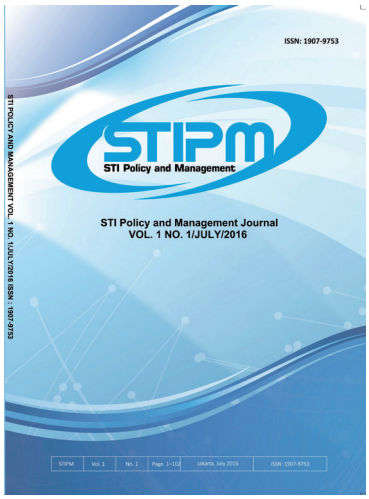

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Intellectual Property Creation of Japanese Companies in China and Thailand

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ABSTRACT

In the age of globalization, Japanese companies are globalizing their operations. They have recently been increasing the number of overseas R&D centers in Asia, especially in China and Thailand. Using the United States patent and industrial design data, the paper finds the following points quantitatively. Japanese companies are increasing the number of patents and industrial designs created in the two countries. They used local talents from the beginning in China for both patents and industrial designs. In Thailand, they used local talents for industrial designs from the beginning, while Japanese expertise in Thailand was used for patents in the beginning. In any case, the role of Japanese in Japan is important. Compared with multi-national companies (MNCs) from other countries, the IP creation activities of Japanese companies are weak compared to their amount of foreign direct investment to China and Thailand.

I. INTRODUCTION: JAPANESE-OWNED R&D CENTERS IN CHINA AND THAILAND

In the age of globalization, Japanese companies are globalizing their operations, including in research and development (R&D). Considering Japan's location in Asia, the number of overseas Japanese R&D centers in Asia has recently been increasing, especially in China and Thailand (Table 1).

The popularity of China and Thailand as choices for Japanese companies in establishing R&D centers is based on the fact that these two countries are the most popular choices as production sites for Japanese companies (Table 2).

This paper opens with research questions in the next section. Do these R&D centers operated by Japanese companies in China and Thailand create intellectual properties such as patents and industrial designs? Then, the paper explains the methodology to use the United States patent and industry design database. In Section III, the IP creation of Japanese companies is compared with that of multinational companies (MNCs) of other countries. The paper finds out that the IP creation activities of Japanese companies are weak compared to their amount of foreign direct

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Table 1.
Overseas R&D Sites of Japanese Companies

Ranking	2012	2011	2010
1	China 10.8%	China 9.8%	China 8.4%
2	The United States 6.0%	The United States 6.4%	The United States 6.0%
3	Western Europe 3.7%	Western Europe 4.7%	Western Europe 3.9%
4	Thailand 3.0%	Thailand 2.5%	Thailand 2.3%
5	Korea 2.0%	Korea 1.6%	Korea 1.5%

Note. The data means the ratio of companies that possess R&D sites in a respective country.

Source: JETRO (2012), 2011FY Survey on International Operations of Japanese Firms (in Japanese), March 2012 and JETRO (2013), 2012FY Survey on International Operations of Japanese Firms (in Japanese), March 2013.

Table 2.
Overseas Manufacturing Sites of Japanese Companies

Ranking	2012	2011	2010
1	China 43.8%	**China** 45.8%	**China** 46.2%
2	Thailand 18.5%	**Thailand** 21.8%	**Thailand** 24.1%
3	The United States 2.3%	The United States 15.9%	The United States 18.3%
4	Indonesia 11.0%	Indonesia 11.9%	Indonesia 11.9%
5	Vietnam 10.3%	Taiwan 10.4%	Taiwan 11.0%

Note. The data means the ratio of companies that possess manufacturing sites in a respective country.

Source: JETRO (2012), 2011FY Survey on International Operations of Japanese Firms (in Japanese), March 2012 and JETRO (2013), 2012FY Survey on International Operations of Japanese Firms (in Japanese), March 2013.

investment to China and Thailand. In Section IV, this paper analyzes how Japanese companies create intellectual properties (IPs) in China and Thailand, focusing on the utilization of local talents. The paper finds that local talents were employed from the beginning in China for both patents and industrial designs. In Thailand, they used local talents for industrial designs from the beginning, while for patents Japanese expertise in Thailand were used in the beginning. In all cases, the role of Japanese engineers in Japan was found to be important. Finally, the paper states concluding remarks.

