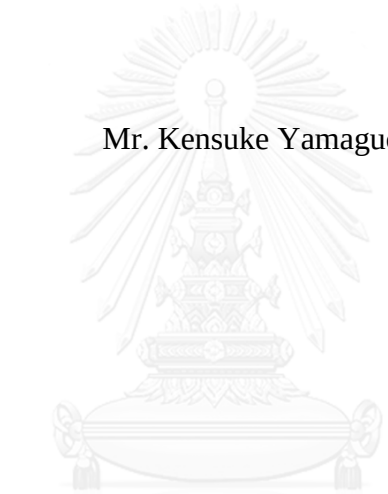
PETROCHEMICAL INDUSTRY IN MAP TA PHUT AND AUTOMOTIVE INDUSTRY IN LAEM CHABANG: A COMPARATIVE STUDY OF INDUSTRIAL ADAPTATION IN EASTERN SEABOARD

Mr. Kensuke Yamaguchi



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อุตสาหกรรมปิโตรเคมีในเขตมาบตาพุดและอุตสาหกรรมยานยนต์ในเขตแหลมฉบัง: การศึกษาเปรียบเทียบการปรับตัวของอุตสาหกรรมในพื้นที่ชายฝั่งทะเลตะวันออก

นายเคนสุเกะ ยามะกุชิ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาอักษรศาสตรดุษฎีบัณฑิต
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Thesis Title	PETROCHEMICAL INDUSTRY IN MAP TA PHUT AND AUTOMOTIVE INDUSTRY IN LAEM CHABANG: A COMPARATIVE STUDY OF INDUSTRIAL ADAPTATION IN EASTERN SEABOARD
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เคนสุเกะ ยามะกุชิ : อุตสาหกรรมปิโตรเคมีในเขตมาบตาพุดและอุตสาหกรรมยานยนต์ในเขตแหลมฉบัง: การศึกษาเปรียบเทียบการปรับตัวของอุตสาหกรรมในพื้นที่ชายฝั่งทะเลตะวันออก (PETROCHEMICAL INDUSTRY IN MAP TA PHUT AND AUTOMOTIVE INDUSTRY IN LAEM CHABANG: A COMPARATIVE STUDY OF INDUSTRIAL ADAPTATION IN EASTERN SEABOARD) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ. ดร. มนัสกร ราชากรกิจ, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ. ดร. นวลน้อย ตรีรัตน์ , หน้า.

วิทยานิพนธ์นี้มีเป้าหมายในการศึกษาการพัฒนาชายฝั่งทะเลตะวันออก โดยวิเคราะห์ความแตกต่างระหว่างอุตสาหกรรมปิโตรเคมีและอุตสาหกรรมยานยนต์อันสืบเนื่องจากสภาพการเปลี่ยนแปลงทางธุรกิจ เพื่ออธิบายสาเหตุที่อุตสาหกรรมปิโตรเคมีหดตัวลงท่ามกลางการแข่งขันโลก เมื่อเปรียบเทียบกับอุตสาหกรรมยานยนต์ที่ยังสามารถคงขีดความสามารถทางเทคโนโลยีและการแข่งขันได้ นับแต่การเกิดวิกฤตทางการเงินในภูมิภาคเอเชีย

ประเด็นการอภิปรายที่ผ่านมามีเพียงการเชิดชูการพัฒนาทางเศรษฐกิจของภูมิภาคจากมุมมองของหน่วยงานรัฐหรือการประณามผลกระทบเชิงลบที่เกิดขึ้นทางด้านสังคมและสิ่งแวดล้อมเท่านั้น แต่ไม่มีการหยิบยกประเด็นความแตกต่างของอุตสาหกรรมทั้งสอง วิทยานิพนธ์นี้วิเคราะห์และยกประเด็นโครงข่ายระบบอุตสาหกรรมยานยนต์ที่มีการพัฒนาขึ้นเป็นระบบโครงข่ายซึ่งสลายพรมแดนของบริษัทต่างๆ และคงความได้เปรียบด้านธุรกิจในภูมิภาคนี้

จากการสัมภาษณ์แบบกึ่งโครงสร้าง อุตสาหกรรมปิโตรเคมีมีลักษณะของระบบอุตสาหกรรมเป็นรูปแบบเอกเทศ ประการแรกองค์กรระดับภูมิภาคที่เกิดขึ้นจากทางธุรกิจนี้ไม่ให้ความสำคัญด้านการมีปฏิสัมพันธ์ทางสังคม ประการที่สองโครงสร้างอุตสาหกรรมของบริษัทที่มีเพียงสองสามแห่ง มีการพัฒนาเป็นแนวดิ่งและเชื่อมโยงกันเองในกลุ่มของตนเท่านั้น ประการที่สามกลุ่มบริษัทเหล่านี้มีระบบบริหารและการตัดสินใจแบบศูนย์กลาง

แต่ในอีกด้านหนึ่ง อุตสาหกรรมยานยนต์กลับมีลักษณะเป็นระบบอุตสาหกรรมโครงข่าย ประการแรกองค์กรที่มีระบบบริหารแบบล่างสู่บนได้ช่วยเสริมสร้างการปฏิสัมพันธ์ทางสังคมระหว่างวิศวกรชาวไทยที่มีความชำนาญ ประการที่สองโครงสร้างอุตสาหกรรมของไทยส่วนใหญ่ไม่ได้พึ่งพาระบบห่วงโซ่อุปทานแนวดิ่งของญี่ปุ่น ประการที่สามองค์กรธุรกิจเป็นแบบกระจายอำนาจและแรงงานที่มีความชำนาญสามารถทำงานตามวิจารณญาณของตนได้ระดับหนึ่ง

วิทยานิพนธ์นี้จึงสรุปข้อแนะนำสามประการดังนี้ ประการแรกอุตสาหกรรมปิโตรเคมีควรพิจารณาการเปลี่ยนรูปแบบจากบริษัทเอกเทศเป็นรูปแบบโครงข่าย โดยไม่กระจุกตัวกันเฉพาะในกลุ่มอุตสาหกรรมพลังงาน ประการที่สองระบบอุตสาหกรรมปิโตรเคมีควรใช้ประโยชน์จากพลวัตของอุตสาหกรรมยานยนต์ที่ตั้งอยู่ใกล้เคียง ประการที่สามสำหรับการเชื่อมโยงในระดับภูมิภาคควรเป็นการร่วมมือจากล่างสู่บนเพื่อนำไปสู่การเป็นศูนย์กลางเครือข่ายทางสังคมของภูมิภาค

อย่างไรก็ตามวิทยานิพนธ์นี้ยังคงเหลือคำถามที่สำคัญสำหรับการศึกษาเพิ่มเติม ได้แก่สาเหตุของการพัฒนาที่เป็นเอกเทศของบริษัทในอุตสาหกรรมปิโตรเคมีในประเทศไทย ซึ่งควรศึกษาจากมุมมองของพฤติกรรมการแสวงหาค่าเช่าทางเศรษฐกิจของทรัพยากรพลังงาน

สาขาวิชา ไทยศึกษา ลายมือชื่อนิสิต .....

ปีการศึกษา 2559 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

ลายมือชื่อ อ.ที่ปรึกษาร่วม .....

5680524622 : MAJOR THAI STUDIES
KEYWORDS: INDUSTRIAL ADAPTATION / PETROCHEMICAL INDUSTRY / AUTOMOTIVE INDUSTRY / RESOURCES CURSE / EASTERN SEABOARD DEVELOPMENT

KENSUKE YAMAGUCHI: PETROCHEMICAL INDUSTRY IN MAP TA PHUT AND AUTOMOTIVE INDUSTRY IN LAEM CHABANG: A COMPARATIVE STUDY OF INDUSTRIAL ADAPTATION IN EASTERN SEABOARD. ADVISOR: ASST. PROF. MANASKORN RACHAKORNKIJ, Ph.D., CO-ADVISOR: ASSOC. PROF. NUALNOI TREERAT, Ph.D., pp.

Focusing on the Eastern Seaboard Development, this dissertation addresses differences between the petrochemical industry and automotive industry in responding to a changing business environment. It explains why the automotive industry, in contrast with the petrochemical industry which has declined in the face of global competitions, remains technologically dynamic and competitive since the Asian financial crisis.

Current debates—which either glorify the region's economic development from the bureaucratic perspectives or which vilify its adverse impact from social and environmental perspectives—don't address the difference of two industries. The dissertation argues that a network-based industrial system is emerging in the automotive industry which is blurring supporting-firms boundaries and sustaining regional advantage.

Based on semi-structured interviews, the character of the independent firm-based industrial systems is found out regarding the petrochemical industry. First, regional lobbying organizations are indifferent to the pattern of regional social interaction. Second, industrial structure is heavily vertically integrated in a few major corporate groups where inter-group transactions are rare. Third, the corporate groups have their own centralized management and decision-making systems.

On the other hand, the automotive industry has the character of the network-based industrial system. First, a bottom-up organization helps to create and sustain regular patterns of regional social interaction among skilled Thai engineers. Second, the Thai industrial structure is largely independent of the traditional Japanese vertically-integrated supply chain system. Third, corporate organization is decentralized and skilled workers are at their discretion to act to some extent.

Three recommendations are drawn. First, it should be considered for the petrochemical industry to shift the character of the industrial system from being an independent firm-based one to a network-based one through an unbundling of energy industries. Second, the petrochemical industry should utilize the dynamism in the adjacent automotive industry. Third, for this regional integration, a bottom-up consortium is needed as a hub of regional social networking.

Still, the dissertation leaves a further important question for Thai study: what is the reason behind the fact that the petrochemical industry has an independent firm-based industrial system in Thailand? The question ought to be addressed through the lens of rent-seeking behaviors for energy resources.

Field of Study: Thai Studies
Academic Year: 2016

Student's Signature .....
Advisor's Signature .....
Co-Advisor's Signature .....

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Finally, I wish to thank all those who helped me both in Thailand and Japan throughout the three years of my doctoral study. Most of all, I would like to dedicate this dissertation to my wife, Yuka, and son, Kosuke, for their patience and endless support.

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CHAPTER 1: INTRODUCTION

1.1 Nation States and Energy Resources

1.1.1 Background

This dissertation will address the relationship between nation states and energy resources. The securing of energy resources has always been one of the most critical drivers for any country's development since the Industrial Revolution. Thus, resource contestations can bring on hefty disputes and have triggered World Wars. Indeed, a motivation behind Japan's expansion during World War II was to secure oil resources. Even after the Wars, the securing of energy resources remains critical drivers for international dynamisms. For example, the European Coal and Steel Community (ECSC) was the original body for today's European Union (EU). Also, the Organization of the Petroleum Exporting Countries (OPEC) has been influencing international society through its control of the oil price.

Saudi Arabia, one of the OPEC members, has been developing its economy since March 1938 when the Dammam oil reserve was discovered in Dhahran. After World War II, the country expanded energy development and oil production resulting in the country's prominent presence on the international stage. Triggered by the outbreak of the 4th Middle East War in October 1973, OPEC increased the oil price without a proper coordination with the other international oil players, resulting in a four-fold price increase by December. Since this particular oil shock, OPEC, including Saudi Arabia has been increasingly influential in international relations. Moreover, it is not only OPEC members but also a number of other countries that have achieved development through their control of energy resources. For example, Norway has been successful in its macroeconomic development through its sovereign wealth fund - the National Insurance Fund - based on revenue from Norwegian oil exports.

Yet, it should be noted that the possession of energy resources does not automatically bless nation states. The resource can even be a curse. Consider the example of Nigeria, an OPEC member country. The country began oil developments in the Niger Delta in 1956. Since then, the country had increased oil production which also increased government revenue. Nigeria became an OPEC member in the mid-1970s. But at the same time, local communities near the oil reserve were still struggling against poverty. When the tax revenue allocated to local governments declined due to the end of the oil boom, community frustration eventually burst into social turmoil. Currently, resource conflicts and civil wars are repeating themselves. The 'curse' of resources is happening not only in Nigeria but also in other African countries such as Ghana, Uganda, Tanzania, and Mozambique. We can also observe some energy-related problems in the gas dispute between Russia and Ukraine.

This dissertation focuses on the natural gas in Thailand. This resource has significantly affected the country's recent developments, and shows both aspects of curse and blessing. On one hand, the natural gas has been utilized for a petrochemical industry development in the Eastern Seaboard (ESB) Region, which has developed the country's economy. On the other hand, it seems the industry is not so flexible to adapt a changing business environment while an adjacent automobile industry has well adapted. Based on this case study, this dissertation aims to draw implications for institutions which aim to minimize the curse factor in resource possession and to enhance the blessing factor.

1.1.2 Objectives

Objectives of this dissertation are:

1) To explain differences between petrochemical industries in Map Ta Phut (MTP) and automotive industries in Laem Chabang (LCB) responding to a changing business environment

2) To analyze the factors affecting adaptive capacity of the two industries
3) To draw recommendations for a further sustainable regional development in the Eastern Seaboard region

1.2 Recent Studies on the Thai Political Economy

1.2.1 Post-Bureaucratic Polity

There are some traditions in the school of the Thai political economy. Drastic revisions became inevitable for the school because of structural changes in its political economy from the 1980s to the 1990s. Thanks to the massive increase of Foreign Direct Investment (FDI) since 1988, the country has improved performance in its manufacturing sector and it has been called one of the Newly Industrialized Countries (NICs). This structural change was linked with political regime shifts such as deepening party politics after General Chartchai Chunhavan, the recession of the military influence and the progress of democracy after the Black May incident in 1992. Thus, the previous framework could not capture the Thai political economy properly and needed revisions. A previous review points out that there have been three approaches in the recent development[1](Suehiro & Higashi, 2000).

The first approach is post-bureaucratic polity. Notably, the most prominent figure to discuss bureaucratic polity in Thailand was Fred Riggs[2](Riggs, 1966). Observing Thai politics in the 1950s, he pointed out the following three phenomena. First, the political elite were dominated by bureaucracy without control by extra-bureaucratic political institutions such as parliament and political parties. Second, in the decision-making process of budget allocation for economic development, official institutions such as the budget committee in parliament were quite weak while informal drivers such as conflicts of interest between ministries and patron-client relationships were significantly influential. The process was not transparent and

[1] See Suehiro and Higashi (2000).
[2] See Riggs (1966), for example.

institutionalized. Third, Chinese businessmen requested a variety of political asylum when they gave a political donation to the Thai bureaucracy. As pariah entrepreneurs, Chinese businessmen deepened cozy relationships with the Thai bureaucracy.

The perspective of bureaucratic polity was quite dominant in the 1950s and 1960s before the new political movement. In the 1970s, Benedict Anderson, a prominent scholar on nationalism, initiated the criticizing of this perspective when he saw the political turmoil leading toward the "14 October 1973 uprising" as a consequence of the rise of the urban-middle class[3](Anderson, 1977). The study was followed by a number of case studies. For example, in criticizing the first point of bureaucratic polity, Kroekkiat Phiphatseritham found that a number of ministers after 1975 were business elites not dominated by bureaucracies[4](เกริกเกียรติ พิพัฒน์เสรีธรรม, 2525).

Also, with regards to the second point on public institutions, Anek Laothamatas addressed the importance of the Joint Public and Private Sector Consultative Committees-- Ko. Ro. Oo.-- and relevant organizations in policy-making processes in the 1980s[5](Anek Laothamatas, 1992). He pointed out the increasing importance of those capitalist groups and the declining influence of informal drivers such as conflicts of interest between ministries and patron-client relationships. This was also verified in the Thai policy-making process after the second oil shock[6](Muscat, 1994).

As for the third point, a number of recent studies since the 1980s on the Thai family business have criticized the fact that Chinese businessmen, seen as pariah entrepreneurs, have deepened a cozy relationship with the Thai bureaucracy[7](เกริกเกียรติ พิพัฒน์เสรีธรรม, 2525) (Kraisak Choonhavan, 1984) (Hewison, 1989) (Suehiro, 1989). The Chinese-Thai family business is more influential than traditional pariah entrepreneurs.

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[3] See Anderson (1977).
[4] See **เกริกเกียรติ** (2525).
[5] See Anek (1992).
[6] See Muscat (1994).
[7] See, for example, **เกริกเกียรติ** (2525), Kraisak (1984), Hewison (1989),and Suehiro (1989).

For example, the 1985 study by Pisan and Guyot was symbolically titled "Bureaucratic Polity at Bay"[8](Pisan Suriyamongkol & Guyot, 1985). It clearly stated that pariah entrepreneurs were the heritage of the past and that the new Chinese-Thai family has emerged with educated people preferring careers in the emerging private sector over the government sector or civil service.

Others also found that bureaucratic polity was at bay. Notably, Pasuk Phongpaichit and Chris Baker, leading figures in the study of Thai political economy, pointed out that non-bureaucrats such as urban and local capitalists, new technocrats, and other emerging stakeholders have become critical political actors in the policy-making process[9](Pasuk Phongpaichit & Baker, 1998). As actors other than bureaucrats become more influential, the school of the Thai political economy needs to shed more light beyond the traditional bureaucratic polity onto the post-bureaucratic polity.

1.2.2 Stable Adjustment in Macroeconomy

Neoclassical economists have coherently pointed out the importance of market mechanisms in remarkable macroeconomic developments in East Asia. At the beginning of the 1980s, Bella Balassa, a Chief Economist at the World Bank, argued the critical importance of getting the "price mechanism" right, and attributed the elimination of market distortion by governments to macroeconomic development[10](Balassa, 1982). As represented by Narongchai Akraseranee, this view was shared among macroeconomists focusing on Thailand by the 1980s[11](Narongchai Akrasanee, 1973).

In the 1990s, the argument by revisionists and statists that nation states drive industrializations through significant market interventions counteracted the

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[8] See Pisan and Guyot (1985).
[9] See Pasuk and Baker (1998).
[10] See Balassa (1982).
[11] See Narongchai (1973).

neoclassical view[12](Amsden, 1992) (Deyo, 1987) (Wade, 1990) (Haggard, 1990). This counterargument was emphasized in the Thai context when economic growth became very strong after structural adjustment policy by General Prem Tinsulanonda's government. It is noted that none other than the World Bank studied the mechanism of stable economic growth and the importance of fiscal and debt policy[13](Warr, 1996).

The study examined the way the Thai government had dealt with recent exogenous shocks such as the primary commodity boom from 1972 to 1974, the first oil shock from 1973 to 1975, the second oil shock from 1978 to 1979, and the FDI boom from 1987 to 1990. It specifically examined the fiscal policy dealing with the expected inflation due to the surge of imported goods during those exogenous shocks. As a result, the World Bank observed that the market mechanism adapted itself toward these exogenous dynamisms and that the significance of fiscal policy was limited in itself. It should be noted that the aim of the fiscal policy is to make market mechanisms work properly by targeting discretionary change.

Do government policies have a significant impact on economic development? It has been argued that the industrial policy of a government is not always relevant to the country's rapid industrialization. Scott Christensen strongly disagrees; he argues that the industrial policy was not only relevant but it could also have adverse effects such as allowing for political corruptions and political opportunisms[14](Christensen, Dollar, Amar Siamwalla, & Pakorn Vichyanond, 1992). While the significance of government policy may be limited, market mechanisms have led the Thai economic development. Based on these understandings, the current argument on development has shed its light more on institutions which enable economic development by making the market work properly.

[12] See, for example, Amsden (1992), Deyo (1987), Wade (1990), and Haggard (1990).
[13] See Warr (1996).
[14] See Christensen et al. (1992).

1.2.3 Institutional Approach

Recently, scholars have suggested that the market mechanism is necessary but not sufficient in itself for economic development. Acknowledging market failure, they stress more on institutions which coordinate the conflict of interests among stakeholders[15](Doner, 1992). Even though they also admit the limitations of governmental policies, they still emphasize the role of the government as a coordinator in the conflict of interests and in solving problems through collective actions[16](Hawes & Liu, 1993).

The seminal study in this approach was the study on Ko. Ro. Oo. by Rangsan Thanaphonphan under General Prem's government[17](รังสรรค์ ธนะพรพันธุ์, 2532). The study by Anek on business organization, introduced above in the discussion on post-bureaucratic polity, can also be located in this school. The most influential findings in this approach were given in a series of studies by Richard Doner[18](Doner, 1991) (Doner, 1992) (Doner & Unger, 1993) (Doner & Ramsay, 1997). He insisted that business organizations and Ko. Ro. Oo. were critical organizations in the Thai economic development. A special relationship between public and private sectors – Competitive Clientalism—sustained by those organizations has enabled sound competitions in the private sector.

Competitive clientalism originated from the cozy relationship between Chinese businessmen and Thai politicians during the times of bureaucratic polity. The relationship was not between a certain businessman and a certain politician, for Chinese businessmen tended to form an organization to deal or bargain collectively with the politicians. After all, a particular politician might not stay in power for a long

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15 This institutional approach originates from comparative politics. The approach refers institutions as a coordinating organization in the conflict of interests for state's development (Doner 1992).
16 See, for example, Hawes and Liu (1993).
17 See **รังสรรค์** (2532).
18 See, for example, Doner (1991, 1992), Doner and Unger (1993), and Doner and Ramsey (1997).

time due to frequent regime changes. As a consequence, the cozy relationship between groups enabled a sound competition in the Thai economy.

This preferable public-private partnership was also pointed out in the study by Christensen, which focused more on the role of private banks as a coordinator[19](Christensen, 1993). Also, this type of coordination can be interpreted as a certain social capital[20](Unger, 1998). Furthermore, in focusing on institutions, a number of case studies were specifically conducted in the agro-industry and the banking and telecommunication sectors[21](Suehiro, 1987) (Sakkarin Niyomsilpa, 2000) (Christensen, 1993) (พัชรี สิโรรส และสมชาย ภคภาสน์วิวัฒน์, 2538) (Maxfield, 1998).

1.3 Approach of this Dissertation

1.3.1 Modification of the Institutional Approach

Based on Thailand as a case study, this dissertation aims to draw an implication for institutions which enable nation states to escape from the curse and to enjoy the blessings of resources. Thailand has added value to its natural gas since the 1980s, enabling economic development in this country. Yet, the added-value has been declining especially since 2000. In short, while the natural gas has blessed this state to some extent, it has not ensured its sustainable prosperity for a longer term.

The second approach—Stable Adjustment in Macroeconomy—cannot properly capture the governmental resource policy, for the approach focuses on market mechanisms. Yet, market mechanisms have not extracted all the benefits from natural resources. It tends to be the governmental policy which has enabled this extraction. As is the case of Thailand, the government policy is one of the key factors in adding value to natural gas, so we cannot exclude it from our scope at all.

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19 See Christensen et (1993).
20 See Unger (1998).
21 See, for example, Suehiro (1987), Sakkarin (2000), Christensen (1993), **พัชรี**(2538), and Maxfield (1998).

Also, the first approach—post-bureaucratic polity—cannot properly address the Thai case. Surely, one of the key actors in economic development based on natural gas is its state energy enterprise. The driver by this new actor might be analyzed in the post-bureaucratic polity approach. Yet, this analysis itself cannot explain the trend of a declining added-value from natural gas since 2000. The trend cannot be resisted without a drastic change of stakeholders.

This dissertation will follow the school of the Third approach--Institutional Approach—and focus on the relevant institutions in addressing the recent added-value on natural gas in Thailand. In taking this approach, I would pay attention to three additional areas in this dissertation. First, institutions should be analyzed in relation to industrial structures and labor market. Following in the traditions of scholars in comparative politics, the Institutional Approach focuses on the role of institutions in relevant policy processes. Yet, this focus does not explain an economic performance which depends on industrial structures and labor market.

Secondly, the first attention is justified when we observe that institutions seemingly irrelevant to economic policy often have more significant impact on economic performances than those created to implement policies. Indeed, the number of Ko. Ro. Oo., which is the typical subject in this Institutional Approach, has been declining since the Chartchai government. The significance of relevant business organizations in economic performance has also been decreasing.

On the other hand, the increase in FDI in the 1990s has meant the emergence of more bottom-up institutions. These have had an economic impact through their conflicts of interests in the private sector. It is noted that the character of this bottom-up institution is path-dependent in accordance with local contexts. Thus, this dissertation shall focus on the bottom-up institutions under the local context in the Eastern Seaboard (ESB).

Thirdly, this dissertation would nevertheless never negate the role of the government. Following the tradition of the Institutional Approach, I shall make the case that the government has a role in coordinating conflicts of interests and in solving collective-action problems. One of the reasons why some relevant business organizations only have a limited function in recent economic development is the dynamism of a rapidly globalizing business environment. Those organizations are not effective anymore because the business environment is so much more dynamic. The government is in need of a new coordination.

1.3.2 Chapters in this Dissertation

Chapter 2 gives an overview of the way Thailand has utilized the natural gas in the Gulf of Thailand. Notably, the country depends on natural gas for 70% of its power generation. This is used by household consumers but also by industries, in particular, the petro-chemical industry which improves economic viability. This was the key for the country to escape from the resource curse. The chapter describes how the country developed its off-shore reserves, how it utilized its resources effectively for its petrochemical industry, and how it advanced the Eastern Seaboard (ESB) development plan.

Chapter 3 explains the analytical framework for sustainability in the ESB industrial region. This is critical in helping Thailand to escape the resources curse. We will also see how there is a sharp contrast in the responses of the petrochemical and automotive industries in the ESB toward recent business dynamisms. While the petrochemical industry has difficulty in adapting to changes, the automotive industry has adapted well. This is not a new problem but an age-old problem as post-Fordism literature since the 1970s has long discussed regional adaptations toward harsher competitions. Based on this literature, the analytical framework to compare two industries in the ESB is drawn. Based on relevant semi-structured interviews, the performances of the petrochemical and automotive industries will be shown in Chapter 4 and Chapter 5, respectively.

Chapter 6 uses relevant quantified data to verify the results based on qualified data in previous chapters. First, using the ESB start-up date, I describe the historical development of both the petrochemical and automotive industries. Second, using the current snap-shot supply-chain data, I try to compare the character of economic transactions in both industries. Third, looking at other relevant cases outside Thailand, I examine how business transactions are actually dependent on the type of the industry. Summarizing the thesis, Chapter 7 draws implications based on the results and discussions in the preceding chapters.

CHAPTER 2: ADDING VALUE TO NATURAL GAS IN THE EASTERN SEABOARD OF THAILAND

Chapter 2 gives an overview of the way Thailand has utilized the natural gas in the Gulf of Thailand. Notably, the country depends on natural gas for 70% of its power generation. This is used by household consumers but also by industries, in particular, the petro-chemical industry which improves economic viability. This was the key for the country to escape from the resource curse. The chapter describes how the country developed its off-shore reserves, how it utilized its resources effectively for its petrochemical industry, and how it advanced the Eastern Seaboard (ESB) development plan.

2.1 Impact of China's Boom on Resource Dependence in Southeast Asia

Recently, the "resource curse" theory has been increasingly attracting attention among ASEAN countries[22](Ianchovichina & Martin, 2004) (Ianchovichina & Walmsley, 2005) (Ng & Yeats, 2003) (Weiss & Shanwen, 2003). It has been argued that a comparative advantage in natural resources actually contributes to low growth rates and thus to a divergence in per capita incomes between resource-rich and resource-poor economies. Famous papers by Sachs have asserted this finding on the basis of econometric results[23](Sachs & Warner, 1995) (Sachs & Warner, 2001). The following explanations can be offered for this phenomenon.

First, due to "Dutch Disease", exports of natural resource can inhibit growth in manufacturing exports[24]. As revenues from resource exports increase, the given nation's currency appreciates in relation to the currencies of other nations, resulting in

[22] See Ianchovichina and Martin (2004), Ianchovichina and Walmsley (2005), Ng and Yeats (2003), and Weiss and Shanwen (2003).
[23] See, for example, Sachs and Warner (1995, 2001).
[24] The Dutch Disease is the causal relationship between the increase in the economic development of a specific sector (eg. natural resources industry) and a decline in other sectors (eg. non-natural resource industry).

that nation's other exports becoming too expensive for other countries to buy, thereby making those sectors less competitive[25](Corden, 1984). As manufacturing sectors are commonly believed to generate positive productivity externalities, this effect would reduce the economy's potential for dynamic growth. To make matters worse, the greater concentration of GDP and trade in the resource sectors magnifies the effects of global market volatility, as world commodity prices fluctuate much more than the prices of other goods[26](Hausmann & Rigobón, 2003).

Second, the exploitation of natural resource wealth may reduce returns in human capital investments, which then decreases incentive for educational attainment[27](Gylfason, 2001). Therefore, resource-rich countries risk falling into a form of low-level equilibrium trap in attempting to climb "the ladder" of product variety or quality in the manufacturing sector, where human capital inputs are increasingly intensively employed on each successive rung. Indeed, there are examples of countries currently facing the "middle-income trap" in this way.

Third, recent political economy papers argue that resource wealth promotes the emergence of the "predatory state" rather than the "developmental state", either by actively encouraging the former through corruption related to resource rents, or by undermining the latter when revenue flows associated with resource extraction reduce the efficiency of policy and administration[28](Auty, 2001). In countries with mineral resources, government bodies or institutions exist to facilitate the extraction of these resources, for instance, by way of issuing permits or licenses. Many are vulnerable to bribery and corruption or are just ineffective. Cases in Latin America and sub-Saharan Africa have suggested that extractive institutions in the predatory state can actually hamper national economic growth[29](Acemoglu, Johnson, & Robinson, 2002) (Acemoglu, Johnson, & Robinson, 2005).

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[25] See Corden (1984).
[26] See Hausmann and Rigobon (2003).
[27] See Gylfason (2001).
[28] See Auty (2001).
[29] See Acemoglu et al. (2002, 2005).

ASEAN has rarely attracted attention as a casualty of the resource curse, for resource-rich countries in this region appear to have succeeded in their economic growth. Figure 1 shows the average per capita growth rates (1975–2001) for the group of countries in which primary exports made up at least 60% of merchandise exports in 1971. It can be seen that Malaysia, Indonesia, and Thailand form a distinct group which, though it had an initial above-average resource-dependence, experienced average GDP growth rates in 1975–2001, notably higher than the mean for this sampling of countries.

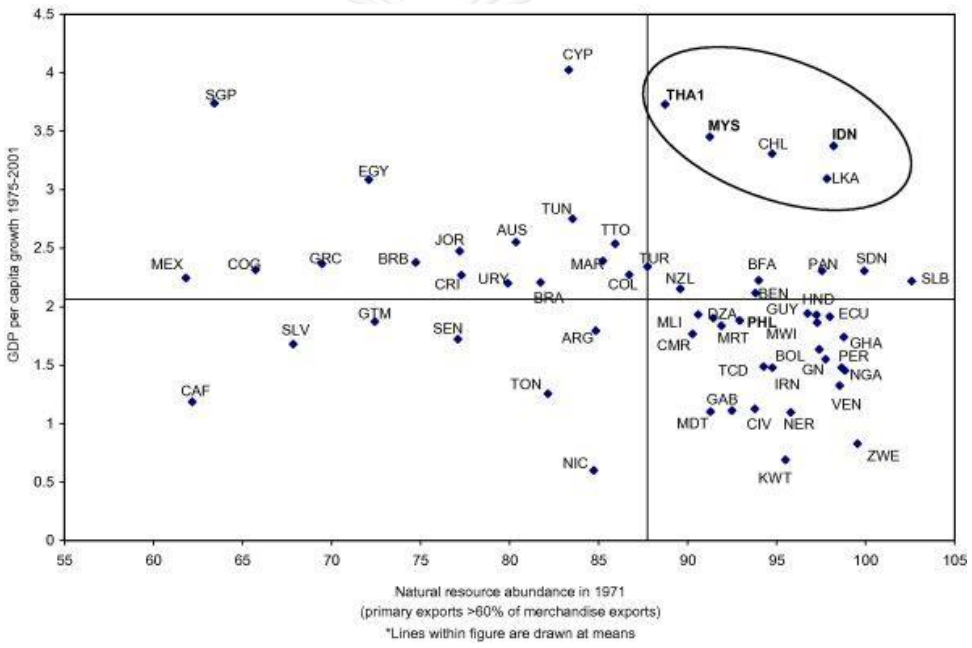

Figure 1: Natural Resource Abundance and Per Capita Growth Rates
Source:(Coxhead, 2007)

The most obvious explanation is that the Plaza Accord in 1985 resulted in currency appreciation for the region's exporting countries, which led to the boom in foreign direct investment (FDI) into the region's developing countries; net FDI flows to SE Asia (excluding Singapore) surged from $US1.1 billion in 1985 to more than $US7.2 billion in 1991. This massive increase in capital inflows ushered in a decade

of labor-intensive industrialization and ensured the inclusion of Indonesia, Thailand, and Malaysia in the World Bank's group of eight ''East Asian miracle'' economies. So there has to be a reason why the resource curse has surfaced for this region and why it has been attracting attention - the region's deepening economic integration with China. In the 1990s, ASEAN's share in China's total imports increased from 6% to 9%, indeed a significant increase in value terms[30](Ianchovichina & Walmsley, 2005) (Ng & Yeats, 2003). Accordingly, recent analyses have indicated that China's increasing size and involvement in regional trade will cause SE Asia's resource-abundant economies to become less specialized in labor-intensive manufacturing, and more specialized in resource-based exports[31](Ianchovichina & Martin, 2004) (Ianchovichina & Walmsley, 2005) (Ng & Yeats, 2003) (Weiss & Shanwen, 2003).

Furthermore, it has been said that the less developed countries with weaker institutions—Cambodia, Laos, Myanmar, and Vietnam—will possibly become trapped in the resource curse when they extract natural resources for potential economic development[32](Coxhead, 2007). This chapter aims to understand how nation states can escape from the curse, based on Thailand as a successful case in this region. The second section of this chapter will provide various diagnoses of the resource curse in Indonesia, Malaysia, and Thailand from broader perspectives other than economics. The third section highlights natural gas utilization in Thailand. Lastly, Section 4 concludes with recommendations for institutional settings.

