



Automation and ‘Thailand +1’ Strategy of Japanese Companies in Thailand by Thai Engineers

Masayuki Kondo

Kaishi Professional University, Japan

ARTICLE INFO

Article History:

Received : 16 November 2021

Revised : 19 November 2021

Accepted : 20 November 2021

Available online : 15 December 2021

Authorship Contribution:

Author is the main contributor

Keywords:

Automation,

Thailand+1 Strategy,

Japanese Companies,

Thai Engineers

ABSTRACT

Japanese companies have the second largest number of overseas manufacturing sites in Thailand after in China. To cope with labor cost increase, on one hand, they automate their production processes using robots. On the other hand, they establish satellite manufacturing sites in lower-cost labour countries. This movement is called “Thailand+1” Strategy. The paper discusses these two movements comparing with the experiences of Japanese companies in Japan in the late 1980s coping with rapid Japanese Yen appreciation. The paper discusses that the automation in Thailand is now more systematic and needs system integrators, and that local engineers need to be trained as system integrators since the technological operation in Thailand is already heavily localized. In the case of Japan in the late 1980s, shop-floor workers were needed to be mechatronics operators since individual machines became IT (Information Technology)-based. For the “Thailand +1” Strategy, only a part of the production process, which is heavily labor-intensive, is moved out as a satellite factory, while in the case of Japan in the 1980s a whole assembling process was moved out and many parts suppliers followed. Another difference is that local engineers (Thai engineers) play an important role in technology transfer in the case of the “Thailand +1” Strategy, while Japanese engineers transferred technology to overseas factories in the case of Japanese companies in the late 1980s. Japanese companies have become globally operated from Japan-centered.

I. INTRODUCTION

The FDI (Foreign Direct Investment) from Japan to Thailand is huge. The FDI from Japan to Thailand used to occupy more than sixty percent of foreign direct investment. According to the Thailand Board of Investment (BOI) data, the

amount of FDI application of Japanese companies was 42 billion Baht, the largest, in the first half of 2019.

The number of overseas sites of Japanese companies was the fourth largest in Thailand after the United States, China and India in 2017 (Table 1). However, the perception is quite different when looking at the number of overseas sites of Japanese companies per million people.

* Corresponding Author.

E-mail: kondo.masayuki@kaishi-pu.ac.jp



Thailand has the largest number of Japanese company overseas sites per million people of a host country, 56.9 (Table 1).

As far as the number of members of Japanese chambers of commerce overseas concerns, the Japanese Chamber of Commerce, Bangkok, was the largest as of April 2021. The number was 1,685.

Along with the FDI, technology transfer takes place. In order to see the quantity of technology transfer, technology export data is examined. The largest amount of technology exports from Japan was for the United States, 1,598 billion yen, in 2015. Thailand ranked at the third place of 327 billion yen (Table 2). However, the amount of technology exports from Japan per GDP of a recipient country gives a different impression where the amount of technology exports from Japan to Thailand was more than eight times larger than that to the United States (Table 2).

The data of the patent application to Thailand also shows that Japanese companies play a big role in Thailand. More than 30 percent of the patent application to Thailand was made by Japanese companies in 2009, while the companies of foreign countries except Japan occupied around 50 percent. (Table 3). Among the top 10 patent applicants, Japanese companies occupied six places (Table 4).

The patent application by Japanese companies to Thailand means that Japanese companies intend to use the technologies related to the patents applied for in Thailand. Thus, a patent application by Japanese companies to Thailand means technology transfer to Thailand from Japan.

The Japanese government promoted technology transfer from Japan to Thailand and assisted Japanese companies to transfer technology from Japan to Thailand.

For example, the Japanese government executed various projects to assist King Mongkut's Institute of Technology Ladkrabang and Thailand Automotive Institute. The Association for Overseas Technical Cooperation and Sustainable Partnerships (AOTS), partly financed by the Japanese government, sends Japanese experts and engineers to Thailand or receives

Thai engineers and technicians from Thailand to Japan as trainees based on company needs. The pair of Japan-Thailand Economic Cooperation Society (JTECS) and Technology Promotion Association Thailand-Japan (TPA), partly financed by the former Ministry of International Trade and Industry (MITI), transferred manufacturing technologies and calibration technologies from Japan to Thailand (Kondo, 2010).