II. RESEARCH QUESTIONS AND METHODOLOGY

A. Research Questions

The first research question here is whether Japanese companies create IPs in China and Thailand which are belong to upper-middle-income-conomies. According to the classification of overseas R&D centers by Ronstadt (1977), the R&D centers of Japanese companies in China and Thailand are Transfer Technology Units (TTUs) or Indigenous Technology Units (ITUs) because the prevalence of Japanese-owned factories in both China and Thailand imply a close relation to product manufacturing or product improvement.

If they create IPs in China and Thailand,

1. Who are the inventors? Are there local engineers or Japanese engineers in China and Thailand? Are Japanese engineers in Japan also involved?
2. How do the IP creation activities of Japanese companies differ between China and Thailand?
3. How do the IP creation activities of Japanese companies differ between patents and industrial designs?
4. How can the IP creation activities of Japanese companies be compared with those of MNCs from other countries?

Table 3.
FDI to China in 2012

	Country/Region	Amount (million US dollars)	Share(%)
1	Hong Kong	71,289	63.8
2	**Japan**	7,380	6.6
3	Singapore	6,539	5.9
4	Taiwan	6,183	5.5
5	The United States	3,130	2.8
6	Korea	3,066	2.7
7	Germany	1,471	1.3
8	Netherland	1,144	1.0
9	The United Kingdom	1,031	0.9
10	Switzerland	878	0.8
	Others	9,605	8.6

Source: The author tabulated using the data on JETRO HP (October 31, 2013).

In order to answer these questions, the paper adopts a research approach as follows. The paper adopts a fact-finding approach rather than a hypothesis-proving approach or a hypothesis-finding approach since this is a new research area. To clarify the fact of the IP creation activities of Japanese companies, a quantitative approach is employed rather than a qualitative approach. The quantitative approach is explained in the next sub-section.

B. Methodology

In order to analyze the creation of patents and industrial designs by MNCs in China and Thailand, data are constructed and are analyzed as follows. The United States Patent and Trademark Office (USPTO) Registered Patent Database (1976–2013) was used to retrieve data.

The retrieval conditions for China were:

1. That China must be included as an Inventor Country; and
2. That a specific country must be included as an Assignee Country. In this paper, 'a specific country' is one of the top ten countries measured by foreign direct investment (FDI) amounts to China.[1]

Retrieved data were classified into patents and industrial designs. New plants were excluded. The nationality of each inventor was judged by name as the database has only addresses.

The retrieval conditions for Thailand were similar to those for China.

III. IP CREATION OF JAPANESE COMPANIES COMPARED WITH MNCS OF OTHER COUNTRIES

A. In China

First, we look at the FDI China received. The data detailing FDI to China in 2012 reveals that Hong Kong is an overwhelmingly large investor, occupying 63.8 percent of all FDI to China (Table 3). It may be the case that many MNCs established regional headquarter companies in Hong Kong that then invested in China. Hong Kong was followed by Japan, Singapore and Taiwan, whose shares ranged from 5 to 6 percent each.

In order to analyze the creation of patents and industrial designs by MNCs in China, data are constructed and are analyzed as follows. USPTO Registered Patent Database (1976 - 2013) was used to retrieve data as explained in Section II(B.

In China, Taiwanese and US companies were very active and created more than 7,000 patents (Table 4). They were followed by Hong Kong

[1] Patents could be applied for by local subsidiaries of MNCs. Such analysis was not conducted in this paper, since it is extremely difficult to identify the mother country of a MNC subsidiary by name only. In the case of Thailand, 267 US IPs were applied for by Thai companies and the author identified that a small portion of them were applied for by famous Singaporean subsidiaries, Taiwanese ones and Japanese ones.

companies (1,231 patents), Japanese ones (701 patents) and German ones (476 patents).

Taiwanese companies created more than ten times as many patents as Japanese companies in China, although they invested an amount similar to Japanese companies in China (Table 5). US companies also created more than ten times as many patents as Japanese companies in China, although they invested half the amount. German companies created 70 percent of patents of Japanese companies in China, although they invested only 20 percent of what Japanese companies did in China. Hong Kong companies, on the other hand, created a little less than two times of patents of Japanese companies in China, although they invested more than ten times of Japanese companies in China.

