992: 44)

Question No. 8.

Who really handles each of the following jobs, local staff or foreigners?

A. Foreigners (1-point)
B. Foreigners with assistance from local staff (2-points)
C. Local staff with assistance from foreigners (3-points)
D. Local staff (4-points)
E. No plan to localise (0-point)

The author interviewed 17 manufacturers on technology transfer. By industrial type, 17 manufacturers include one automobile assembler, nine auto parts manufacturers, one air-conditioner and six electrical parts manufacturers. By country, 11 manufacturers are located in Thailand and six are in Malaysia. By ownership, two Thai firms are fully Thai-owned; other two have a Thai-majority; three Thai firms and three Malaysian firms are fully owned by Japanese. The remaining seven firms are joint ventures with a Japanese-majority. The details are shown in Table-7.

Table-7 Seventeen Surveyed Firms in Thailand and Malaysia in 1998

Name	Start-up	Capital	in mil.	Local capital	Japanese capital	Emp.	Exp.	Products and processes
1	1988	182	Baht	0	100	626	12	Assembly of feeders, sorters,
2	1989	135	Baht	51	49	340	20	Mould and dies for cars
3	1963	500	Baht	100	0	4800	4	Injection and assembly of plastic wares
4	1991	1300	Baht	0	100	776	23	Air-conditioners
5	1990	372	Baht	46	54	215	7	Mould and dies for cars
6	1984	834	Baht	46	54	3550	40	Car assembly
7	1987	220	Baht	30	70	3900	50	Metal press, injection and assembly of VCR parts, etc.
8	1974	117	Baht	66	34	371	5	Stamping and assembly of steel wheels
9	1989	250	Baht	100	0	461	2	Nuts and bolts for construction, automobiles, heat treatment
10	1989	898	Baht	19	71	213	7	Press and assembly of auto parts
11	1966	4	Baht	0	100	280	6	Nuts and bolts for automobiles
12	1994	6	Ringit	0	100	148	2	Press, injection and assembly of car audio parts
13	1990	27	Ringit	8	92	800	7	Press, injection and assembly of HDD parts, VCR parts, etc.
14	1991	2	Ringit	31	69	260	2	Steel shafts for printers, copiers
15	1989	15	Ringit	49	51	308	3	Micro electrical capacitors
16	1990	10	Ringit	0	100	650	6	Press, electroplating and assembly of HDD parts
17	1989	40	Ringit	0	100	1700	22	Assembly of power supplies, transformers, cashiers and facsimiles

Source: Author's survey in January and February 1998

Note: Emp. = Number of employees including expatriates Exp. = Number of expatriates

4. Level of Technology Transfer

As explained above, the author asked two questions concerning technology transfer; "No. 7, level of technology (or technology transfer)" and "No. 8, staff localisation".

(1) Level of Technology

On average, interviewees are not satisfied with the present level of technology. An exception was observed at an automobile assembler (F-6), which began its operation in 1984 and, at present, has 3550 employees. The firm gave the highest scores of 5-points to six categories excluding "maintenance" and three "creative technologies". The majority capital share in this firm is owned by a Japanese automobile assembler and managed by 40 Japanese expatriates. Automobiles are branded as Japanese cars. The assembling firm is considered to have acquired a minimum level of "operational" and "improvement" technologies. Nevertheless, complete technology transfer of "creative technologies" has not yet been done because investment in R&D costs too much and the market share is so small to cover the expenditure (F-6).

Among Asian countries, only Korean and Malaysian automobile assemblers have enough size of the market share for R&D. A parts manufacturer for VCR , CRT, HDD, etc. also gave comparatively high scores (F-7). At this firm, 5-points were given to three categories; "QC", "production management" and "improvement of dies and jigs". This firm began its operation in 1987 and, at present, 3900 workers including 50 Japanese expatriates are employed. The other four firms (F-3, F-4, F-15, F-16) each gave 5-points to "operation", "QC" or " improvement of dies and jigs". Scores given by other firms were 4-points or less.

As a result, average scores ranged from 3.8-points to 0.9-point; the highest to "operation" (3.8) and the lowest to "R&D for new products" (0.9). Concerning "operation", the average score was 3.8 because no firms scored less than 3-points including two at 5-points. These figures show that these firms and their staff are capable enough but have not reached the level of Japanese firms, even in daily operation.

As for "QC", the average score was 3.7-points, next to "operation". This means local staff understand the importance of QC and advanced QC systems have already been introduced. In the case of these local firms, most of the products were supplied to customers such as Toyota, Mitsubishi, Canon, Sharp, Sony, Sanyo, Matsushita, etc. Consequently, suppliers are requested to practice very strict quality standards.

Delivery time is also important. The unsatisfactory score of 3.4-points for "production management" demonstrates that local firms still have difficulty in meeting deadlines. The score of 3.3-points for "maintenance" shows that these firms still have to rely on outside experts for the maintenance of machines. Especially in case of trouble with CNC machines, they have to rely on outside experts including the staff at the Japanese plant, which is often the model for overseas plants.