As described above, Japanese companies established many companies in Thailand and transferred technology vigorously from Japan to Thailand.

Based on this fact, this paper discusses the Japanese company strategy of automation with robots system integration and "Thailand+1" strategy (setting up satellite factories in neighboring countries) compared with Japanese company experiences in the late 1980s to cope with acute yen appreciation caused by Plaza Accord in 1985. That is, automation with robots and moving factories overseas.

The paper points out that the automation in Thailand is conducted mainly by Thai engineers, and that the technology transfer of Thailand+1 is mostly conducted by Thai engineers, while the automation and technology transfer to overseas factories in the late 1980s were conducted by Japanese engineers (Kondo, 2021).

As concluding remarks, the paper discusses the merits of using Thai engineers in the automation in Thailand and technology transfer from Thailand to Thailand+1 destination countries.

II. ANALYTICAL FRAMEWORK

When domestic production cost increases, companies have two options to cope with this challenge (Table 5). One is to enhance domestic productivity to absorb production cost increases. The other is to move production activities to a country where production cost is lower.

This paper analyzed the case of Japanese companies in Thailand in the 21st century where they face the production cost increase in Thailand due to labor cost increase caused by the economic growth of Thailand and the policy of the Thai government. Before doing so, this paper reviewed a similar experience of Japanese companies in the

Table 1.
Number of Japanese Company Overseas Sites

Country	Japanese Company Sites (as of October 1, 2017)	Japanese Company Sites per one million people (in 2017)
China	32,349	23.0
The United States	8,606	26.5
India	4,805	3.6
Thailand	3,925	56.9
Indonesia	1,911	7.2

Source: Ministry of Foreign Affairs, Japan, and United Nations.

Table 2.
Technology Exports from Japan

Top 5 Destinations	Technology Exports from Japan (million yen)	Technology Exports from Japan per GDP (Standardized making the United States 1.0)
The United States	1,597,947	1.0
China	476,504	0.5
Thailand	327,284	8.6
The United Kingdom	234,061	1.1
Indonesia	146,243	1.8

Note. The data of Technology Exports from Japan is 2015FY data and GDP data is 2018-year data.

Sources: The Survey of Research and Development of Japan and IMF.

Table 3.
Patent applications from Japan to Thailand (in 2009)

Nationalities of Applicants	Total	Thailand	Foreign countries (excluding Japan)	Japan
Patents	5,857	1,025	3,008	1,824
Utility Models	1,467	1,416	51	0
Industrial Designs	3,873	3,171	419	283
Trade Marks	36,087	24,734	9,415	1,938

Source: The author tabulated using the data contained in JETRO Home Page.

Table 4.
Top 10 Patent Applicants in Thailand

	Number of patents	Applicants	Nationality
1	146	Honda Motor Co. Ltd. Honda Motor Co. Ltd.	Japan
2	84	Thailand National Science and Technology Development Agency	Thailand
3	82	Unicharm Corp.	Japan
4	60	UNILEVER NV	Netherlands
5	56	Thailand Institute of Scientific and Technological Research	Thailand
6	47	Mitsubishi Electric Corp.	Japan
7	46	Sumitomo Chemical Co. Ltd.	Japan
8	43	Kao Corp.	Japan
9	39	COLGATE PALMOLIVE Co.	The United States
9	39	MICROSOFT Corp.	The United States

Note. The number of publicized patent applications was 4,300 in 2012.

Source: Japanese Patent Office (2015).

Table 5.

Measures to Cope with Domestic Production Cost Increase Taken by Japanese Companies

Measures to Cope with Domestic Production Cost Increase	(Case of Japan in the 1980s due to Acute Yen Appreciation)	(Case of Thailand in the 21 st Century due to Labor Cost Increase)
Domestic Productivity Enhancement	Automation (ME (Microelectronics) equipment or MECHATRONICS)	Automation (System Integration, Robots, etc.)
Moving to Lower Cost Countries	Hollowing Out Phenomena in Japan	Thailand +1

1980s. They suffered from comparative domestic production cost increase in Japan in the export market because of the acute Japanese Yen appreciation. On one hand, Japanese companies introduced ME (Microelectronics) machines, such as CNC (Computer Numerical Control) machines and robots. Japanese companies also moved out their production activities to the lower labor cost countries such as China and Thailand. This phenomenon is called “Hollowing Out”.