For industrial designs, Taiwanese companies and US companies were very active in China and created more than 1,000 industrial designs, though their ranking orders differed from the case of patents (Table 4). They were followed by Hong Kong companies, Japanese ones and Dutch ones.

When compared to the FDI amount, Taiwanese and US companies performed much better in the case of industrial designs than the case of patents. US companies created more than 27 times the number of industrial designs of Japanese companies; Taiwanese companies created more than 21 times the number (Table 5). Hong Kong companies created nearly ten times the number of industrial designs of Japanese companies, though they created a little fewer than twice the number patents of Japanese companies in China. For German companies, the situation in the case of industrial designs was the same in the case of patents.

In relation to the all registered patents and industrial designs at USPTO, Japanese companies were not active in creating patents and industrial designs in China. Though the data is only for the year 2012, the ratios of all registered patents and industrial designs at USPTO of MNCs of other countries compared with those of Japanese companies were smaller than the same ratios of patents and industrial designs created in China (Table 5).

B. In Thailand

The FDI data on Thailand in 2012 shows that Japan is an overwhelmingly large investor, contributing 63.5 percent of all FDI to Thailand (Table 6, Table 7). The position of Hong Kong in the case of China was taken by Japan in the case of Thailand, followed by Singapore, the Netherlands and the *United States* followed. Their shares were around three percent.

In order to analyze the creation of patents and industrial designs by MNCs in Thailand, data are constructed and are analyzed as follows. USPTO Registered Patent Database (1976 - 2013) was used to retrieve data as in the case of China.

Table 4.
Creation of Patents and Industrial Designs in China by MNCs (1976-2013)

Order of FDI Amount	Country/Region	Patents	Industrial Designs	Total
1	Hong Kong	(3)1231	(3)576	1807
2	**Japan**	(4)701	(5)62	763
3	Singapore	141	16	157
4	Taiwan	(1)7993	(2)1360	9353
5	The United States	(2)7150	(1)1697	8847
6	Korea	181	1	182
7	Germany	(5)476	41	517
8	Netherland	168	(4)78	246
9	The United Kingdom	58	21	79
10	Switzerland	321	36	357

Note. 1. Regarding the data of the United States, multiple counts among States might exist.
2. Numbers in ( ) show the ranking.

Source: The author tabulated using the data on JETRO HP on October 31, 2013.

Table 5.
IP Creation Indices of Top Five Patent Creating Countries in China

	FDI in China in 2012	Patents with an inventor in China	Industrial Designs with a Designer in China	Registered US Patents in 2012	Registered US Industrial Designs in 2012
Japan	1.0	1.0	1.0	1.0	1.0
Taiwan	1.1	11.4	21.9	0.2	0.5
The United States	0.5	10.2	27.4	2.4	6.6
Hong Kong	10.9	1.8	9.3	0.01	0.1
Germany	0.2	0.7	0.7	0.3	0.6

Source: The author.

Table 6.
FDI to Thailand in 2012 (the order of FDI amount)

	Country/Region	# of investments	Amount (million Baht)	Share(%)
1	**Japan**	761	348,430	63.5
2	Singapore	103	19,418	3.5
3	Netherland	36	17,971	3.3
4	The United States	49	17,890	3.3
5	Hong Kong	33	12,864	2.3
6	Australia	27	12,452	2.3
7	Taiwan	58	11,711	2.1
8	China	38	7,901	1.4
9	Malaysia	37	7,739	1.4
10	Switzerland	16	6,152	1.1
10	India	25	6,100	1.1

Source: The author tabulated using the data on JETRO HP (October 31, 2013).

Table 7.
FDI to Thailand in 2012 (the order of the number of FDI)

	Country/Region	# of investments	Amount (million Baht)	Share (%)
1	**Japan**	761	348,430	63.5
2	Singapore	103	19,418	3.5
3	Taiwan	58	11,711	2.1
4	The United States	49	17,890	3.3
5	Korea	48	3,988	0.7
6	China	38	7,901	1.4
7	Malaysia	37	7,739	1.4
8	Netherland	36	17,971	3.3
9	Germany	34	2,942	0.5
10	Hong Kong	33	12,864	2.3

Source: The author tabulated using the data on JETRO HP (October 31, 2013).