As for "improvement technologies" which include "minor process improvement (kaizen)", "improvement of dies and jigs" and "improvement of machines", scores ranged from 3.5-points to 2.9-points. Parts manufacturers necessarily use quite a large number of moulds, dies and jigs to process their products. The maintenance and improvement of moulds, dies and jigs are indispensable. Consequently, it seems that most firms put a considerable weight on dies and jigs. Probably this is the reason for a high average score of 3.5-point for "improvement of dies and jigs". Other improvement technologies are still low because "kaizen", "improvement of machines", "process design technology" require more accumulation of experience and basic knowledge in products and production processes. The average length of operation of 17 firms is ten years and only three among these 17 firms have a history of more than 10 years. It is no doubt that they have to rely on foreign companies or foreign experts. It seems to be an acceptable theoretical hypothesis that, the longer the firm operates and the more experience it accumulates, the higher the level of technology the firm will demonstrate in the absence of other factors obstructing the learning process of the firm.

Table-8 Level of Technology Transfer

	At the time of Start-up										In 1997-98									
No.	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	1	1	1	1	1	1	1	1	0	0	3	3	3	3	3	3	3	3	0	0
2	1	2	0	0	0	1	1	1	1	0	3	4	2	2	2	3	2	2	2	1
3	na	na	na	na	na	na	na	na	na	na	5	2	4	2	3	3	3	0	0	0
4	1	1	4	1	1	1	1	1	0	0	4	3	5	3	3	3	3	3	1	1
5	2	1	2	2	2	2	2	2	1	1	3	2	4	4	3	4	3	3	3	2
6	3	3	2	2	2	1	2	0	0	0	5	4	5	5	5	5	5	3	3	2
7	1	1	1	1	1	1	1	0	0	0	4	4	5	5	4	5	4	0	0	0
8	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
9	3	3	2	2	2	3	3	3	3	2	3	3	3	3	3	4	3	4	3	3
10	0	0	0	0	0	0	0	0	0	0	3	3	2	2	1	1	2	1	1	0
11	2	1	2	2	1	1	0	0	0	0	4	3	4	4	3	3	0	1	1	0
12	2	1	2	1	0	2	2	0	0	0	4	3	3	3	2	3	3	3	2	1
13	4	3	3	2	1	0	0	0	0	0	4	4	3	3	2	2	2	1	0	0
14	2	2	2	2	2	1	0	0	0	0	4	4	4	4	4	4	4	3	0	0
15	2	2	2	1	1	2	1	1	0	0	4	4	5	4	4	4	3	3	0	0
16	1	1	3	1	0	0	0	0	0	0	4	4	4	4	4	5	3	3	2	3
17	na	na	na	na	na	na	Na	na	na	na	na	na	na	na	na	na	na	na	na	na
Av.	1.8	1.6	1.9	1.3	1.0	1.1	1.0	0.6	0.4	0.2	3.8	3.3	3.7	3.4	3.1	3.5	2.9	2.2	1.2	0.9

Note: The figures on the top columns from 1 to 10 correspond to the figures in Table-5 and Av. refers to the average figures of 17 firms.

(2) Staff localisation

On average Western firms send fewer expatriates than do Japanese firms. At the same time, it is also widely believed, especially among the Asian intelligentsia, that the lower number of foreign expatriates proves a quick technology transfer in Western firms. They often claim that Japanese firms maintain so many expatriates for such a long time that local staff are not allowed to learn technology and not provided a chance to manage subsidiary firms. What follows is a comment by a MIDA officer whom I visited to collect information about FDI in Malaysia.

Table-9 Staff Localisation

	At the time of Start-up										In 1997-98									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	2	2	2	2	2	2	2	2	0	0	3	3	3	3	3	3	3	3	1	1
2	3	3	1	1	1	1	2	1	2	1	4	3	2	3	2	3	3	1	3	1
3	4	4	4	4	4	4	4	4	4	4	4	4	3	4	3	1	3	1	1	1
4	2	2	2	2	2	2	2	2	0	0	4	3	2	4	3	4	3	3	1	1
5	2	3	2	2	2	2	1	2	2	2	2	3	3	3	3	3	1	3	3	3
6	3	3	3	3	3	3	3	3	3	0	3	3	3	3	3	3	3	3	3	0
7	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	3	1	1	1
8	1	1	1	1	1	1	1	1	1	1	3	3	3	3	4	4	4	4	4	1
9	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4	4	4	4	4	4
10	1	1	1	1	1	1	1	1	1	1	3	3	3	2	2	2	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	3	2	3	2	2	2	2	2	2	2
12	1	2	2	2	1	2	2	2	1	1	4	4	3	3	2	3	3	2	2	2
13	2	1	2	2	1	1	1	0	1	0	4	3	3	4	2	2	2	0	2	0
14	1	1	1	1	1	1	1	1	1	1	3	3	4	3	3	3	3	1	1	1
15	2	2	1	2	2	2	2	1	1	1	4	4	3	4	3	4	3	2	1	1
16	1	1	1	1	1	1	1	1	1	1	3	4	4	4	3	3	3	2	1	1
17	na	na	na	na	na	Na	na	na	na	na	na	na	na	na	na	Na	na	na	na	na
Av.	1.9	2.0	1.8	1.9	1.8	1.8	1.8	1.7	1.5	1.2	3.4	3.3	3.0	3.2	2.8	2.9	2.8	2.1	1.9	1.3

Note: The figures on the top columns from 1 to 10 correspond to the figures in Table-5 and Av. refers to the average figures of 17 firms.

The comparison between Western and Eastern subsidiary companies

(a) Capital ratio

Western companies are willing to transfer technology and prefer joint ventures. Among them, large companies want majority shares, while SMEs for the domestic market want minority shares. In contrast, Eastern (Japanese and Taiwanese) companies want full ownership and don't transfer technology.