III. METHODOLOGY

The research methodology used is semi-structured interviews on Thailand+1. The interviewees include executives of Japanese companies in Thailand and executives of Japanese companies in Cambodia which are subsidiary companies of the Japanese companies in Thailand, Japanese engineers to train Thai engineers on system integration, Japanese engineers to sell robots and automation systems in Thailand and a Japanese coordinator to transfer Japanese system integration technology from Japan to Thailand in a project supported by the Japanese government.

To conduct a study on the case of Japan in the 1980s due to acute Japanese Yen appreciation, a literature study and the experiences of the author were used.

IV. STRATEGIES OF JAPANESE COMPANIES IN JAPAN TO COPE WITH YEN APPRECIATION IN THE LATE 1980S

A. Japanese Yen Appreciation in the late 1980s

The dollar/yen exchange rate used to be 360 yen/dollar for a long time after WWII. Then, it

became 308 yen/dollar based on the Smithsonian Agreement in 1971. In February 1973, the fixed exchange rate system changed to the floating exchange rate system. The rate became 256 yen/dollar in March 1973.

On September 22, 1985, the “Plaza Accord” was reached among five economically major countries in New York. In 24 hours, the exchange rate of the US dollar went down from 235 yen/dollar to 200 yen/dollar. In a year, the exchange rate became around 150 yen/dollar (Table 6).

Japanese companies took two actions to cope with this acute yen appreciation. One was automation to reduce labor cost and to improve labor quality and product quality at the same time. The other option was to move their factories overseas where production cost, especially labor cost, was lower.

B. Automation

Japanese companies actively introduced industrial robots for production in the 1980s. Industrial robots developed as excellent automation machines in the 1980s. Japan occupied nearly 70 % of all industrial robots in the world in the 1980s and 23 % in 2014 according to the International Federation of Robotics. Japan had the largest number of industrial robots in the world. Japan reached the world share of 88 % in production and 75 % in shipment in 10 years from 1980.

Robot-related organizations were established. Incorporated Association: Japan Industrial Robot Association (renamed as Japan Robot Association in 1994) was established in 1973. The Robotics Society of Japan, an academic association, was organized in 1983.

However, the introduction of industrial robots was not easy. Changes were required for

a company to introduce IT (information technology) – based machines such as industrial robots.

First, the organization needed to be changed. On one hand, IT-related sections were created. On the other hand, related worker units were closed. For example, when painting robots were introduced, the painting worker section was closed.

Second, the worker role changed. Supervisors became engineers; operators became multi-skilled; and maintenance staff became knowledge workers (Kondo, 1999).

C. Overseas Factories for Assembling

Assembling processes were moved out from Japan to lower cost labor countries. Since China started its “reform and opening policy” in 1979, China was one of the favorite destinations for Japanese companies.

Their parts suppliers followed. Thus, the hollowing out of Japanese industry followed. The amount of FDI (Foreign Direct investment) from Japan apparently increased from 1985 (Table 7).

This movement was called “Hollowing Out” and caused social and economic problems in Japan (Seki, 1997). Some regions faced serious problems such as the collapse of the local society.

However, key component production was retained in Japan. The key component production required experience and know-hows.

Technology transfer to overseas was conducted by Japanese engineers from Japan at that time.

V. STRATEGIES OF JAPANESE COMPANIES IN THAILAND TO COPE WITH LABOR COST INCREASE IN THE AGE OF AEC

A. Automation with Robots

According to JETRO (Japan External Trade Organization) Survey (JETRO, 2019), the largest management issue for Japanese companies in Thailand was “labor cost increase” (Table 8). Wages were rising rapidly.

The minimum daily wage was 300 Baht anywhere in Thailand from January 2013, while the daily wage in Ayutthaya near Bangkok was 190 Baht in November 2011 (Onozawa, 2013). In addition, it was difficult to secure human resources. The unemployment rate was around one percent.

Japanese companies as well as Thai companies in Thailand, promoted automation using robots to decrease labor work. According to JETRO Survey (JETRO, 2018), 30 % of Japanese manufacturing companies in Thailand already introduced industrial robots and 18 % of these were under consideration of introducing industrial robots. One Japanese company formed a project team of Thai engineers for original automation using industrial robots.