Retrieval conditions were similar to those in the case of China. The difference was that the top ten countries were retrieved using FDI amount or FDI by project numbers.

In Thailand, US companies were very active and created nearly 400 patents (Table 8). The rank is followed by Japanese companies (84 patents), German ones (32 patents), Taiwanese ones (22 patents) and Dutch ones (16 patents).

US companies created more than four times as many patents as Japanese companies in Thailand, although they invested only five percent the amount (Table 9). German, Taiwanese and Dutch companies each created 20 to 40 percent of the

patents created by Japanese companies, though their investment amount is less than five percent of Japanese companies.

For industrial designs, US companies were also in the lead with 41 industrial designs (Table 8). They were followed by Japanese companies, as was the case in patents, with 19 industrial designs. The ratio of industrial designs created by US companies compared with Japanese companies was 2.2. This ratio was much smaller that the US–Japan ratio in the case of patents.

The countries taking the third and fourth places differed from the case of patents. The third was Swiss companies (12 industrial designs); and the fourth was Hong Kong companies (10 industrial designs). The fifth was Taiwanese companies (2 industrial designs).

Based on their respective FDI amounts, German, Taiwanese and Dutch companies created industrial designs less actively when compared to Japanese companies (Table 9). However, US companies created industrial designs more actively than Japanese companies, based on their FDI amount.

When considering all registered patents and industrial designs at USPTO, Japanese companies were not very active in creating patents in Thailand. Though the data is only for the year 2012, the ratios of all registered patents at USPTO of MNCs of other countries compared with those of Japanese companies were smaller than the same ratios of patents created in Thailand (Table 9). For industrial designs, the situation was the opposite, though the number of industrial designs was small.

Table 8.
Creation of Patents and Industrial Designs in Thailand by MNCs (1976-2013)

Order of the number of FDI	Country/Region	Patents	Industrial Designs	Total
1	**Japan**	(2) 84	(2) 19	103
2	Singapore	3	0	3
3	Taiwan	(4) 22	(5) 2	24
4	The United States	(1) 369	(1) 41	410
5	Korea	4	0	4
6	China	2	1	3
7	Malaysia	0	0	0
8	Netherland	(5) 16	0	16
9	Germany	(3) 32	0	32
10	Hong Kong	9	(4) 10	19
Within Top 10	Australia	9	0	9
regarding FDI	Switzerland	9	(3) 12	21
Amount	India	1	0	1

Notes. 1. The data period is 1976-August 2013 for the United States.
2. Numbers in ( ) show the ranking.
Source: The author tabulated using the data on JETRO HP (October 31, 2013).

Table 9.
IP Creation Indices of Top Five Patent Creating Countries in Thailand

	FDI in Thailand in 2012	Patents with an inventor in Thailand	Industrial Designs with a Designer in Thailand	Registered US Patents in 2012	Registered US Industrial Designs in 2012
Japan	**1.00**	**1.0**	**1.0**	**1.0**	**1.0**
The United States	0.05	4.4	2.2	2.4	6.6
Germany	0.01	0.4	0.0	0.3	0.5
Taiwan	0.03	0.3	0.1	0.2	0.5
Netherland	0.05	0.2	0.0	0.04	0.1

Source: The author.

In comparison, the performance of Japanese companies was different in China. In China, Japanese companies were relatively good in creating patents relative to the MNCs of other countries – better than in creating industrial designs, while they were relatively good in creating industrial designs relative to the MNCs of other countries than in creating patents in Thailand (Table 5 and 9).

IV. ROLE OF LOCAL ENGINEERS, THAT OF LOCAL JAPANESE ENGINEERS AND THAT OF JAPANESE ENGINEERS IN JAPAN

A. In China

For patents, Japanese companies started creating patents in China in the 1980s. They increased the number of patents created in China gradually and made a rapid increase in the 2000s.

The roles of Chinese and Japanese engineers in China as well as Japanese engineers in Japan were as follows. Chinese engineers were main inventors from the 1980s and Japanese engineers in China became more involved as time passed by (Table 10 and Figure 1). Cases where no Chinese engineers were involved increased though the absolute number was small. Japanese engineers in Japan were involved in any cases to a large extent. As Subramaniam and Venkatraman (2001) suggest, cross-national teams have great new product development capability. The presence of Japanese engineers in Japan was apparent in the cases where no Chinese were involved. As a whole the involvement of Japanese engineers in Japan was decreasing.