(b) Senior managers

In Western subsidiaries, CEOs are Malaysians in many cases. In Eastern

subsidiaries, CEOs are Japanese with some exceptions like Matsushita.

(c) The number of expatriates

Western subsidiaries try to minimize the number of expatriates and the maximum number is two. In contrast, Eastern subsidiaries tend to maximize the number of expatriates.

(Mr. Phang Ah Tong, MIDA, interviewed by author, 10th February 1998)

As quoted above, it seems that there is a gap between Western and Eastern (or Japanese) subsidiary firms in capital ratio, in the number of senior managers and in the number of expatriates. Concerning the capital ratio, the author agrees with Mr. Phang's point that Western large corporations prefer majority ownership. The reason for the majority ownership is to guarantee the success and profit.[11] Eastern firms are latecomers and happy with entry into the market. Therefore, Eastern firms, or latecomers, don't care so much. On the other hand, big corporations have already established a system to maintain a profit, i.e. a way to monopolise the market. For them, privilege is the most important matter, not competition. They don't want to compete. That will explain why GM and Ford withdrew from Thailand when their privileges were lost in the late 1970s. Japanese automobile firms remained and struggled even after they lost privilege and protection[12].

The next issue is the number of expatriates and senior managers. As the author once examined[13], it is true that Western subsidiary firms send fewer expatriates and tend to employ local senior managers. However, it is doubtful that a smaller number of expatriates equals faster technology transfer. Technology transfer involves training. Japanese firms tend to train the staff from the outset. Their typical training method is OJT. OJT needs trainers, i.e. Japanese expatriates. In contrast, Western firms tend to employ educated or trained staff, minimising inside training. Western firms depend on manuals, while Japanese firms depend on

[11] Suehiro's survey shows that most Western monopolistic firms in Thailand enjoy full ownership in petroleum, chemical, automobile, electric, computer, etc. Quoted in the Author's thesis, *The Spread of the Japanese Type Production System into Asia, the Case of Auto and Electrical Parts Industries in Thailand*, (SOAS, University of London, March 1996, p. 149)

[12] Author's thesis, p. 290.

[13] Appendix B in Author's thesis, pp.. 328-9. Western firms send 1.4 expatriates and Japanese firms 6.0 expatriates on average.

OJT, not manuals.

In addition, Japanese subsidiary firms have a language problem with management. In Western firms the management language is probably English. But, in Japanese subsidiary firms, the management language is Japanese or the local language. Therefore, educated Asians are not happy with the Japanese average expatriate who is unable to speak English. From the viewpoint of technology transfer, it is not easy to decide which is better, to send fewer expatriates, or more. The author believes that technology transfer needs training and training needs expatriates. Manuals alone will not suffice.

Due to the efforts of training, local staff will learn technology to maintain production; at first only "operational technologies", and then more difficult technologies such as "improvement technologies" or "creative technologies". Finally, they will become independent. Question No. 8 aimed to examine this issue.

As mentioned, two firms (F-3 and F-9) are fully Thai-owned. Nevertheless, F-3 employs four Japanese and F-9 employs two Japanese, partly under a technology license with Japanese firms and partly on individual contracts. In either case, Japanese experts are wanted because Thai firms lack technologies to supply Japanese customers. For example, F-3 supplies Japanese customers with auto parts, electrical parts or OA parts, using moulds provided by customers. F-3 is not yet capable of designing or making moulds. From the viewpoint of Japanese standards, neither firm is able to improve production processes or machines in use. In either case, the answer to Question No. 8 or "the staff localisation" is A, B, C or E (1, 2, 3 or 0-point or foreigners' involvement), not D (4-point or local staff). The meaning of A, B, C, D and E is explained in the section 3. (Also see the questionnaires in Appendix B).

On average, the survey shows that in "operational technologies" local staff are in charge, with or without foreign assistance. That brought the answer average to somewhere between 3 and 4 points, closer to 3-points (i.e. with assistance). Above all, "QC" and "production management" are supported by foreign assistance. As for "improvement technologies", figures ranged between 2-points and 3-points, very close to 3-points. This shows that, on average, local staff are in charge of these technologies with foreign assistance.

Exceptions are F-3, F-8 and F-9. F-3 (plastic injection) answered 1-point, which means moulds are provided and maintained by foreign customers. F-8 (steel wheel) and F-9 (nuts and bolts for construction) answered 4-points, which means moulds and dies are made and maintained by local staff without foreign assistance. Both cases need lower quality standards. Hence, no assistance, or vice versa. Concerning "creative technologies", most answers ranged from 0-point to 3-points, excluding F-8 and F-9. This shows that generally speaking "creative technologies" are carried out by foreign experts in co-operation with counterparts in Japan, or carried out wholly in Japan (0-point).

5. Clues for Success

Although many economists in the West and the East believe that technology inevitably spreads and facilitates industrialisation (e.g., Landes, Rosenberg, Akamatsu), many countries and regions have failed in industrialisation so far. The author claimed that, comparatively speaking, Japanese FDI has facilitated Asian technological development and industrialisation. However, technology transfer is not yet complete. There are many obstacles—political, cultural, geographical, institutional, or else—to further develop local technological capability. In the following part, some critical issues for further technology transfer will be discussed. The author does not agree to the opinion that every body should learn English and use it as the management language. The author will introduce a successful case of technology transfer which adopted step-by-step expansion. Here, a solid management policy and the flexibility in management are indispensable.