Thailand as a whole promotes automation with industrial robots. Thai Ministry of Industry, cooperating with the Japanese Government, asked a Japanese company, DENSO, to foster Thai system integrators for factory automation (Kondo, 2019). While in the 1980s, automation took place at the work unit level, in the 21st century automation is more systemized. Thus, system integrators are in demand.

Table 6. The Yen/dollar Exchange Rate (unit: yen/dollar)

year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
rate	226.7	220.5	249.1	237.5	237.5	238.5	168.5	144.6	128.2	138.0
year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
rate	144.8	134.7	126.7	111.2	102.2	94.1	108.8	121.0	130.9	113.9

Source: IMF

Table 7.

FDI from Japan (unit: million dollars)

year	1984	1985	1986	1987	1988	1989	1990
FDI	5,965	6,452	14,480	19,519	34,210	44,130	48,024

Source: JETRO

At TGI (Thai-German Institute, a public training center), Center of Robotics Excellence (CORE) was established. In Core, Japanese companies (Fanuc, DENSO, Mitsubishi, Yasukawa and DAIHEN) provided training on robotics. An experimental network connecting 8 collaborating regions were organized for automation and robotics as well.

The University level efforts are also made. FIBO (Institute of Field roBOTics) of KMUTT (King Mongkut's University of Technology Thonburi) fosters robotics teaching stuff in 24 universities. Thai universities are active in participating in robot contests.

In addition to the public sector efforts, the private sector efforts were also made. Thai Automation and Robotics Association (TARA) was established in 2018 in line with Thailand 4.0 plan to promote automation and robot use. TPA established TPA Automation Robotics & IoT Institute (TARII) in 2018. On a commercial basis, some Japanese robot manufacturers in Thailand opened a Robot Show Room/Training Center in business districts. Their customers are both Thai and Japanese companies.

In 2018, the International Federation of Robotics (IFR) estimated the shipment of general-purpose robots to Thailand would be 6,000 robots in 2020, though they were 2,646 robots in 2016.

B. Situation in CLMV Countries and ASEAN

In CLMV (Cambodia, Laos, Myanmar and Vietnam) countries near Thailand, the conditions are not bad for foreign investors. The governments welcome FDIs. They establish special economic zones in large cities and along borders. They

provide attractive tax concessions to FDIs. The wage rates are comparatively low, and the labor force is relatively abundant.

Not only as production sites, CLMV countries are attractive as markets as well. The total population was 167 million in 2017, and the per capita income is increasing.

Since Thailand and CLMV countries are members of ASEAN (Association of South-East Asian Nations), the economic integration of ASEAN helps companies in ASEAN countries to establish new companies in other ASEAN countries. ASEAN Economic Community (AEC) started in 2015 to realize a single market and production base.

C. Vertical and Horizontal Expansion

There are two ways to expand production capabilities: vertical expansion and horizontal expansion.

For vertical expansion, production process is expanded to the upper stream of production or the lower stream of the production. The case of "Thailand+1" Strategy described below is one variation of vertical expansion. First, vertical disintegration of the production process takes place. Then, a part of the production process is transferred to another site. As a whole, production capacity is expanded. However, no expansion occurs in the direction of the upper stream or the lower stream of production.

For horizontal expansion, a certain volume of a copy of production process is constructed in another site. "Thailand+1" Strategy described below is the case of horizontal expansion.

Table 8.
Management Issues in Thailand for Japanese Companies

Management Issues	2019	2018
Labor cost increase	63.5 %	59.3 %
Difficulty in quality control	52.9	58.6
Rise of competitors in terms of cost	47.3	49.5
Employee quality	47.0	50.1
New customer	46.7	46.1

Source: JETRO (2019).

VI. THAILAND +1

A. Background of Thailand+1

Thailand has been developing well and now suffers from the Middle-Income Trap. The wage is rapidly rising as stated above. In addition, it is difficult to secure human resources. The unemployment rate is around one percent.

Moreover, the political situation is not very stable. There could be natural disasters, such as flooding, as well. Therefore, some companies in Thailand are inclined to move some manufacturing functions to other countries.

Under this situation, Japanese companies are increasing their operation in CLMV countries (Table 9).