2.2 Resources Curse in Indonesia, Malaysia, and Thailand

2.2.1 Overview of Energy Resources Development

Indonesia produced 852 thousand barrels per day (BPD) of crude oil in 2014, ranking 23rd in the world and 1st in ASEAN. The country has been producing crude oil since 1952, and in 1962 enrolled as a member in OPEC. Yet, after 1991, both the

[30] See Ianchovichina and Walmsley (2005), Ng and Yeats (2003).
[31] See Ianchovichina and Martin (2004), Ianchovichina and Walmsley (2005), Ng and Yeats (2003), and Weiss and Shanwen (2003).
[32] See Coxhead (2007).

decreasing production and the increasing demand within the country resulted in an increase in oil imports (Figure2). Despite the fact that Indonesia is still exporting approximately 500 thousand BPD, it has become an oil-importing country, even withdrawing from OPEC in 2009. In the case of natural gas, its annual production in 2014 was 7.1 billion cubic feet per day (BCFPD), which ranked as the 10th largest amount in the world and the largest in ASEAN. Throughout the 1980s and 1990s, liquefied natural gas (LNG) exports, especially to Japan, led the production (Figure3). With the decrease in oil production, gas utilization has, since 2005, been shifting from export to the domestic market; current domestic consumption now accounts for approximately 50% of the production.

Malaysia's crude oil production in 2014 was 666 thousand BPD, making it the 12th largest in the world and second-largest oil producer in Southeast Asia, just behind Indonesia. The production had been increasing since the 1970s, reaching its peak at 776 thousand BPD in 2004 (Figure2). As domestic demand rose, its export also became restricted, until eventually Malaysia also became an oil-importing country in 2014. The country produced 6.4 BCFPD of natural gas in 2012, placing it 12th in the world and 2nd behind Indonesia in ASEAN. Production started in the 1970s, surging with LNG exports in the 1980s (Figure 3). Since the mid-2000s, domestic consumption has been restricted, resulting in the amount of LNG exports being second behind Qatar since 2007.

Thailand is the 32nd largest oil-producing country in the world and 4th largest in ASEAN behind Indonesia, Malaysia, and Vietnam. Offshore production started commercially in the 1980s, but did not result in sufficient production to meet domestic consumption needs. With domestic consumption on the increase, it was forced to import substantial amounts of oil (Figure 2). Natural gas, on the other hand, is produced in substantial amounts, at 4.1 BCFPD, which is 19th largest in the world and 3rd largest in ASEAN, behind Indonesia and Malaysia. The country started production in 1981, targeting the domestic market and avoiding exporting. With an increase in domestic demand, however, the country began importing from Myanmar

through the gas-pipeline in 1998 and even importing LNG from Qatar in 2011 (Figure 3).

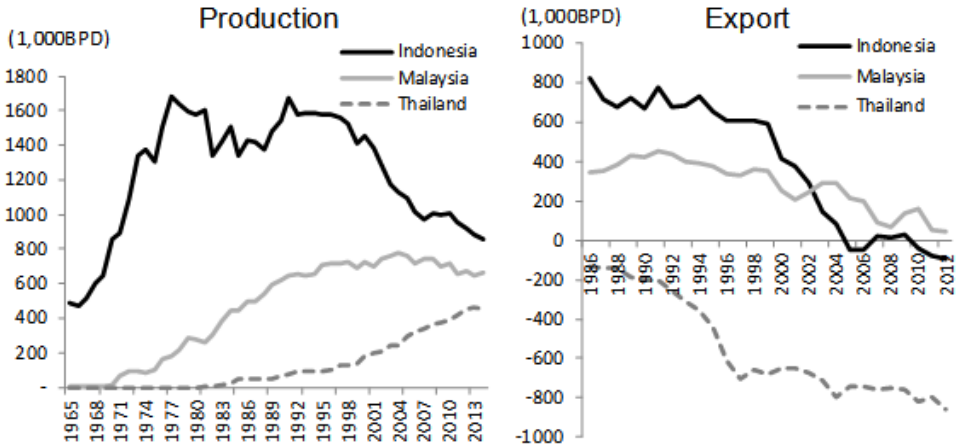

Figure 2: Production and Export of Crude Oil in Indonesia, Malaysia, and Thailand
Source: (BP) (U.S. Energy Information Administration)

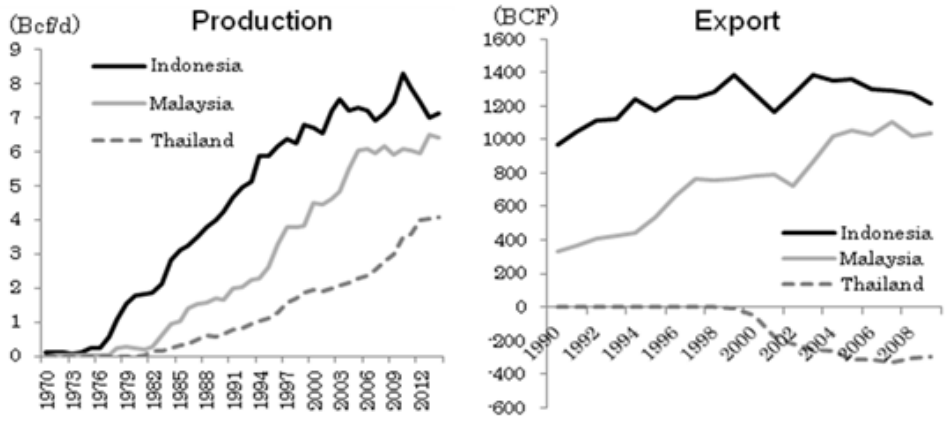

Figure 3: Production and Export of Natural Gas in Indonesia, Malaysia, and Thailand
Source: (BP) (U.S. Energy Information Administration)

2.2.2 Measuring the Resource Curse

After discovering substantial amounts of energy resources, three ASEAN countries started commercializing their resource developments in the 1980s. In terms of political, social, and economic perspectives, these countries have been diagnosed with the resource curse by some quarters[33](Sovacool, 2010). First, an economics assessment includes these factors: "GNP/GNI per capita", "% of population living on less than $2 a day", "Average annual rate of inflation" and other proper metrics. In the case of countries suffering from the resource curse, the former two metrics would be lowered while the last metric would be increased due to Dutch Disease. Second, to measure the social aspect, metrics such as "Adult Literacy Rate", "Infant Mortality", and "Prevalence of Undernourishment" are used. All of these metrics would be low because the resource curse would result in an insufficient provision of public goods. Third, the political aspect can be seen in an instrument such as the "Transparency International Rating" which would be an appropriate metric as it assesses the amount of corruption in a country.

The diagnoses for the three countries under study are summarized in Table 1. First, with regards to the economic aspect, most of the applied metrics show a recent improvement in performance for each country. The GNP/GNI per capita decreased between 1997 and 2007, unsurprisingly as the Asian financial crisis occurred in 1997. Despite this depressed economic environment, the macroeconomy grew steadily. This validates the argument that these countries have not been trapped in a resource curse[34](Coxhead, 2007). Moreover, most of the social and political metric values showed recent improvements too. In both economic and non-economic aspects, Table 1 shows an absence of evidence of a resource curse in these countries.

[33] See Sovacool (2010).
[34] See Coxhead (2007).

Table 1: Resource Curse Indicators for Indonesia, Malaysia, and Thailand, 1987-2007

	Indonesia			Malaysia			Thailand		
Year	1987	1997	2007	1987	1997	2007	1987	1997	2007
Economic Aspect									
GNP/GNI per capita	$762	$1,429	$1,349	$3,359	$6,025	$5,237	$1,732	$3,605	$2,866
% of population living on less than $2 a day	n.a.	59%	52%	n.a.	27%	9%	n.a.	24%	25%
Average annual rate of inflation	8.5%	11%	13%	1.3%	2.7%	2.3%	3.1%	4%	2.3%
	Indonesia			Malaysia			Thailand		
Year	1987	1997	2007	1987	1997	2007	1987	1997	2007
Non-Economic Aspect									
Infant mortality (/ thousand live birth)	109	66	31	31	17	11	42	20	7
Undernourishment rate (% population)	n.a.	9%	6%	n.a.	3%	3%	n.a.	30%	22%
Transparency Rating	n.a.	80/85	126/180	n.a.	29/85	47/180	n.a.	61/85	80/180

Source: (The World Bank) (Transparency International)

As for escaping from the resource curse, it is important to note that the macroeconomy does not depend heavily on the windfall revenue from resources[35](Ascher, 1999). Indeed, the three countries in this study have achieved an independent macroeconomic system compared to other countries in OPEC faced with severe consequences as a result of the resource curse (Figure 4). First, oil and gas for these three countries account for 30% of their total exports whereas they make up more than 60% of exports for OPEC members. Second, oil and gas contribute much less to the GDPs of these three countries (less than 10%) than they do in OPEC members. Indeed, OPEC members rely heavily on oil rent. Third, the percentage of government revenue attributable to oil and gas in the three countries are around a third of countries in OPEC.

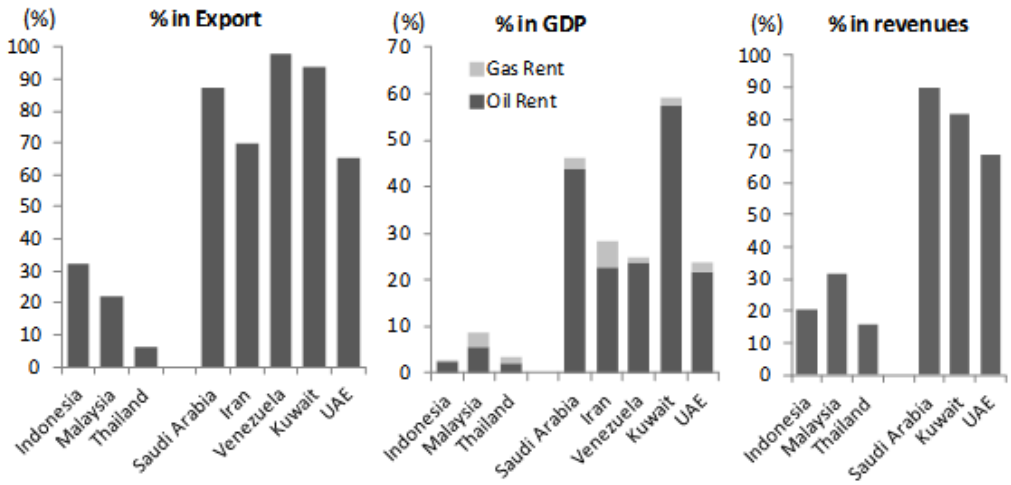

Figure 4: Hydrocarbon Dependence: Comparison between the Three ASEAN and OPEC Countries

Source: (International Monetary Fund) (The World Bank)

Among these three countries, the economy of Thailand especially is the most independent of gas and oil. With a sound economic structure, the future possibility of the resource curse is low. Since the beginning of production, Thailand has never exported its energy resources. According to the orthodox resource curse theory, if Thailand had enjoyed windfall revenue from the export of its resources, the FDI

[35] See Ascher (1999).

inflow after the Plaza Accord would have benefited the other manufacturing sectors in this country less. Indeed, the inflow benefitted this country more than it did Indonesia and Malaysia, which, to some extent, exported their energy resources to the international market. The domestic utilization of natural gas in Thailand will be reviewed in the next section.

2.3 Development of Off-shore Natural Gas in the Gulf of Thailand

2.3.1 Discovery of Natural Gas

Thailand waited 60 years, a long time for a significant development in domestic energy resources. As an initial effort in 1921, some public entities already tried oil resource development. Subsequently, in 1954, after domestic companies discovered an oil field in northern Thailand, mining titles were issued. In 1962, under the mining law, the government extended the mining right to the US company, Union Oil. In other words, foreign investors entered the energy resource market as early as the 1960s.

Having said that, these efforts were just sporadic and resulted in a scarce achievement. But these sporadic efforts were transformed into substantial ones by one particular trigger - the nation's ratification of the Convention on the Continental Shelf in 1968. This ratification enabled the development of offshore fields, which was much more promising than that in onshore fields. In the following year, the National Economic Development Board (currently the National Economic and Social Development Board, i.e. the NESDB) immediately gave concessions to Union, Conoco, Texas Pacific, and BP in 17 off-shore fields in the Gulf of Thailand.

The off-shore field was perceived as promising at this point because of the positive result of geophysical explorations in crude oil and natural gas under the sea. In the exploration around 1970, the result showed that there was a stratum in the Tertiary and Mesozoic era at 1,000km in depth and 100-200km in width in the Gulf of

Thailand (Figure 5). It is this stratum that contains oil all over the world[36](Sawada, 1971). Thus, the probability of the existence of oil or natural gas in the newly opened off-shore field was scientifically supported in the early 70s.

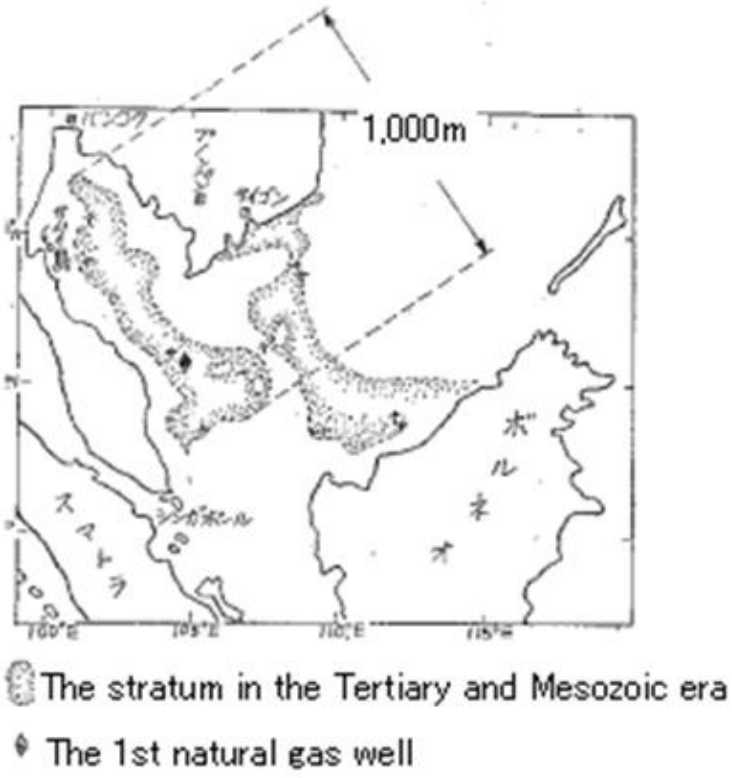

Figure 5: The Result of Geographical Exploration around 1970
Source: (Sawada, 1971)

Backed by this scientific evidence, the government actively attracted foreign investors for the development of energy resources. In March, 1971, the government established the Petroleum Act and the Petroleum Income Tax Act. These Acts established that 1) the involved companies shall not be under state control; 2) the produced commodity shall be freely exported; 3) the royalties shall be only 12.5% without any additional government-take. These assurances by the Thai government 'strongly activated the foreign investors'[37](Board of Investigation, 1978). It should be noted that while the Acts allowed for the export of energy resources, this never actually happened.

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[36] See Sawada (1971).
[37] Board of Investigation (1978)

2.3.2 Investment boom for natural gas development

With the investment bottleneck removed, investors reacted swiftly. It was the Japanese investor, MOECO (Mitsui Oil Exploration Co. Ltd),that became involved with the initial endeavor to develop natural gas in the Gulf of Thailand, which has sustained the Thai economy since 1981. In Japan, under the Petroleum Development Corporation Act in 1967, the Petroleum Development Corporation was established to obtain the "Japan Flag" for oil resource development. Meanwhile, the Japanese government encouraged former conglomerates such as Mitsubishi and Mitsui to promote the "Japan Flag" initiative. In 1969, based on Mitsui & Co., Ltd. and Mitsui Mining Co., Ltd., MOECO was established as the vanguard of seven big companies (Mitsubishi, Sumitomo, Fuyo, Toyo-Sekiyu, World Energy, Central Energy, and Mitsui).

In March, 1969, Mitsui Mining, a major shareholder of MOECO, had a friendship agreement with Conoco (Continental Oil Co.) in which the two negotiated a 50-50% equity participation in the development of the 10/11 zone in the Gulf of Thailand. After examining the result of Conoco's seismic exploration, Mitsui Mining participated in the joint project with Conoco on the condition of the assignment of concessions to MOECO. Accordingly, in 1970, the concession was transferred to MOECO. Further, in 1971, the company received 20% of the concession in the 12/13 zone in the Gulf of Thailand, which was owned by Union (Union Oil Company of California).

In this way, under the Petroleum Development Corporation Act, MOECO launched its projects for resource developments in the Gulf of Thailand. In the initial stage, however, they could not find any oil or gas field. The Japanese Chamber of Commerce in Bangkok publishes a newsletter and in its October issue in 1971, it was pointed out that "the geological engineers understand the difficulties of the projects. Though they don't want to start the projects, they have to start it because of the

governmental pressure"[38](Sawada, 1971). The difficulty was well recognized in the Thai government and its mining resource department especially was said to understand the situation well too.

At that time, it was thought that the possibility of striking oil was a mere three-thousandth percent. This was a very low possibility. In the Gulf of Thailand, however, it took the 8th drilling to hit natural gas. In January 1973, Union found the promising gas field in the 12th zone in the partnership with MOECO (Figure 6). Following these initial successes, others also introduced majored projects into the Gulf of Thailand. As a result, gas/condensate was found in 4 wells (out of 11) in 1974 and 2 wells (out of 9) in 1975. Particularly in the blocks of 10/11, 12/13, and 15/16, Union and Texas Pacific accelerated their projects, resulting in 27 successful wells out of 38 wells, all drilled between 1976 and 1980 (Table 2)[39](Kawanaka, 1982).

Table 2: Development of Off-shore Field

Company	Concession	Completed	Company	Concession	Completed
Union	B-12	29/1/73	Union	B-12	28/1/79
Conoco	B-10	1/3/74	Union	B-12	24/3/79
BP	B-16	4/3/74	Union	B-12	24/4/79
Union	B-13	21/5/74	Union	B-13	29/5/79
Tenneco	B-15	27/12/74	Union	B-10	13/7/79
Union	B-12	2/7/75	Union	B-10	20/9/79
Union	B-12	24/8/75	Union	B-10	16/10/79
Union	B-10	12/6/76	Union	B-10	8/12/79
Union	B-13	28/10/76	Union	B-11	18/1/80
Tenneco	B-15	15/10/76	Texas Pacific	B-15	23/3/80
Texas Pacific	B-15	29/5/77	Union	B-10	17/3/80
Texas Pacific	B-16	9/11/77	Union	B-13	9/5/80
Texas Pacific	B-15	19/3/78	Union	B-13	15/6/80
Texas Pacific	B-16	4/5/78	Union	B-12	19/7/80
Union	B-12	14/10/78	Union	B-12	24/8/80
Texas Pacific	B-15	2/11/78	Union	B-11	25/11/80
Union	B-12	29/11/78	Tenneco	B-15	2/6/73
Texas Pacific	B-15	28/11/78	Amoco	B-6	29/8/74
			Union	B-12	6/10/74

Source: (Kawanaka, 1982)

[38] See Sawada (1971).
[39] See Kawanaka (1982).

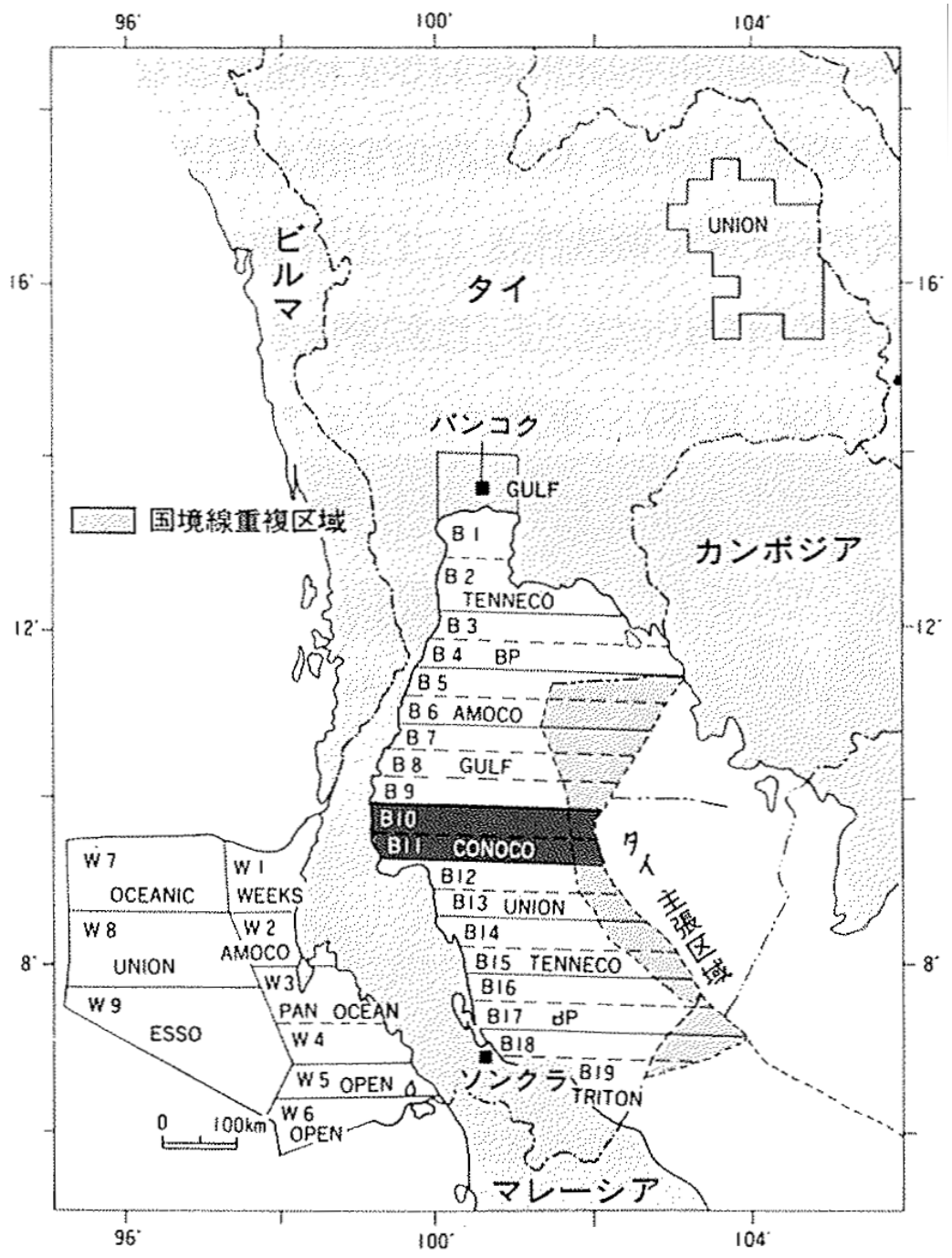

Figure 6: Off-shore Field Location
Source: (Kawanaka, 1982)

2.3.3 Natural Gas in Oil Crisis

It might be said that the Thai government probably benefited the most from this investment boom in natural gas. As stated, Union found the first gas field in the Gulf of Thailand in 1973, when there was the first oil crisis, which forced a 5% supply reduction for Thailand. Like Japan, the country imported more than 80% of its primary energy supply. In spite of illegal imports of crude oil from the black market, Thailand was still about 10% short in primary energy.

The Thai government countered the loss in foreign oil supply with the following measures. The first was raising the price of petrochemical products (Table 3). By this measure, the government "shifted the increased cost caused by the OPEC onto the consumers while simultaneously requiring them to conserve energy."[40] Second, under an emerging edict dealing with oil supply shortage, conservation was ordered through a quota restriction. Also under the edict, the national petroleum policy committee was formed, and it imposed some orders such as the 10% reduction of oil consumption by the government and other public entities. The third measure was to diversify supply sources. Indeed, the import from Qatar surged from 400,000 BBL to 12,800,000 BBL.

Table 3: Retail Price of Petroleum Product in Bangkok Municipality

Date	Gasolin Super	Regular	Kerosene	Hi-Speed Diesel
Before Jul.4, 1973	2.1	1.91	1.34	0.98
Jul. 4	2.3	2.09	1.45	1.05
Nov. 14	2.69	2.5	1.78	1.41
Dec. 17	3.01	2.82	1.78	1.6
Feb. 27, 1974	3.62	3.43	2.41	2.33
Mar. 15, 1977	4.22	3.93	2.68	2.64
Mar. 10, 1978	4.98	4.69	2.68	2.64

Source: (Board of Investigation, 1978)

[40] See Board of Investigation (1978).

These measures were similar to those imposed in other resource-poor countries such as Japan. In short, the measures aimed to conserve the consumption of petroleum and relevant product as long as it did not substantially harm economic activities. Yet, what is absolutely different from Japan is that Thailand developed its off-shore natural gas as an alternative and nurtured relevant industries, which transformed Thailand from a resource-poor to a resource-rich country. A rough calculation regarding the impact of natural gas development is shown as follows.

First, in 1982, the daily production of natural gas in the Gulf of Thailand can be assumed to be at least 150 MMCFD (Million Cubic Feet Day). This estimated production of natural gas equals 25,000BBL of petroleum oil. In 1982, the domestic daily demand of petroleum and petroleum-based product is 220,000BBL in the country. Thus, an approximate 10% conservation of total production (25,000/220,000) is possible, which roughly equals 310,000,000Baht. Including royalties and corporate tax, around 250,000,000 Baht could be considered as an improvement of trade balance. As the trade deficit in 1982 in Thailand was roughly 3,000,000,000 Baht, the addition of 250,000,000 Baht would be considered a substantial improvement.

This improvement of balance was interesting for the Thai government especially after 1979 when the second oil crisis further damaged the balance of the country. In the seminar “Oil price increase and Thai economy”, Director General Olarn Chaipavat (Thai Central Bank) articulated that “domestic energy development [was] essential” in addition to “the conservation of energy consumption” in order “to improve the balance of payment”[41](Olarn Chaipavat, 1979).

[41] See Olarn (1979).

2.3.4 Government's Courageous Decision

To say is one thing; to practice another. The investment risk in the development of domestic energy resources as an alternative to imported oil is massive. That was why the country could not realize this development for more than 60 years. Having said that, in the 1970s, the country was in a fortunate condition in that the upstream natural gas development was promising thanks to the boom stated above. Thus, what was left as an alternative energy to imported oil was to install a gas pipeline connecting offshore fields with demand sites.

Indeed, the government courageously decided to install the gas pipeline. Giving a debt guarantee to the Natural Gas Organization of Thailand (NGOT)[42], the government allowed the organization to invest in the pipeline and in relative facilities with a $500,000,000 loan from the World Bank. Then, in 1978, Union/MOECO signed a sales contract of 250 MMCFD with the NGOT. In 1981, finally, the pipeline was completed at a length of 425km under sea and 170km on land. In August that year, the production of gas condensate in the Erawan gas field began.

Initially, however, there was a "short-fall problem" in that production could not deliver the amount stated in the sales contract. Union/MOECO could only produce 100MMCFD, far less than the 250 MMCFD quoted in the contract. Chirayu, then Deputy Minister for Trade articulated that "the shortfall caused various problems for EGAT and Siam Cement as well as PTT"[43](Chirayu Isarangkun, 1984). EGAT is the Electricity Generating Authority of Thailand, Siam Cement is a Bangkok-based conglomerate and PTT is the Petroleum Authority of Thailand, all major players in the growing energy industry.

As a result, there was even a contestation between MOECO and the Ministry of Industry regarding the amount of royalties. Thus, MOECO accelerated its

[42] In 1978, a new Petroleum Authority of Thailand (PTT) took over from the Oil Fuel Organization and the Natural Gas Organization of Thailand.
[43] See Chirayu (1984).

development with further loans from major banks, including export and import banks. In 1983, MOECO moved up to further production in Banpot ahead of the contract. Finally, in June, 1984, the shortfall problem was solved and the contestation was also internationally arbitrated in 1986. After the shortfall problem was dealt with, production was accelerated.

Initially, the natural gas from the Gulf of Thailand was used for power generation by EGAT (520MMCFD) at Ban Pakon and Southern Bangkok and by Siam Cement (50MMCFD) at Saraburi. But it is well known that gas used only to generate power is not as productive as when it is used for petrochemical industries where it can have so many applications, for instance, as reactants or in many industrial services.

Recognizing this unproductive use of resources, the government swiftly planned to rechannel gas resources toward industries instead. In December, 1980, "the Committee to Develop Basic Industries on the Eastern Seaboard (Chairman: Prem)" was set up. More specifically, Dr. Snoh Unakul, a former Secretary-General of NESDB crafted the "Eastern Seaboard Development Plan" in the 5th National Economic Development Plan and initiated the National Petroleum Corporation (NPC). Natural gas has sustained the petrochemical and fertilizer industries in the ESB regions since 1984, and this development has become a symbol of the country's import-substituting industrialization (Table 4).

Table 4: Demand of Natural Gas in Thailand

(Unit: MMCFD)

	Power Generation				Industrial Source						
	EGAT	Cement	Others	Sub-Total	Petro Chemical	Ferti-lizer	Soda Ash	Sponge Iron	Metha-nol	Sub-Total	Total
1982	200	0	0	200	0	0	0	0	0	0	200
1983	220	30	0	250	0	0	0	0	0	0	250
1984	208	30	0	238	62	0	0	0	0	62	300
1985	325	30	10	365	115	0	0	0	0	115	480
1986	411	42	36	489	204	46	10	15	40	315	804
1987	423	79	49	551	214	56	15	20	80	385	936
1988	446	85	50	581	218	61	15	20	80	394	975
1989	465	85	53	603	221	61	15	20	80	397	1000
1990	448	97	55	600	224	61	15	20	80	400	1000

Source: (Kawanaka, 1982)

2.4 Adding Value to Natural Gas

2.4.1 Utilization of Natural Gas

Against the backdrop of oil shocks, resource development corporations began drilling for prospective oil in the Gulf of Thailand at the beginning of the 1970s. In 1973, Unocal Corporation found offshore natural gas, and a number of drilling explorations carried out by international corporations such as Conoco, Texas Pacific, and MOECO soon followed. After other discoveries of natural gas reserves in the Gulf, the government decided to borrow $US50 billion from the World Bank for the construction of a natural gas pipeline. In 1978, the Port Authority of Thailand signed the gas purchasing agreement with Unocal for 250 MMCFD. After the completion of the pipeline in 1981, commercial production started in 1982. While the country did start to import gas from Myanmar in 2000 and LNG from Qatar in 2011, Thailand's self-sufficiency still remains around 80%.

Figure 7 shows the utilization of domestic natural gas. Initially, all offshore natural gas was used for generation by EGAT with a take-or-pay contract ("Electricity"). In 1984, the Gas Separation Plant (GSP) started operating in the production of LPG, as well as ethane and propane. After 1986, gas was also used for industrial boilers and burners ("Industry").It also became an alternative fuel for vehicles ("Transportation"). Over the past 30 years, the utilization of domestic natural gas has become highly diversified, from being generation-oriented to a multitude of purposes, especially in the GSP. For example, in 2007, the GSP consumed around one-fourth of the domestic natural gas.

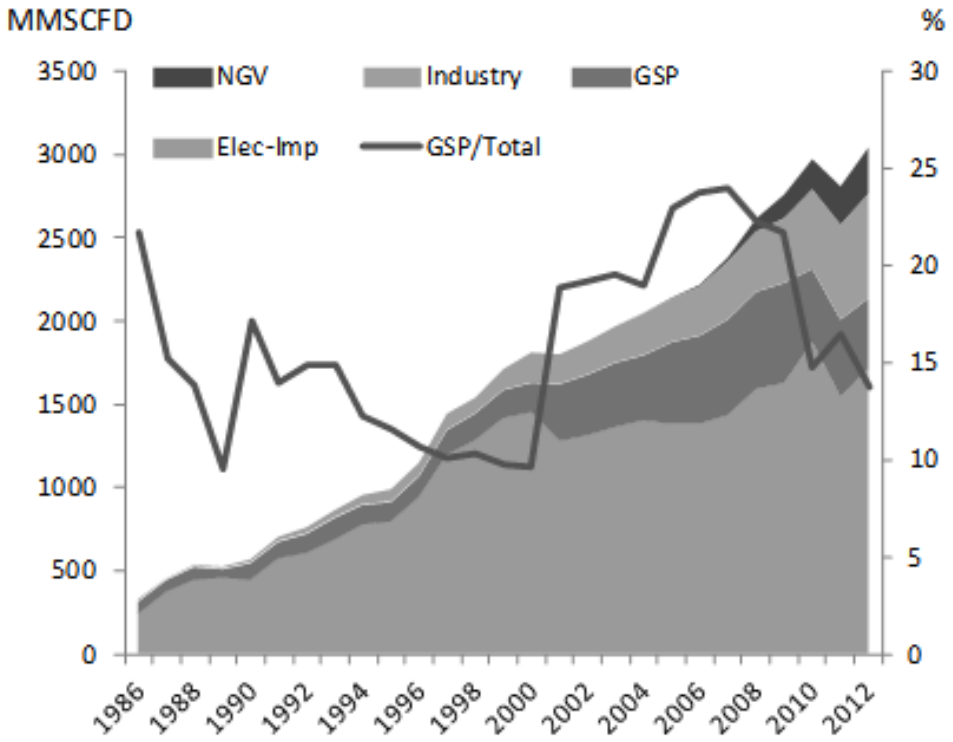

Figure 7: Utilizations of Domestic Natural Gas in Thailand
Source: (Energy Policy and Planning Office)

2.4.2 Development of Petrochemical Industry

In Thailand, there are mainly three upstream sources for the petrochemical industry: ethane and propane separated from natural gas and naphtha refined from crude oil and condensate. In the upstream, both olefins and aromatics are produced as a source for the downstream. In the case of olefins, ethylene is made from ethane and naphtha, while propylene is made from propane and naphtha. As for aromatics, mainly benzene and paraxylene are made from naphtha. Through the intermediate process, the downstream produces commodities such as polyethylene (PE), polyvinyl chloride (PVC), polypropylene (PP), and polystyrene (PS). While PE and PVC are made from ethylene, PP is made from propylene, and PS is made from aromatics.

During the 1980s, the utilization of the GSP was still limited, as the downstream industry did not exist. The downstream industry developed after 1989 when the National Petrochemical Corporation (NPC) I (37.99% owned by PTT) started operations to produce ethylene and propylene using ethane derived from natural gas. Because imported naphtha was less expensive compared to the domestic ethane, the naphtha cracker was mainly constructed in the 1990s to produce benzene and paraxylene, in addition to olefins (ethylene and propylene). In the 2000s, the ethane cracker came into focus because of the increasing price of imported naphtha. In this way, after the 1990s, the domestic production of basic products (ethylene, propylene, benzene, and paraxylene) was started and their various downstream commodities, such as PE, PC, PP, and PS began to be commercially produced (Figure 8).