(1) Minimising the training loss

Minimising the training loss is critical for success. Mostly, training of workers is carried out in-house and sometimes in Japan, depending on the need and the policy. In the beginning, many subsidiary firms sent a large number of workers to Japan for training. However, many trained workers in Japan resigned afterwards, especially those with higher education, i.e., university graduates. Learning from past lessons, these firms said that training in Japan should be, too short to learn Japanese language yet long enough to learn a specific technology

necessary for a specific production process of the firm. Efforts to mould them into key personnel in the Japanese way, or in the course of a life-time employment system, seems to have failed.

A Thai firm considers that training in Japan costs too much because trainees very often move to other companies after their training (F-9). A Japanese subsidiary firm (F-11) sent 50 workers to Japan for two-three years each, long enough to learn the Japanese language, in order to prepare for the start-up in 1966. However, among the 50 trained, only one person remains with the firm. Others left for other companies when an investment rush from Japan occurred in the 1980s. An air-conditioner manufacturer (F-4) sent 60 workers to Japan before start-up in 1991. However, 40 workers among them resigned after training in Japan. Above all, especially, none of the university graduates, 12 engineers, remained in the firm after training in Japan. The managing director of F-4 regrets that he should have followed other peoples' advice not to expect much from university graduates. They are likely to change their jobs after acquiring some experience. Probably, there is no decisive way to keep staff in the company because of the local culture.

In Western societies and Asian elite's societies, it is presupposed or even encouraged to change companies. From this viewpoint, they blame the Japanese labour market. For them, it is a closed market and lacks fluidity. However, it is natural for trainers to expect the trained local staff to remain and become key personnel. A solution is not to expect scarce university graduates in developing countries. It is better to employ and train high school graduates. The Malaysian training scheme, Human Resource Development Fund[14], is very helpful for training of local staff from this viewpoint. Some firms (F-4, F-7, F-9) explained that they provide their staff with basic training because they consider not only technical skills but also basic knowledge such as mathematics, technical terms, etc. are necessary for upgrading their technological level.

(2) Language problems, a communication tool for technology transfer

In the case of international technology transfer, teachers are very often foreigners. As

[14] Employers are allowed to apply for training grants according to Human Resources Development

observed in this survey, technical experts normally speak only Japanese, which impedes local staff's learning. Therefore, Japanese firms or local firms have to find a better way of communication. From this viewpoint, we will examine the language capability of managing directors. Fourteen firms in the survey have Japanese managing directors. Most of them speak only Japanese. The residual three firms have local managing directors. They speak their local languages as shown in Table-10.

F-3 is Thai-owned, the managing director of which does not speak English or Japanese. As F-3 has many Japanese customers, it employed Japanese experts. F-9 is also Thai-owned. Mr. Chalum, the owner's son and the managing director of F-9, has studied engineering in Japan and speaks Japanese fluently. Then, F-13 is a Malaysian factory, owned by a Japanese firm. The managing director of F-13 was educated in Japan and speaks both Japanese and the local language.

Table-10 Language in the Senior Staff Meeting

Firm	MD	Language	Firm	MD	Language
1		Japanese	10		Japanese → English
2		Japanese	11		Japanese
3	Local	Local	12		Japanese?
4		English?	13	Local	Local and Japanese
5		English (AMD, Itochu)	14		Japanese (AMD, Tomen)
6		English?	15		English
7		English (AMD, Nissho)	16		Japanese
8		English → Japanese	17		English (MD, Nichimen)
9	Local	Local and Japanese			

Note: MD refers to managing director, AMD assistant MD. Japanese MDs from SMEs don't speak good English. Therefore, they employed MD or Assistant MD from Sogo-shosha; Itochu, Tomen, Nichimen, Nissho, etc.

Interviews showed that many Japanese firms faced language difficulties. The management language depends on the language capability of the Japanese expatriates. Japanese managers and technical experts very often rely on body language for OJT because

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Fund 1992 (Source: Secretariat, Human Resources Development Council, Malaysia).

they are seniors and consider themselves too old to learn foreign language. In the USA and India, the author witnessed local staff complaining of the language incapability of Japanese managers[15]. Nevertheless, English is not almighty. What follows are complicated language problems observed in the survey.

(a) A Switch from English to Japanese (F-8)

In July 1994, Central Motor Wheel (the holding company of F-8) increased its share of capital from 4% to 27% and took greater management control of F-8, sending six expatriates to replace the then five managers. Until then, management of the firm was led by persons from steamship and trading companies. In the past years, Central Motor Wheel sent only one expert to take care of technical matters at the firm. This big change in the management after 20 years of operation occurred due to the following reasons.

(i) F-8 has been a protected monopolized factory in the production of steel wheels in Thailand.

(ii) The recent expansion of the car market in Thailand invited the establishment of an aluminium wheel plant (Enkei, 1988). Further threat of entry by other manufacturers of steel wheels emerged.

(iii) Car assemblers also wanted a better assurance of the quality and cost reduction for steel wheels.

The problem for the new expatriates arrived in 1994 was the management language. After the replacement of the management members, the language for the weekly meetings was changed from English to Japanese. Thai managers attend the meetings and listen to the translation. In a sense, the local staff had to suffer from the switch in language.

(b) A switch from Japanese to English

[15] The author observed the cases at a Honda's supplier, a Japanese SME (Ohio, June 1991), and at a Japanese joint venture to assemble automobiles in India (Delhi, August 1997).