For industrial designs, Japanese companies started creating industrial designs in China recently in the 2000s. They increased the number of industrial designs created in China gradually.

The roles of Chinese designers, Japanese designers in China and Japanese designers in Japan were as follows (Table 11 and Figure 1). Japanese companies started creating industrial designs mainly by Chinese designers and to some extent by Japanese designers in China. The involvement of Japanese designers in Japan was a little more than half in the cases where Chinese designers were involved and was heavy in the cases where Chinese designers were not involved and Japanese designers in China were involved.

B. In Thailand

For patents, the creation activities of Japanese companies in Thailand started in the late 1980s. The number of patents created in Thailand

Table 10.
The Changes of the Roles of Chinese Engineers in Patent Creation (unit: %)

Decade	With Chinese inventors (of which with Japanese inventors in Japan) <of which with Japanese inventors in China>	With no Chinese inventors		Total (of which with Japanese inventors in Japan)
		With Japanese inventors in Japan (of which with Japanese inventors in Japan)	With no Japanese inventors in Japan (of which with Japanese inventors in Japan)	
1980s	100(56)			100(56) **9 patents**
1990s	93(69) <2>	7(100)		100(71) **45 patents**
2000s	80(45) <6>	19(90)	1(71)	100(54) **471 patents**
2010s	79(37) <21>	21(100)		100(33) **24 patents**

Note. The number of data in the 1980s (1984–1989) and the number of data in the 2010s (2010–2011) are limited.
Source: The author.

Table 11.
The Changes of the Roles of Chinese Designers in Industrial Design Creation (unit: %)

Decade	With Chinese inventors (of which with Japanese inventors in Japan) <of which with Japanese inventors in China>	With no Chinese inventors		Total (of which with Japanese inventors in Japan)
		With Japanese inventors in Japan (of which with Japanese inventors in Japan)	With no Japanese inventors in Japan (of which with Japanese inventors in Japan)	
1980s	-	-	-	-
1990s	-	-	-	-
2000s	88(54)<4>	6(100)	6(50)	100(56) **32 designs**
2010s	100(95)			100(95) **20 designs**

Note. Both the number of data in the 2000s (2003–2009) and the number of data in the 2010s (2010–2012) are limited.
Source: The author.

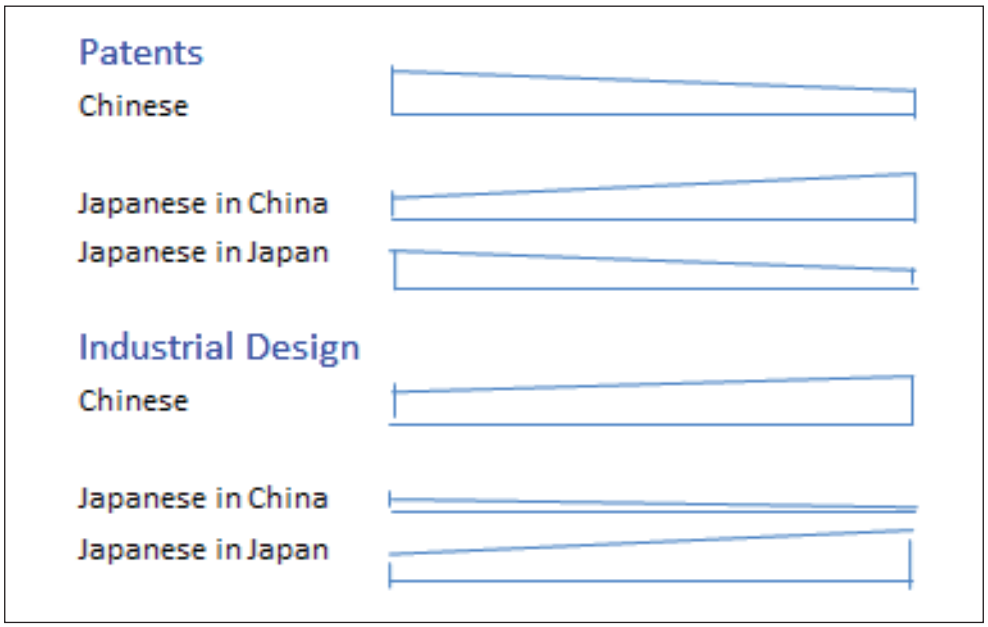


Figure 1. The Changes of the Roles of Chinese Designers in Industrial Design Creation (unit: %)

gradually increased, making a rapid increase in the 2000s.