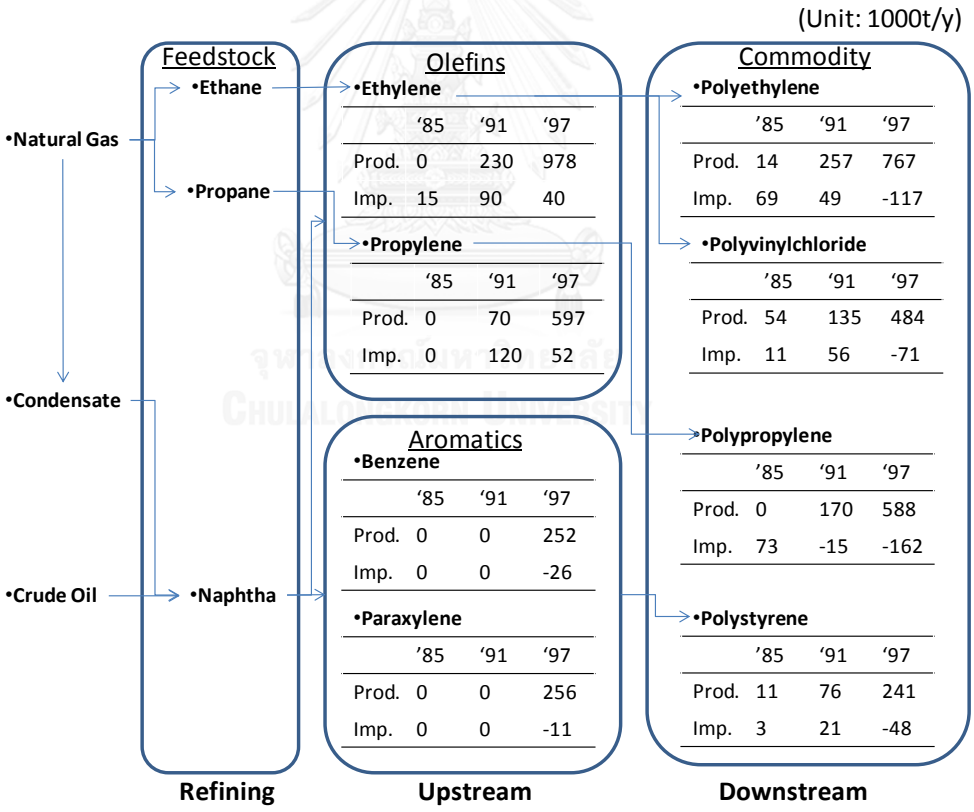

Figure 8: Production and Import of Downstream Chemicals according to Year, Amount, and Origin

Source: (Jyukagaku Kogyo Tsushinsha)

The added value in “Petroleum Refinery and Products” has always been larger than that in the total added value in “Crude Oil and Natural Gas”, and this gap increased steadily after downstream development came into being (Figure 9). With this increase of petrochemical industries, the ratio of its added value to the total added value in manufacturing also increased, reaching 16% in 1998. Though both the added value and the ratio have recently decreased due to a competitive global market, the Thai petrochemical industry (ethylene derivatives: 3.9 mil ton, propylene derivatives: 2.3 mil ton) is still much bigger than the other two resource countries: Indonesia (ethylene derivatives: 1 mil ton, propylene derivatives: 0.6 mil ton) and Malaysia (ethylene derivatives: 1.4 mil ton, propylene derivatives: 0.8 mil ton) (Ministry of Economy, Trade, Industry, Japan 2015).

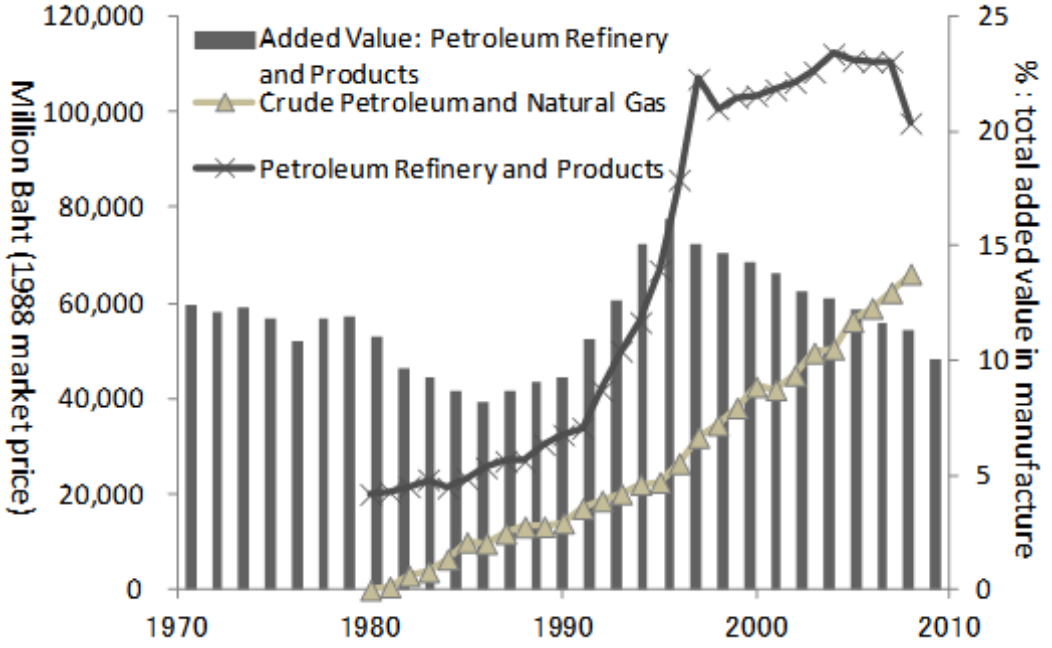

Figure 9: Added Value in Petroleum Refinery and Products

Source: (Office of the National Economic and Social Development Board)

This value-adding process through the GSP is mostly located near the Map Ta Phut area in the Rayong Province. The National Economic and Social Development Board (NESDB) developed the region under the 5th National Economic Social Development Plan (1982-1986). With assistance from international donors, such as the Japanese Official Development Assistance (ODA), especially after the Plaza Accord, basic infrastructure has been rapidly developed. In fact, between 1982 and 1993, the Japanese ODA directed approximately 20% of its budget to the ESB, and this was utilized for a deep-sea port, roads, railways, waterlines, and the GSP in Rayong[44].

The economic development in the Rayong province has been more remarkable than any other region in the country since the 1980s. For example, from 1981 to 1986, the Gross Provincial Product (GPP) of Rayong was remarkable thanks to the development of the natural gas industry. After this initial industry, the petrochemical industry followed and it has in turn sustained growth in the province resulting in the GPP of Rayong currently being the biggest in the country, surpassing Bangkok. In this way, the natural gas and related industries have benefited the local region outside Bangkok, and this has in turn contributed to the nation's concerns regarding inequality.

2.5 The Importance of Industrial Region in Value-adding Process

Based on Thailand's experience described in the previous section, three conclusions could be drawn regarding less developed countries considering the usage of their energy resources. First, Thailand controls the wealth from natural gas through transparent contracts with foreign resource companies. For example, the Port Authority of Thailand (PAT) entered into the gas purchase agreement with UNOCAL, under which Thailand can control the way the natural gas is utilized. If this agreement had been one where the resource company (foreign in this case) had control, the

[44] See Ariga and Eshima (2000).

natural gas could have been exported in accordance with soaring prices in the international market. In giving a disproportionate share of the resources' value to private foreign companies, the country might have been at risk of Dutch Disease.

Thailand's approach provides a good lesson for Myanmar. For example, due to its low domestic demand, Myanmar started exporting gas to Thailand in 2000 and to China in 2013. But since the country became an official democracy in 2011, its domestic oil demand has risen. As these exports are under long-term take-or-pay contracts, Myanmar cannot reclaim resource control over current reserves. Yet, the country needs to reclaim future resource control from international resource companies by opting for a transparent contract similar to Thailand's.

Second, Thailand has efficiently added value to its natural gas industrial region with its long-term economic plan. At the initial phase of resource extraction, Thailand had no comparative advantage in the petrochemical industry. For example, there was insufficient infrastructure in the Rayong province to meet its hopes of being one of the biggest industrial regions in ASEAN. To work against this disadvantage, NESDB crafted the long-term ESB development plan, which attracted the Japanese ODA after the Plaza Accord, to help develop the necessary infrastructure. Based on this development, the Thai petrochemical industry succeeded in moving from upstream to downstream after the 1990s.

It is difficult to realize comparative advantages in the long run. For example, this challenge can be observed in Vietnam, a country that has been producing and exporting crude oil since 1986. While the domestic demand of petrochemical products has increased, especially after enrolment in the World Trade Organization, the required investment for the value-adding process has been delayed. In 2009, Vietnam finally began operation of its oil refinery at Dung Quat, which produces far less than what its domestic demand requires. Currently still exporting crude oil, the country imports petrochemical products, only worsening the trade balance. Vietnam, therefore, needs a value-adding plan that targets a certain industrial region in the long run.

Third, the government role is absolutely essential during the initial phase of resource utilization. It is the government who will negotiate a transparent contract with international companies and who can make a long-term plan for an industrial region. For example, Thailand's transparent contract with UNOCAL was agreed to by PAT, which owns the majority of the shares of NPC I. In addition, the fund procurement for basic infrastructure in Rayong was also planned by the NESDB. In this way, the public sector has an essential function in the initial stage. On the other hand, this could also increase the risk of rent-seeking, which may have a negative effect on the national political economy[45](Collier & Hoeffler, 2004) (Ross, 2001). This impact should be further studied focusing on Thailand and other resource countries in ASEAN.

[45] See, for example, Collier and Hoeffler (2004) and Ross (2001).

CHAPTER 3: INDUSTRIAL SYSTEMS FRAMEWORK FOR THE ANALYSIS OF CONTRASTING ADAPTATION PROCESSES

Chapter 3 provides an analytical framework for sustainability in the ESB industrial region. This is critical in helping Thailand to escape the resources curse. We will also see how there is a sharp contrast in the responses of the petrochemical and automotive industries in the ESB toward recent business dynamisms. While the petrochemical industry has had difficulty in adapting to changes, the automotive industry has adapted well. This is not a new problem but an age-old problem as post-Fordism literature since the 1970s has long discussed regional adaptations toward harsher competitions. Based on this literature, the analytical framework to compare two industries in the ESB is drawn.

3.1 Previous Studies of ESB

3.1.1 The Technocrat's Perspective

After reviewing three decades of literature pertaining to the Eastern Seaboard Development Program, it can be seen that there are a number of relevant previous studies by technocrats and academia. In this section, after introducing the technocrat's perspective, academic literatures will be considered in terms of economic, social, and environmental impacts.

A group of Thai Technocrats had great expectations of the ESB program. They believed the project would lead to sustainable economic growth and an economic shift from relying on agriculture. In the early phases of the ESB program, studies and writings pertinent to the ESB program in economic, social and political aspects representing the view of the Thai Technocrat and the Thai government showed that they agree with the Eastern Seaboard Development Committee and the

National Economics and Social Development Board who were the main supporters of the ESB program.

During the Sea Resources and Thai Industrial Development: Eastern Seaboard Development Case Study Seminar in mid-1984, the work of two Thai Technocrats were presented: "Natural Gas and Eastern Seaboard Development" by Thongchat Hongladarom, Director of the Petroleum Authority of Thailand and "Sea Resources and Thai Industrial Development: Eastern Seaboard Development Case Study" by Sawit Potiwihok, Chief of Action Plan Analysis and Coordination Section, the Office of National Economics and Social Development[46](ทองฉัตร หงศ์ลดารมภ์, 2527) (สาวิตต์ โพธิวิหค, 2527a).

Thongchat Hongladarom explained the history of natural gas discovery in the Gulf of Thailand, and the potential when the natural gas can be separated and used as raw materials in the petroleum and chemical fertilizer industries. He then gave details on developments in the Eastern Seaboard, including the natural gas separation plant program, the liquid petroleum gas market development program, the national fertilizer industry program and the petrochemical industry development program. He also discussed the Petroleum Authority of Thailand's role on the management of natural gas as a raw material in various industries, its capacity to meet the demand of the gas separation plant which will in turn build confidence for domestic and international investors. In addition, the Petroleum Authority of Thailand coordinated with relevant sectors, public and private, to establish the National Fertilizer Corporation and the National Petrochemical Corporation.

In the same direction, Sawit Potiwihok discussed the overall ESB program from the beginning to the target which is the establishment of the whole chain of petrochemical industry. Moreover, Sawit also gave the reasons why the Eastern Seaboard was chosen as the industrial development target: 1) the existing development and undersea gas pipeline in the Gulf of Thailand to the Map Ta Phut

[46] See ทองฉัตร (2527) and สาวิตต์ (2527).

area, 2) the suitable geography for constructing a deep water port, 3) the sufficient available area for creating an industrial district, 4) the adequate fresh water resources, 5) the almost complete existing basic public utility infrastructure and 6) the proximity to Bangkok.

Apart from the Sea Resources and Thai Industrial Development Seminar, the Effect of Eastern Seaboard Development in the next decade Seminar in 1988 also emphasized the view of the Thai Technocrat on the ESB program, as can be seen especially in the opening statement and lecture by Snoh Unakul, the Secretary of the National Economics and Social Development Board. He pointed out that the ESB program will encourage economic development in Thailand, especially in the industry sector which was still small in comparison with the sector in developed countries[47](มหาวิทยาลัยศรีนครินทรวิโรฒ บางแสน, 2531). Furthermore, the ESB program's main strategy was to expand growth away from the center in Bangkok through developing infrastructure which will support industrial goods export, and building a new industrial base connecting to ports similar to that in Korea and Japan. The program also sought to develop the northern and northeastern regions through industries connecting to the ESB.

Furthermore, Snoh stated that there were originally three possible approaches in executing the project: all investments to be undertaken by the government, all investments to be undertaken by private sectors, or a division - the government would invest in infrastructure while private sectors would invest in industries. In the end, the most suitable approach was the last option because the government would not have to deal with the risk of huge investments and the hassle of integrating different government sectors, but it could still control the direction of development through infrastructure.

Apart from the Technocrat's view that the ESB program would have a positive effect on every aspect in Thailand, the ESB program also gave much

[47] See **มหาวิทยาลัยศรีนครินทรวิโรฒ** (2531).

importance to the Technocrats as the new face of public administration. The report, "Eastern Seaboard Development and Public Administration" by Sawit Potiwihok indicated that the Thai government made adjustments to the public administration to accommodate the ESB program through establishing the Eastern Seaboard Development Program Committee (ESDPC) and subcommittees. The government also directed important departments to form the Office of the ESDPC so that it can better coordinate and follow up with the program[48](สาวิตต์ โพธิวิหค, 2527b). The efficient decision-making and clear overall and secondary plans enabled a relatively swift program operation.

Not surprisingly, most of the ESB literature from the Technocrats and the government regarding the ESB program is positive. But the article "Eastern Seaboard Area: The Past, Present and Future" by Sunisa Boonyopas from the Office of National Economics and Social Development Board, which was written while the concrete ESB program was being accomplished indicated not only its positive impact on the economy, its potential in contributing to manufacturing and industrial growth and the advancement of the national and local economy, it also indicated that the ESB has caused environmental and pollution issues in many cases[49](สุนิสา บุณโยภาส, 2550). Therefore, future developments should take into consideration the environment and human resources within the industry.

3.1.2 Economic Impact

"Question and Answer: The Truth about the Eastern Seaboard Area Development Plan" by the Office of the Eastern Seaboard Development Committee was a document created to clarify the truth about the Seaboard Area Development Plan according to the government and sectors involved. But the document also properly reflected concerns on economic and social impact and the different

[48] See **สาวิตต์** (2527).
[49] See **สุนิสา** (2550).

viewpoints of the media, newspaper and the public[50](สำนักงานคณะกรรมการพัฒนาพื้นที่บริเวณชายฝั่งทะเลตะวันออก, 2528). For example, in economic terms, there were concerns that the Eastern Seaboard Development Program would generate a lot of public debt and that despite its high costs, it would provide little employment. The ESB plan would also need a huge amount of foreign currency to purchase machinery, equipment, etc. There were concerns about the worthiness of the additional investments and the inappropriateness of investing in a large project during the economic slowdown in the late-1980s.

Apart from the concerns raised in literature during the development of the ESB program, some studies also suggest that the ESB program development did not help the economic structure in Thailand to become self-sustaining. The study, "The Three Provinces on the Eastern Seaboard Area and the unequal development between local and overall dependent development in Thai Economy" indicated that the government's expectations on the role of the three provinces on the Eastern Seaboard were not met. The government had hoped that the ESB plan would help to adjust the Thai economic structure and rid the regions of any uneven development[51](กฤช เพิ่มทันจิตต์ และ สุธี ประศาสน์เศรษฐ, 2530). On the contrary, the ESB developments encouraged the dependent economic mechanism, and increased the inequality or differences among the regions. The authors examined the industrial structure in the regions in terms of production type and target, technology, management and capital cost, and found that the three provinces on the Eastern Seaboard region have the characteristics of a new production source for international companies. These international corporations usually concentrate different tasks in different countries and hence, this would not help Thailand to reduce its need to rely on other countries in any way.

In the article, "The Role of Japan on Eastern Seaboard Development Program", Wichian Intasi gave additional perspective on the support the Eastern Seaboard Development Program received from the Japanese government and private

[50] See **สำนักงานคณะกรรมการพัฒนาพื้นที่บริเวณชายฝั่งทะเลตะวันออก** (2528).
[51] See **กฤช และ สุธี** (2530).

sectors in many areas. Through the Japan International Cooperation Agency (JICA), Japan has had a role in helping the Thai government analyze the program and the feasibility of the industrial development in the Eastern Seaboard since the mid-1970s[52](วิเชียร อินทะสี, 2542). Moreover, the Japanese also gave loans to support the infrastructure construction from the early-1980s to the early 1990s (Table 5).

Table 5: Japanese ODA for ESB

(Unit: Million Yen)

Year	Total Amount of ODA	ODA for ESB Development	Share (%): ESB/Total
1982	84,240	21,570	25.6
1983	67,360	1,720	2.6
1984	49,432	9,927	20.1
1985	60,793	23,537	38.7
1986	32,489	12,283	37.8
1987	72,646	3,003	4.1
1988	49,493	13,948	28.2
1989	66,357	14,798	22.3
1990	43,773	28,455	65.0
1991	84,687	9,065	10.7
1992	127,375	6,362	5.0
1993	104,462	34,100	32.6
Total	843,107	178,768	21.2

Source: (Ariga & Ejima, 2000)

Wichian further speculated on several aspects of the interesting role Japan played in the ESB program: (1) The Japanese government had a role guiding and making decisions on the form of development because of the knowledge and technological limitations of the Thai government; (2) The Japanese government used this project to increase employment for its own private sectors; and (3) The issue of

[52] See **วิเชียร** (2542).

whether the program would break even economically and the issue of long-term international debt.

Wichian also analyzed the details and suggested that aid from the Japanese government may be categorized into two groups: (1) Academic collaboration through the JICA in preparing the prototype and doing feasibility studies and (2) Monetary Loans, especially for investment in infrastructure. In the same way, the role of the Japanese private sectors can be divided into two phases. In the first phase, the Japanese private sectors entered as engineering consulting companies and contractors, and in the second phase, the Japanese private sectors had roles as investors in the Thai industry. Statistics in the years 1994-1996 revealed that the value of Japanese investment projects in Chachoengsao, Chonburi and Rayong summed up to more than 60% of the Japanese investment in all of Thailand.

3.1.3 Social Impact

The impact of the ESB project on the economy, both macro and micro, has appeared in many studies. But the impact on communities and individuals has also been documented in studies stretching from the beginning phases of the ESB project in the mid-1980s to the later phases in the late 1990s and even after the project was accomplished.

"A Study of Society and Culture of Communities in the Eastern Seaboard Development Plan" by Paradee Mahakan is a report that gives a broad overview of the condition of the society and culture in the areas affected by the Eastern Seaboard development[53](ภารดี มหาขันธ์, 2530). The researchers started examining the issue of change in the Eastern Seaboard region after implementing the development program. They found that the development resulted in labor immigration from outside of the region which altered the population structure of the area.

[53] See **ภารดี** (2530).

"A study of the Eastern Seaboard development and its impact: A benchmark survey of the psychosocial-economics status of the residential area and new town" by Sasipat Yodpet and others is considered one of the earliest studies documenting the changes in the nature of the population in the ESB development area on both macro and micro levels[54](สุดสงวน สุธีสร และคณะ, 2533). The goal of this study was to examine the condition of the communities troubled and affected by the land expropriation due to the Eastern Seaboard development plan, and to present ways to alleviate the problems. It can be said that this study presented a different point of view from the reports by the government and private sectors in the late 1970s. The researchers pointed out that the Eastern Seaboard development for industrial profit resulted in land expropriation in many areas, and affected locals. In some areas, more than 60% of the locals had trouble finding new dwellings because of the insufficient reimbursements. They also faced unemployment from having to relocate far from their employers.

Moreover, a report by Supang Chantavanich, "A study on the Condition of the Society and Culture of the Eastern Seaboard Region Report" presented the effects on people's way of life as well as changes in terms of social value[55](สุภางค์ จันทวานิช, 2529). This research aimed to study the relationships between economic trends, technology from the industrial development program and the pattern in social-cultural change. The author pointed out how the ESB program might have positive effects, including the emergence of towns and a better quality of life for the population. It also promoted a modern attitude and values toward work i.e. emphasis on achievement, independence and discipline, and the opportunity for local people to govern themselves and further develop democracy. However, negative impacts might also occur, including the damage to nature and the ecosystems. New laws enacted to handle issues might not be an effective defensive measure due to the lack of enforcement. Religions, beliefs and values may also decline while consumerism increases as a result of less spiritual stability. The quality of life in terms of the material rises, while its spiritual quality falls. Extended family relations in the city dissipate leaving behind only nuclear families.

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[54] See **สุดสงวน** (2533).
[55] See **สุภางค์** (2529).

Apart from studies in the beginning phases of the ESB project, the report "The Social Effect of the Eastern Seaboard Industrial Development on local communities" by Surichai Wungaeo and others is also another important work. It examined the ESB program after it had been implanted for over a decade and provided a more complete picture[56](สุริชัย หวันแก้ว ปรีชา คุวินทร์พันธุ์ และประสิทธิ์ สวาสดิ์ญาติ, 2543). The goal of this research was to study the effects of the process of industrialization and in particular, the social impact of the Eastern Seaboard development program on local communities. The economic, local political and international contexts were crucial in the formation of the ESB project. In particular, the global and local economic recoveries in the late 1980s, and the recovery of the Japanese Yen resulted in the relocation of industries and investment funds.

In terms of local communities, the authors identified two groups. First, agricultural communities, where it was found that there were more changes in land ownership. Locals shifted from agricultural work to industrial employment, and differences in economic and social status started to emerge. Moreover, communities were affected by the environment and pollution started to appear. Second, communities involved in fisheries also experienced more changes in land ownership. Immigrant laborers moving into the region built tourist attractions, and environmental changes, in particular in air and water, affected all communities.

Surichai would like to point out that social issues emerged from planning without participation on the part of the local people. Both the planning and problem-solving were centralized. Therefore, there should be more opportunities for communities to participate in development planning, and development plans should include more social considerations. Other mechanisms should also include problem-solving, follow-up evaluations and participation by the public.

[56] See **สุริชัย** (2543).

3.1.4 Environmental Impact

The impact of the ESB program on the economy and society of Thailand was both positive and negative. It also had an environmental impact, especially in the eastern region of the country. Most environmental problems started to emerge in the early-1990s or after the ESB industries started operations. However, most of the environmental issues were documented in the form of news and articles in the newspapers rather than in studies or long articles.

It might be said that "Chemical Fertilizer Industry" by Sadang Singhawara was one of the earliest articles addressing problems affecting the environment in the ESB[57](แสดง สิงหะวาระ, 2527). At first, the article discussed the developmental background of the chemical fertilizer industry in Thailand, the amount of land and sea resources (natural gas, phosphate rock and potash) that can be used in the chemical fertilizer industry, stockholder structure, production capacity, the value of investment by the chemical fertilizer corporation as well as problems within the developing chemical fertilizer industry. These included infrastructural difficulties, slow construction, employment contracting, funding, training of future operators and marketing strategies. It then discussed potential environmental problems from chemical fertilizer plants including air pollution in the surrounding area, danger to agricultural crops, the quality of water, port and dwellings as well as ecotourism and historic sites in the vicinity.

The article "Eastern Seaboard Development and Environmental Contamination" by Banyat Suksringam indicated that the changes in the environment in the Eastern Seaboard area reflected a trend of increasing pollution, especially water and air pollution which had caused as many as 52,203 cases of illness in 1992, increasing from 30,000 cases of illness in 1991[58](บัญญัติ สุขศรีงาม, 2536). Most of the patients suffered from respiratory conditions. Water resources were also contaminated at a high rate. At the end of the article, the author argued that the industrial

[57] See **แสดง** (2527).
[58] See **บัญญัติ** (2536).

development in the ESB program had neglected the environmental and pollution aspects, and that the issuing of the Enhancement and Conservation of National Environmental Quality Act (1992) was a retroaction in hindsight.

Similarly, “20 Years of Eastern Seaboard and the Environmental Situation” by Sompol Yosthasak is an article reflecting environmental issues as a result of industrial development following the ESB program from 1984-2004[59](สมพล ยศฐาศักดิ์, 2547). The author suggested that environmental issues had emerged in the early-1990s, and had multiplied immensely since the 2000s. Environmental issues included water and air pollution from the petrochemical industry. Although there was Environmental Impact Assessments (EIA), these evaluations were conducted in isolation rather than in co-ordination. The lack of comprehensiveness also meant that some environmental risks also escaped detection. The author concluded that the environmental problems in the ESB programs were caused by many factors. These included attempts by the industry to reduce capital costs associated with environmental responsibility, the local government’s incompetency in controlling, caring and monitoring of environmental problems and the local people’s lack of alertness in preventing environmental impact. There was also no or little studying of the local or overall EIA of the ESB program to assess how much pollution the region could handle, how the industry should expand, and if a “buffer zone” between residential and industrial areas should be allocated. As a result, environmental risk has been remained, which caused the huge public attention when the legal case started at Administrative Courts in 2007 (Figure 10).

[59] See **สมพล** (2547).

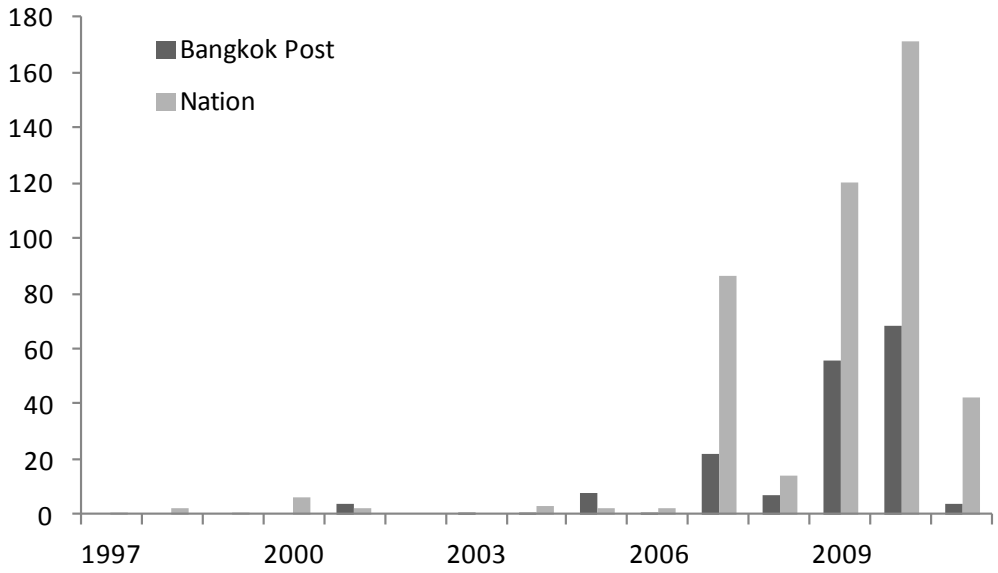

Figure 10: The Number of Relevant Articles in "Bangkok Post" and "Nation"
Source: (Yamaguchi, Oyama, Kakuwa, & Shiroyama, 2012)

Recently as stated, ESB has attracted the increasing attention due to its environmental and social sustainability. Yet, its economic sustainability has not been fully analyzed by academia, which will be highlighted in this chapter of this dissertation.

3.2 Contrasting Economic Performances

Thailand, which had not developed manufacturing sectors, has succeeded in its industrializations since the late 1980s. The country achieved economic growth with annual rates averaging 10% till the Asian Financial Crisis in 1997. The growth was remarkable compared with the Indonesian growth in the same period. While the GDP per capita between the two countries had no significant differences in the early 1980s, that in Thailand is currently twice as large as that in Indonesia.

Together with the machinery and food industries, the petrochemical and automotive industries have taken a major role in this industrialization (Figure 11), both of which are mostly located in the Eastern Seaboard (ESB) region such as the Chonburi, Chachoengsao, and Rayon provinces. According to the NESDB, the average annual growth rate of the Gross Regional Products (GRP) per capita in the ESB was 12.1% from 1991 to 1995, which was far superior to that in other regions. In the same period, the average annual growth rate of value added generated by the manufacturing sector in the ESB was 22.0%, which is also the highest rate throughout the country.

Seen against the backdrop of an accelerated economic globalization, it is inevitable that the ESB would have increasing competition from other industrial regions. There are mainly two industrial areas in the ESB. While a petrochemical industry has been flourishing since government initiatives strongly backed off-shore developments in the Map Tha Phut (MTP) area, an automotive industry has been agglomerated in the Laem Chabang (LCB) area, triggered by Japanese investments after the Plaza Accord (Appendix A).

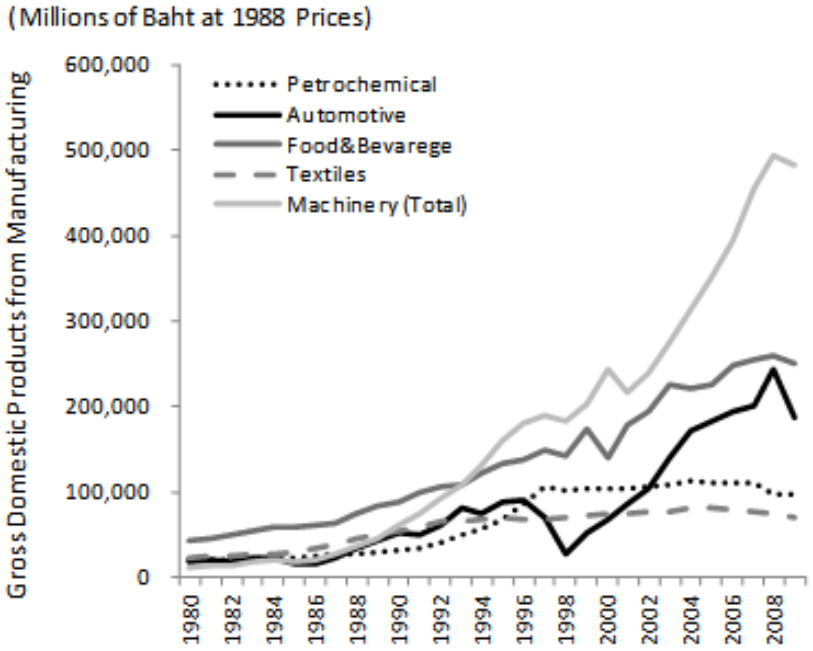

Figure 11: Gross Domestic Products from Major Industries

Source: (Office of the National Economic and Social Development Board)

There has been a sharp contrast in economic performance between the petrochemical and automotive industries since 1998 (Figure 12). On one hand, instead of shifting to higher-value-added products, the petrochemical industry has stuck to basic petrochemical products such as ethylene even though its cost competitiveness has declined due to economies of scale in other countries such as China. With its declining competitiveness, basic petrochemical products from Thailand cannot get advantage of an emerging market in developing countries.

On the other hand, the automotive industry has adapted well to an emerging exporting market in pick-up trucks after the crisis in 1997. After the crisis, the Thai government advocated the Asian Detroit Plan which set 2 million a targeted production in 2010. Among major automotive companies, Toyota took this driver most within its Innovative International Multi-purpose Vehicle (IMV) project since 2004. Notably, in the following three years, the company increased its sales in Asia by three times. In this way, both the production output and nationalization index have lately increased.