The following case is a switch in the opposite direction, from Japanese to English. F-10 is a stamping company for Mitsubishi cars in Thailand initiated in 1989, two years later than another FDI in the USA. The first and second presidents of F-10 did not understand English. Neither did other Japanese expatriates. Consequently, they employed Japanese-Thai translators. Management was carried out in Japanese for nearly ten years from 1989 to 1997, when the new president replaced the second president. As the new president and his vice president once worked for the start-up of another subsidiary firm in the USA from 1987 to 1992, Thailand looked totally different from the USA for them. They are familiar with English, but not with the Thai language and culture. They found that Thai staff did not understand the English manuals and papers they brought, which they had used in the USA.

The new president considers that technology transfer in Thailand is slower and more difficult than in the USA. What follows is his comment.

i. The level of technology is far lower than that in the USA and Taiwan.

ii. It is very difficult to communicate with local staff because they don't understand English at all. We have to educate QC, QA staff. They have to understand English for ISO.

iii. The operation doesn't proceed without Japanese expatriates. That should be improved. There is no manual for standard operations. We have to arrange manuals.

The new president has many ideas to advance technology transfer and staff localisation. An obstacle for them is the management language. He holds a senior staff meeting every morning for about an hour hoping to promote understanding of QCD. However, they don't understand English. If they don't understand English, that means they don't understand the president. The firm is suffering from the switch in management language. The president considers that if they can not improve, all staff needs to be replaced. Otherwise, this plant has to be shut down. He says, the company cannot continue losing money. The case is serious. However, the author considers that the matter is how to hold the leadership. The language is not the essence.

(c) The case of local managing directors who speak Japanese

Mr. Tan and Mr. Chalum showed rare examples in the sense that they are local managing directors with Japanese language capability. This seems to be perfect. However, the former presented a far better management than the latter. The difference lies in the staff's motivation and the system to maintain it.

It is not enough only to produce. It is necessary to produce products with QCD. If not, the staff's motivation and the management system to guarantee it have to be developed. The former is a subsidiary firm of Japanese origin and has a model to copy. Meanwhile, the latter is fully owned by a Thai. The firm is trying to learn from Japan and Korea in many ways; introduction of new machines and equipment, technology licensing with Japanese firms, joint ventures with Korea and Japan, invitation of Japanese experts, etc. Nevertheless, machines and contracts alone could not change the people. The firm lacks something critical for QCD. A Japanese JODC[16] expert in the heat treatment section said that this firm has no standard to follow. In other words, this firm has not acquired technology yet. Very high turn-over obstructed the accumulation of technology. In conclusion, the language alone doesn't help or matter. Other examples represent successes even though Japanese expatriates didn't understand English or the local language.

Mr. Tan, an employee and the managing director of F-13 studied in Japan from his high school days up to his post graduate degree. He is completely fluent in the Japanese language and was employed in Japan by the holding company. At first, F-13 recruited two or three managing directors from Sogo-shosha, but these trials were not successful. Finally, Mr. Tan was promoted to managing director and successfully put the subsidiary firm onto a development course. This example shows that Japanese former managing directors, in spite of their English capability, failed probably due to lacking in production knowledge. Mr. Tan had a background in engineering and working experience in a Japanese SME. In addition, his language capability and cultural understanding must have facilitated his successful management.

In conclusion, there is no decisive management language to choose. Language is only part of communication for technology transfer. The real practice is far more complex. The matter is not so simple to conclude that "English is the best choice". Japanese is the best for

Japanese expatriates and local languages are the best for local staff.

(3) An excellent management policy

Even if the technologies involved are difficult to learn, FDI can be successful if it is planned carefully step-by-step. Also, a solid management policy and the flexibility in management are indispensable.

(a) Start from a small scale

F-7 is an example of successful FDI. Failures are often caused by the gap between the plan and the slow pace of real learning by local staff. The learning pace depends considerably on the understanding by local staff of the Japanese management philosophy or the team spirit. From the viewpoint of local staff, the speed of learning depends on the effectiveness of Japanese technology transfer because Japanese expatriates normally speak neither English nor Thai.

Table-11 The Growth Process of F-7

	May 87	Nov 87	Dec 87	May 88	Jan 89	Apr 90		Oct 94
Japanese expatriates	3	4	4	8				41
Thai workers	7	36	80	140				*3800
Press machines	7		15					111
Injection machines					2	5		81
Total number of employees	10	40	84	148				*3800

Source: F-7 *3800 includes 41 expatriates.

In 1987 F-7 was established by Muramoto, a small-medium metal press specialist in Kobe. Muramoto had been a supplier of small press parts and had no technology in assembly or injection. It made an amazingly rapid and successful expansion into Thailand by acquiring new technologies. Because there are only a few subcontractors (shitauke) in foreign countries, Japanese set makers have to rely on any Japanese suppliers that have good established facilities with well trained workers. Muramoto has established a very good production system

with the company's strict policy on quality and delivery time.Due to the policy, sales grew very rapidly. The firm diversified step-by-step following the increase of orders.