B. Operational of Thailand +1

Thailand+1 is the strategy of Japanese companies residing in Thailand to keep their operation in Thailand and to establish their new sites outside Thailand. In this case, they move a part of their production process, especially a labor-intensive part, to a neighboring country where the wage is lower than in Thailand (Figure 1). In other words, “Thailand+1 is a vertical disintegration of a production process in Thailand to move a labor-intensive process to a neighboring country where the wage is lower”. The emptied space could be used for the expansion of the remaining process. This strategy is interpreted as a type of intra-company fragmentation between Thailand and CLMV countries (Oizumi, 2013).

In fact, Japanese companies in Thailand already started setting up subsidiaries in CLMV countries. As of the end of the fourth quarter of 2014, at least 134 companies had established production sites or sales sites in CLMV countries

(Umesaki, 2017). Other 65 companies were under consideration.

The operation of Thailand+1 companies largely receives various assistance from mother companies in Thailand. In the case of a company which the author visited, it receives parts and raw materials procured in bulk by a Thai mother company; it delivers finished products in bulk to a Thai mother company; it receives business supports from a Thai mother company regarding general affairs, accounting and so on; and it receives production management supports from a Thai mother company regarding quality control, safety measures and so on (Figure 2). Moreover, the president of a Thailand+1 company is an executive of a Thai mother company, who is Thai.

C. Thailand +1 Compared with China +1

The strategy of Thailand+1 is markedly different from that of China+1. A main reason for China+1 is political risk aversion rather than wage increase. The initiative of the decision is taken by the headquarters in Japan, unlike the case of Thailand+1. A certain ratio of the whole production process is copied or moved to a country outside China (Figure 3). The capacity which remains in China may depend on how that company evaluates the Chinese domestic market.

There exists another strategy ‘Thailand+1’. With this strategy, a copy of a production process of a Japanese Thai company is newly established in another country (Figure 4).

A model process is a process in Thailand, not in Japan. That is, Thailand+1’ is a horizontal expansion of a Japanese Thai company. This strategy is similar to the China+1 strategy.

The demand in ASEAN or a designation country is larger than the capacity of a Japanese

Table 9.
Japanese Companies Operating in CLMV Countries

Country	As of October 1, 2017	As of October 1, 2012
Vietnam	1816	1211
Cambodia	309	125
Laos	135	83
Myanmar	438	75

Source: Japanese MOFA, Survey on Overseas Japanese Companies (in Japanese).

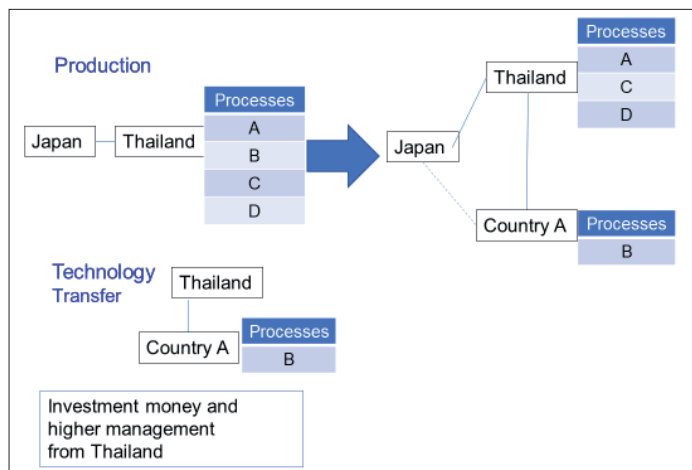


Figure 1. Thailand+1

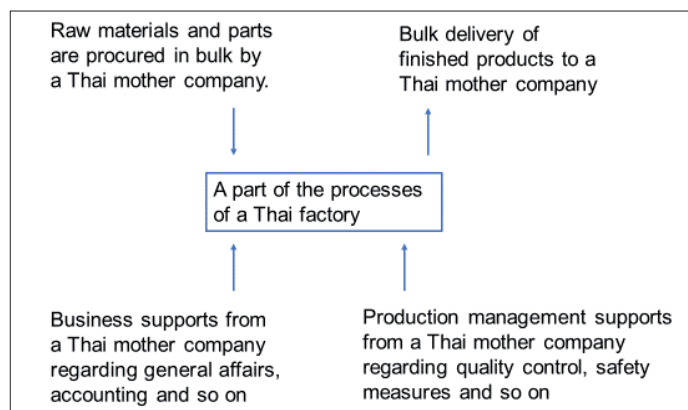


Figure 2. Business Operation of Thailand+1 Company

Thai company. The decision is, in many cases, done by the headquarters in Japan.