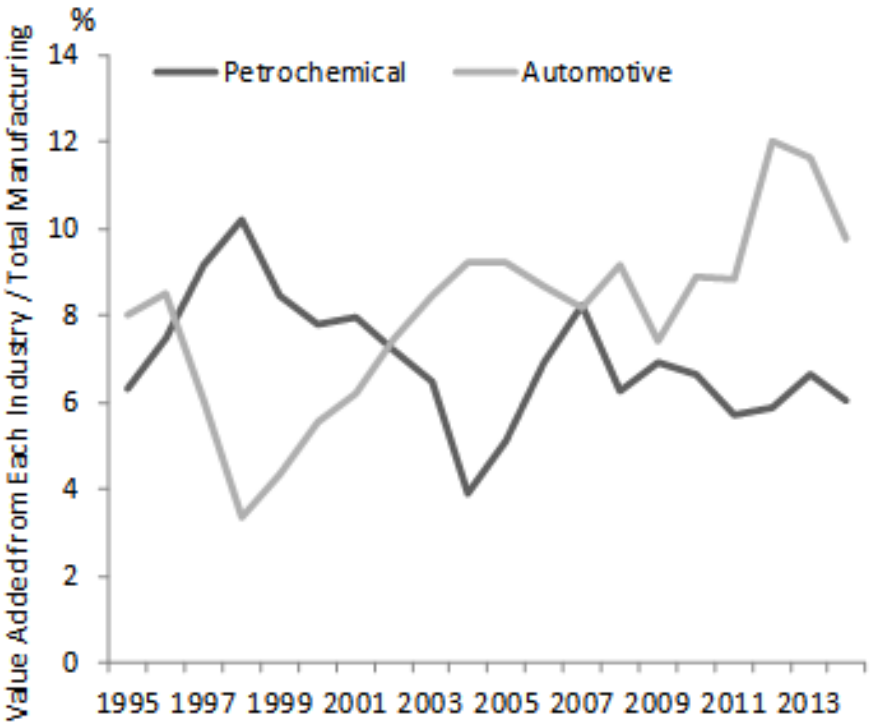

Figure 12: Added Value from Petrochemical and Automotive Industries
Source: (Office of the National Economic and Social Development Board)

3.3 Analytical Hypothesis

This research aims to address the differences in regional adaptations between MPT and LCB. Regional adaptation is defined as the evolutionary process whereby a region becomes better able to be resilient in its environments. Its research hypothesis is that MPT, more than LCB, is embedded in less flexible industrial systems. The regional economy in LCB is based on denser social networks. Indeed, in many parts of the world and in many historical periods, regional network-based industrial systems have been identified as a critical factor in development[60](Best, 1990) (Sabel, 1989) (Sabel & Zeitlin, 1985) (Sabel & Zeitlin, 2002) (Piore & Sabel, 1984) (Scranton, 2000)

For example, in disputing the dominant accounts of Japan's growth, scholars of Japanese development have argued that the role of government policy has been vastly overstated and that networks of small and medium-sized suppliers rather than vertical integration, have been the source of industrial strength[61](Friedman, 1988) (Cusumano, 1985). They highlighted the importance of social ties between firms and of trust and cooperation as a source of industrial flexibility[62](Clark, 1979) (Dore, 1973) (Ouchi, 1980). Similar arguments have been made by recent empirical studies in Italy and Germany[63](Herrigel, 2000) (Piore & Sabel, 1984) (Pyke & Sengenberger, 1992) (Sabel, 1989) (Scott, 1988) .

Observers of business describe the formation of networks of vertically disaggregated firms which are independent but linked to suppliers and customers as collaborative relationships[64](Belussi, 2005) (Helper, MacDuffie, & Sabel, 2000)

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[60] See Best (1990), Sable (1989), Sable and Zeitlin (1985, 2002), Piore and Sable (1984) and Scranton (2000).
[61] See Friedman (1988) and Cusumano (1985).
[62] See Dore (1973), Clark (1979) and Ouchi (1980)
[63] See Piore and Sable (1984), Sable (1989), Herrigel (2000), Scott (1988) and Pyke and Sengenberger (1992).
[64] See Belussi (2005), Helper et al. (2000), Johanson and Mattson (1987), Johnston

(Johanson & Mattson, 1987) (Johnston & Lawrence, 1991) (Miles & Snow, 1992) (Powell, 1990) (Sako & Helper, 1998) (Storper, 1997). Sociologists and economists similarly note the growing prevalence of stable, long-term relationships between firms rather than arms-length, short-term market exchange[65](Granovetter, 1985) (Eccles, 1981) (Ouchi, 1980) (Stinchcombe & March, 1965).

Although a number of experiences shows the importance of flexibility in business transactions backed by dense social-networks in a process of regional adaptation, this aspect has not often attracted the attention of regional scholars. On one hand, regional development is often portrayed just as the product of risk-taking entrepreneurs and innovative small firms[66](Gilder, 1988). In this view, unimpeded flows of capital, skilled labor, and information have both initiated and sustained an ongoing process of new firm formation. The presence of coordinating institutions, ample supplies of venture capital, an industrial park, and the absence of market constraints such as government regulation of labor unions have supported a virtuous cycle of entrepreneurial start-ups and small-firm led industrial development.

This view of regional development combines the assumptions of neoclassical economics with a Schumpeterian vision of the dynamism of innovating entrepreneurs. It sees the technological vitality of a certain region as the product of the struggle for market leadership among atomistic enterprises. And it tends, either implicitly or explicitly, to associate small-scale enterprises with superior efficiency and capacity for innovation. The prescription for American industry is thus to promote entrepreneurship and small firm-led development by insuring free flows of capital, labor and technology and removing all constraints on the free functioning of markets.

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and Lawrence (1991), Miles and Snow (1992), Powell (1990), Sako and Helper (1998), and Storper (1997).

[65] See Granovetter (1985), Eccles (1981), Ouchi (1980), and Stinchcombe and March (1965).

[66] See Gilder (1988).

On the other hand, an alternative understanding of the regional economy has emerged[67](Borrus, 1988) (Ferguson, 1988) (Krugman, 1986) (Ferguson, 1988). This account stresses the vulnerability of competitive capitalism. It views the region's entrepreneurialism and fragmented industrial structures as a liability given the increasingly capital-intensive cost structure of high technology production. From this perspective, small and medium sized firms are no match for Japan's large, vertically integrated corporations which are supported by the policies of an interventionist state. The survival of the regional economy depends, in this view, on government support to promote technological advance, corporate consolidation and the achievement of scale.

The view that increased scale, even vertical integration, is required for industrial adaptation is based on the assumption that technology determines the most efficient organization of production. This is an old theme in social sciences especially in the US. Efficiency has, for most of the 20th century, been associated with the vertically integrated mass production corporation in which coordination is achieved by corporate managers pursuing economies of scale and factory rationalization. Production efficiency is seen, in particular, as the ability to amortize large investments in plant and equipment over high production volumes in order to achieve a low cost competitive position.

Alfred Chandler's classic account thus describes the rise of the modern corporation in the US as the most efficient organizational response to technological development,-particularly in the construction of the railroads[68](Chandler, 1990) (Chandler, 1993). In this view, the advantage of the large scale corporation lies in its ability to capture increasing economies of scale. Oliver Williamson similarly concludes that the modern corporation is "first and foremost an efficient instrument", using a transaction cost approach to demonstrate that corporate hierarchies are an

[67] See, for example, Ferguson (1988), Borrus (1988), Nelson (1984), and Krugman (1986).
[68] See Chandler (1990, 1993).

optimal market outcome, given certain conditions[69](Williamson, 1975) (Williamson, 1985).

The view of the state as a key actor in promoting national industrial advance also builds on certain traditions in economic development. Acknowledging that the pressure of market competition alone might not be sufficient to call forth the appropriate organizational form, Gerschenkron and Shonfield stress the role of organized political intervention to help domestic industry achieve the scale necessary to compete in the world economy[70](Gerschenkron, 1962) (Shonfield, 1965). In these cases the state coordinates the investment and research associated with high volume production.

Scholars in this tradition view Japan as the latest model of efficient industrial practices. Japan's success in semiconductors is attributed to extensive government support for technological advance and coordination of investment in a capital intensive industry; and its industrial structure is inundated by large scale integrated corporations. The logical conclusion is that governments in other nations must now intervene to assist domestic procedure to achieve similar economic structures—or risk falling behind in international markets.

Both the free market view and its critics have neglected the role of social networks in the regional economy and their inherent flexibility. Operating from the assumptions of liberal theory, both treat the organization of the economy as separate from the rest of social and political life. This tendency is most evident in neoclassical economics, which explicitly relegates politics and markets to autonomous spheres. In this framework, any form of intervention in the economy is an obstacle to the efficient allocation of resources produced by market competition. Competition alone motivates firms to adopt optimal industrial structures. Any intervention in the economy is therefore viewed as an obstacle to the efficient allocation of resources.

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[69] See Williamson (1975, 1985).
[70] See Gerschenkron (1962) and Shonfield (1965).

Similarly, proponents of government support have also minimized the extent to which social networks can shape the course of economic transaction. While the state might like and support the idea of domestic firms meeting global standards, it does not do more than merely acknowledging the existence of these social networks. Politics remains the lubricant to finance and orchestrate whatever technology has determined to be most efficient—the mass production corporation which competes on the basis of scale and cost-cutting.

By minimizing the role of social networks in economic transactions, both of the dominant approaches to the development of regional economy overlook a wide range of efficient and alternative ways of organizing industrial production, other than free markets and the hierarchical corporation. On one hand, the market view overlooks the distinctive social relationship that exists between the business community and the technical community within a region. This relationship can promote an on-going recombination of resources and continuing diffusion of skills and information. On the other hand, the proponents of mass production supported by government overlook the remarkable success of a large number of firms in some regional economies such as Silicon Valley which have explicitly avoided high volume production in favor of specialization strategies which target niche markets and focus on innovation and quality rather that cost.

Recently, scholars of industrialization have drawn increasing attention to the re-emergence of regional economies, reminiscent of the 19th century industrial districts described by Alfred Marshall[71](Herrigel, 2000) (Piore & Sabel, 1984) (Pyke & Sengenberger, 1992) (Sabel, 1989) (Scott, 1988). They document the technological dynamism of these regions—which include the most successful industrial regions in Europe—and the distinctive blend of competition and collaboration among firms which compete on the basis of innovation and quality, not just cost. And they detail how local institutions like families, trade associations, and research institutes support strategies of flexible specialization.

[71] See, for example, Piore and Sable (1984), Sable (1989), Herrigel (2000), Scott (1988) and Pyke and Sengenberger (1992).

3.4 Perspectives of Agglomerations Theory

Since the 1990s, a theoretical development in regional economy has been noticed: it reflects the realization of the importance of regional economy against the backdrop of economic globalizations. There are roughly three analytical perspectives for industrial agglomerations (Figure 13).

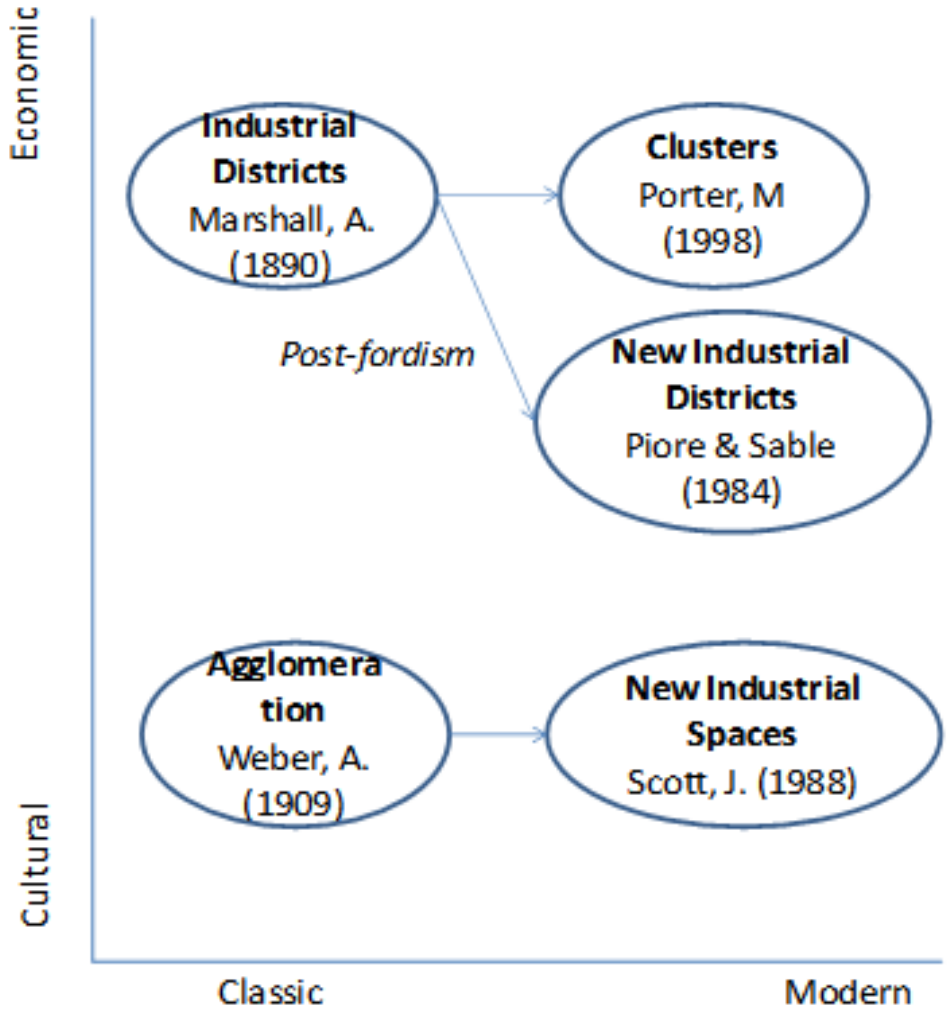

Figure 13: Schools of Regional Economy

3.4.1 Perspective on External Economies

The first perspective focuses on external economies in explaining the agglomeration mechanism. One of the prominent groups in this school is new economic geographers such as Paul Krugman[72](Krugman, 1990) (Krugman, 1991). The notion of external economies is simply that producers benefit from sharing the costs of common external resources such as infrastructure and services, skilled labor pools, specialized suppliers, and a common knowledge base. When these factors of production are geographically concentrated, firms gain the additional benefits of spatial proximity, or "economies of agglomeration." Once such an advantage is established in a particular industry of locality, the presence of external economies ensures that the advantage becomes self-reinforcing[73](Marshall, 1920).

This industrial cluster theory by Michael Porter tries to address the mechanisms of this external economies based on a number of successful industrial agglomerations[74](Porter, 2008) (Porter, 2011). He argues that agglomerations benefit each producer with a better access to specialized inputs, employers, information, complementarities with other producers, a cheap access to public entities and goods, and an improvement of incentive mechanisms, all of which results in better productivity in the cluster. Based on the external economies, Porter addresses the importance of cluster as a source of competitiveness in a globalized economy.

Based on the classical free-market viewpoint, this perspective focusing on the concept of external economies has been most popular among mainstream economists. The student of this school views successful regions as examples of external economies that have derived from industrial localization: as cumulatively self-reinforcing agglomerations of technical skills, venture capital, specialized suppliers and services, infrastructure, and spillovers of knowledge associated with proximity to universities and informal information flows. Yet, the concepts of agglomerations and

[72] See Krugman (1990, 1991).
[73] For the original statement, see Alfred Marshall (1920).
[74] See Porter (2008, 2011).

external economies cannot explain why clusters of specialized technical skill, suppliers, and information produced a self-reinforcing dynamic of increasing industrial advance in some regions while producing stagnation and decline in other regions. The simple fact of spatial proximity evidently reveals little about the ability of firms to respond to the fast-changing markets and technologies that now characterize international competitions.

3.4.2 Perspective on Corporate Relations

So a new genre of research - New Economic Geography- has been expounded by economists. More recently, economic geographers, especially from the California School, have focused on corporate relations in geographical proximity to address agglomerations[75](Scott, 2000) (Scott, 2002) (Storper, 1995) (Storper, 1997) (Storper & Venables, 2004). For example, Allen Scott explains the agglomeration mechanisms of the Los Angeles megalopolis based on the Williamson's transaction cost theory. He argues that it is economically more rational for each company to advance vertical disintegration and connect with outer companies rather than to stick to vertical integration when the market is uncertain. In this context, each company tries to minimize the transaction cost with outer companies, resulting in geographical agglomerations.

Michael Storper focuses more on the cultural aspects of corporate relations such as personal relations, reputations and norms rather than transaction costs. In economic geography, this is called the Cultural Turn. He stresses the existence of relational assets emerging from multi-faceted transactions between adjacent corporations. It is production systems in a high territoriality based on relational assets that enables some industrial agglomerations to stay sustainable among economic globalizations.

[75] See, for example, Scott (2000, 2002), Storper (1995, 1997), and Storper and Venables (2004).

As a new criticism against the free-market view point, this perspective has been influential among experts in human geography However, this approach overlooks the fact that relations of professional identity and trust exist prior to these economic relationships. The ongoing interaction allowed by the geographic clustering of an industry fosters the social solidarity that makes collaborative supplier relations needed for flexible production possible. In addition, the recent cultural turn of economic geography could not sufficiently address the mechanisms in the dynamic adaptation process of industrial systems. For example, cultural accounts cannot explain the shift from arm-length to more cooperative supplier relationships occurring in some successful regional economies.

3.4.3 Perspective on Social Networks

The last perspective focuses on social networks in a region. In the context of post-Fordism in the 1970s and taking Third Italy as a case study, Piore & Sable made flexible specialization theory the focus of their seminal study[76](Piore & Sabel, 1984). The region Third Italy dealt with market volatility and diversity by allowing economic transactions among specialized small firms to be as flexible as possible. The authors argued that regional social networks consisting of social ties between firms, existences of coordinators and the active roles of local municipality offices have enabled the production system in the region to stay resilient.

Recently, production systems based on regional social networks have been the focus of studies in many countries. While Silicon Valley is one of the most popular subjects in this school, studies in Europe since the 1990s have also drawn practical policy implications from the theory of regional innovation systems[77](Braczyk, Cooke, & Heidenreich, 1998) (Cooke, Uranga, & Etxebarria, 1997) (Morgan & Cooke, 1998). It is different from traditional national innovation studies in that the regional innovation theory stresses collaboration, trust and knowledge- sharing between firms,

[76] See Piore and Sable (1984).
[77] See, for example, Braczyk et al. (1998), Cooke et al. (1997), and Morgan and Cooke (1998).

and entrepreneurship. In particular, the sharing and exchange of tacit knowledge through face-to-face communications in a regional network has been recently highlighted[78](Gertler, 2003).

3.5 Methodology

3.5.1 Industrial Systems Framework

Regional adaptations springing from the network-based industrial systems in the hypothesis above originated in the school of post-Fordism. Taking industrial regions in developed countries as examples, the school discussed regional advantage against the backdrop of the rise of Japan then. The "Flexible Specialization" theory by Sable, which focused on flexible economic transactions among craftspeople as a strength in Third Italy has been especially influential in this field[79](Piore & Sabel, 1984).

Following this seminal work, Saxenian addressed the regional adaptation in Silicon Valley using the "Industrial Systems" framework[80](Herrigel, 1989) (Saxenian, 1996). Based on the case of Silicon Valley, the industrial systems framework assumes that firms are embedded in a social and institutional setting that shapes, and is shaped by, their strategies and structures[81](Granovetter, 1985). The concept of an industrial system is geared toward capturing the historically evolved relationship between the internal organization of firms and their connections to one another and to the social structures and institutions of their particular localities.

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78 See Gertler (2003).
79 See Piore and Sable (1984).
80 See Herrigel (1989) and Saxenian (1996). Saxenian (1996) notes that "the notion of an industrial system is adapted from Herrigel's concept of industrial order." According to Herrigel (1989), industrial order is defined as "the sum of practices, rules, and institutions that constitute and shape the way the production of goods and its administration take place."
81 See Granovetter (1985).

The framework has three dimensions: (i) local institutions and culture, (ii) industrial structure, and (iii) corporate organization. First, local institutions refer to public and private organizations such as universities, business associations, and local governments, as well as the less formal hobbyist clubs, professional societies, and other forums that create and sustain regular patterns of social interactions in a certain region. These institutions shape and are shaped by the local culture, the shared understandings and practices that unify a community and define everything from labor market behavior to attitudes toward risk-taking. It is noted that a region's culture is not static, but rather is continually reconstructed through social interactions.

Second, industrial structure refers to the social division of labor—the degree of vertical integration—as well as to the extent and nature of links between customers, suppliers, and competitors in a particular sector or complex of related sectors. The school of regional development usually analyzes this aspect of industrial systems extensively while often neglecting its close relationships to the other two dimensions of an industrial system. Third, the final dimension—internal firm organization—includes the degree of hierarchical or horizontal coordination, centralization or decentralization, and the allocation of responsibilities and specialization of tasks within the firm.

It is noted that these three dimensions are closely interconnected[82](Dosi, 1988) (Kline & Rosenberg, 1986) (Putnam, 2001) (Putnam, Leonardi, & Nanetti, 1994) (Sabel, 1993). No single dimension alone adequately accounts for the adaptive capacity of an industrial system, nor is any single variable prior to or causal of the others. Also, in practice, the three dimensions tend to become mutually reinforcing components in coherent regional economies.

[82] The significant interconnections are well awarded not only by non-economists such as Putnam (1994, 2001) and Sabel (1993), but even by economists. See, for example, Dosi (1988) and Kline and Rosenberg (1986).

3.5.2 Data Collection

Since November 2014, a qualitative data has been acquired using in-depth, open-ended questionnaires in semi-structured interviews (Appendix B). The questions dealt with all three aspects in an industrial system framework. The interviews were conducted in Bangkok, the ESB, and Tokyo. Interviewees were professionals and employees who have worked in the ESB (Appendix C). Based on the theoretical saturation principle, both interviews for petrochemical and automotive industries were completed when they reached a point where no new information is obtained from further interview[83](Glaser & Strauss, 2009). The interviewees are summarized as Figure 14.

To re-examine the character of industrial systems, relevant factory data were also gathered (Table 6). First, the data of start-up factory in ESB was gathered both for petrochemical and automotive industry (Appendix D). The numbers of the start-up are 254 in the petrochemical industry and 440 in the automotive industry. Second, the data of factories in relevant supply-chain was gathered (Appendix E). While the number of factories in the petrochemical major supply chain is 84, the number of major supporting companies for the Japanese car makers is 200. Third, based on the factory data, the character of industrial systems were re-examined as shown in Chapter 6.

[83] See Glaser and Strauss (2009).

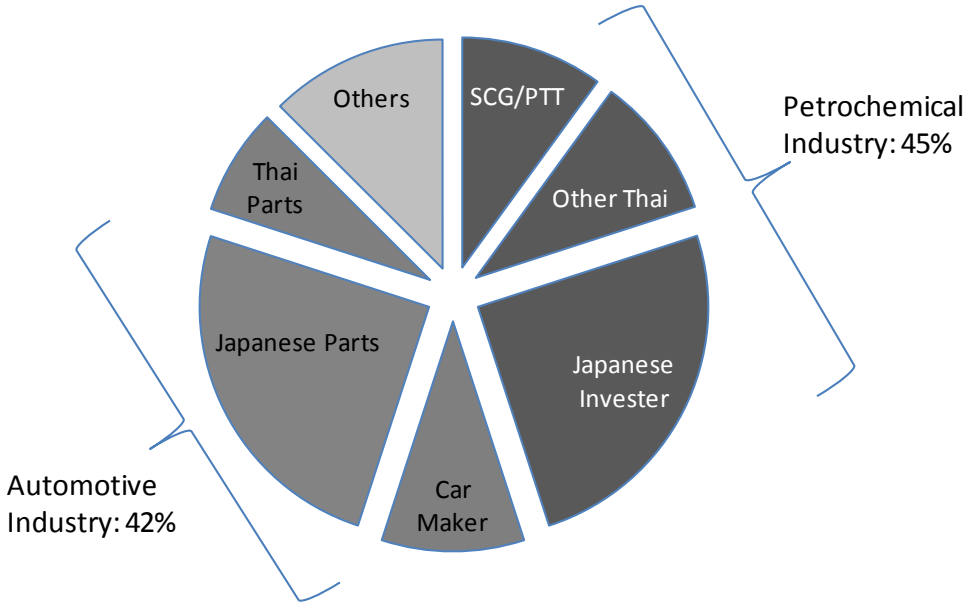

Figure 14: Summary of Interviewees.

Table 6: The Number of Factory Subject for Data-collection

	Petrochemical Industry	Automotive Industry
Start-ups in Eastern Seaboard	254	440
Factories in Major Supply-Chain	84	200

CHAPTER 4: THE PETROCHEMICAL INDUSTRY IN MAP TA PHUT

Chapter 4 gives the result of the relevant semi-structured interview for the current and former practitioners related to the petrochemical industry in ESB. As the industrial systems framework is consisted of the three dimensions such as local institutions and culture, industrial structure, and corporate organization, the qualitative result is accordingly shown as follows with the considerations of the inter-dimensional relationship.

4.1 Elite Engineers

4.1.1 Conservative Traditions

After the initial off-shore development in the Gulf of Thailand, gas pipelines finally reached the Map Ta Phut (MTP) seaport in Rayong province in 1980. Ethane could be separated from the natural gas for ethylene and propylene productions as the gas from the Gulf is applicable for petro-chemical industries. Based on the basic products such as ethylene, further downstream industries have flourished in Map Ta Phut (MTP).

Engineers working in the petrochemical industries in MTP can be characterized as an elite urban middle-class mostly from Bangkok. It is said that an urban middle-class is quite conservative in its lifestyle and vested interests while at the same time showing quite negative attitudes towards the authoritarian political regime including the military and police. Sometimes, the political beliefs of this urban middle class can even result in demonstrations[84](Anderson, 1977) (Suehiro, 2003). Considering that the engineer in MTP is an elite middle-class, his conservative character is more remarkable.

[84] See, for example, Anderson (1977) and Suehiro (2003).

The conservative engineer separates his work and private life rigorously. This separation is a great contrast to the lifestyle of engineers in the automotive industry around Sriracha, a coastal town in the province of Chon Buri. These latter engineers have less of a distinction between their work and their private lives. Many of them are graduates from the engineering faculties of elite universities, who usually emphasize their identity as an elite middle class from Bangkok.

In the automotive industry, the engineer's identity is dominated by his work as well as a fusion between his work and private life. These engineers enjoy a distinct social identity as skilled automotive engineers working in Laem Chabang (LCB) area. It is Sriracha that epitomizes this identity. There is no place for hanging out around MTP. Though Rayong city has developed recently, its scale is not comparable to Sriracha. An engineer who has worked in MTP explains the lifestyle as follows:

> *"Most engineers in MTP stay in Rayong city with their families. We [donot stick] to the city. Rather, whenever there are some meetings in Bangkok, we frequently go to Bangkok."*[85]

As engineers do not spend a lot of time in the local city after work, informal information exchanges are limited. But this was not always the case. At the beginning of the development in the1980s, there were more exchanges. For example, the former president of Thai Plastic and Chemicals Public (TPC) explained "in establishing the Thai PVC production, we worked hard in MTP. In our neighborhood, Dr. Pailin, the former President and CEO of the Petroleum Authority of Thailand (PTT) managed his factory. We all have close relationships."[86] There was indeed some shared working identity in MTP in the initial stage. As this pioneering identity faded away, this working attitude did not sublimate itself into some common social identity.

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[85] Interview, Veerapon Puangpitayavut, President of FTI Rayong, May 13, 2015.
[86] Interview, Somchai Kongsala, a former President of Thai Plastic and Chemicals Public, November 3, 2014.

4.1.2 Entrepreneurship Mind

Conservative elites affect the character of labor markets and the pattern of entrepreneurships in MTP. While job-hopping is quite frequent in Thai career-building, engineers prefer a stable career based on their loyalty to big companies. Employers of those companies also try to enclose these elite engineers with long-term contracts.

As for entrepreneurships, though the number of start-ups increased in the 1980s and 1990s, it has been decreasing since the Asian Financial Crisis in 1997. This trend is in contrast to the automotive industry. In the automotive industry in LCB, the number of start-ups has rebounded after the temporal downfall due to the Asian Financial Crisis.

This trend of start-ups shows the risk-averse character of potential entrepreneurs in MTP. In view of outer shocks such as the Asian Financial Crisis in 1997 and the World Financial Crisis in 2007, they try not to take risks. Elite engineers who have worked for major companies such as the PTT and the Siam Cement Group (SCG) under long-term contracts have become more conservative. Few launch their own start-ups. PTT and SCG have been able to attract and hold on to their elite engineers by offering their low-risk benefits as well as a prestigious brand image.

It is also noted that other than PTT and SCG, there were few role-models in MTP of successful start-ups. The past experience of the corporation called Thai Petrochemical Industry (TPI) also makes the situation worse. After its establishment in 1978 by Prachai Leopaoratana, a Thai of Fujian Chinese descent, TPI became one of the biggest petrochemical companies in MTP, rivaling even PTT and SCG. Massive investments in petrochemical industries and huge debts due to business diversifications began to make its financial situation dire after the Asian Financial Crisis and eventually resulted in bankruptcy.

In 2005, the Stock Exchange of Thailand accused Mr. Prachai of corruption. He had resisted the reconstruction plan of the government, and Thailand's bankruptcy court ordered the equity receivers to dismiss Mr. Prachai. The board directors finally decided to dismiss Mr. Prachai in 2006. PTT is currently a major shareholder of the TPI which has been renamed Integrate Refinery Petrochemical Complex Public Company Ltd. (IRPC.) After losing his own company, Mr. Prachai tried to move into politics as a leader of the Matchima Thipataya Party in 2007. He was subsequently charged with the illegal manipulation of stock prices and the Party was dissolved by the Constitution Court in Thailand. Mr. Prachai was ruined, symbolizing the absence of entrepreneur role models in the petrochemical industries in MTP. There is little motivation for elite engineers to follow this story.

4.1.3 Public Support

One reason for the risk-averse tendencies of entrepreneurships is the nature of their funding. In looking at the amount of capital owned by investment entities in the petrochemical industry, it can be seen that Thai enterprises account for a ratio significantly higher than in other industries. Yet, it should be noted that local enterprises are financed not only by private banks but also by public entities.

In fact, a number of start-ups are subsidiaries of PTT backed by the Ministry of Energy. For example, government support is evident in the National Petrochemical Corporation (NPC) I, one of the pioneering start-up projects in MTP. The NPCI comprises an olefin center and four downstream companies basing on ethane and propane provided by PTT's gas separation plants. In February, 1984, the NPC was established as the operating body of the olefin center. Forty-nine percent of the NPC capital was originally owned by PTT, the largest state enterprise. In addition, as four downstream companies needed to tie an exclusive contract with this olefin center regarding ethylene and propylene provision, it can be concluded that the start-up risks of NPCI could only be taken by PTT when significantly backed by the government.

This public-driven nature in financing is not different from another major start-up called the NPCII. Targeting not only ethylene and propylene but also aromatic compounds such as benzene based on imported naphtha, the NPCII encompasses the Thai Olefins Corporation (TOC) which runs the naphtha cracker and the Aromatics Thailand Corporation (ATC) which operates the aromatic plants. While the TOC is owned by PTT (40%) and NPC (11%), the ATC is solely owned by PTT. A significant influence of PTT was recognized by a pioneering Japanese investor of Mitsui Chemicals in Japan:

> *"In the initial phase of MTP, [the] government initiated the industry, which is absolutely different from privately driven industrial agglomerations in other developed countries. In this public driven agglomeration, it was also difficult for us to launch joint-venture through technology transfer."* [87]

After these initial public-driven start-ups, private companies also began investing in the upstream petrochemical industry, which was enabled by the deregulation in 1994. One of the biggest start-ups in this context was initiated by the Siam Cement Group (SCG) in 1996, targeting 600 thousand tons of the annual ethylene production, which was the biggest plant all over the world. While this was not significantly supported by the government, 30% of the SCG share was owned by Crown Property Bureau (CPB) [88]. In other words, relevant start-up risks were not taken by private investors. Considering that the SCG can still continue their plant operations in MTP while an environmental lawsuit is still pending, the advantages of this nature of financing and risk-taking are self-evident.

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[87] Interview, Kenichi Yoshida, a former Thai representative of Mitsui Chemicals, December 14, 2014.

[88] The Crown Property Bureau (CPB) is the quasi-government agency responsible for managing the property of the crown of the Kingdom of Thailand.

Indeed, the start-ups in MTP are not driven by risky entrepreneurships with private lenders but significantly safeguarded by more public entities such as the government and the royal family. This is a stark contrast to the situation of the automotive industries in LCB. While there are plenty of information flows regarding financing in LCB, the flow is scarce in MTP, which also makes the business environments unfavorable for entrepreneurships other than major companies such as the PTT and SCG.

4.1.4 Collaboration between Academia and Industry

Without a doubt, some of the traditional elite universities are the first-rated educational institutions in this part of the world. And its engineering faculties have sent a number of brilliant graduates to major companies such as the PTT and SCG for many years. Indeed, these two companies always rank among the most popular companies in interviews with students. The bond between academia and industry is so strong that a former Japanese trader laments:

> *"Needless to say, the alumni from elite universities are very competent. Yet, today, we cannot offer [a] much better salary for them than the [local Thai] companies. In particular, PTT and SCG [seem to] offer better [salaries] for [the] most brilliant students. This trend is getting even stronger."*[89]

While there are traditionally strong relationships with its alumni, the contribution by academia to private research and development is relatively limited. In terms of contribution, King Mongkut's University of Technology Thonburi may have an advantage as it has strengthened its tie with the National Science and Technology

[89] Interview, Kiyoshi Kasahara, a former trader for Tomen, January 21, 2015.

Development Agency (NSTDA). While traditional public universities have strengthened its ties with the PTT and SCG through scholarship programs, cooperation between industry and academia has only just started.

And what is more regrettable, the relationship between this institution and newly established small and medium-sized enterprises (SMEs) is even scarcer. It is not easy for SMEs to access competent research institutions in collaboration on start-ups. In addition to the physical distance between Rayong and Bangkok, there are also a number of barriers such as the high-rate of overheads. There are also few local research institutions with which SMEs can collaborate.

The strong cooperation between industry and academia is so critical for regional innovations that it has become a factor for major consideration by regional planners all over the world. Indeed, in 2002, the NSTDA established the Thailand Science Park (TSP) near the Nava Nakorn Industrial Estate, Pathum Thani Province. There are now 52 SMEs and start-ups in the Park with 2000 employees involved with research and relevant tasks[90](Chachanat Thebtaranonth, 2007). The tenants can enjoy tax deductions as well as a variety of services regarding human resource, technical set-ups, accounting, infrastructure and property rights. In this way, the TSP contributes to local start-ups.

Recent regional developers have acknowledged that cooperation with research institutes could be beneficial for regional economies through technical, human, and information spill-over. While MTP traditionally has a strong relationship with the most prominent research institutions, this relationship does not extend well into other regions.

[90] See Chachanat (2007).

4.1.5 Federation of Thai Industries

As a regional institution, the Rayong branch of the Federation of Thai Industries (FTI) has an important function in lobbying against the municipality office. Lobbying issues are variable. For instance, the recent environmental lawsuit in MPT has drawn attention to the issue of land zoning. Regional stakeholders are also sharing and discussing common problems in the operation and management of petrochemical plants.