As shown in Table-11, F-7 started from the smallest scale of a plant with only 10 persons and seven press machines. The land and the building were rented in order to minimize the risk. F-7 chose a gradual step approach. It increased machines and lines gradually. The project succeeded at first in the press process, and then started the assembly of "loading" mechanisms. Although F-7 had no know-how other than press, the firm was successful also in the assembly process and plastic injection. Three Thai students employed at the Kobe factory in Japan contributed greatly to the success of F-7. They became familiar with the company's policy. When they returned to Thailand, they became crucial in the start-up of the factory. They wrote manuals in the Thai language. In contrast, as shown in Table-12, another firm in the same industry failed due to the gap between the plan and the real practice in learning.

Table-12 A Contrast Between a Scale-up Method and a Scale-down Method

	X Co., Ltd. (in 1993)	F-7 (in 1993)
Start up	1987	1987
Ownership	Japan 100%	Japan 100%
Capital	60 million baht	130 million baht. (initiated from a small scale → 220 mil B in 1994)
Assets	936 million baht	460 million baht
Employment	2156	2800 (→3800 in 1994)
Equipment	Press M/C, Injection moulding M/C, Sintering furnace, Riveting M/C, Tapping M/C, Lathe M/C	Press M/C, Injection moulding M/C
Products	VCR components, Reel and mechanical discs, Clutches, gears and cassette units, Chassis units.	VTR parts, CRT parts, Video camera parts
Sales amount	2413 million baht (in 1991) → scale-down	2000 million bahts (in 1991) → 4180 million baht (in 1994)

Source: SEAMICO, 1993

Note: X Co. and F-7 started similar businesses though X Co. on a larger scale, with a wider range of processes, which required a big amount of investment. X Co. was not so successful. Two main stumbling blocks were: (1) Financial difficulty due to the over-investment and (2) technological problems, i.e. the difficulty in learning of forging, machining and heat treatment all at once. F-7 avoided these two difficulties by a gradual scale-up method.

(b) A solid management policy and the flexibility

Diversification and expansion of the business lines were achieved in a short period. If the management policy is very well understood and the organization is functioning flexibly, diversification and expansion will be achieved successfully. The key to the firm's success lies in the management system mentioned above. If the firm is trusted by customers, technologies will be introduced from the customers whenever necessary.

A comparison between the "all-at-once method" and "gradualism" showed that "gradualism" was more successful. As mentioned, F-7 started from the metal press lines where it was confident. Then, with the assistance of a set maker, it expanded its process to assembly and injection. In contrast, another electric component maker, in the same business, started a full set of processes from the beginning—metal press, injection, assembly, heat treatment and machining (Table-12). The teaching of all processes at the same time failed. Also, the large scale investment created financial difficulties. The result of the whole project was found to be unsuccessful. Although it is very difficult to tell the causes for failures, it seems to be safer to start from a small scale investment in the case of SMEs because they normally lack full range of information and, in addition, the local policy is really changeable.

(4) How to develop creative technologies

The survey clearly showed that level of creative technologies at local firms is still very low (Table-8, Table-9). R&D activity needs huge investment both in human resources and facilities. Yet, the return on the investment is not guaranteed. The local market size is too small for R&D investment. That is the reason for the low level of creative technologies. The first thing to do is to upgrade the general technological level of the nation. The number of graduates and teachers in engineering are smaller in developing countries than in developed countries. Furthermore, it is said that, half of the engineers graduated from the Chulalongkorn University are engaged in non-manufacturing industries. This tendency has to be remedied

through a change in policy orientation. Only to request foreign firms to invest in R&D will not suffice.

Bibliography

Akamatsu, Kaname, "A historical pattern of economic growth in developing countries", *The Developing Economies*, (March-August, pp. 3-25, 1962)

Amsden, Alice H., *Asia's Next Giant: South Korea and Late Industrialization*,(New York: Oxford University Press, 1989)

Fransman, M. (ed.), *Machinery and Economic Development*, (London: Macmillan, 1986)

Fransman, M., *Technology and Economic Development*, (Brighton: Wheatsheaf, 1986)

Fransman, Martin, "Technological Capability in the Third World: An Overview and Introduction to some of the Issues raised in this Book", in Fransman, M. and King, K. (eds.), *Technological Capability in the Third World*, (London: Macmillan, 1984: 3-30)

Howe, Christopher, *The Origins of Japanese Trade Supremacy*, (London: Hurst & Company, 1996)

Kojima, Kiyoshi. "Transfer of Technology to Developing Countries, Japanese Type versus American Type", *Hitotsubashi Journal of Economics*, (Tokyo: February 1977)

Kojima, Kiyoshi., *Japanese Direct Foreign Investment; a model of multinational business operations*, (Tokyo: Charles E. Tuttle, 1979)

Landes, David, *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*, (Cambridge: Cambridge University Press, 1969)

Ogawa, Eiji, *Modern Production Management: A Japanese Experience*, (Tokyo: APO, 1984)

Ozawa, Terutomo, *Multinationalism, Japanese Style*, (Princeton: Princeton University Press, 1979)

Rosenberg, N. and Birdzell, L. *How the West Grew Rich, The Economic Transformation of Industrial World*, (London: I.B. Tauris, 1986)

Rosenberg, Nathan (ed.), *The Economics of Technical Change*, (Hamondsworth: Penguin, 1971)

Rosenberg, Nathan, *Exploring the Black Box, Technology, Economics, and History*, (Cambridge: Cambridge University Press, 1994)

Rosenberg, Nathan, *Inside the Black Box: technology and economics* (Cambridge: Cambridge University Press, 1982)

Rosenberg, Nathan, *Perspectives on Technology*, (New York: Cambridge University Press, 1976)