The roles of Thai and Japanese designers in Thailand as well as Japanese designers in Japan in this case differed from the case in China. In the beginning, patents were created by Japanese engineers in Thailand together with Japanese engineers in Japan (Table 12 and Figure 2). In the 1990s Thai inventors started to appear. Additionally, some foreigners in Thailand were sole inventors. In the 2000s, the role of Thai engineers became substantial in patent creation, though the role of Japanese engineers in Thailand were still important. In all previous decades, Japanese engineers in Japan were closely involved, though their role has slightly diminished recently. An interesting factor is the involvement of inventors in other countries in patent creation. In other words, some patents were created through an international network.

The situation was quite different in the case of industrial designs. The industrial design activities of Japanese companies in Thailand started only in the latter half of the 2000s. The design

Table 12.
The Changes of the Roles of Thai Engineers in Patent Creation (unit: %)

Decade	With Thai inventors (of which with Japanese inventors in Japan) <of which with Japanese inventors in Thailand>	With no Thai inventors		Total (of which with Japanese inventors in Japan)
		With Japanese inventors in Japan (of which with Japanese inventors in Japan)	With no Japanese inventors in Japan (of which with Japanese inventors in Japan)	
1980s		100 (100)		100 (100) **2 patents**
1990s	11(100)<0>	47(78)	42(0)	100(53) **19 patents**
2000s	52(69)<14>	46(54)	2(100)	100(63) **56 patents**
2010s	33(0)<0>	33(50)	33(0)	100(17) **6 patents**

Note. The number of data in the 1980s (1988–1989) and the number of data in the 2010s (2010–2012) are limited.
Source: The author.

Table 13.
The Changes of the Roles of Thai Designers in Industrial Design Creation (unit: %)

decade	With Thai inventors (of which with Japanese inventors in Japan) <of which with Japanese inventors in Thailand>	With no Thai inventors		total (of which with Japanese inventors in Japan)
		With Japanese inventors in Japan (of which with Japanese inventors in Japan)	With no Japanese inventors in Japan (of which with Japanese inventors in Japan)	
1980s	-	-	-	-
1990s	-	-	-	-
2000s	91(100)<0>	9(100)		100(100) **11 designs**
2010s	88(71)<0>	13(0)		100(63) **8 designs**

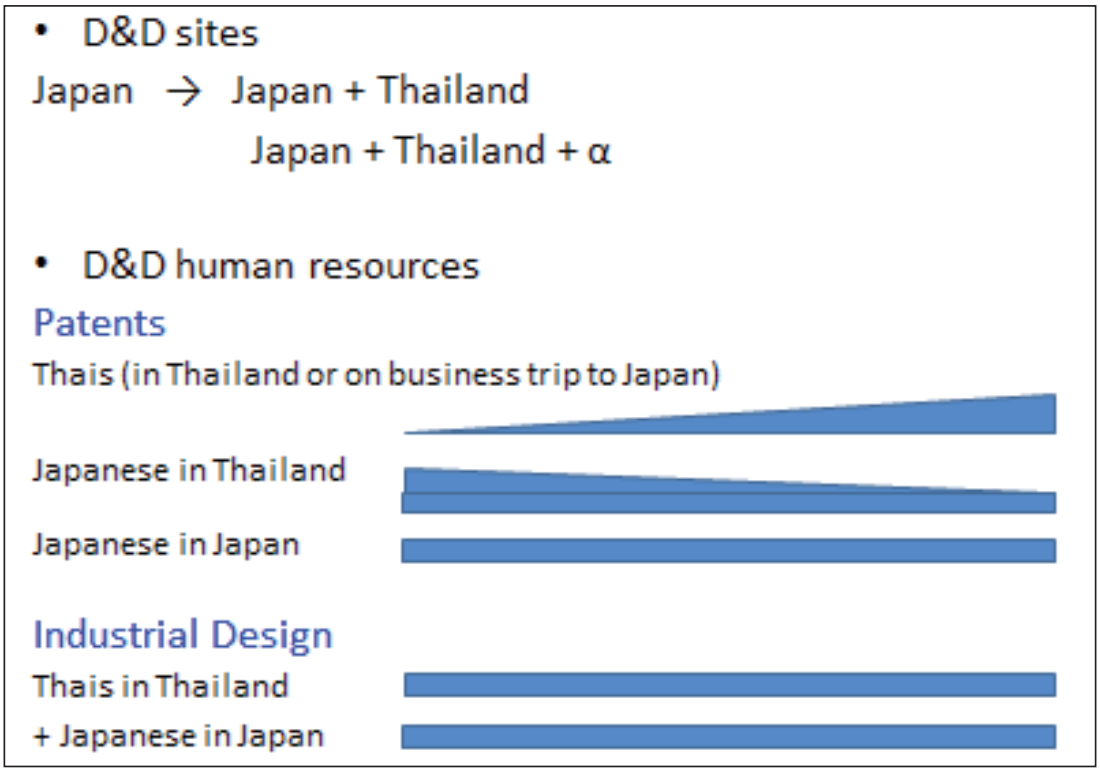
Note. Both the number of data in the 2000s (2006 -2009) and the number of data in the 2010s (2010 -2012) are limited.
Source: The author.