Yet, important issues such as those related to economic transactions are not well discussed in this region. Rather, the FTI Petrochemical Industry Club regularly holds its business meetings in Bangkok where member headquarters are located. There also seems to be differences in their interests: industrial sustainability or the sustainability of MTP as a region. The President of the Club said:

> *"While PTT started from energy developments in the Gulf of Thailand, SCG started from commodities of petrochemical industry. Thus, the former sticks more to the MTP's sustainability than the latter. SCG can easily move away once it finds more suitable place for its petrochemical business. Indeed, SCG has been more interested in Vietnam in its ASEAN plan."* [91]

Since new start-ups are rare in MTP, the PTT and SCG *have to be* the main actors for sustainable development in the area. Yet, the decision-making of these major companies is conducted in Bangkok where their headquarters are located. Thus,

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[91] Interview, Ekarat Thongtawach, President of FTI Petrochemical Industry Club, August 11, 2015.

the sustainability of the industry as a whole rather than just MTP is more important to Bangkok. Not surprisingly, there is a lack of institutions which should exist to facilitate dialogues between MTP and Bangkok.

4.2 The Self-Sufficient Group

4.2.1 Mass Production Systems

In MTP, the corporate character of each SME is heavily influenced by the tradition of the PTT and SCG. Economic transactions are also inflexible, following in the traditions of capital-owning structures. Regional industrial structure is characterized as vertical integration within self-sufficient corporate groups.

As a number of technology enterprises in MTP are PTT and SCG subsidiaries, they focus more on their relationship with Bangkok where the headquarters are located. Regional inter-group linkage has not been well advanced. Economic activities center on the inner group's inflexible economic transactions, and information flows and flexible transactions among different groups seldom occur.

Subsidiaries of the PTT and SCG often replicate the modern mass-production system of the headquarters. In any downstream sector, enterprises have to transact with huge factories which have adopted the mass production system for basic products such as ethylene. Through an inflexible transaction with this mass production system, each enterprise naturally adjusts its production system to reap the Economies of Scale.

This adoption is enabled by the human relationships the manager class has between headquarters and subsidiaries. The mass production system in modern corporate management is transferred to local subsidiaries by managers from Bangkok.

4.2.2 Rivalry between PTT and SCG

In the beginning process of the petrochemical industry in the 1980s, the PTT group initiated ethylene production from ethane separated from natural gas. Then it went into downstream business. The SCG, on the other hand, started with downstream commodities originally buying feedstock from the PTT. Then, in 1990s, it went into the upstream business using cheaper imported naphtha for its own ethylene production. This was the beginning of the rivalry between the PTT and SCG groups. More and more vertical integrations progressed within each group, with competitions becoming increasingly severe between groups. This situation was observed by Japanese engineers in Thailand:

> *"Locating adjacently, PTT and SCG groups [have] no collaborations in between. It seems that the one makes strategies to beat the other. In [a] limited market, this is indeed zero-sum situations."* [92]

This observation is shared by a Thai insider no less than the President of the Petrochemical Industry Club:

> *"Eventually, the supply chain and the innovation strategy are totally distinctive between PTT and SCG group. Perhaps, we might need some public organizations for collaborative*

[92] Interview, Yuzo Suzuki, a former Thai representative of Mitsubishi Kakoki Kaisha, January 7, 2015.

innovations such as NEDO [New Energy and Industrial Technology Development Organization] in Japan."[93]

As the group boundaries become distinct, these engineer-managers also have less contact with regional groups. For example, upper management staff usually does not attend the regional meetings of FTI Rayong and others. Their strategy is decided in Bangkok with global business dynamisms in mind, so it does not always reflect accurately the concerns of the regional context in MTP. In this way, the sufficiency of one group of players within a large entity has been strengthened at the expense of the other players, in this case, regional players. As vertical integration theory implies, production process is mostly completed within a group from feedstock provision to basic products and commodity production.

4.2.3 Vertical Integrations

While the PTT has expanded its business from upstream energy industry into downstream petrochemical industry, the SCG started from commodity production in the downstream. The vertically integrated industrial structure and mass-production system centered on basic chemical products have mutually strengthened. They certainly secured regional advantages for MTP before the Asian Financial Crisis in 1997.

At the same time, however, basic industrial infrastructure became expensive in MTP. For example, the electricity tariff in MTP is more expensive than other regions in Thailand and even other ASEAN countries. A vertically integrated business structure did not encourage competition for cheaper power supply. As a small Japanese investor points out, major industries prefer expensive but stable power supply:

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[93] Interview, Siriwarang Sanee, Manager of the Siam Cement Company, September 1, 2015. Ekarat Thongtawach, President of FTI Petrochemical Industry Club, August 11, 2015.

> *"We decided [on] MTP as our plant site in ASEAN since the provision of basic infrastructure here was quite cheap. Recently, however, the tariff has been getting more expensive, it is difficult to find some regional benefit here. Now that MTP [has been] designated as [a] pollution control zone due to the pollution accident, few foreign investors can launch new petrochemical projects here."* [94]

Increasingly, there are fewer regional advantages to attract new investors. After the Asian Financial Crisis, the number of start-ups in petrochemical industries dropped from 19 (1991-1995) to 18 (1996-2000) and then to 16 (2001-2005). Along with this decrease is a plunge in the value added in this industry since 1997.

4.3 Hierarchy and Formality

4.3.1 Management in Siam Cement

The management in MTP is characterized by formal decision-making procedures, loyal long-serving employees, and conservative workplace procedures and routines. In particular, Japanese business admires the SCG, ranked as one of the most popular companies in the industry:

> *"Siam Cement is indeed a first-rated global company, invited even by the World Economic Forum to Davos. As its employees are also well-educated, we cannot but help*

[94] Interview, Makoto Kobayashi, Vice President of TOA-Dovechem Industries, January 12, 2015.

treating the company as a first-rate global company from the outset."[95]

In traditional family businesses in Thailand, critical decision-makings are often done by the owner-families. Bottom-up decision making from the factory levels is rare, as is the promotion of factory-level engineers to management boards in the headquarters. Totally different from other traditional family business companies owned by Chinese Thai, the SCG has crafted its organization prioritizing competent engineers over family members. For example, the SCG established a centralized decision-making institution called the Group Board of Directors (GBD), which is in charge of all the projects and investment plans in the whole group. The board members of the GBD are competent engineers, mostly graduates from the Faculty of Engineering, Chulalongkorn University. Also, most of the presidents of subsidiaries are from the same institution. In this way, the SCG has increased its capacity to absorb technological innovations in this current time of diverse industrial conglomerates[96](Suehiro, 1990).

This development is enabled by the modern business management style from western countries. Against the backdrop of oil shocks, the SCG started its management reform process in the 1970s. There were two pillars in this process. First, as all the subsidiaries are 99.9% owned by Siam Cement Public Company (SCC) the, SCC became a holding company in SCG. Previously, the subsidiaries had been owned by various shareholders other than the SCC.

Second, in line with this establishment of the holding company, the decision-making of each subsidiary became solely centralized by the SCC, for which the GBD was established. Under the GBD, there is an Executive Committee (EC), which controls the presidents of subsidiaries. Members of the EC also play a role as director

[95] Interview, Masakazu Okamoto, Chairman of YMPPD, January 19, 2015.
[96] See Suehiro (1990).

in various divisions such as cement, construction, machine, pulp, merchandise, petrochemical and so on.

The reform above was promoted mainly by those who had been formally trained in the United States in institutions such as the Harvard Business School. In this way, SCG's management developed a modern westernized centralized system similar to major companies in the US.

4.3.2 Segregation from Region

Similar to SCG, the PTT also put its emphasis on competent engineers when it adopted a modern management style modelled after major western corporations. In fact, top managers such as Dr Pailin (former CEO, PTT) and Mr Boworn (former President, PTTGC) have had actual petrochemical factory level work experiences in MTP, Rayong. Mr Boworn recalls how PTTGC has developed with MTP:

> *"There was nothing in MTP [which] was a small fishing village. Local villagers conducted farming in a self-sufficient manner. But business activities drastically changed the region into the current status."* [97]

Because competent engineers now have greater chances of becoming top managers, the desire to job-hop has diminished. Though the job-hopping culture in Thailand is strong, these elite engineers have developed a different attitude toward career-building with loyalty to major companies such as the PTT and SCG. But competent engineers are also increasingly sticking to their inner organizations and the politics supporting these organizations, resulting in a separation from regional society.

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[97] Interview, Boworn Vongsinudom, a former president of PTTGC, November 18, 2014.

As a result, the PTT and SCG groups have become segregated from regional society in MTP. Their economic transactions are also not embedded deeply into the regional society.

4.3.3 Hierarchy in a Company

In MTP, a career-building style reminiscent of the Japanese has evolved for elite engineers - loyalty toward company, long-term contract and generous fringe benefits. Though this Japanese career-building style is not prevalent in Thai society, it does work effectively in MTP. As the President of the FTI Petrochemical Industry Club explains:

> *"Major companies [such] as SCG promises better salary for engineers than the other opportunities, around which top engineers gather naturally. Also considering their career building inside organizations, head-[hunting] is rare between SCG and PTT."* [98]

This type of organizational culture usually contains within it a rigorous hierarchy. In accordance with class of position, there are sharp differences in authority, salary, and fringe benefits. As the class of position is also influenced by seniority systems, an absolute merit system based absolutely on performances is not adopted. These conditions mean that it is advantageous for engineers to be engaged with one company for a long time. To sum up, industrial systems in MTP are characterized by a formal and vertical structure, more conservative and top-down management, and significantly greater formality in the workplace.

[98] Interview, Ekarat Thongtawach, President of FTI Petrochemical Club, August 11, 2015.

CHAPTER 5: THE AUTOMOTIVE INDUSTRY IN LAEM CHABANG

Chapter 5 gives the result of the relevant semi-structured interview for the current and former practitioners related to the automotive industry in ESB. As the industrial systems framework is consisted of the three dimensions such as local institutions and culture, industrial structure, and corporate organization, the qualitative result is accordingly shown as follows with the considerations of the inter-dimensional relationship.

5.1 A Technical Community

5.1.1 Shared Identity

Automotive engineers in Laem Chabang (LGB) are proud of themselves as pioneers. After the Asian Financial Crisis in 1997, the rapid spread of relevant supporting industries to cope with an expanding automotive market in ASEAN helped them to foster and strengthen a shared identity.

This shared identity is also reinforced by their homogeneity. Most of their forefathers are Chinese Thai, who immigrated from China right after World War II. Moreover, the current generations are not the elite from formal education systems; rather some have been educated in vocational schools. In addition, most of them have worked in the Japanese automotive assemblies and supporting industries. So their Japanese training is also a badge of identification:

> *"We try to educate unskilled workers [in] the way of manufacturing. After the training, they easily job-hop to other opportunities for better salary. While we are concerned*

about technological leakages and the cost of the education as well, the job-hopping is frequent among Thai engineers. As a result, we are functioning as an educational institutional to develop skills among Thai engineers."[99]

Besides the acquisition of sufficient skills, these engineers are characterized by individualism as well as a competitive spirit. Unlike the engineers of major companies in MTP, they are less intimidated by both business and technical risks. In LCB, successful engineers are admired for their individual technical achievements have also brought them wealth.

5.1.2 Technology Transfer from Japan

There is no doubt that Japanese technicians have played a critical role in transferring technology to Thai engineers in supporting industries. There are both formal and informal channels in this technology transfer. In the case of formal transfer, technical cooperation such as license affiliation has been conducted with subcontractors. The solid technical cooperation in the Toyota Cooperation Club (TCC) is one of the famous examples. The technical cooperation among group companies is an essential element for major Japanese automobile companies.

On the other hand, what is often overlooked is an informal technology transfer through senior Japanese engineers. There are plenty of examples of Japanese gaining re-employment in local supporting industries in Thailand as an advisor after retiring from larger automotive makers in Japan. Indeed, academic interest has been attracted to the fact that an increasing number of retired Japanese has transferred their technical know-how and management skills to Thailand[100](Kawabe, 2004). Indeed, one such retired Japanese in LCB confirms:

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[99] Interview, Tosei Takenaka, a former Thai representative of Minebea, May 9, 2013.
[100] See, for example, Kawabe (2004).

> *"In LCB, there are many Japanese who are working for the Japanese automobile makers as well as [for] the local Thai supporting industry. Especially, the number of engineers has increased since 2000, when the Japanese baby-boomer generation reached the retirement age. After returning from their initial assignment to Japan from Thailand on behalf of Japanese companies, these expatriates have come back as advisors. We have our technical know-how, management skills, and human-networks here. After all, we love to stay in Bangkok."* [101]

5.1.3 Social Networks

In LCB, Sriracha provides Japanese engineers with ample opportunities for social interaction. In fact, daily conversations and information exchanges are regular work tasks for the Japanese engineers. An informal social exchange at the Chonburi Rayong Japanese Association in Thailand can often affect business transactions more than formal meetings. That is why a number of Japanese pubs and restaurants have opened in Sriracha, now nicknamed Thailand's Osaka. Moreover, the second Japanese School after the first in Bangkok opened in 2009.

Social opportunities are important and essential not only for the Japanese engineers but also for the Thai engineers. As in Rayong, there are formal meetings such as the monthly get-togethers held by the FTI Chonburi. Receiving grants from

[101] Interview, Kiyoshi Kasahara, a former trader for Tomen, January 21, 2015.

the FTI head-quarters, these meetings help to co-ordinate a regional lobbying for developments in infrastructure, social welfare, and public security.

Apart from the lobbying at the official institution, there is also a non-official institution where more substantial information can be exchanged for business transactions in terms of customers, markets, and technologies. For example, the Management Automotive Club (MAC), established 10 years ago in LCB, also provides local Thai engineers with informal social opportunities. The engineers pay for their memberships themselves.

Originally, the MAC was established by those who were in charge of human resources management in each company to deal with the strong labor unions in this region. Yet, currently, regular meetings discuss not only the labor union but also current markets, career-buildings, salaries, bonuses and so on. A variety of Thai engineers have participated. The participants are mainly young and middle-class Thai engineers who usually stay on after the regular meeting to deepen a friendship.

These social networks are not only useful for information exchange regarding market and salaries; they also provide substantial recruiting opportunities for potential job-hoppers. Informal regional institutions such as the MAC often function as unofficial recruiting centers in LCB. There are headhunters specializing in recruiting engineers for particular positions. For example, members of the Summit Group have used these headhunters/these networks to recruit successfully. This recruiting system is also recognized by a Japanese manager:

"It seems that the information regarding competent engineers is shared in the local Thai society. Job-hopping and head-

hunting should be conducted based on this shared information. We Japanese don't know the detail though." [102]

It is a given rule in career-building among Thai engineers that they repeatedly job-hop for better opportunities. But Japanese makers and supporting industries traditionally have had a different system – the career employment system. That's why they cannot easily accept frequent job-hops by the Thai workers and they even have a gentlemen's agreement limiting headhunting[103]. Yet, even Japanese supporting industries have benefitted from job-hopping from the smaller Thai supporting industries.

5.1.4 Distance by Auto-bicycle

The geographical proximity of the factories is also a contributing factor to labor mobility. Usually, engineers target their next opportunity in terms of the distance which they can reach on their auto-bicycle, a common mode of transport in Thailand. Thus, job-hopping never radically changes the social relationships among Thai engineers. A Japanese manager says:

"After all, as they seek [their] next opportunity [according to how far] they can go by their auto-bicycle, job-hopping doesn't take them away from their own social networks. Moving from this industrial estate to adjacent industrial

[102] Interview, Toshihide Saeki, a former President of Automobile Alliance Thailand, December 24, 2014.
[103] Interview, Thanapol Srithong, Employment Relations Manager of IHI Turbo, May 13, 2015.

estates, they maintain and even enhance [the] same social networks." [104]

Social networks usually do not weaken as a result of job-hopping. Rather, job-hopping enhances the social networks as it means each engineer prioritizes informal human relationships over loyalty toward the company. In LCB, there are few engineers who treat corporate loyalty as the key to career-building. Many of them try to maintain and enhance their own social networks using informal social institutions.

As a result, skilled engineers in LCB have developed a loyalty to technical achievement and social community rather than to each company and organization. This communal identity as fellow engineers, high labor mobility, and informal information exchange has enhanced the technical capacity among Thai engineers in LCB as a whole.

With this enhancement, the regional advantage for new start-ups is further improved. More and more start-ups have gathered in this region, especially after 2000 when the ASEAN regional market started expansion. The increasing number of start-ups also feeds into the local social network. In this way, the regional economy in LCB has co-evolved with its informal social networks.

5.2 Cooperation and Competition

5.2.1 Technical Achievement

In LCB, there are ample opportunities in start-ups for Thai engineers, both as their own business and as source of employment. The entrepreneurship is legitimized by some remarkably successful cases in LCB such as the Summit Group and the Somboon Group, which have developed their business through technical and financial

104 Interview, Hiroshi Hosokawa, Managing Director of Toyotsu Chemiplas, December 25, 2014.

cooperation with Japanese investors. As a result, the number of start-ups has been increasing sharply since the 1990s, some of which are even absolutely owned by Thai shareholders.

Apart from economic motivations, these entrepreneurs have the technical motivations to manufacture quality automotive parts. The entrepreneurs have an engineering spirit. For example, Mr. Sunsurn Jurangkool, a founder of the Summit Industrial Group (SIG) was formerly a technician fixing sheets. Starting from this small technology, he massively developed the SIG through cooperation mainly with Mitsubishi. The quality requirements of Japanese assemblers are very strict but this strictness has provided technical opportunities for those Thai engineers. And, to some extent, some successful technical enterprises like the SIG are respected among the local engineers in LCB.

This regional culture encourages technical risks and accommodates failure. Not unusually, some Thai engineers in LCB have tried to launch their own start-ups with the technical skills and management know-how they have acquired from working with Japanese makers and supporting industries. In the first-tier industry, around half of start-ups are still owned by Japanese shareholders while the other half are mostly owned by Thai shareholders. In the second-tier industry, major shareholders are Thais who have procured finances from local lenders.

5.2.2 Thai Local Lender

Usually, it is said that a Thai lender is more risk-tolerant than a Japanese lender, which also means that the Thai engineers would show a stronger entrepreneurial spirit. A Japanese policy-maker who has promoted active foreign investment for Japanese companies laments:

> *"The Thais' entrepreneurs are quite risk-tolerant compared to Japanese entrepreneurs and lenders. Especially, the Thai*

lenders were so tolerant that they easily financed projects in which we could never take any risks." [105]

It is also noted that these capitalists have often emerged from technology-based enterprises. After a certain success in start-ups, some managers try to finance new and upcoming start-ups. For example, after his success in the manufacturing of automotive parts such as brakes, Mr Manoj Leekomonchai, a founder of the Manoj Group, began investing in relevant start-ups, resulting in the large group consisting of 37 technical enterprises. In this way, capitalists and entrepreneurs could share substantial business information regarding customers and markets, creating a more favorable business environment for start-ups.

5.2.3 Technical Specialization

These technological start-ups have also been enabled by the Japanese assemblers and manufacturers of key parts already agglomerated in LCB. Thanks to this agglomeration, each start-up can specialize in its own technical achievements without having to concern itself with other issues.

In the first tier, although many Japanese manufacturers have started their business in LCB, the business transactions of the start-ups are not limited to a certain assembler. For example, they will provide parts to both Toyota and Honda, thus coordinating their business quite autonomously and independent of any original Japanese investor. This tendency is even stronger among the second-tier supporting industry. In LCB, the supporting industries conduct their business in an autonomous fashion, and this has weakened vertical integrations.

As stated before, Thai engineers have achieved technical specialization through technical transfer from Japan, both formally and informally. In addition, this

[105] Interview, Daisuke Matsushima, a temporary transferred officer at NESDB, June 16, 2015.

specialization is technically supported by training institutions such as vocational schools. There are a number of training centers around LCB. For example, in Amata Nakhon Industrial Estate, a pioneering school supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has trained Thai engineers with tool and die skills.

Also, recently, the Thai Automotive Industry, the Thai Industrial Park, and the FTI have trained engineers without foreign participation. There have been criticisms questioning the practicability of these trainings. Yet, they surely contribute to promoting basic skills among engineers before they branch off into specializations. This importance is also realized by a Japanese manager:

> *"I admit that there are brilliant engineers who graduate from elite universities such as Chulalongkorn University. Yet, usually, we seek more non-elite engineers who can tolerate the daily Kaizen activity in factories. From this purpose, we can find our potential engineers in vocational schools and training centers."*[106]

5.2.4 Regional Cooperation in Fragmented Structure

The industrial structure that has emerged from this environment is quite fragmented. Start-ups try to differentiate their products from others, and to deepen their specializations in order to survive in a particular niche market in the automotive industry. As this process of industrial specialization and fragmentation repeats itself, the region develops a diverse, adaptable and resilient industrial ecology. The difficulties of any single enterprise could no longer destabilize an entire supply-chain.

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[106] Kazuo Kikkawa, a former President of Tomen Thailand, December 17, 2014.

Such a decentralized industrial system is totally different from the Japanese centralized Keiretsu system. Theoretically, Keiretsu has been pointed out as an advantage of the Japanese automotive industry[107](Aoki, 1990) (Friedman, 1988) (Imai, Nonaka, & Takeuchi, 1985). Conversely, LCB's fragmented character is an advantage in the industrial systems because it provides the flexibility and resilience of the industrial fabric.

According to the conventional understanding of the free market theory, the region's fragmented and specialized firms might have generated mutually destructive forms of competition. They could also have shown themselves to be incapable of taking complex or long-term investments. But this is not the case in LCB which has achieved success in its regional economy instead.

This success lies in a supportive social structure and institutions which have provided a platform for mutual learning and adjustment in LCB. In spite of coming from separate firms, engineers have mutually learned by exchanging information on markets, customers, and technologies. In this way, the social network the engineers enjoy has made the industrial system in LCB more resilient in a dynamic business environment.

This social network is based on informal institutions such as MAC. MAC has held a monthly meeting for the last 10 years, which makes for the strong network among Thai engineers.

They share information which is helpful in making their region more resilient. For example, an academic lecture about the global automotive market might be given by university professors, after which participants would discuss the positioning of LCB. In this bottom-up way, LCB has adapted well to the rapid changes in the business environment since the Asian Financial Crisis.

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[107] See, for example, Aoki (1990), Imai et al. (1985), and Friedman (1988).

5.3 Japanese Production Systems

5.3.1 Toyota Production Systems

In terms of origins, the production system of each technical firm in the automotive industry is largely influenced by the Japanese automotive industry. In particular, the Toyota Production Systems (TPS) is one of the most influential production systems. In order to maintain product quality, Toyota actively conducts TPS training for its first and second-tier suppliers. So does Toyota in LCB.

It has been said that the technical capacity of supporting industry in Thailand is far behind the technical requirements. This situation has improved, especially after 2000 when supporting industries started expansion in LCB. The entrepreneurs have tried to incorporate the TPS into their manufacturing and have gained the emerging market by providing the required quality. Toyota also officially transfers the TPS to those supporting industries in the TCC.

The TPS was originally a system designed for the small-lot productions of many products when Toyota tried to challenge the Ford mass-production systems. In order to reduce the seven categories of wastes --overproduction, waiting, transportation, inappropriate processing, excessive inventory, unnecessary motion, and defects—the TPS consists of two pillars: Just in Time (JIT) and Jido-ka.

JIT aims to produce a requested amount only when it is needed. First, assemblers should prepare all that is necessary, including getting parts, to deal with any request. Second, assemblers should give the information to the stage just preceding theirs exactly what and how much they would need for their assembling. Third, in accordance, the preceding process provides the requested amount to the process directly following. In this way, each process in the supply chain can respond in a timely manner toward the final request.

Jido-ka means automation which enhances labor productivity in a factory. Previously, assembling machines continued manufacturing even when they happened to produce defective products. Under this Jido-ka concept, Toyota added on facilities to identify defects, which automatically stops the assembling. . This automation means that one doesn't need a staff for every machine in an assembly process. Instead he can control multiple processes and the whole labor productivity is also improved.

The TPS requires the delegation of authority and responsibility to each worker. For example, the JIT should transfer information regarding the required parts from latter stage to former stage by using Kanban[108]. This Kanban information should be decided by the assemblers in the latter process. Also, in Jido-ka, each worker can oversee multiple stations within an assembly but at the same time he has to be responsible for them. In this way, the worker's responsibility is large compared to those in the Ford systems.

5.3.2 Decentralized Decision-making

Needless to say, there are many enterprises which do not apply the TPS. Since the production and management systems are largely influenced by the final assemblers, some are influenced by other Japanese makers such as Honda and Nissan.

Sometimes it is said that the TPS is one of the typical production systems in Japan. In practice, the TPS is unique and does not represent all Japanese production systems. Each manufacturer has its own style, and this has caused variable production systems in supporting industry in LCB too.

For example, in dealing with the small-lot productions of many products. Honda took a different approach to achieve JIT. While the TPS transfers parts to be assembled from previous to latter step with Kanban, Honda tries to generalize the

[108] Kanban (看板) is a scheduling system for lean manufacturing and just-in-time manufacturing. Kanban is an inventory-control system to control the supply chain.

parts across various types of vehicle. Through this generalization, a previous process can manufacture generalized parts regardless of what the latter process requests.

While TPS focuses more on the process of assembling, it is said that Honda has put more emphasis on the architecture which has made manufacturing at the factory easier. To develop this architecture properly, decision-making is, to some extent, transferred to supporting level.

In this way, the Japanese automotive production systems are commonly characterized by the delegation of authority and responsibility to factory level. This point has been pointed out by many previous studies[109](Aoki, 1990) (Imai et al., 1985). While each worker in the assembly line has a certain responsibility, each supporting industry tries to respond to the strict quality control demanded by the Japanese assembling makers.

5.3.3 Labor Motivation

Thus, the motivation of each worker is an essential component in maintaining quality. For example, while Jido-ka means automation, this Jido-ka's effectiveness depends on the worker's motivation. After identifying the defects, the machine stops and signals with Andon that something is wrong[110]. Yet whether a follow-up is done swiftly or not depends on the worker's motivation. In addition, an engineer who doesn't use his ingenuity in using machines is called a Catalog Engineer. Engineers are encouraged to put their own ingenuity onto the assembling lines and not just fall back on existing solutions.

From the workers' perspective, this means they should always try to respond to this expectation by improving their own technical capacity. What is required in this process are tacit knowledge as well as formal textbook knowledge. In particular, the

[109] See Aoki (1990) and Imai et al. (1985).
[110] Andon (行燈) is a type of alarm~~ing~~ system, often refers to a tower of lights of different colors with different status conditions assigned to different color lights.

former is more precious as it has to be acquired based on long-term experience partnered with motivation. A former Toyota manager says:

> *"It takes some time for workers to gain production know-how. After all, they have to acquire [this] by themselves through Kaizen motivation. Thus, manager should motivate workers properly."* [111]

Surely one of the main management tools in sustaining motivation is an economic incentive such as a decent salary. For example, the salary in Toyota consists of a basic salary and a production bonus. The basic salary is determined by the position of the employee while the production bonus is a commission system based on the quality and quantity of production. In this way, a worker is incentivized for improving productivity.

Recently, the use of local human resources in LCB has improved. Normally supporting industry consists of a few Japanese managers and a number of Thai workers. But recently, an increasing number of Thais has entered management. Indeed, the Vice President in Toyota, Thailand is Thai. This localization is preferable also for Japanese:

> *"There are many difficulties for labor management of Thai workers. But recently we have done it better than before. I think one of the factors is that we can progress to the use of local people in management. When our Thai counterpart can*

[111] Interview, Suparat Sirisuwanangkura, Honorary Chairman of FTI Automotive Club, November 25, 2014.

be in charge of labor management, our whole management becomes also improved." [112]

Recently the number of Thai managers has also increased in joint-venture companies. A Thai even became President of Thai Obayashi, a group company of Obayashi Corporation of Japan. The engineers who are better trained and have greater technical skills have found that they can command higher salaries and promotions up the career ladder. In this way, the motivation of engineers in LCB has been sustained at high standards.

Based on their shared identity, engineers have strengthened social networking in the automotive supporting industry in LCB. This social network is maintained by informal regional institutions. As a consequence, its industrial system is characterized by unclear boundaries between work and private life, between one company and another, and between company and the regional economy. This system is quite contrasting to that in MTP where there is clear boundary between the PTT and SCG groups. In the next chapter, this contrast will be discussed.

[112] Interview, Makoto Kobayashi, Vice President of TOA-Dovechem Industries, January 12, 2015.

CHAPTER 6: RE-EXAMINING A DISTINCTIVE CHARACTER OF INDUSTIAL SYSTEMS BETWEEN PETROCHEMICAL AND AUTOMOTIVE INDUSTRY

Chapter 6 uses relevant quantified data to verify the results based on qualified data in previous chapters. First, using the ESB start-up date, I describe the historical development of both the petrochemical and automotive industries. Second, using the current snap-shot supply-chain data, I try to compare the character of economic transactions in both industries. Third, looking at other relevant cases outside Thailand, I examine how business transactions are actually dependent on the type of the industry.

6.1 Re-examining Characters of Industrial Systems

6.1.1 Regional Reversal

In MPT, corporate groups such as the PTT and SCG have deepened vertical integrations from upstream to downstream of petro-chemical industries to the extent that an inter-group transaction is not substantial and the labor market has become inflexible. On the other hand, in LCB, there are flexible supply-chains beyond a Japanese "Keiretsu" structure though ultimate assemblers are still Japanese firms such as Toyota. Also, among local second and third tiers, the labor market is so flexible that the job-hopping of skilled labors remains a local feature. So although engineers do change jobs, the region does not actually experience any significant loss in skilled manpower.

The Federation of Thai Industry (FTI) has official local branches in both Chonburi and Rayong provinces. In a similar manner, local SMEs have used these branches to strengthen their lobbying power. Yet, what is different is that there are informal bottom-up local institutions in Chonburi such as the MAC. As can be seen in

LCB, such informal institutions allow for flexible information flows which help industrial systems to stay flexible.

Based on the informal bottom-up institutions such as MAC, there are flexible supply-chains independent of the Keiretsu systems. There is also a flexible market of skilled labor, which allows the local supporting automotive industry to adapt efficiently to any dynamic changes in the business environment. As a consequence, the number of start-ups has been increasing in the automotive industry while that in the petrochemical industry has been declining since the year 2000 (Figure 15)[113].

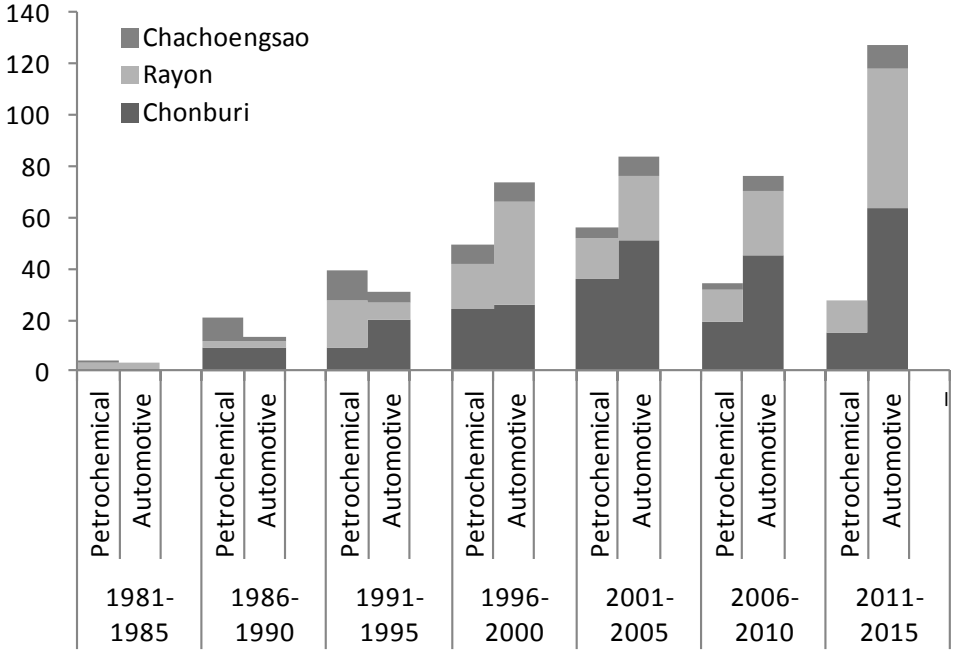


Figure 15: Number of Start-ups in ESB
Source: (Comm Bangkok, 2011)

[113] A raw data of relevant factories is shown in Appendix D.

6.1.2 Speculations from Saxenian's Study

A similar reversal was observed in the United States between Silicon Valley and Route 128 in the 1970s and 1980s. For example, the number of employees in the electronic components and semiconductor industries rose sharply in Silicon Valley while the number remained rather stable in Route 128 (Figure 16). Companies in Silicon Valley also grew faster than those in Route 128. By 1990, 39 of the top 100 fastest-growing electronic companies were located in Silicon Valley and only a few were based in Route 128 (Figure 16).

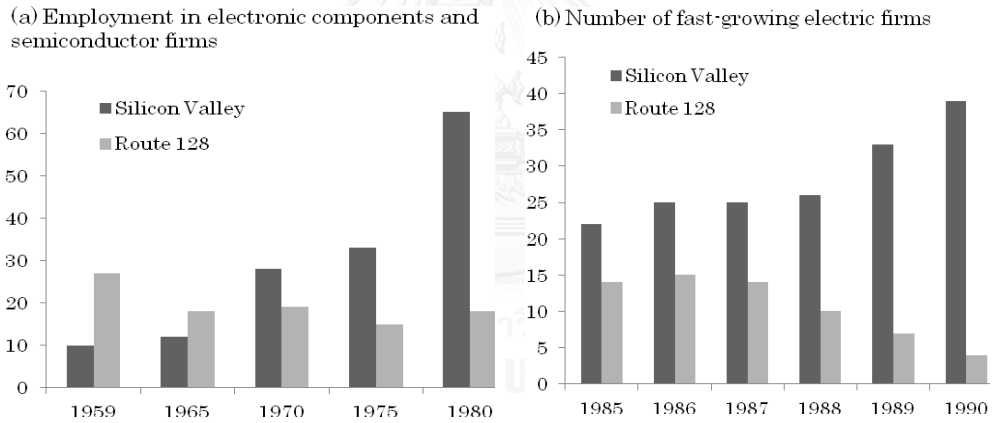


Figure 16: Regional Reversal between Silicon Valley and Route 128
Source: (Saxenian, 1996)

Saxenian attributes this reversal to the character of industrial systems[114](Saxenian, 1996). According to her study, there is an industrial system in Silicon Valley which makes business transactions flexible and which allows the region to adapt to the severer competition from Japan. As a consequence, economic

[114] See Saxenian (1996).

development in Silicon Valley has flourished since the 1980s. At the same time, Route 128 has lost its regional advantage in a significant way. She concludes that industrial systems that allow for flexible economic transactions will also enable a region to become more adaptable in the face of changing exogenous factors.