Rosenberg, Nathan, *Technology and American Economic Growth*, (New York: Harper & Row, 1972)

Rosenberg, Nathan, *The Emergence of Economic Ideas, Essays in the History of Economics*, (Aldershot: Edward Elgar, 1994)

Santikarn, Mingsarn, *Technology Transfer, a Case Study*, (Singapore: Singapore University Press, 1981)

SEAMICO, *Directory of Supporting Industries in Thailand-1993*, (Bangkok: SEAMICO/TDRI, 1993)

Suehiro, Akira, *Capital Accumulation in Thailand, 1855-1985*, (Tokyo: Center for East Asian Cultural Studies, 1989)

Sumeth, Vongpanitlerd, *The Development of Thailand's Technological Capability in Industry*, (Bangkok: TDRI, 1992)

TDRI, *The Development of Thailand's Technological Capability in Industry, Vol. 5, Electronics*, (Bangkok: TDRI, 1989)

Veblen, Thorstein, "The Opportunity of Japan", *The Journal of Race Development*, Vol. VI, July 1915, reprinted in Veblen, Thorstein, Essays in Our Changing Order, (London: Routledge, 1915/1994: 248-66)

Veblen, Thorstein, *Imperial Germany and Industrial Revolution*, (London: Secker and Warburg, 1915/1939)

Veblen, Thorstein, *The Instinct of Workmanship*, (London: Routledge, 1914/1994)

赤松要「我国羊毛工業品の貿易趨勢」『商業経済論叢』第13巻上 1935年

赤松要「吾国経済発展の綜合弁証法」『商業経済論叢』第15巻 1937年7月

赤松要「東亜貿易の歴史的類型」東京商科大学東亜経済研究所編『東亜経済研究年報 第一輯』日本評論社 1942年

赤松要「わが国産業発展の雁行形態 - 機械器具工業について」『一橋論叢』第36巻第5号 1956年11月

小川英次「技術移転と中小企業」『商工金融』第43巻12月号 1993年

小川英次『現代の生産管理』日本経済新聞社 1982年

日経産業消費研究所『アジアへの技術移転Ⅱ　研究報告書』日経産業消費研究所 1992年

山中篤太郎『中小工業の本質と展開』有斐閣 1948年

吉田和男『日本型経営システムの改革』読売新聞社 1995年

吉田和男『解明日本型経営システム』東洋経済新報社 1996年

Appendix A

Table-13 Number of Machine Industries by Size

	1952	1960	1970	1980	1985	1990	1993
4-9	12790	16149	50290	74013	78878	80581	76963
10-19	8283	14973	25384	25338	27738	29948	28725
20-99	7220	16368	21966	25559	30551	32439	30906
100-999	1190	3129	5382	5068	6252	6750	6581
1000-	103	252	467	398	462	481	473
total	29586	50871	103489	130376	143881	150199	143648

Source: Tsusansho, Kogyotokei Hyo, 1952-1993, each year.

The above machine industries include the steel and iron industry (code no. 31), the metal products industry (code no. 33), the general machine industry (code no. 34), the electric machine industry (code no. 35) and the transportation industry (code no. 36). Calculated by the author.

Table-14 Number of People Engaged in Machine Industries

	1952	1960	1970	1980	1985	1990	1993
4-9	80167	106601	323857	441641	473897	483954	460350
10-19	112480	205269	362672	349280	384170	412919	396663
20-99	278297	652906	926694	1002646	1211593	1280532	1221983
100-999	296605	728558	1324589	1253989	1544313	1667007	1652498
1000-	246517	626957	1184097	955319	1085371	1079194	1067843
Total	1014066	2320291	4121909	4002875	4699344	4923606	4799337

Source: Tsusansho, Kogyotokei Hyo, 1952-1993, each year. See the note of Table 3-12.

Table-15 The Ratio of Overseas Production (Japanese firms which invested in Asia)

	Ratio of overseas production (%)		Production growth rates (1992 to 1994)	
	1992	1994	Overseas production	Domestic production
Audio visual (AV) appliances	94	220	41%	Minus 40%
AV parts	49	73	33	Minus 11
Electric appliances	27	39	28	Minus 10
Electric appliances parts	48	73	30	Minus 14
Office Automation (OA) equipment	25	31	24	2
OA parts	25	29	29	11
Camera and parts	42	64	26	Minus 18
LSIs, ICs, transistors	14	24	101	14
Moulds and dies	55	60	11	1
Automobiles	36	45	16	Minus 7
Auto parts	21	31	36	Minus 8

Total (Includes all machine industries)	35	50	32	Minus 8

Source: Nippon Kikai Yushutsu Kumiai (Japan Machinery Export Co-operative), quoted in Shoko Sogo Kenkyusho, Kaigai Seisan-no Shinten-to Shitauke Kikai Kinzokuseihin Seizogyo-no Kudoka, March 1995: 24, unpublished. Ratio of overseas production = the amount of the overseas production / the amount of the domestic production

Table-16 Investment in the Auto Parts Industry (Includes 35 auto/electrical parts industry)

Capital	Classified by country					Unclassified	Total
share	Thailand	Japan	Asia	West	sub total		
100%	157	2	2	4	165		
80-99%	8	7	0	0	15		
51-79%	80	12	0	4	96		
Majority	245	21	2	8	276	*56	332
20-50%	16	55	18	10	99		
1-19%	6	3	8	5	22		
Minority	22	58	26	15	(121)		
Total	267	79	28	23	(397)		

Source: SEAMICO, 1993. Minority share holder firms are subject to double and triple counting. *56 firms are unclassified because (i) share holders are not disclosed or (ii) there are no majority holders.