VII. TECHNOLOGY TRANSFER OF THAILAND +1

A. Technology Transfer of Thailand +1

In the case of Thailand+1, since the investment and management come from a Japanese Thai company, the technology comes from the Japanese Thai company as well (Figure 1). In this case, Thai engineers are in charge to transfer technology.

Thai engineers do not have language problems in training workers in Laos and Cambodia. Lao language is quite similar to a dialect of the Thai language; and the Cambodia language has some common words with the Thai language.

For China+1, Japanese headquarters plays an important role in technology transfer as well (Figure3), since FDI decision is made by Jap-

nese headquarters. A Japanese Chinese company is also involved to some extent.

For Thailand+1', although FDI decision is made by the Japanese headquarters, technology transfer is mainly managed by a Japanese Thai company (Figure 4).

B. Assistance of Japanese Government

Responding to the Technology Transfer from Thailand by Thai engineers in the cases of Thailand+1, the Japanese government provides assistance accordingly.

One is the third country training (Figure 5). Trainees from CLMV countries come to Thailand, and they are trained by Thai trainers in Thailand. The other is a local training in each CLMV country, where Thai trainers are sent from Thailand. In both cases, Japanese trainers are sent from Japan when needed.

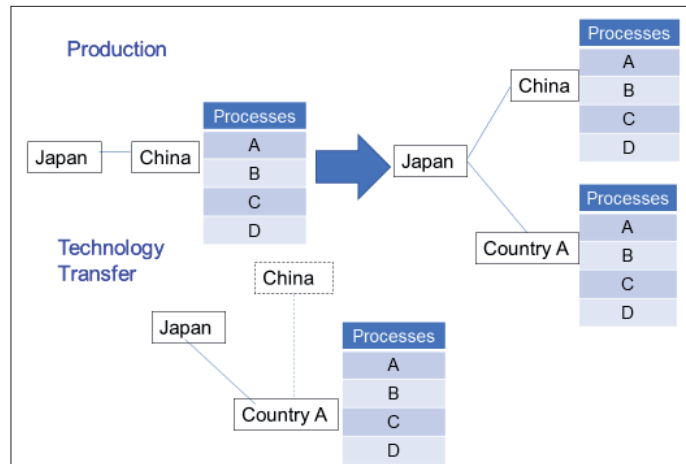


Figure 3. China+1

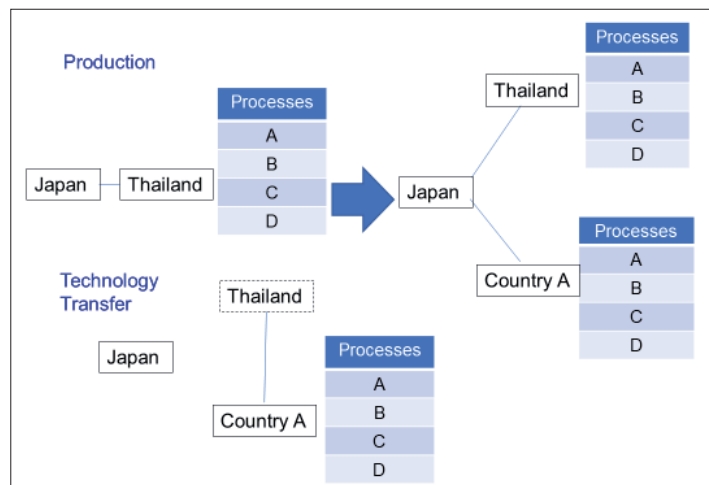


Figure 4. Thailand+1'

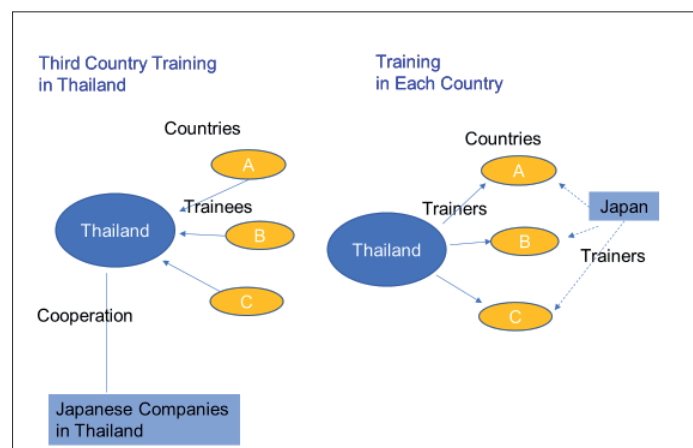


Figure 5. Assistance by the Japanese Government for Technology Transfer from Thailand by Thai Engineers