Based on speculation from the Saxenian's study, it can be assumed that industrial systems in LCB have a character similar to that in Silicon Valley while that in MPT is more similar to that in Route 128. Indeed, Chapter 4 and Chapter 5 suggest these similarities with qualified data. In this chapter, the character of industrial systems is re-examined based on quantified data such as factory records[115].

6.2 Independent Firm-based Industrial Systems in Petrochemical Industry

6.2.1 PTT & SCG Group

As mentioned in Chapter 2, ethylene, propylene, benzene, and paraxylene are the main chemical products in the upstream of the Thai petrochemical industry. Based on these as feedstock, other products are manufactured further downstream. While some products are processed through intermediate industries, others go directly from the upstream industry to the downstream industry to be processed. For example, polyvinyl chloride (PVC) is manufactured in the downstream via vinyl chloride (VC) in an intermediate stage while high/low density polyethylene (HDPE and LDPE) are made directly from ethylene. Figure 17 summarizes the main products flow in the Thai petrochemical industry.

[115] A raw data of relevant factories is shown in Appendix E.

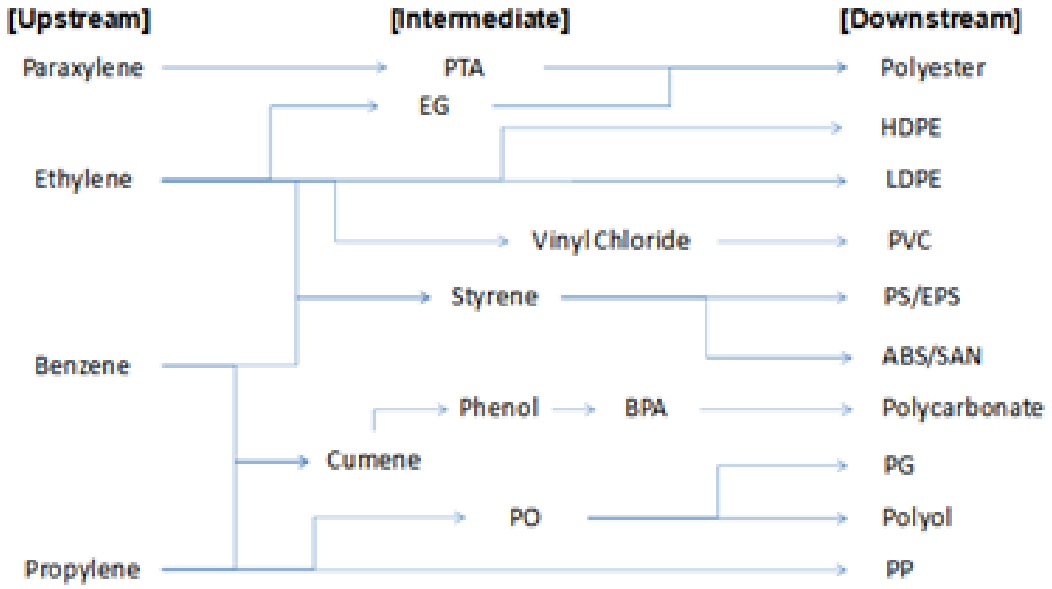


Figure 17: Main Flow of Petrochemical Products in Thailand

Table 7 shows the dominance of the PTT group and SCG group in this flow from the upstream to the downstream. For example, the upstream of ethylene derivable is monopolized by the PTT (61.7%) and SCG group (38.3%). The whole processes of ethylene and propylene derivables are nearly monopolized by the two groups. Unlike this critical part of the petrochemical industry, the other process is more liberalized. For example, 70% and 100% of the downstream benzene and paraxelene derivables are manufactured by companies other than these two groups. The intermediate process of benzene and paraxelene derivables is also shared by players other than the PTT and SCG groups.

Table 7: The Production Capacity and Number of Subsidiaries in PTT and SCG Group

Unit (Capacity): KTA

		Upstream			Intermediate			Downstream		
		Capacity	%	N	Capacity	%	N	Capacity	%	N
Ethylene	PTT	2736	61.7	3	1168	59.3	3	2036	40.9	8
	SCG	1700	38.3	2	800	40.7	2	2786	55.9	5
	Others	0	0.0	0	0	0.0	0	158	3.2	1
Propylene	PTT	1364	53.2	5	562	58.1	2	1427	57.4	3
	SCG	1200	46.8	2	390	40.3	1	720	29.0	1
	Others	0	0.0	0	15	1.6	1	339	13.6	10
Benzene	PTT	1039	76.5	3	1201	62.8	3	177	16.4	2
	SCG	320	23.5	2	300	15.7	1	107	9.9	3
	Others	0	0.0	0	410	21.5	2	798	73.8	14
PX	PTT	1683	77.0	2	0	0.0	0	0	0.0	0
	SCG	0	0.0	0	1440	51.7	1	0	0.0	0
	Others	504	23.0	1	1347	48.3	2	1689	100.0	11

Source: PTIT

The following list shows the PTT and SCG subsidiaries which are engaged in the ethylene and propylene process. In the case of the PTT group (Table 8), there are 14 subsidiaries (3 for the upstream, 3 for the intermediate, 8 for the downstream), which are engaged in the ethylene derivable process. Also, there are 11 subsidiaries (5 for the upstream, 3 for the intermediate, 3 for the downstream) in the PTT group engaged in the propylene derivable process. In general, the PTT's average shareholding of its subsidiaries is around 40% in each section (Table 8).

In the case of the SCG group (Table 9), there are 9 subsidiaries (2 for the upstream, 2 for the intermediate, 5 for the downstream), which are engaged in the ethylene derivable process. Also, there are 4 subsidiaries (2 for the upstream, 1 for the intermediate, 1 for the downstream) in the group engaged in the propylene derivable process. Overall, the SCG's average shareholding of its subsidiaries is more than 50% in each section (Table 9)[116].

[116] As shown in Chapter 4, the SCG's shareholding in subsidiaries is rather large compared to PTT.

Table 8: Operating Year of Ethylene and Propylene Derivable in PTT Group

	Share-	Ethylene			Propylene		
Company	holding*	Upstream	Midstream	Downstream	Upstream	Midstream	Downstream
IRPC	38.5%	1997	1997	1988	1997		1990
PTTGC	48.9%	①1989 ②1995		2004	①1989 ②1995		
PTTPE	48.9%	2010		2010	2010		
TOC Glycol	48.9%		2006				
Vinythai	12.2%		1995	1992			
BPE	48.9%			1994			
Thai Ethanolamine	48.9%			2009			
Thai Ethoxylate	48.9%			2006			
HMC	41.0%			1989	2010		1989
SPRC	5.4%				1996		
Advance Biochemical	12.2%					2010	
PTT Asahi	48.5%					2012	
PTT Phenol	69.3%					2010	
Thai ABS	38.5%						1992
Average Shareholding**	39.9%	45.4%	33.2%	42.0%	36.5%	43.3%	39.3%

Source: Petroleum Institute of Thailand (PTIT)

***The PTT's shareholding in each subsidiary company.**

Table 9: Operating Year of Ethylene and Propylene Derivable in SCG Group

	Share-	Ethylene			Propylene		
	holding*	Upstream	Midstream	Downstream	Upstream	Midstream	Downstream
MOC	67.0%	2010			2010		
ROC	64.0%	1999			1999		
MTP HPPO	50.0%					2011	
SSMC	50.0%		1997				
TPE	100.0%			1989			
SPE	50.0%			1999			
SSLC	50.0%			1992			
TPC	91.0%		1989	1976			
TPC Paste Resin	91.0%			1997			
TPP	50.0%						1994
Average Shareholding	66.3%	65.5%	70.5%	76.4%	65.5%	50.0%	50.0%

Source: Petroleum Institute of Thailand (PTIT)

***The SCG's shareholding in each subsidiary company.**

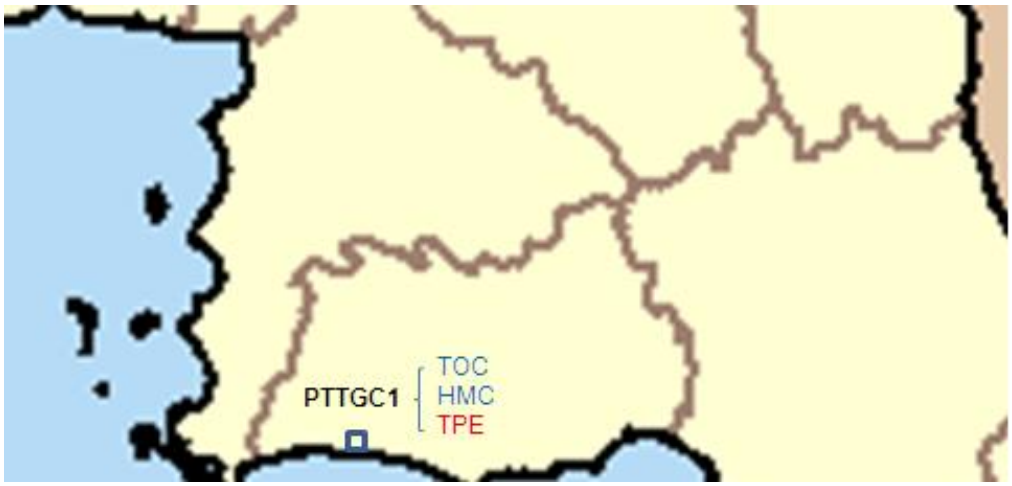
6.2.2 Independent Firm-based Industrial Systems

As shown in the table above, each company has started operation in the process of ethylene and propylene derivable, which can be located as in Figure 18. In the 1980s, there was only one ethane-based petrochemical complex by NPC whereas 4 subsidiaries operated in the downstream. Currently the NPC complex is owned by PTTGC, where Thai Olefins (TOC) and HMC Polymers (HMC) from the PTT group are engaged in the production of the ethylene and propylene derivable while Thai Polyethylene Company (TPE) from the SCG group are also in the production.

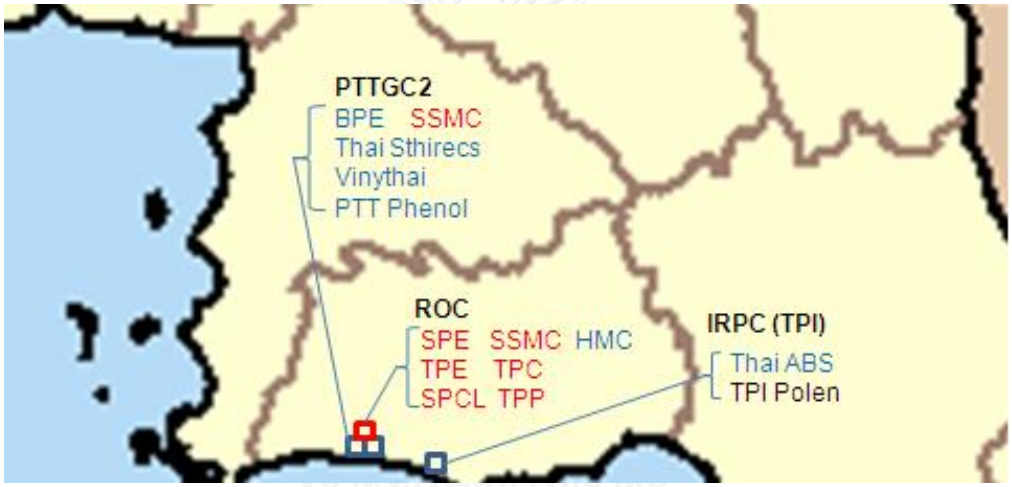
Also in the 1990s, a naphtha-based NPC2 complex also owned by PTTGC started its operation in MTP. After a deregulation in 1994 enabled private companies to operate in the upstream, SCG and IRPC (former TPC) located naphtha-based crackers in MTP and Rayong respectively. Currently, in the production of the ethylene and naphtha derivables, there are 5 PTT subsidiaries out of 7 companies in PTT complexes such as NPC1, 2 and IRPC. Also, there are 6 SCG subsidiaries out of 7 companies in the SCG complexes such as Rayong Olefins (ROC).

In 2010, two new crackers were constructed. PTTPE started a new ethane cracker in the PTT group while MOC started the operation of a new naphtha-based cracker in the SCG group. The processing of intermediate and downstream ethylene and propylene derivables is covered by PTTPE in the former petrochemical complex building while three SCG subsidiaries are accommodated in the latter complex.

1980s



1990s



2000s

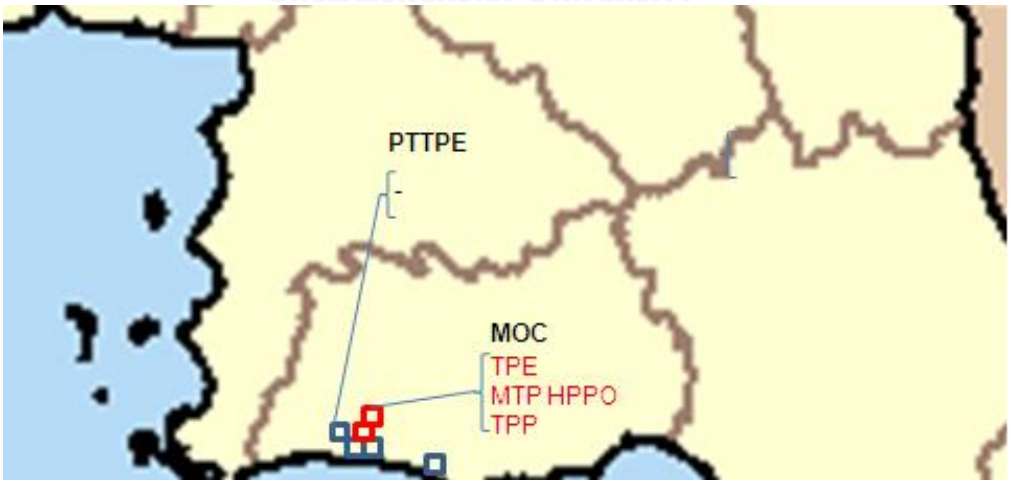


Figure 18: Development of Petrochemical Complex in Ethylene / Propylene Derivable
Source: PTIT

Currently, there are 7 crackers (5 by the PTT group and 2 by the SCG group) which are engaged in the upstream production of the ethylene and propylene derivables. Ethylene produced at the cracker owned by the PTT group goes on to be processed by the PTT subsidiaries in the intermediate and downstream. Likewise, the cracker activities in the SCG group are followed up on by mostly SCG subsidiaries. It should be noted that the different crackers are "followed" by different companies but essentially, these companies are from the same group. For example, PTTGC1 and PTTGC2 have different downstream companies mostly from the PTT group while there are differences in the downstream in MOC and ROC mostly from the SCG group. There is a vertically-integrated independent supply chain in each complex.

6.3 Network-based Industrial Systems in Automotive Industry

6.3.1 First-tier Industry

There is an enlarging supply-chain in the automotive industry around LCB. In this section, first-tier companies which have direct transactions with Japanese assembling makers are the focus (Figure 19). In 1980s, the start-ups were concentrated in the Bangkok Metropolitan region and the Samut Prakan province. In particular, there were a number of start-ups in the Ladkrabang Industrial Estate, the Bangplee Industrial Estate, and the Bang Poo Industrial Estate, all of which is close to the Toyota's Samrong factory, the Nissan's Samut Prakan's factory, and the Isuzu's Samrongtai factory.

In the 1990s, a number of foreign direct investments (FDI) from Japan came to Thailand as a result of the Plaza Accord in 1985. The FDI focused on manufacturing industries such as the automotive industry. Due to the Board of Investment's (BOI) zoning policy together with the infrastructure development in the NESDB's Eastern Seaboard Development plan, a number of automotive start-ups in the first-tier industry rushed into the Chonburi (25 start-ups) and Rayong provinces (24 start-ups).

This trend was accelerated by the establishment of Toyota's second factory in the Gateway City Industrial Estate in 1996. It is noted that the second region to see a concentration of automotive companies was the Ayutthaya province in which the Honda's assembling factory is located. In the 2000s, the number of first-tier start-ups decreased but second and third-tier companies were springing around the first-tier factories (Figure 20).

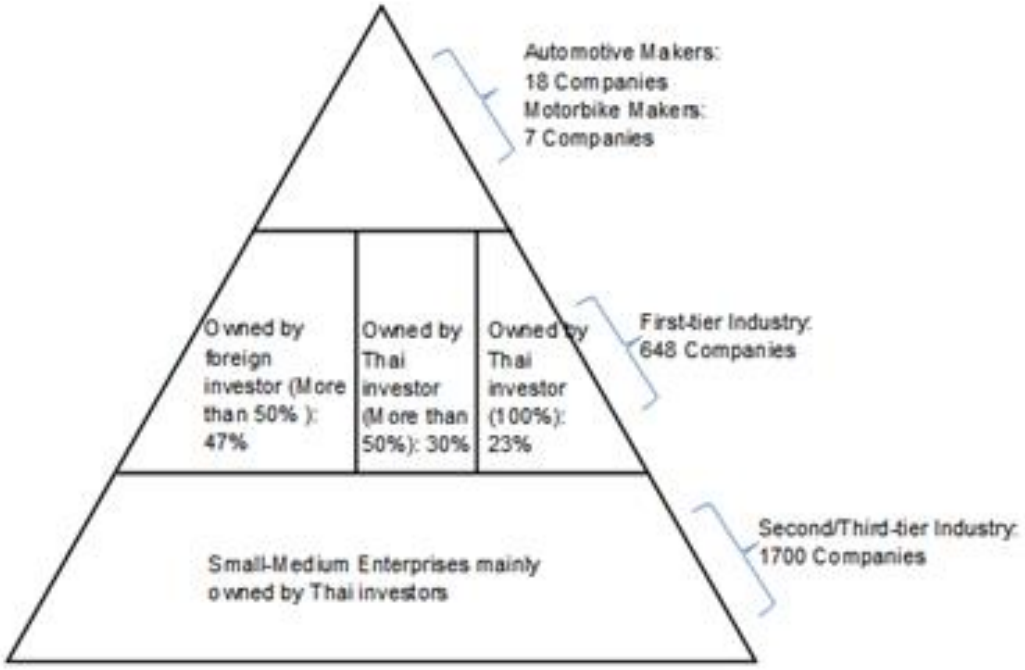
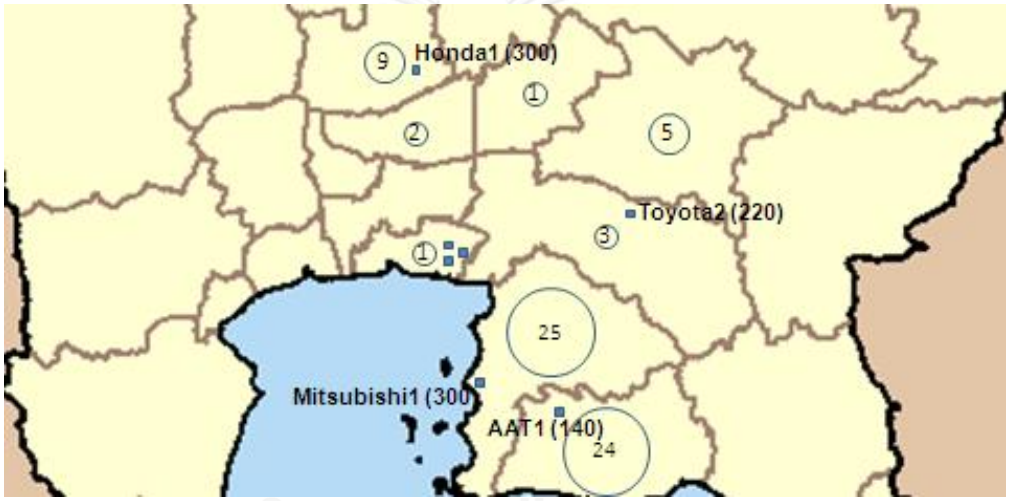


Figure 19: Structure of the Thai Automotive Industry

Source: Thai Automotive Institute

1980s

1990s



2000s

Figure 20: Start-ups of First Tier Industry for Japanese Assembler
Source：(Industrial Research Institute)

There are 74 companies in the first-tier industry for Toyota. Around half of them are also supporting Honda and/or Isuzu. (Table 10). In this table, for example, 50% of the first-tier companies of Toyota, that is 37, also have transactions with Honda. On the other hand, 59% of the first-tier companies of Honda also have transactions with Toyota. In this way, the overlapping rate among Toyota, Honda and Isuzu is about 50% to 60%, which means around half of the first-tier companies serving Toyota, Honda, and Isuzu are the same ones. Dealing with market dynamism and uncertainty, the supply chain is integrated deeply (Wong and Boon-itt 2008). This character of supply-chain is different from the Japanese traditional supply chain where each automotive manufacturer would have its own supply chain.

Table 10: Overlapping Rate of First Tier in Automotive Makers

(%)

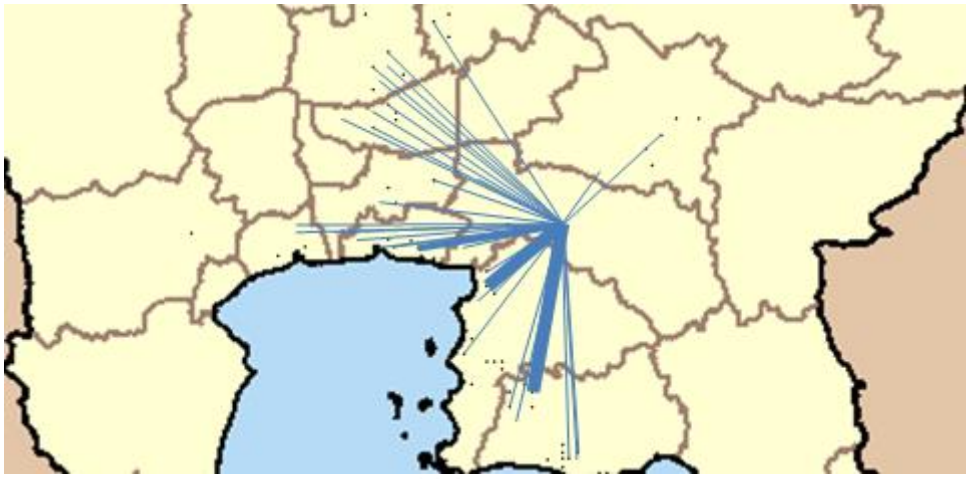
	(N)	Toyota	Honda	Isuzu	AAT	Mitsubishi	Nissan	Hino
Toyota	74	-	**50**	**58**	49	41	31	14
Honda	63	**59**	-	**56**	46	48	33	10
Isuzu	73	**59**	48	-	42	38	36	15
AAT	54	**67**	**54**	**57**	-	**54**	35	17
Mitsubishi	58	**52**	**52**	48	**50**	-	38	16
Nissan	48	48	44	**54**	40	46	-	21
Hino	15	**67**	40	**73**	**60**	**60**	**67**	-

Source: (Industrial Research Institute)

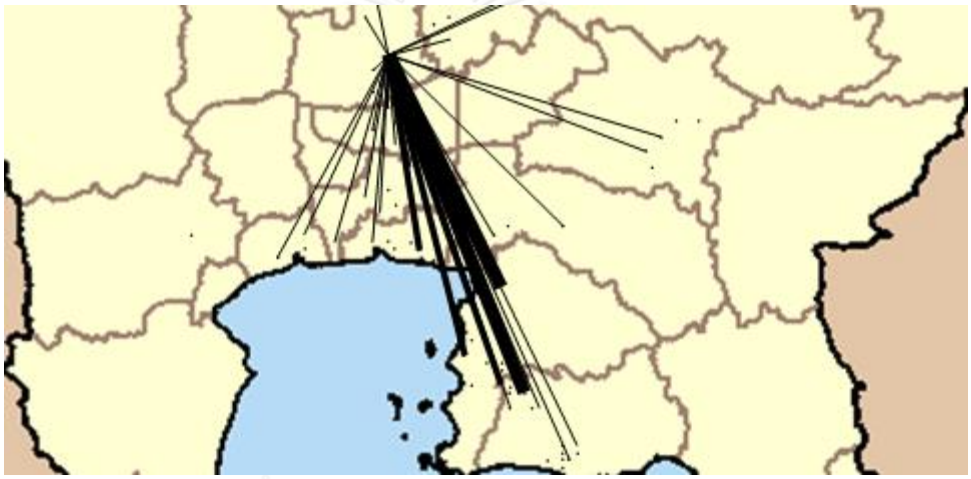
6.3.2 Network-based Industrial Systems

Figure 21 shows the locations of the first-tier industry and the assembling factories of Toyota, Honda, and Isuzu. In this map, the largest assembling factories can be seen: Gateway (Toyota), Rojana (Honda), and Samrong (Isuzu) though there are some other assembling factories.

Toyota



Honda



Isuzu

Figure 21: Location of the First Tier Companies
Source : (Industrial Research Institute)

There are three major regions which provide automotive parts to the assembling factories above. The first region is LCB around Amata Nakhon Industrial Estate, which includes the northern part of Chonburi Province and the southern part of Chachengsao Province. The second region is the ESB around the Eastern Seaboard Industrial Estate, which includes the northern part of Rayong Province and the southern part of Chongburi Province. The third region is SMP around the Bangplee Industrial Estate, which includes Bangkok Metropolitan and Samut Prakan Province.

The largest automotive companies are mostly located in these three regions. In Table 11, the top 50 companies (sales / EBIT base in 2011) in each region are counted[117]. In particular, a number of companies are concentrated in the LCB region. Also, the concentration is even high among larger industry. For example, based on sales, 13 out of the top 30 (43%) and 6 out of the top 10 (60%) are located in the LCB region. Also, based on EBIT, 14 out of the top 30 (47%) and 7 out of the top 10 (70%) are located in this region.

Table 11: Locations of Major Automotive Parts Industry

Year 2011	LCB	ESB	SMP	Total
Sales	N (%)	N (%)	N (%)	N (%)
Top 10	6 (60%)	3 (30%)	1 (10%)	10 (100%)
Top 30	13 (43%)	10 (33%)	4 (13%)	27 (90%)
Top 50	20 (40%)	14 (28%)	8 (16%)	42 (84%)
EBIT	N (%)	N (%)	N (%)	N (%)
Top 10	7 (70%)	2 (20%)	1 (10%)	10 (100%)
Top 30	14 (47%)	8 (27%)	6 (20%)	28 (93%)
Top 50	22 (44%)	13 (26%)	12 (24%)	47 (94%)

Source: (Asia Industry Research Institute)

[117] Earnings Before Interest & Tax (EBIT) is an indicator of a company's profitability, calculated as revenue minus expenses, excluding tax and interest.

The labor flow is quite dynamic in these industrial regions. Especially in the LCB area, this dynamism is observed not only among unskilled workers but also skilled workers. There are a plenty of job opportunities for skilled people in a region like LCB. In 2007, there were 22,259 skilled labors while there were 6,448 unskilled labors in the automotive parts sector in Chonburi province[118]. Regarding the automotive parts industry, the total number of skilled and unskilled labors in Chonburi province was second largest after that in Samut Prakan province. Yet, the ratio of skilled labor is around 78%, which is larger than that in Samut Prakan province. As stated before, major first tier industries looking for skilled workers are gathered in this region. In LCB, the dynamism of this labor flow lowers the boundaries among companies, and the area emerges as a highly skilled industrial region fulfilling the requirements of Japanese assembling makers[119](Humphrey & Memedovic, 2003).

6.4 Industrial Systems and Economic Performances

It has been argued that the nature or character of industrial systems directly impacts on the economic performances of each industry. Yet, one might claim that the petrochemical industry has had a harsher business environment than the automotive industry, resulting in its poorer economic performance no matter what the nature of its industrial system is. This section tries to respond to this argument, and concludes that the character of industrial systems still has a significant impact on economic performances.

6.4.1 Automotive Industry in Japan

Figure 22 shows recent trends of automobile productions since 1995 in major manufacturing countries. As stated, Thailand has gradually revived the number of

[118] See NESDB and the World Bank (2010).
[119] It is also noted that lower-tier local company is also integrated in this dynamism (Hamphrey and Memedovic 2003).

production that fell during the Asian Financial Crisis in 1997. The production in China has been boosted more rapidly due to its cheaper labor cost. On the other hand, the number of automobiles produced in the US and Japan, which had been the largest before the Global Financial Crisis, is currently behind the one in China.

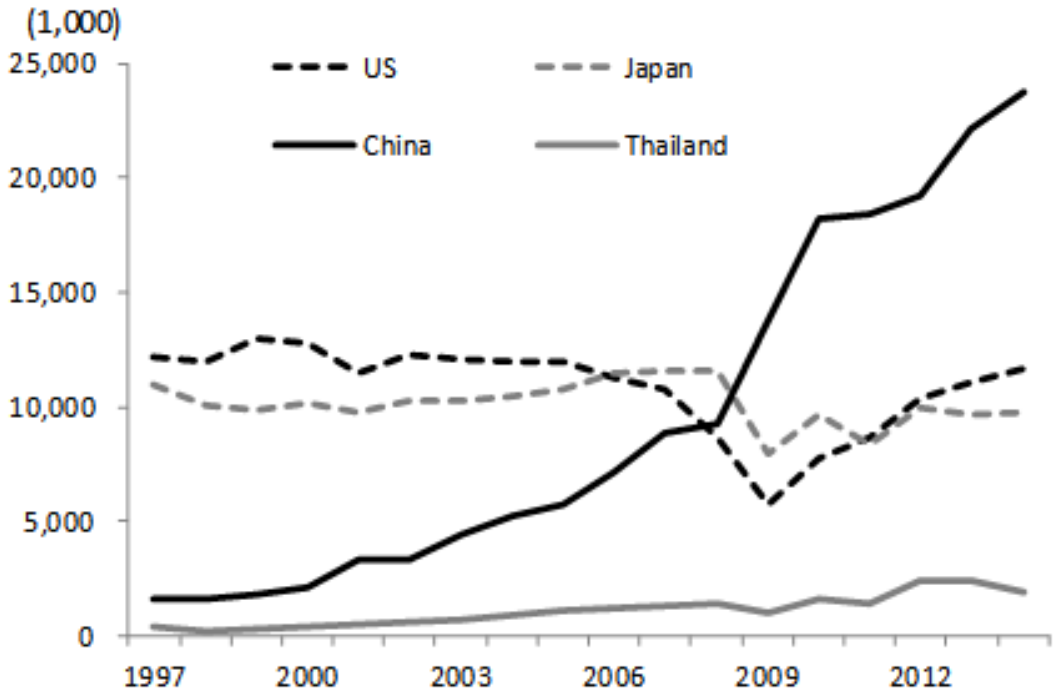


Figure 22: Annual Automobile Production in Major Production Countries
Source: OICA

Yet, there are differences between the US and Japan in terms of the recent revival after 2009. While the US have swiftly increased its production due to low-rate borrowings, lower job-loss rate, and increasing property prices, Japan has not been able to revive its production level. Because of its limited domestic market, Toyota's

domestic production since 2009 has remained around 4 million while Nissan and Honda's have remained around 1 million. To deal with the growing market in developing countries, they have increased their production capacities outside Japan (Figure 23).

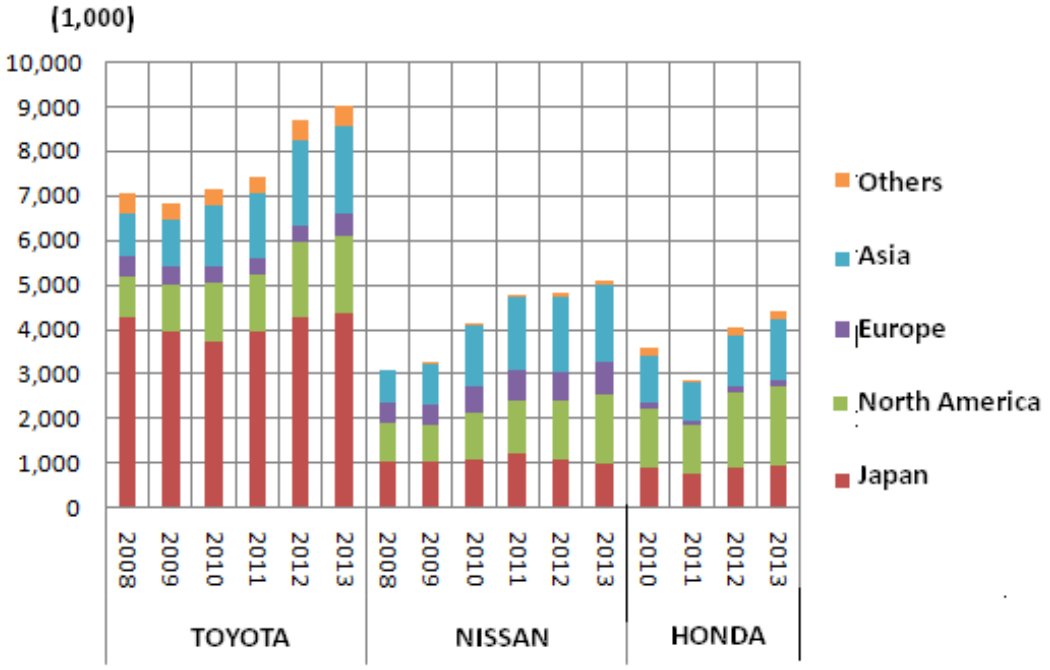


Figure 23: Automobile Production in Each Region by Major Japanese Makers
Source: Company's HP

6.4.2 Japanese Keiretsu Systems

Even though the automotive markets in China and other developing countries have been increasing, Japan cannot revive its domestic production level by increasing exports due to the recent trend of the devalued yen. Domestic production has become far more expensive than production in developing countries, which have also been sustained by the Japanese traditional supply-chain system called Keiretsu.