Table-17 Investment in the Electrical Parts Industry (Includes 35 auto/electrical parts industry)

Capital	Classified by country					Unclassified	Total
Share	Thailand	Japan	Asia	West	Sub total		
100%	109	41	25	11	186		
80-99%	17	25	9	9	60		
51-79%	87	13	16	6	122		
Majority	213	79	50	26	368	*26	394
20-50%	39	41	34	19	133		
1-19%	30	4	15	11	60		
Minority	69	45	49	30	(193)		
Total	282	124	99	56	(561)		

Source: SEAMICO, 1993. Minority share holder firms are subject to double and triple counting. *26 firms are unclassified because (i) share holders are not disclosed or (ii) there are no majority holders.

Appendix B

A Survey on Technology Transfer

Teikyo University of Science and Technology
Akira Kuroda

1. Profile of the Company

Name of company			
Tel		Fax	
Managing Director			
Capital shares	Japan %	Thailand %	Other ( ) %
Foreign partner's name and home address			
Capitals MB		Yearly sales MB	Export ratio %

A Brief history of the company

(Please explain the change and diversification in products and processes, expansion of factories, construction of additional factories, increase in capital investment, the change in partners, etc.)

2. Number of workers (experienced and un-experienced)

Experienced workers = workers with skills which need more than one year training and experience.

Un-experienced workers = workers who need less than one week training, in other words, workers who are easily replaced by others.

Main products			
Main processes			
A. Number of employees (excluding B)	the time of start-up year ( )	2-3 years ago 1994	present time 1997
1. Employees in production (Experienced workers) (Un- experienced workers)	( ) ( )	( ) ( )	( ) ( )
2. Employees in sales and administration			
3. Total number of A (1+2)			
B. Number of foreign expatriates			

3. Technical Training in Japan and foreign experts / trainers

	Number of local workers	Turn-over (number of workers who left in the past one year)	Number of workers who are trained in Japan and still in the company	Number of workers trained in Japan, including the number who left the country	Number of foreign experts staying in the company at present	Total number of foreign experts who have worked for the company in the past
Production						
Sales and administration						
Total						

(Note) Turn-over: Please describe the number of resigned workers after the training above.
Also, explain the reasons of their resignation.

4. The place of the purchase of parts and materials.

Circle the numbers appropriate	Describe the items
1. In-house production 2. from local Thai firms 3. from local Japanese firms 4. from firms in NIEs 5. from firms in ASEAN 6. from the parent firm 7. from firms in Japan 8. from firms abroad	

NIEs: Korea, Taiwan, Hong Kong, Singapore

ASEAN: Indonesia, Malaysia, Philippines, Brunei

5. Please describe the parts and materials difficult to purchase in Thailand

Names of the parts, materials	Describe the main cause of the trouble			
	low quality	high price	delivery	quantity
	low quality	high price	delivery	quantity
	low quality	high price	delivery	quantity

6. The manufacturing processes assigned to local suppliers (including small firms)

Please describe how your company selected and then fostered the firm to become your suppliers.

7. Measuring of technology transfer

How far the transfer is completed for each 10 categories below? Please evaluate by the grades f r o m 0 to 5. 0 refers to the level of no technology before the start- up and 5refers to the level of completed technology transfer in which local staff reach the same level as foreign partners.

	At the beginning of the start of the factory year ( )						At present year 1997					
1. Operations	0	1	2	3	4	5	0	1	2	3	4	5
2. Repairing and maintenance	0	1	2	3	4	5	0	1	2	3	4	5
3. QC	0	1	2	3	4	5	0	1	2	3	4	5
4. Production control	0	1	2	3	4	5	0	1	2	3	4	5
5. Minor process improvement	0	1	2	3	4	5	0	1	2	3	4	5
6. Improvement of dies and jigs	0	1	2	3	4	5	0	1	2	3	4	5
7. Improvement of machines	0	1	2	3	4	5	0	1	2	3	4	5
8. Process design technology	0	1	2	3	4	5	0	1	2	3	4	5
9. Designing of parts & products	0	1	2	3	4	5	0	1	2	3	4	5
10. R&D of new products	0	1	2	3	4	5	0	1	2	3	4	5

8. Who really handles the following each job, local staff or foreigners?

A. Foreigners
B. Foreigners with assistant local staff
C. Local staff with assistant foreigners
D. Local staff
E. No plan to localise

	At the beginning of the start of the factory year ( )					At present year 1997				
1. Operations	A	B	C	D	E	A	B	C	D	E
2. Repairing and maintenance	A	B	C	D	E	A	B	C	D	E
3. QC	A	B	C	D	E	A	B	C	D	E
4. Production control	A	B	C	D	E	A	B	C	D	E
5. Minor process improvement	A	B	C	D	E	A	B	C	D	E
6. Improvement of dies and jigs	A	B	C	D	E	A	B	C	D	E
7. Improvement of machines	A	B	C	D	E	A	B	C	D	E
8. Process design technology	A	B	C	D	E	A	B	C	D	E

9. Designing of parts & products	A	B	C	D	E	A	B	C	D	E
10. R&D of new products	A	B	C	D	E	A	B	C	D	E