VIII. CONCLUSION

This paper has discussed two topics related to the competitiveness enhancement of Japanese companies in Thailand to cope with labor cost increase in Thailand. One is that automation using industrial robots in Thailand is promoted by Thai engineers with the assistance from Japanese engineers. The other is that a new scheme of technology transfer for Japanese companies is emerging associated with the strategies of Thailand+1. That is, technology transfer from Thailand by Thai engineers of Japanese Thai companies.

The merits of technology transfer from Thailand by Thai engineers are 1) self-confidence and affinity of trainees of CLMV countries, and 2) efficiency of time and budget. The trainees of CLMV countries feel “we can do it since Thais could do it”. They have geographic/cultural closeness with Thais, and they observe that Thais operate very well at the factories of Japanese companies in Thailand. They come to Thailand, not to Japan, for training. One possible demerit is that the trainees of CLMV countries might feel that they desire to learn from Japanese trainers directly.

In the future, research could be done with more case studies in the automobile industry and some other industries to further the fact finding. The other direction of future research could be a quantitative analysis to show the efficiency of the new technology transfer scheme.

ACKNOWLEDGEMENT

The author appreciates that the various interviewees kindly accepted my interviews.

REFERENCES

ITI. (2016). 2015FY Report: Can Mecon Region Take Advantage of Opportunities of China+1 and Thailand+1 (in Japanese), ITI Research Series No. 26, March 2016.

Japanese Patent Office. (2015). Patent Application Trend Report – Macro Study – (in Japanese), March 2015.

JETRO. (2018). 2018 Survey on Business Conditions of Japanese Companies in Asia and Oceania (in Japanese), December 2018.

JETRO. (2019). 2019 Survey on Business Conditions of Japanese Companies in Asia and Oceania (in Japanese), November 2019.

Kondo, M. (1999). Characteristics of Microelectronics Automation and the Role of Production Engineers – The Case of Japan Based on a Questionnaire Survey, *Human Factors and Ergonomics in Manufacturing*, Vol. 9 (2) 185-201, John Wiley & Sons, New York.

Kondo, M. (2010). Private-Sector-Driven International Technology Transfer with the Initiative of a Recipient Country - The Case of Technology Promotion Association (Thailand-Japan) -, *Proceedings of PICMET 2010, Phuket, Thailand, July 18-22, 2010*, pp. 527-534. ISBN: 1-890843-22-9.

Kondo, M. (2019). Japan’s Monozukuri Technology Transfer to Thailand+1 Destinations (in Japanese), *Proceedings of the 34th Annual Academic Conference of Japan Society for Research Policy and Innovation Management, Tokyo, October 26-27, 2019*, pp.382-386.

Kondo, M. (2019). Thai Industry: Automation and Robot Use are Advancing (in Japanese), *Techno Salon, Nikkei Business Daily Newspaper*, page 6, October 29, 2019

Kondo, M. (2021). Automation and “Thailand+1” Strategy of Japanese Companies in Thailand by Thai Engineers, *Proceedings of The 17th ASIALICS International Conference, Online, November 3-5, 2021*, pp. 302-314.

Oizumi, K. (2013). The Potential of the “Thailand-Plus-One” Business Model—A New Fragmentation in East Asia—, *RIM Pacific Business and Industries Vol. XIII, No. 50*, pp. 2-20.

Onozawa, M. (2013). Mekong Countries – How to use Thailand+1 – (in Japanese), *JETRO Sensor*, June 2013, pp. 56-57.

Seki, M. (1997). Beyond Hollowing Out (in Japanese), *Nihon Keizai Shimbun Shuppan*.

Umezaki, S. (2017). Current Status and Issues of Thailand+1 Investment (in Japanese), *IDE World Trend*, No. 265, P.5, November 2017.