A keiretsu “系列”, a type of informal business group, is a set of companies with interlocking business relationships and shareholdings. The keiretsu maintained dominance over the Japanese economy for the second half of the 20th century. For example, Table 12 shows the automotive parts supply from Keiretsu. The proportion of supplies from Keiretsu in Toyoda exceeded 60% in the 1980s; the ratio in Honda was also nearly 50%. Combining internal production with Keiretsu, the ratio is beyond 70% in Toyota and 40% in Honda. Notably, Nissan detached itself from the traditional Keiretsu transaction under the Nissan Revival Plan in 1999, but the ratio was still 40% in 2002[120].

Table 12: Internal Parts Supply and from Keiretsu

	1984	1987	1990	1993	1996	1999	2002
Toyota	**73**	**73**	**72**	**73**	**72**	**72**	**72**
Internal	12	13	11	11	10	12	10
Keiretsu	61	61	61	62	62	61	62
Nissan	**64**	**64**	**63**	**64**	**64**	**63**	**40**
Internal	10	11	10	8	8	7	4
Keiretsu	54	53	53	56	56	56	36
Honda	**44**	**45**	**50**	**52**	**49**	**48**	**42**
Internal	5	5	5	5	5	5	4
Keiretsu	38	40	45	47	44	44	38

Source：IRC

It has long been pointed out that Keiretsu is one of the advantages of the Japanese automotive industry in global markets. For example, Masahiko Aoki treated closed, exclusive and long-term Keiretsu transactions between automotive makers and parts manufacturers as rational institutions in providing expensive but quality parts in a stable manner[121](Aoki, 1990). Yet, the increasing market in developing countries has recently called for a review of the traditional supply chain based on Keiretsu systems.

[120] For Nissan Revival Plan, see http://www.nissan-global.com/GCC/NRP/SUPPORT/revival-e.pdf.
[121] See Aoki (1990).

As stated, Nissan started its reform plan under Carlos Ghosn's leadership in 1999. It tried to find cheaper supply chains outside the Keiretsu system. Specifically, in order to reduce purchasing cost by 20% within three years, Ghosn tried 1) to centralize purchasing policy on a global scale, 2) to reduce the number of part companies from 1145 to 600 by the year 2002, and 3) to finally decrease the number of its subsidiaries from 1394 to a drastic 4.

This deconstruction was accelerated by the recent trend in automotive manufacturing called module manufacturing, which was initiated by Volkswagen in Germany. Unlike the traditional approach which is to develop each part for each model, module manufacturing develops common modules for multiple models. It is said that it is module manufacturing which has driven the recent triumphs of Volkswagen by reducing the cost of development and production. Not only Nissan but other Japanese automotive makers including Toyota have also followed this manufacturing trend and gradually detached itself from the traditional Keiretsu supply chain. In departing from tradition, Japanese automotive makers are trying to find new comparative advantages in its domestic production in order to compete against new manufacturing countries such as China.

6.4.3 Petrochemical Industry in Europe and the United States

As stated, the economic performance in the Thai petrochemical industry has dwindled since the Asian Financial Crisis, resulting in a relatively low value added in this industry. In fact, this trend is also shared by the Japanese petrochemical industry (Figure24). Both countries face severe competition from emerging players such as China and the Middle East.

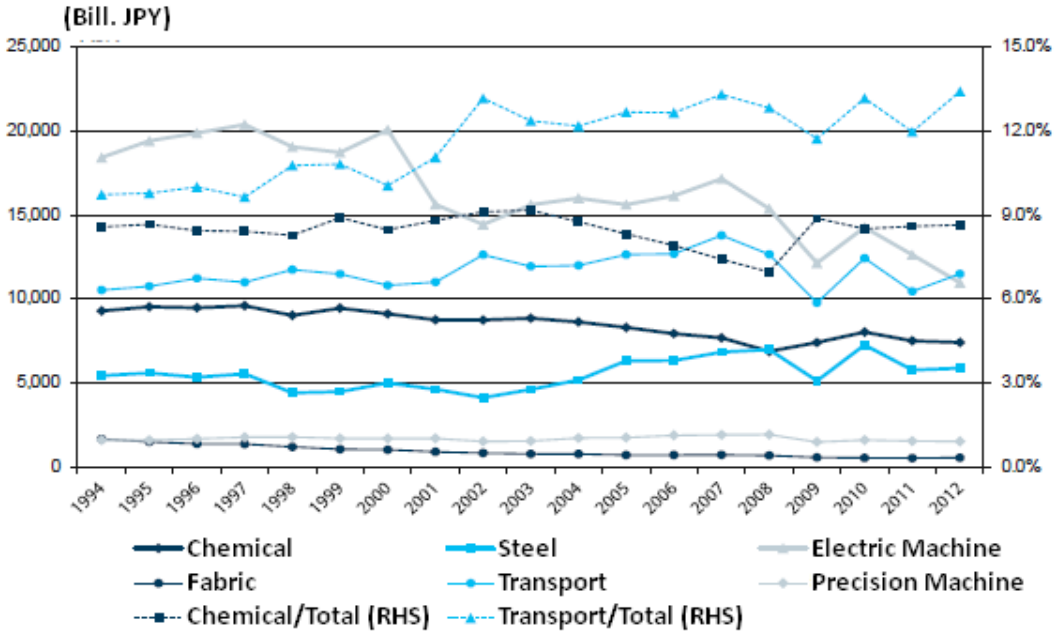


Figure 24: Added-values in Each Industry in Japan
Source: Cabinet Office, Japan; Barclays Research

First, China has increased its production capacity of basic chemical products due to the economies of scale. It is even launching a coal-based chemical industry using its cheaper coal. Second, the Middle East also has increased its production capacity in separating ethane from domestic natural gas. This increase has strong backing because these countries are trying to counter unemployment and reduce the fiscal dependence on oil exports. Third, the recent commercial production of shale gas has made the United States a new player. The newly produced shale gas could possibly provide cheaper ethane as feedstock for the industry.

Against the backdrop of a sluggish growth in the domestic market, existing players in Thailand and Japan have faced severer challenges while Du Pont—one of the existing giants in this industry—has been improving in its economic performance. Figure 25 compares the company with other major companies in terms of "Earnings before Interest, Taxes, Depreciation, and Amortization (EBITDA)"[122]. The Dow Chemical index has been decreasing since 2005. Due to the recent surge of the oil

[122] EBITDA is an accounting measure calculated using a company's net earnings, before interest expenses, taxes, depreciation and amortization are subtracted.

price, the BASF index has increased since 2009 as 35% of its EBITDA is derived from the Oil and Gas segment.

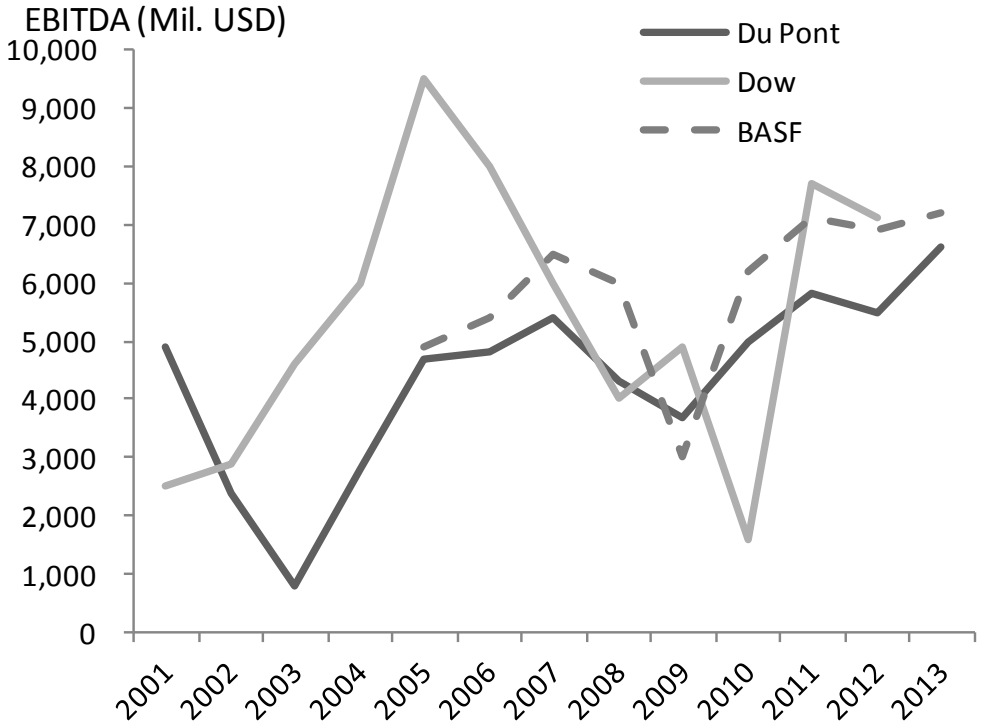


Figure 25: Recent EBITDA Trend among Major Chemical Companies
Source : Factset; Datastream; Bloomberg; Barclays Research

On the other hand, Du Pont has achieved good performance even without any benefit from the Gas and Oil segment. Looking at "Earnings before Interest and Taxes (EBIT)" in each segment, it can be seen that the company has relatively balanced structures compared to Dow Chemical and BASF (Figure26). For example, Dow Chemical depends heavily on Functional Plastics while BASF on Gas and Oil. Without the windfall benefit given by the surge of the oil price, Du Pont has focused more on emerging fields such as genetically modified organisms in life science.

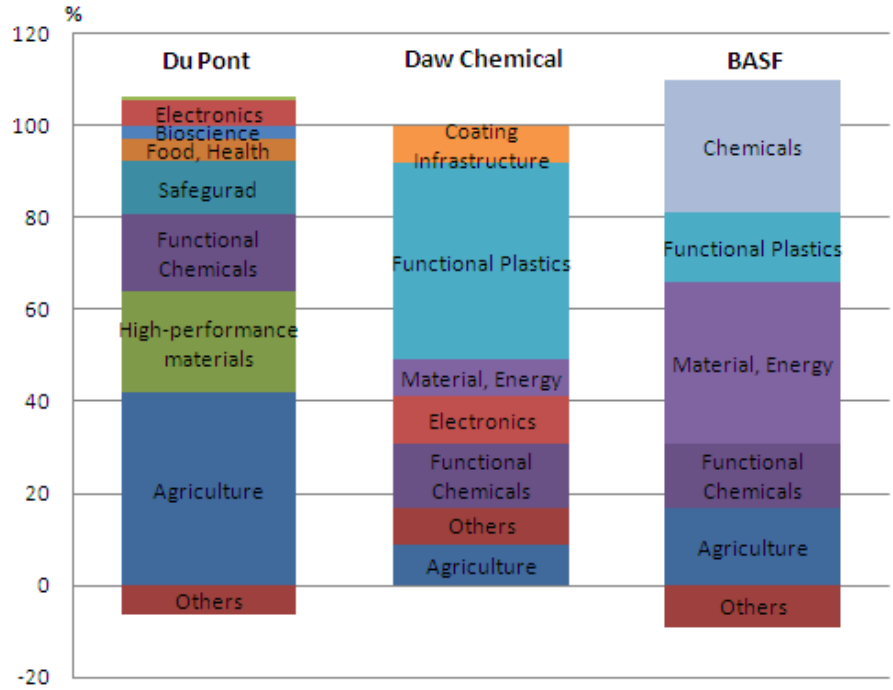


Figure 26: EBIT in Each Segment of Major Chemical Companies
Source : Factset; DataStream; Bloomberg; Barclays Research

6.4.4 Vertical Disintegration for Specialty Products

This shift to adapt to the new business environment was possible after 1999 when DuPont sold all of its shares of Conoco, a major American oil and gas producing company. This brought Du Pont around 50% of all its sales, and it acquired the Pioneer Hi-Bred agricultural seed company. In the 1980s Du Pont tried to maximize its profit based on vertical integrations. It acquired Conoco in 1981, to give itself a secure source of the petroleum feedstocks necessary for the manufacturing of many of its fiber and plastics products.

When it realized that it had emerging competitors mainly from developing countries, the company shifted its strategy from mass-producing chemical commodity to high-value specialty products. Currently, the company has no segment at all for

mass-production commodities unlike other major companies such as Dow Chemical (Figure 26).

It is not the first time that a company realizes the importance of shifting toward high-value added products. In the 1970s, many Eastern European and OPEC companies began manufacturing mass-production commodities. But the shift toward specialization was said to be "an absolutely necessary strategy"[123] and "Large chemical companies (are) tumbling over one another in the rush to get into specialties"[124]. In 1983, a business article titled "New Chemical Business Recovery May Be Very Different" reported:

> *"The Idea that the commodity sector is mature or maturing, that the huge export market for many chemicals is contracting, and that producers are moving inexorably into specialties is accepted so widely it is in danger of becoming a truism. Around the industry, producers echo the line that companies must position themselves in those markets—or "niches," in the new sense of narrowly defined opportunities—in which they will be most competitive."*[125]

Accordingly, European companies such as Rhone-Poulenc (France), Solvay (Belgium) and Imperial Chemical (England) went into specialties. Also, major American companies such as Du Pont and Dow Chemical launched their business in specialties though they still had mass-production commodities based on their vertical integrations. Eventually, in 1981, Du Pont bought Conoco, one of the world's oil majors.

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123 Winston Williams "Dow Broadens Product Lines" New York Times Feb11 1981.
124 "Beware the Specialties Fad" Chemical Week Oct14 1981
125 David Webber "New Chemical Business Recovery May Be Very Different" Chem. Eng. News 61(2), 1983.

While Du Pont finally responded to the needed shift, Dow Chemical has stuck to the mass-production of commodities, which accounts for around 40% of the company's whole profit. As a result, the Dow's earning rate in 2012 is around 7% while the Du Pond's rate is 15%. This trend is more evident among Japanese petrochemical companies. For example, the profit ratio from mass-production commodity is 51% (Mitsubishi Chemical), 49% (Sumitomo Chemical) and 72% (Mitsui Chemical), resulting in an earning rate of 3% (Mitsubishi Chemical), 2% (Sumitomo Chemical) and 0% (Mitsui Chemical). Realizing the disadvantages in the global competition, the Japanese government has strongly urged those companies to make the needed shift under the Industrial Competitiveness Enhancement Act[126].

6.5 Industrial Systems in ESB

This dissertation tries to address the adaptive character of industrial systems in explaining the different economic performances between petrochemical and automotive industries in the ESB. Chapter 4 and Chapter 5 suggest that the network-based industrial system has enabled the automotive industry to adapt well to recent changing business environment while the adaptive capacity of the petrochemical industry based on the independent firm-based industrial systems is less impressive. This contrasting character of industrial systems is similar to that between Silicon Valley and Route 128(Saxenian, 1996).

This chapter tries to examine the character of industrial systems with quantified data such as start-up registrations, which is suggested by a series of semi-structured interviews in Chapter 4 and Chapter 5. As a result, it is seen that the PTT and SCG groups respectively have developed vertically-integrated supply-chains in each petrochemical complex (6.2) while the first-tier automotive part industry around Amata Nakhon Industrial Estate forms a quality industrial region with lowering

[126] For English version, see http://www.japaneselawtranslation.go.jp/law/detail_main?re=02&vm=04&id=2585

boundaries of each company (6.3). In this way, quantified data also supports the findings by qualified data.

Still, however, there may be a suggestion that economic performances depend more on global industrial trends rather than industrial systems. Thus, 6-4 discussed the validity of this observation by picking up some other cases of petrochemical and automotive industries in the 2000s. The Japanese automotive industry is not dealing well with the global competition, and even Toyota is currently collapsing under its traditional Keiretsu system. On the other hand, in the petrochemical industry, Du Pont has been successful in detaching itself from mass-production commodities while going into specialty products in spite of the increasing global competition.

In this way, it can be concluded that the character of industrial systems decides the adaptive capacity and, to some extent, the economic performance of a company. The automotive industry has developed better industrial systems in this sense. It should also be noted that investments from the Thai themselves have increased. For instance, Table 13 shows the number and capital of start-ups in the ESB[127]. While the portion of the Thai start-ups has declined significantly in the petrochemical industry from 40.9% (1991-2000) to 16.7% (2001-2010) in its capital base, the Thai portion in the automotive industry has increased from 6.7% (1991-2000) to 13.8% (2001-2010) in its capital base. A resilient industrial system sustained by local investors based on local networks is emerging in the Thai automotive industry.

[127] A raw data is shown in Appendix D. “Thai Startup” is defined as a startup which is shared by Thai investors more than 50%. “Foreign Startup” is defined as a startup which is shared by Thai investors less than 50%.

Table 13: Thai vs foreign start-ups in petrochemical and automotive industry

	1981-1990		1991-2000		2001-2010	
	No	Capital	No	Capital	No	Capital
I. Petrochemical (1)	25	15035	78	30367	72	10051
Thai Startup (2)	11	3226	27	12408	12	1750
Foreign Startup	14	11334	51	17958	60	8301
II. Automotive (3)	15	13839	96	39438	126	42114
Thai Startup (4)	4	2480	23	2640	16	5823
Foreign Startup	11	11359	73	36798	110	36291
III. Thai/Total (%)						
Petrochemical: (2)/(1)	44.0	21.5	34.6	40.9	16.7	17.4
Automotive: (4)/(3)	26.7	17.9	24.0	6.7	12.7	13.8

Source: (Comm Bangkok, 2011)

CHAPTER 7: CONCLUSION

7.1 Summary of Dissertation

7.1.1 Motivation of Study

Before analysis above, the dissertation gave a motivation behind the analysis, which is to draw an implication for institutions which enable nation states to escape from the curse of resource ownership and to enjoy the blessings instead. Against our intuitions that resource wealth can lead to a country's development, there are a number of experiences that show that resources can curse a country. In particular, the utilization of natural gas can drastically change the direction of a country's political economy. Based on this case study, this dissertation has aimed to draw implications for institutions involved in the oil and gas as well as petrochemical and automotive industries.

To approach this aim, the dissertation focused on relevant institutions and organizations based on a study of the recent developments of the Thai political economy. Observing structural changes from the 1980s to the 1990s, the scholar has doubted the validity of the bureaucratic-polity approach. Instead, the recent political economist has generated three new approaches such as post-bureaucratic polity, stable adjustment in macroeconomy, and institutional and organizational approach. In order to draw an implication for institutions which enable nation states to escape from the curse and to allow the resource to bless them, this disseration followed the institutional and organizational approach.

After examining recent disciplinary studies regarding the resource curse, the way that Thailand has utilized its natural gas was diagnosed. Indeed, the theory of a resource curse has not been examined much in the context of Southeast Asia. However, in view of the region's increasing economic relations with China, the

resource curse has become a focus for both policy makers and academia. In conventional wisdom, the export of natural resources should be an advantage for the region. However, concern has been increasingly raised, particularly in Indonesia, Malaysia, and Thailand, on which this dissertation has conducted a resource curse diagnosis.

As a result, it was concluded that those countries have not been cursed by the ownership of resources. Indeed, looking at Thailand's trade structure especially, there is little need for concern regarding a resource curse. Eschewing windfall incomes from a direct export of their resources, the country has tried to add economic values to the resource through industrial developments such as the petrochemical industry. The value-adding process in the petrochemical industry has been efficient and effective in a small industrial region called the ESB. In this sense, the sustainable development of this regional economy has a critical significance for the country

7.1.2 Analytical Part

The analytical objectives of this dissertation are 1) to explain differences between petrochemical industries in Map Ta Phut (MTP) and automotive industries in Laem Chabang (LCB) responding to a changing business environment; 2) to analyze the factors affecting adaptive capacity of the two industries; and to 3) draw recommendations for a further sustainable regional development in the Eastern Seaboard region.

First, it described a problem setting and hypothesis in order to address the sustainability of the region. First of all, it showed the relevant literature survey regarding the ESB. While there are a number of studies, their scopes generally focus on the technocratic perspective, the socio-economic impact and the environmental impact. There are a few studies which try to capture the sustainability of the regional economy in the ESB. This is also the major analytical topic in this dissertation.

Then, in describing a specific problem setting, it compared the recent economic performances of the petrochemical and automotive industries in the ESB. Contrasting performances between the two can be observed. While the petrochemical industry has been in an economic slump since the Asian Financial Crisis, the automotive industry has swiftly recovered in the same period. To tackle this puzzle, it set the hypothesis that the different adaptation capacity of each industry is the cause of the contrasting economic performances. Adaptation capacity has been academically discussed in the post-Fordism school, from which it draw an analytical framework named industrial systems[128](Saxenian, 1996).

A region's industrial system consists of three dimensions and their inter-linkages: local institutions and culture, industrial structure, and corporate organization. Regional institutions are a variety of formal and informal organizations which create and sustain regular patterns of regional social interaction. Industrial structure refers to the social division of labor—the degree of vertical integration—as well as to the extent and nature of links between customers, suppliers, and competitors in relative sectors. Corporate organization includes the degree of hierarchical or horizontal coordination, centralization or decentralization, and the allocation of responsibilities and specialization of tasks.

Based on open-ended questionnaires used in semi-structured interviews, it described the character of the independent firm-based industrial systems in the petrochemical industry around MTP. First, while the FTI has regional and industrial branches, these lobbying organizations are indifferent to the pattern of regional social interaction. Second, industrial structure is heavily vertically integrated in the PTT and SCG groups where inter-group transactions are rare. Third, both PTT and SCG groups have their own centralized management and decision-making systems more typically seen in big western companies.

Following, it captured the character of the network-based industrial system in the automotive industry around LCB. First, unlike the FTI branches, a bottom-up

[128] See Saxenian (1996).

organization called the MAC helps to create and sustain regular patterns of regional social interaction among skilled Thai engineers. Second, the Thai industrial structure is largely independent of the traditional Japanese vertically-integrated supply chain called Keiretsu system. Third, corporate organization is decentralized and skilled workers are at their discretion to act to some extent, which is typical in the notable Toyota Production System.

As a seminal study by Saxenian suggested, it is the contrasting characters of industrial systems which cause differences in the adaptation capacity of each industry, which in turn leads to different economic performances in the problem setting[129](Saxenian, 1996). Using a set of quantitative data, it further discussed the hypothesis tested by qualitative data. Local supply chain data suggests that a vertically integrated supply chain in each petrochemical complex is based on share-holding relationships while an industrial region of automotive supporting firms can and did have economic transactions with multiple Japanese makers.

While these quantitative findings should supplement the qualitative results, there could be a following counter-argument: the different performance is caused by the character and competition of each industry itself not by the character of industrial systems. To respond to this argument, some other cases in relevant industries were observed. For example, the Japanese automotive industry, which stuck to its keiretsu system, has had difficulties in responding to recent changes in the business environment. Also, in the petrochemical industry, the Du Pont case shows that it is possible to have economic success thanks to the disintegration strategy. These cases should, to some extent, negate the counter-argument above.

This dissertation aims to draw an implication for institutions aiming to help nation states become blessed rather than cursed by their ownership of resources. The Thai case suggests that the value-adding process on resources is important and that it can be effectively and efficiently enabled in a small region such as the ESB. On the other hand, compared to the automotive industry, it can be seen that the sustainability

[129] See Saxenian (1996).

of the petrochemical industry in the ESB may be problematic in a longer run. Thus, recommendations in the next section should deal with this concern.

7.2 Recommendations

When technology and market remain relatively stable over time, vertical integration and corporate centralization can enable needed economies of scale and market control. This process was exactly observed in the petrochemical industry in Thailand. In an age of volatile technologies and markets, however, the more horizontal coordination provided by inter-firm networks has enabled firms to retain the adaptability and flexibility needed for resilience. On this assumption, three recommendations are drawn for further development in the ESB.

7.2.1 Vertical Disintegrations

The first recommendation for the petrochemical industry is simply to shift the character of the industrial system from being an independent firm-based one to a network-based one. As stated before, and in comparison to the automotive industry, the industrial system of the petrochemical industry has more a firm-based rather than a network-based character. Learning from the recent success in the automotive industry, managers and policymakers need to overcome their outdated conception of the group as a separate and self-sufficient entity; they need to recognize that within a region, adaptation is a collective as well as an individual process.

To be sure, an industrial system is the product of historical processes that are not easily imitated or altered. It should be noted again that each dimension of industrial system-- local institutions and culture, industrial structure, and corporate organization—is closely interconnected, yet no single dimension is prior to or causal of the others. As these three dimensions are mutually reinforcing components in a regional economy, we cannot change the character of the systems by changing a certain dimension. Rather, we have to deal with systems as a whole.

This is difficult, yet a recent positive sign has emerged. Against the backdrop of the global competition, PTT is trying to re-structure its petro-chemical industry. For example, it sold all its shares in Bangchak Petroleum Public Company and its 36% share of Star Petroleum Refining Company. This unbundling of its upstream sector is similar to what Du Pont did in the 2000s. With this unbundling, PTT can shift from mass production of commodity to more value-added specifics in the way Du Pont did. If we promote this direction of industrial restructuring with the reform of the other two dimensions, the industrial systems could be significantly changed.

7.2.2 Regional Integrations

The second recommendation for the petrochemical industry is to utilize the dynamism in the automotive industry. While the industry should shift from the mass-production of commodities to more high value added specifics, it is difficult to decide the specific direction of this shift. The industry eventually has to decide what the focus of its research and development should be. One of the possible directions of its research and development might be to focus on the neighboring automobile industry as its customers.

Indeed, there is a huge demand for petrochemical products in the automotive industry. While it procures some of its parts from the petrochemical industries in MTP, others are still imported. So there is still a large potential in the research and development of high-valued engineering plastics in MTP. If future innovations in the petrochemical industry focus in this area, they should have an advantage over imports because of the geographical proximity.

The industrial restructuring such as an unbundling of its upstream industry could make the petrochemical company more flexible. Furthermore, it is regional integration in the ESB that could enable a successful innovation. Although both industries have been adjusting from the beginning, there are scarce inter-connections between the petrochemical and automobile industries in the ESB. Without dense

information exchange and human relationships in between, the necessary innovation cannot take place in a timely fashion.

7.2.3 A Bottom-up Consortium in ESB

In order to enable this regional integration, the third recommendation is to craft a bottom-up consortium as a hub of social networking in the ESB. This consortium should consist of multiple industries including the automotive and petrochemical industries, local government, and local research institutes. It aims to address the direction of needed innovations and a comprehensive plan in the ESB, which should make social networking denser and more intense.

It should also be noted that this bottom-up consortium is different from top-down organizations such as the FTI. The local FTI conducts its activities financially supported by the FTI headquarters. This means that the activities will not be driven by local initiatives. In order to effectively facilitate local initiatives for further business opportunities in the ESB, the bottom-up consortium has to be self-financed by members such as local industries, local government, and local research institutes.

In 2015, Rayong Advanced Institute of Science & Technology was launched by PTT. Based on a number of other cases, such a local institute can be expected to become a hub for the local bottom-up consortium. For example, cross-licensing among participants is one of the options to facilitate regional innovations in this institute. This should reduce the risk of legal action against violation of patents, and encourage further innovations. In this way, local research institutes can function as a hub for the local bottom-up consortium.

These recommendations do not deny the role of public policy by central and local governments. In order to solve possible collective action problems, regional policy should be designed to catalyze and coordinate relations among the myriad public and private actors that make up the regional economy. At this moment, the Eastern Seaboard Development Committee could be one feasible organization in

planning this regional policy[130]. For further implementation, it also needs collaboration with the local municipal government.

To make this implementation feasible, the local government should be able to collect tax revenues as well. In the context of decentralization, the revenue sources should be transferred from the center to the local. Currently, Bangkok Metropolitan levies the corporate tax if the headquarters of the corporation is in Bangkok. In the case of factories in the ESB, a significant portion of tax revenue will go to local municipal government once tax revenue sources are transferred to the local. In this way, the accountability of local municipal offices should be increased not only for economic performance but also for environmental and social problems[131](Supaporn Pinyochatchinda & Walsh, 2012).

These are the recommendations that would make the regional economy in the ESB sustainable. One may consider that Thailand does not have to stick to the ESB for its macroeconomic development and that the country should focus more on adding value in the service sector. While agreeing with this assertion, I shall stick to the sustainability of this region since economically-speaking, it is precisely this sustainability that will reduce the risk of the resource curse.

7.3 Future Prospects

7.3.1 An Unexplored Issue

Through the comparison of the industrial systems in both the petrochemical and automotive industries, this dissertation addressed the different economic performances of both industries against the backdrop of increasing competition. While the automotive industry with its network-based systems has adapted well to business dynamisms, the petrochemical industry with its independent firm-based

[130] Chair is Prime Minister. Secretary is Secretary General of the National Economic and Social Development Board.
[131] For example, see Supaporn and Walsh (2012).

industrial systems has experienced harsher moments in a globalized economy. The recommendations stated above are needed to sustain this regional economy in the ESB where adding value to natural gas has been a precedent.

The limitations of this study should start with this question: why are there differences between the petrochemical and automotive industries? What is the reason behind the fact that the petrochemical industry has an independent firm-based industrial system while the automotive industry has a network-based one. One may wonder whether the character of the industrial systems depends on the type of industry. In examining this point, I would draw a hypothesis for further study.

It has been said that capital-intensive industries such as the petrochemical industry tends to have independent firm-based industrial systems while labor intensive industries such as the automotive industry has network-based ones[132](Saxenian, 1996). Yet, as shown in Chapter 6, there are a number of counter-evidences, which shows that the type of industry does not decide the character of industrial systems.

The petrochemical industry in Thailand has crafted an independent firm-based industrial system. The reason behind this is that ethylene and propylene production in the upstream petrochemical industry had been legally monopolized by the state energy enterprise until the deregulation in 1994. Naturally, its subsidiaries were able to get into business in the downstream petrochemical industry more easily than other potential investors. This is the process of firmly vertically integrated systems.

Rival companies thus should follow this way to sustain cost-competitiveness. Before the deregulation, SCG and IRPC (former TPC) were engaged in downstream business. After the deregulation, they tried to go into upstream business to sustain cost competitiveness. Eventually, a few independent firm-based industrial systems came into existence within the PTT and SCG groups.

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[132] See Saxenian (1996).

The question is why the government had legalized the monopoly by the state enterprise in ethylene and propylene production. Surely, such a safeguard is necessary when it is developing industries that would substitute imports. That monopoly was safeguarded until 1994, possibly damaging sound competitions in the downstream business. The favoring of the state enterprise probably came from the iron triangle of politics, bureaucracy and business. Since the domination of the energy sector by the state enterprise has been safeguarded by the Ministry of Energy, this triangle can be easily formed.

7.3.2 A Contribution to Thai Studies

It cannot be overemphasized that the state enterprise should initiate and take a significant role in developing and adding value to energy resources. In this way, Thailand can detach itself from the resource curse from an economic point of view. One may perhaps wonder if rent-seeking behavior might have brought about huge windfall profit and given a high value added. But it has been generally said that the rent-seeking process is a deterrent to economic development.

Political economists have observed that there are several types of rent-seeking process, which have different impact on economic development[133](Khan & Jomo, 2000). While the rent-seeking process on energy resources does not necessarily deter economic development, the monopoly of resources even if it's by a well-meaning state institution, can alter development by slowing innovations. In the case of ESB, Thailand, this phenomenon is described in Chapter 4.

Herewith, a hypothetical mechanism is implied in that in escaping the worse of the economic impact of a resource curse, a country may have to pay instead the political price of a rent-seeking monopoly. One may wonder if this hypothesis is peculiar to Thailand or generalized as a theory. In the case that this is peculiar only to Thailand, we would then have the important finding of a Thai uniqueness. Otherwise,

[133] See Jomo and Khan (1999).

this should further support the aim of this dissertation which is to draw an implication for institutions enabling nation states to escape from the curse of owning resources and to enjoy their blessings instead. An effective value adding to energy resources may not be sufficient help in escaping from the resource curse. In addition, we also have to regulate the rent-seeking behavior which impairs the adding-value process.

Recently, the question of value-adding to energy resources in Vietnam and Myanmar has arisen. These countries have learned from Thailand's development in the last 30 years. While the main actor in Vietnam is the state-owned PetroVietnam, in Myanmar, it is Myanmar Oil and Gas Enterprise, also a public company. It is safe to assume that the relevant iron triangle exist in both countries. Based on the case in Thailand, the utilization and regulation of these actors should be considered carefully if good relationships between energy and the state are to be achieved in order to deal with the ill-effects of the resource curse. Focusing on the relevant rent-seeking behavior in the political process, I would conduct comparative studies of Thailand, Vietnam, and Myanmar, which should further provide implications for the institutions working to balance the resource curse-blessing dichotomy.