activities were conducted by Thai designers in Thailand and Japanese in Japan (Table 13 and Figure 2). The international comparison of the involvement of Thai engineers was conducted by checking the names of inventors of the patents created by MNCs from various countries[2].

For patent creation, US and Taiwanese companies showed a high level of involvement of local talents. More than 70 percent of the patents created by these MNCs involved Thai engineers (Table 14). Dutch companies also involved Thai engineers in more than 60 percent of their patents created in Thailand. Both Japanese and German companies involved Thai engineers in only 60 percent of their patents created in Thailand.

For industrial design creation, Japanese and Hong Kong companies showed a high involvement of local talents (Table 14). Japanese companies involved Thai designers in nearly 90 percent of their industrial designs created in Thailand. US and Taiwanese companies involved Thai designers in around 50 percent of their industrial designs created in Thailand.

[2] For the case of China, the analysis is still in progress for non-Japanese companies.



Source: The author.
Figure 2. D&D (Design and Development Function Transfer

Table 14.
Involvement of Thai Inventors (1976–2013)

Country/Region	Patents	The Ratios of Thai Engineer Involvement	Industrial Designs	The Ratios of Thai Designer Involvement
The United States	(1) 369	72%	(1) 41	46%
Japan	(2) 84	38%	(2) 19	89%
Germany	(3) 32	34%	0	—
Taiwan	(4) 22	75%	(5) 2	50%
Netherland	(5) 16	63%	0	—
Switzerland	9	11%	(3) 12	8%
Hong Kong	9	89%	(4) 10	80%

Notes. 1. The data period is 1976-August 2013 for the United States.
2. Four patents from Netherland with Thai inventors are the patents of Hitachi Global Storage Company.
3. Numbers in ( ) show the ranking.
Source: The author.

V. CONCLUDING REMARKS

This paper analyzed IP creation activities of Japanese companies in China and Thailand, where they own many overseas factories and overseas R&D centers.

The paper has found out that Japanese companies create IPs in China and Thailand but their IP creation activities are not so vigorous in comparison to their FDI to China and Thailand. In China, US and Taiwanese MNCs create IPs very vigorously in comparison to their FDI to China. In Thailand, US MNCs and those from other countries create IPs vigorously in comparison to their FDI to Thailand.

The level of local talent mobilization in creating IPs depends on the country. In China, for patents, the level of involving Chinese en-

gineers was high from the beginning. A small shift occurred from Japanese engineers in Japan to Japanese engineers in China. For industrial designs, the level of involvement of Chinese designers was high from the beginning as well; and the involvement of Japanese designers in Japan increased.

In Thailand, for patents, the level of involvement of Thai engineers was low in the beginning and became greater. The role of Japanese engineers in Japan decreased slightly. For industrial designs, the level of involvement of Thai designers was high from the beginning instead. The importance of the role of Japanese designers in Japan remained unchanged.

The author is interested in Japanese company IP creation activities in other countries such as India and Russia and plans to pursue further details in the case of China and Thailand by more case studies.

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