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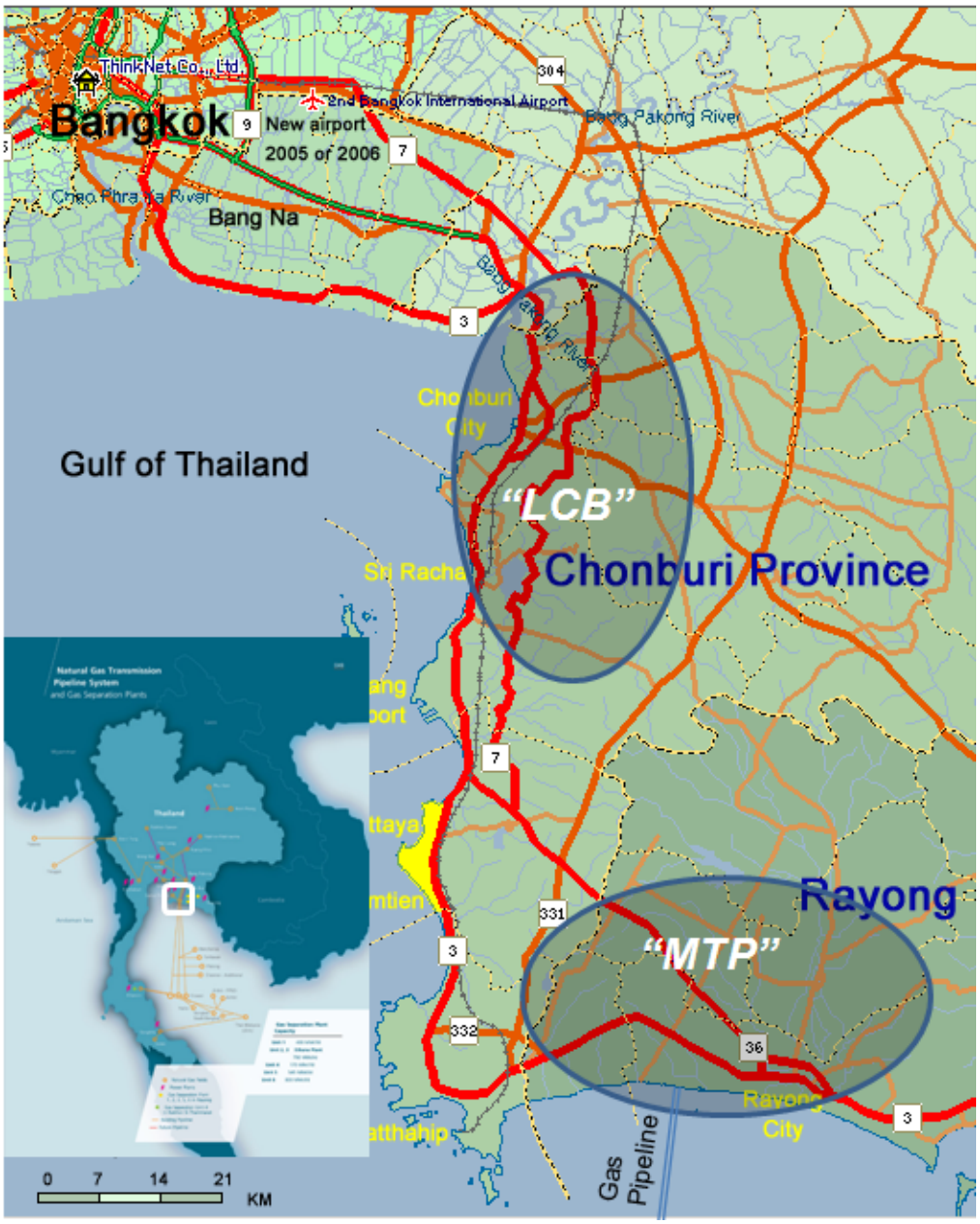
APPENDIX

APPENDIX A: MAP OF EASTERN SEABOARD



APPENDIX B: LIST OF INTERVIEWEES

Organizations	Interviewee	Position
AAT	Toshihide Saeki	Former President
FTI Automotive Club	Suparat Sirisuwanangkura	Honorory Chairman
FTI Chonburi	Suwapun Chanthasarnviwat	Chairman
FTI Petrochemical Club	Ekarat Thongtawach	Chairman
FTI Rayong	Veerapon Puangpitayavut	President
Fujikura Electronics	Hitomi Morita	Former Officer
Hansa International	Motohiro Kurokawa	Advisor
Hansa International	Wataru Tabuchi	President
IEAT	Pichai Junsangsri	Public Relations Officer
IHI Turbo	Thanapol Srithong	Employee Relation Manager IHI Turbo (Thailand)
JETRO Bangkok	Tokio Motoda	Former Representative
JICA, Thailand	Munehiro Fukuda	Expert
JICA, Thailand	Kenji Iwaguchi	Former Representative
Kikuwa	Shoji Kikuchi	Former President
Metal Building	กิตติวุฒิ ศศิวิมลพันธุ์	Managing Director
METI	Mitsutoshi Oriyama	Assistant Director
Minebeya	Tosei Takenaka	Former Thai Representative
Mitsubishi Corporation	Kiwamu Honda	Former Officer
Mitsubishi Kakoki	Yuzo Suzuki	Advisor

Mitsubishi Kakoki	Mitsuru Kanemaru	International Division
Mitsuci Chemicals	Kenichi Yoshida	Former Thai Representative
MITSUI & CO.	Noboru Iwase	Former Managing Director
MKK Asia	Yoshio Makita	President
MOECO	Minoru Fukuda	Thai Representative
NESDB	Daisuke Matsushima	Former Advisor
Nissan Motor Thailand	Takehiko Taniguchi	Former Vice President
PTIT	Siri Jirapongphan	Exective Director
PTTGC	Boworn Vongsinudom	Former President
Siam Cement Public Corpolation	Siriwarang Sanee	Supplychain Manager
TDIC	Motoo Horiguchi	Senior Exective Vice President
Thai Kikuwa Industries	Hideyuki Kikuchi	President
Thai Polyacetal/Thai Polycarbonate Co.	Makoto Kobayashi	Vice President
Thai Summit Harness Public	Peerapong Suntaravipath	General Manager
Tomen	Kazuo Kikkawa	Former Thai Representative
Tomen	Kiyoshi Kasahara	Former Officer
Toyotsu Chemiplas	Hiroshi Hosokawa	Managing Director
TPC	Somchai Kongsala	Former Director
TTTP	Takashi Kono	Advisor
YMP	Masakazu Okamoto	Charman
YMP	Hirosawa	President

APPENDIX C: OPEN-ENDED QUESTIONNAIRE

วันที่ ๙ เมษายน พ.ศ. ๒๕๕๘

เรื่อง ขอความร่วมมือให้ข้อมูลงานวิจัย
เรียน _____

คุณ Kensuke Yamaguchi จากมหาวิทยาลัยโตเกียว ซึ่งปัจจุบันทำงานร่วมกับสถาบันวิจัยพลังงาน จุฬาลงกรณ์มหาวิทยาลัยเพื่อวิจัยโครงการในหัวข้อ "ประวัติความเป็นมาของการพัฒนาพื้นที่ชายฝั่งทะเลตะวันออกให้เป็นเขตอุตสาหกรรม" นั้นมีความประสงค์ที่จะขอความร่วมมือจากท่านในการให้สัมภาษณ์เพื่อรับทราบข้อมูลเพิ่มเติมเกี่ยวกับงานวิจัยดังกล่าว

ทางผู้วิจัยได้เคยทำการสำรวจ และสอบถามข้อมูลจากผู้ประกอบการชาวญี่ปุ่นในเขตพื้นที่ชายฝั่งทะเลตะวันออก และสรุปรายงานเพื่อตีพิมพ์ในวารสารของหอการค้าญี่ปุ่น กรุงเทพฯ (Japanese Chamber of Commerce, Bangkok) โดยหลังจากนี้ ผู้วิจัยมีความสนใจที่จะต่อยอดงานวิจัย โดยมุ่งเน้นที่ช่วงเวลาหลังปี ค.ศ. ๑๙๘๐ ซึ่งมีการวางท่อแก๊สธรรมชาติเข้าสู่พื้นที่มาบตาพุดแล้ว เพื่อศึกษาความสัมพันธ์ระหว่างการพัฒนาแหล่งแก๊สธรรมชาติ กับการเกิดขึ้นของนิคมอุตสาหกรรมและการเติบโตของเศรษฐกิจท้องถิ่นในพื้นที่ชายฝั่งทะเลตะวันออก (จังหวัดฉะเชิงเทรา ชลบุรี และระยอง) โดยผลสรุปที่ได้จากการสำรวจและวิจัยครั้งนี้ จะถูกเผยแพร่ในวารสารวิชาการทั้งในประเทศไทยและประเทศญี่ปุ่นต่อไป

ทางผู้วิจัยจึงใคร่ขอความอนุเคราะห์เพื่อรับทราบข้อมูลในหัวข้อที่ระบุต่อไปนี้ โดยเฉพาะข้อมูลที่เป็นข้อเท็จจริงในอดีตที่สัมพันธ์กับหัวข้อนั้นๆ นอกจากนี้ ทางผู้วิจัยจะส่งผลสรุปจากการสอบถามครั้งนี้ให้ท่านได้ตรวจสอบอีกครั้ง ก่อนนำไปตีพิมพ์ในวารสารวิชาการต่อไป

- องค์กรส่วนท้องถิ่นและวัฒนธรรมระหว่างองค์กรทางธุรกิจ
    - ในพื้นที่ชายฝั่งทะเลตะวันออกมีการจัดตั้งองค์กรหรือหน่วยงานภาคเอกชนขึ้นมาเพื่อดูแลและควบคุมการดำเนินงานทางธุรกิจในพื้นที่หรือไม่ (เช่น หอการค้าส่วนภูมิภาค)
    - วิธีการติดต่อประสานงานทางธุรกิจภายในพื้นที่ชายฝั่งทะเลตะวันออกนั้น มีรูปแบบหรือวัฒนธรรมที่เป็นเอกลักษณ์เฉพาะตัวซึ่งไม่ปรากฏในพื้นที่อื่นหรือไม่
- โครงสร้างทางอุตสาหกรรม
    - ภายในกลุ่มอุตสาหกรรมที่บริษัทของท่านสังกัดอยู่นั้น มีการควบรวมกิจการในแนวตั้ง (Vertical Integration) ของกลุ่มบริษัทที่อยู่ในสายการผลิตเดียวกันมากน้อยเพียงใด
    - ในพื้นที่ชายฝั่งทะเลตะวันออกนั้น มีความเชื่อมโยงกันระหว่างผู้ผลิต ลูกค้า ผู้มีส่วนเกี่ยวข้อง รวมทั้งคู่แข่งทางการค้า มากน้อยเพียงใด (เช่น มีความร่วมมือใดๆ กับคู่แข่งทางการค้าหรือไม่
- รูปแบบองค์กร

- กรุณาให้รายละเอียดเกี่ยวกับ ขั้นตอนหรือลำดับการตัดสินใจภายในองค์กร รูปแบบการบริหารงาน (เช่น ระบบค่าตอบแทน) และนโยบายการจัดจ้างหน่วยงานภายนอก (Outsourcing) เท่าที่จะเป็นได้
- ในบริษัทของท่านมีกลยุทธ์เพื่อสร้างความแตกต่างให้กับผลิตภัณฑ์ (Product Differentiation Strategy) เป็นพิเศษหรือไม่ อย่างไร และมีวิธีการพิเศษสำหรับการออกแบบผลิตภัณฑ์ใหม่ๆ หรือไม่

สุดท้ายนี้ ผู้วิจัยยินดีเป็นอย่างยิ่งสำหรับคำแนะนำหรือข้อเสนอแนะอื่นๆ ของท่านที่เกี่ยวข้องกับ “ประวัติความเป็นมาของการพัฒนาพื้นที่ชายฝั่งทะเลตะวันออกให้เป็นเขตอุตสาหกรรม” ซึ่งท่านต้องการให้ระบุเป็นพิเศษในรายงานผลสรุปจากการสอบถามครั้งนี้

ขอแสดงความนับถือ

ผู้ช่วยศาสตราจารย์ ดร. มนัสกร ราชากรกิจ
ภาควิชาวิศวกรรมสิ่งแวดล้อม คณะวิศวกรรมศาสตร์
รองผู้อำนวยการ ศูนย์ความเป็นเลิศด้านการจัดการสารและของเสียอันตราย (ศสอ.)
จุฬาลงกรณ์มหาวิทยาลัย

APPENDIX D: PETROCHEMICAL AND AUTOMOTIVE FACTORIES IN ESB

Petrochemical Industry

No.		IE	Province	Year	Capital (M THB)	Thai %	Employees
1	A.J. Plast Public	LCB	CBR	1988	600	100	350
2	Abric Eastern International		RYG	1994	160	0	215
3	Adcomat (Siam)	AMN	CBR	1997	50	0	106
4	Adval Tech (Thailand)	ESB	RYG	1997	40		113
5	AGC Matex (Thailand)	AMN	CBR				
6	Alcan Packaging Strong Thaipack	LCB	CBR			100	
7	Ampacet (Thailand)	ESB	RYG	1998		0	
8	Aptar (Thailand)	AMN	CBR	2007			
9	Asahi Plus	HES	RYG	2011	400	0	
10	Asia Composite Materials	AMC	RYG	2011	38	0	
11	Atryz (Thailand)	AMC	RYG	2006	147	0	
12	Auto Interior Products	LCB	CBR	2002	850		
13	Auto Interior Products	HES	RYG				
14	Ayacucho Preform	AMN	CBR	2010	200	0	
15	Bandai Industrial		CCS	1987	475	0	450
16	Bangkok Polyester Public		RYG	1994	1235	77.07	138
17	Bangkok Polyester Public	MTP	RYG	1994	3000	65	300
18	Bangkok Synthetics	MTP	RYG	1994	1173	100	430
19	Basell Advanced Polyolefines	ESB	RYG	1997	169	0.01	8
20	Bayer Polymers	MTP	RYG	1992	7411	0	400
21	Cam Plas (Thailand)	AMN	CBR	2007	50	0	200
22	Carbon Magic (Thailand)		CBR	2005	590		170
23	Cardinal Health 222 (Thailand)	AMC	RYG	1998	1641.3	0	1747
24	CBC Forma	AMN	CBR	2009	180	0	20
25	CBC Ings (Thailand)	AMN	CBR	2008	300	50	350
26	Challenge Technology	WEL	CCS	1993	500		80
27	Chang Thai Plastic	PT1	CBR	2001	20	0	
28	Charoen Pokphand Pet.		RYG		677	100	223
29	Chiyota Gosei (Thailand)	AMC	RYG	2012	100	0	
30	Chubu Techno (Thailand)	HES	RYG	2012	20	0	23

31	Citc Enterprise (Thai)		CBR	2000	60	0	42
32	City Pla (Thailand)	PT3	CBR	2013	32	0	
33	Civica (Thailand)	WEL	CCS	1990	12	0	150
34	Civica Molds	WEL	CCS	1996	20		60
35	Clariant Emulsions		RYG				33
36	Combipack	WEL	CCS	1991	50	100	180
37	Dae Chang Hitech		CBR	2000	58.64	0	100
38	Dae Sung Hitech (Thailand)	AMN	CBR	2001	20	0	
39	Dae Sung Metals		CBR	2007	12	0	
40	Daido Manufacturing (Thailand)	SEI	RYG	1995	250	51	300
41	Daidong Electronics (Thailand)		CBR	1989	10	0	800
42	Daiho Manufacturing (Thailand)	AMN	CBR	2006	708	0	400
43	Daika Kogyo (Thailand)	AMN	CBR	2005	336.45	0	150
44	Daikyonishikawa (Thailand)	HES	RYG	2007	850	0	50
45	Daimei Thai	AMN	CBR	2010	103		
46	Daiso Siam Internaitonal	AMC	RYG	2006	833		
47	Durapak	WEL	CCS	1991	100	100	60
48	Eastern Hobas Pipes		RYG	2002	480	60	70
49	Eastern Polypack		RYG		150	100	400
50	Echo Autoparts (Thailand)		CCS	2002	120	0	
51	Echo Autoparts (Thailand)	AMN	CBR		120	0	
52	EFTEC (Thailand)	ESB	RYG	1998	30		13
53	EIKOU	PT2	CBR	2008	100	0	73
54	Elastomer Prodects (Thailand)	AMC	RYG	2008	35.6	0	
55	Enplas Precision (Thailand)	PT2	CBR	1997	100	0	150
56	Eslen Thai	LCB	CBR	1993	85	60	120
57	Ever Wealth Plastic (Thailand)	AMN	CBR	2004	30	0	70
58	Extreme Packaging		CCS	1997	70	65	51
59	Fineplas (Thailand)	AMC	RYG	2012	50	0	
60	Flexplas	AMC	RYG	2013	14	0	
61	Genesis Baloons		RYG			51	
62	Geoplast		RYG	1993	71	51	28
63	Grand Siam Composites	MTP	RYG	1996	63.7	46.2	
64	Haesung (Thailand)		CBR	2000	24	0	69
65	Hamaka (Thailand)	LCB	CBR	1995	50	0	120
66	Hamaka (Thailand)	AMC	RYG	1995	50	0	120

67	Han Yang M-Tech		CBR	2003	235.5	0	43
68	Hi-P (Thailand)	AMC	RYG	2005	89	0	143
69	Hirai Seimitsu (Thailand)	SHP	CBR	1995	65	25	596
70	Hitachi Chemical Automotive Products	SEI	RYG	1995	166	0	362
71	HMC Polymers	MTP	RYG	1983	800	47	250
72	Hon Chuan FD Packaging		CBR	2005	194	0	26
73	Hoyo (Thailand)	AMN	CBR	1996	16.2	0	220
74	Hymix	AMN	CBR				
75	Imco Food Pack	WEL	CCS	2001	47.9	100	18
76	Ingress Autoventures	ESB	RYG	1996	240	0	217
77	Inpet	AMN	CBR	2005	235	100	80
78	Iwa Packing Industry		CCS	2000	80	0	150
79	Jet Industries (Thailand)		CBR	1990	200	0	1000
80	Kai.Hong.Kong. (Thailand)	PT2	CBR	2014	2		
81	Kana Thai Industrial		CCS	1989	20	20	84
82	Kanagata (Thailand)	WEL	CCS	1989	20	60	47
83	Kanayama Kasei (Thailand)	AMN	CBR	1999	102	0	430
84	Kansai Resin (Thailand)	ESB	RYG	1995	330	9	82
85	Kao Su Packing (Sriracha) Industry		CBR		100	0	155
86	Kasai Teck See	PT2	CBR	2007	110	0	
87	Kawabe Precision (Thailand)	AMN	CBR	2000	108	0	220
88	Kim Pai Coating	WEL	CCS	2006	25	80	
89	Kimpack	WEL	CCS	1998	279	100	9
90	Kinki Yohin (Thailand)	AMC	RYG	2006	200	0	60
91	Kloeckner Pentaplast (Thailand)	ESB	RYG		495	0	130
92	Kohsan Electronics (Thailand)		RYG	2003	32	0	156
93	Koiwa Bond (Thailand)	PT3	CBR	2004	20	0	17
94	Koryo (Thailand)	AMN	CBR	2001	54	0	
95	K-Tech Industrial (Thailand)	AMC	RYG	2009	300		
96	Lenso Vinyl		CCS	1988	136	100	150
97	Lion Containers	WEL	CCS	1993	40	100	300
98	Lohr Trade and Consulting PTS		CBR	1994	5	51	27
99	Macsys Industries (Thailand)	PT1	CBR	2006	12.5	0	
100	Majend Makcs	AMC	RYG	2002	780		
101	MBJ Advanced Polymers	ESB	RYG	1997	300	0	66
102	Mep Hexa (Thailand)	WEL	CCS	1988	112	0	285

103	Mep Technical Center Asia	AMN	CBR	1997	10	0	9
104	Mi Manufacturing (Thailand)	AMC	RYG	2006	35	0	
105	Minoru (Thailand)	ESB	RYG	2010	260		
106	Mitsuwa Chemical (Thailand)	AMN	CBR	2008	102	0	200
107	Miyasaka Components (Thailand)	ESB	RYG	2004	75	0	80
108	Molymer Polytec (Thailand)	AMN	CBR	2005	38	0	30
109	Mytex Polymers (Thailand)	AMN	CBR	2008	120	0	
110	Nagoya Yuka (Thailand)	AMN	CBR	2002	14	0	45
111	NBC (Asia)	AMN	CBR	1998	220	0	82
112	Ncr-Trb Industry		RYG	1997	110		
113	Nex Coating	ESB	RYG	2013	25	0	
114	Nifco (Thailand)	AMN	CBR	2002	200	0	211
115	Nippon Steel & Sumikin Materials	AMN	CBR	2013	61.25	0	25
116	Nizza Plastcis	AMN	CBR	2005	55	100	
117	Nordic Plastic (Thailand)	ESB	RYG	2007	34.6		
118	Nsw (Thailand)	AMN	CBR	2002	65	0	40
119	Ogawa Asia	AMN	CBR	1995	150	0	330
120	Ohe (Thailand)	PT1	CBR	2011	105	0	65
121	Oizuru (Thailand)	AMN	CBR	2002	26	0	45
122	Oizuru Chugen Packaging System	AMN	CBR	2002	8	100	47
123	Okagawa (Thailand)	ESB	RYG	2010	2	0	
124	Okuda Seiko (Thailand)	PT2	CBR	2011	37.7		
125	Pacific Plastic (Thailand)	MTP	RYG	1993	473	50	38
126	Panjawatana Plastic Public	PT2	CBR	1987	276	100	400
127	Pec Manufacturing (Thailand)	ESB	RYG	2000	300	0	65
128	Phanthong Packaging		CBR	1989	129	100	150
129	Piolax (Thailand)	HES	RYG	2000	750		43
130	Piper Plastics (Thailand)	HES	RYG	2011	7		
131	Plaloc Asia (Thailand)	AMN	CBR	2013	170	0	38
132	Plasess (Thailand)	ESB	RYG	2001	100	0	340
133	Plastech Siam	LCB	CBR		40	100	173
134	Poly Vision Precision Mould (Thailand)		CBR	1999	113.562	29.67	266
135	Polyplex (Thailand) Public	SEI	RYG	2003		0	215
136	Prepack Thailand		RYG	1977	412	72	
137	Peflex Packaging (Thailand)	PT2	CBR	2004	3	0	70
138	Rianthai Interplas	WEL	CCS	1989	230	100	

139	Rianthai Rungruang Plastic		CBR	1991	60	99.5	80
140	Roong Thavorn Plastic	WEL	CCS	1992	180	57	80
141	Roong Thavorn Plastic	GAT	CCS	1992	180	57	
142	Roong Thavorn Surface Technology	GAT	CCS	2004	110	99	
143	Rpt Asia	ESB	RYG	2001	41.64	1	51
144	Rpt Design & Machine	SEI	RYG	2013	21.325		
145	S & S Pattarachard	AMN	CBR	1998			
146	S.A. Precision	AMN	CBR	2002	40	0	420
147	S.D.J. Inter	WEL	CCS	2000	18	51.03	
148	Sab & Oh Thailand	AMN	CBR	2005	37	0	40
149	Sabic Innovative Plastics (Thailand)	ESB	RYG	1999	560	0	83
150	Saha Charoen Metal Plastic	AMC	RYG			0	
151	Saha Sehwa		CBR	1997	145	0	
152	Sakura Tech (Thailand)	ESB	RYG	2003	50	0	
153	Samu Dies (Thailand)	AMN	CBR	2004	101.4	87	
154	Samwon Mould (Thailand)		CBR	2002	80	0	70
155	Sanko Gosei Technology (Thailand)	ESB	RYG	1994	370	0	700
156	Sanko Mold & Plastics (Thailand)	AMC	RYG	2012	33		
157	Sekisui Jushi (Thailand)	AMN	CBR	2004	200	0	180
158	Sekisui Jushi Plametal (Thailand)	AMN	CBR	2013	79	0	
159	Sekisui S-Lec (Thailand)	ESB	RYG	2001	430	0	
160	Senmon Packaging		CBR	2000	7	100	
161	Sheico (Thailand)		RYG		95.75	1	222
162	Shin Heung		CBR	1991	22.64	0	41
163	Shinsei Moulding	PT2	CBR	2007	100	0	15
164	Shiraishi (Thailand)	AMN	CBR	1995	30	0	130
165	Shoki (Thailand)		CBR	2012	32	0	20
166	Siam International Tape	WEL	CCS	2000	25	100	
167	Siam Okaya Chemical	SEI	RYG	1997	50	25.5	74
168	Siam Polyethylene	MTP	RYG				
169	Siam Styrene Monomer	MTP	RYG	1997	3300		56
170	Siam Synthetic Latex	MTP	RYG	1993	325	51	16
171	Soken Chemical Asia	AMN	CBR	2010	500	0	55
172	Son & Arrk Thai		CBR	2006	40	0	100
173	Stithai Superware Public	AMN	CBR		2857	52	
174	Stanbee Asia	AMN	CBR	2004	79	0	

175	Sunplac (Thailand)	AMN	CBR	2005	35	0	
176	Supreme Plastic Insdustry		CBR	1998	15		
177	T & M Manufacturing (Thailand)		CBR	2004	120	0	
178	T.KrungThai Industries Public		CCS	1973	208	100	1000
179	Taisei Plas (Thailand)	HRC	CBR	1997	66	3.5	280
180	Taisho Seiki (Thailand)	AMN	CBR	1999	47	0	130
181	Tamaoka Bangkok Corporation	TGI	CBR	2000	6	51	
182	Tapaco Mold	PT1	CBR	2002	45	90	50
183	Tapaco Public	PT1	CBR	2000	92	4.4	420
184	Techno Tools (Thailand)	AMN	CBR	2005	50	0	53
185	Technoplas Industry (Thailand)	AMN	CBR	2004	250	0	365
186	Technoplast (Thailand)		CBR	2014	3	0.67	
187	Tetra Pak Manufacturing (Tha)	ESB	RYG	1988	100	0	157
188	Tez Industries	HES	RYG	2004	10		
189	Tez Manufacturing	ESB	RYG	2004	5		
190	Thai Ever Plastic		CBR	1998	81	0	108
191	Thai Excell Manufacturing	AMN	CBR	2003	103	0	100
192	Thai Film Industries Public		RYG	1983	1365	99.7	670
193	Thai Fuji Plastics	PT2	CBR	2006	130	0	7
194	Thai Fuji Seiki	AMN	CBR	2001	220	0	170
195	Thai Gci Resitop	MTP	RYG	1990	288	3	288
196	Thai Kamaya		CBR	1989	100	49.7	600
197	Thai Kodama		CCS	1988	150	51.33	90
198	Thai Matto Ns	AMN	CBR	1997	100	0	147
199	Thai Mfc	MTP	RYG	1995	200	90	46
200	Thai Miyama Electric	AMN	CBR	2013	10	0	
201	Thai Newton	AMN	CBR	2011	10	0	44
202	Thai Nissei Lamination		CCS	1992	80	88.62	160
203	Thai Nissin Mold	PT3	CBR		128	0	
204	Thai O.P.P. Public	WEL	CCS	1985	60	100	250
205	Thai Pet Reisin	EIS	RYG	2002	900	20	88
206	Thai Plastic & Chemicals Public	MTP	RYG	1966	730	80	317
207	Thai Polyacetal	PIE	RYG	1995	525	40	85
208	Thai Polycarbonate	PIE	RYG	1996	1000	30	300
209	Thai Polypropylene	MTP	RYG	1994	2400	100	100
210	Thai San Seimitsu Kako Lab	AMN	CBR	2011	72.54	0	

211	Thai Scantube		CBR	1989	20	0	130
212	Thai Seshin E.N.F.		CBR	2001	110	0	200
213	Thai Shinkong Industry	MTP	RYG		1798.3	4.76	113
214	Thai Showa Paxxs	ESB	RYG	1998	190	3	160
215	Thai Starlite Manufacturing		CCS	1988	200	0	450
216	Thai Summit Connector	PT2	CBR	2009	43	100	122
217	Thai Summit ESB Auto Parts Industry	ESB	RYG	2003	700		600
218	Thai Synthetic Rubbers		RYG	1995	1106	0	88
219	Thai Yashima	AMN	CBR	2013	6.7	0	
220	Thaimax Plastics		RYG	1995	34	0	40
221	The Label Tech Asia	AMC	RYG	2002	40		
222	Tokai Plastic Industries	AMN	CBR	2002	15	0	35
223	Tokai-M (Thailand)	HES	RYG	2012	15	0	
224	Top Trend Manufacturing	SIP	CBR	1989	60	100	500
225	Toyo Kako (Thailand)	AMN	CBR	2012	100	0	
226	Toyo Shikisai (Thailand)		CBR			0	
227	Toyoda Gosei (Thailand)	AMN	CBR	1994	400	21.5	175
228	Toyoda Gosei (Thailand)	AMN	CBR		400	21.5	
229	Tpc Paste Resin	MTP	RYG	1998	1753	100	78
230	Tpn Flexpak	WEL	CCS	2001	300	100	312
231	Ts Molymer (Chachoensao)		CCS	2007	10		140
232	Tsuchiya (Thailand)	AMN	CBR	2001	150	0	28
233	Tsuchiyoshi Somboon Coated Sand	ESB	RYG	1995	72	29.38	40
234	Tts Plastic		CCS	1992	50	0	1400
235	Ube Chemicals (Asia)		RYG	1996	228	0	72
236	Ube Fine Chemicals (Asia)		RYG	2011	722	0	
237	Ueda Plastic (Thailand)		CBR	2012	30	30	
238	Umw Auto Parts (Thailand)	ESB	RYG	2003	43	0	
239	Unic Technology (Thailand)	PT1	CBR	1997	218.95	0	100
240	Union Nifco		CCS	1998	40	51	565
241	Universal Polybag	LCB	CBR	2000	303.34	100	269
242	Vandapac	AMN	CBR	1988	200	100	1200
243	Vem (Thailand)	ESB	RYG	2008	60		60
244	Vinythai Public	MTP	RYG	1988	9322	49.03	407
245	Visy Packaging (Thailand)	HES	RYG	2009	497.2		
246	West Glory		CBR	1999	6.3	0	70

247	Wilk & Hoeglund Public	AMC	RYG	1983	150	41.5	150
248	Winbest Industrial (Thailand)	WEL	CCS	1991	21	10	230
249	Xaloy Asia (Thailand)	AMN	CBR	2002	1	0	15
250	Yamakoh Precision (Thailand)	AMN	CBR	2007	40	0	200
251	Yamato-Esulon (Thailand)	WEL	CCS	1994	380	0	800
252	Yida (Thailand)	AMC	RYG	2010	170		
253	Yoshino Moong Pattana (Thailand)	WEL	CCS	1994	125	6	700
254	Yuli Plastic (Thailand)	AMC	RYG	2012	30	0	

Source: Factory Directory in Thailand, IEAT

Automotive Industry

No.		IE	Province	YEAR	Capital (M THB)	Thai %	Employees
1	Aapico Amata	AMN	CBR	2000	800	0	550
2	Aapico Forging Public	AMN	CBR	1993	430	0	132
3	Aapico Structural Products	AMN	CBR	2008	524	100	525
4	Advics Manufacturing (Thailand)	PT3	CBR	2011	740		
5	Aeroklas	IPP	RYG	2002	1800	100	
6	Aeroworks (Asia)	LCB	CBR	2000	21	0	116
7	Ah Creation	AMN	CBR	2010	50		
8	Aichi International (Thailand)	PT2	CBR	2002	240	0	
9	Air Systems (Thailand)	PT3	CBR	2012	65	0	120
10	Aisin Ai (Thailand)	WEL	CCS	2002	783.6	0	1030
11	Aisin Chemical (Thailand)		RYG	2000	247.3	0	70
12	Aisin Takaoka Asia	AMN	CBR	1997	100	0	124
13	Aisin Takaoka Foundry Bangpakong	AMN	CBR	2001	475	29.9	735
14	Akebono Brake (Thailand)	AMN	CBR	2006	610	0	347
15	Akita Fb (Thailand)		CCS	2012	10	0	

16	American Axle & Manufacturing (Thailand	HES	RYG	2008	1000	0	195
17	Anden (Thailand)	AMN	CBR	2002	366.88	0	184
18	Aoyama Thai	ESB	RYG	1965	128	0	800
19	Apc (Thailand)	AMN	CBR	2004	50	39	
20	Arvin Meritor (Thailand)	ESB	RYG	1997		0	
21	Asahi Tec Aluminium (Thailand)	AMN	CBR	1989	1480	1	
22	Ashimori (Thailand)	WEL	CCS	1998	390	0	1200
23	Asia Wheel (Thailand)	AMC	RYG	2011	142		
24	Astac Asia (Thailand)	AMN	CBR	2013	30	0	
25	Asuto Global Logistics (Thailand)	AMN	CBR	2013	2		
26	Atsumitec (Thailand)	SEI	RYG	1994	180	41	818
27	Auto Advance Material Mfg.	LCB	CBR		30		219
28	Auto Alliance (Thailand)	ESI	RYG	1995	5000	10	2000
29	Auto Metal	AMN	CBR	2004	140	60	
30	Autoliv	AMN	CBR	1995	260	0.01	200
31	Aw (Thailand)	HES	CBR	2015	2000	0	
32	Bangkok Komatsu	AMN	CBR	1995	620	25.16	364
33	Bangkok Nagatsu	AMN	CBR	2008	100	0	
34	Basf Chemcat	ESI	RYG	1997	185	0	72
35	Beishin Thai	AMC	RYG	2011	4	50.95	
36	Benda (Thailand)	AMC	RYG	2013	200	0	
37	Bhkt	ESI	RYG	2012	15	0	
38	Billtech Automotive	HES	RYG	2011	420		258
39	Bmw Manufacturing (Thailand)	AMC	RYG	1998	810	0	
40	Bolwell Holdings (Thailand)	HES	RYG	2006	20	0	
41	Bosch Automotive (Thailand)	AMC	RYG	1996	267.5		575
42	Bosch Chassis Systems (Thailand)	ESI	RYG		99	0	12
43	Boshoku Automotive (Thailand)	ESI	RYG	2013	331	10	
44	Calsonic Kansei (Thailand)	AMN	CBR	2001	400	0	120
45	Cataler (Thailand)	ESI	RYG	1996	500	0.8	240
46	Central Motor Wheel (Thailand)	WEL	CCS	2009	492	18.5	550
47	Chalybs Cylinders	ESI	RYG	2009	775	30	
48	Chatree Blow (Thailand)	PT1	CBR	2011	10		
49	Cherry Serina	AMN	CBR	1973	90	51	178
50	Chikuma (Thailand)	HES	RYG	2012	75	0	

51	Chuhatsu (Thailand)		RYG	1996	125	4	510
52	Chuhatsu (Thailand)		RYG	1996	125	4	510
53	Cimc Vehicle (Thailand)	AMC	RYG	2007	260	0	
54	Cnk Manufacturing (Thailand)	ESI	RYG	2003	255	0	19
55	Cobra Advanced Composites	AMN	CBR	2006	267		
56	Cobra Engineering	AMN	CBR	2000	60	100	
57	Composite Marine International	AMN	CBR	2005	300		
58	Concordia Yachting		RYG	1999	100	5	150
59	Daito Lang Mirror	PT3	CBR	2012	93	0	28
60	Daiwa Harness (Thailand)	AMN	CBR	2008	70	0	
61	Dana Spicer (Thailand)	ESB	RYG	1992	1084	0	
62	Delloyd Industries (Thailand)	ESB	RYG	2006	100		
63	Delphi Automotive Systems (Thailand)	ESB	RYG	1997	509	0	19
64	Delta Thairung	AMC	RYG	2007	300	0	76
65	Denso (Thailand)	WEL	CCS	2004	200	56	1112
66	Denso (Thailand)	AMN	CBR	1995	200	56	1112
67	Distar Electric Public		RYG	1982	600	65.1	150
68	Ducati Motor (Thailand)	AMC	RYG	2010	220		

69	Dyna Metal	WEL	CCS	1973	200	50	360
70	Ekk Eagle (Thailand)	AMN	CBR	2009	200	0	
71	Endo Forging (Thailand)	GAT	CCS	1996	270	0	
72	Enshu Molding Products (Thailand)	AMN	CBR	2007	94.4	0	70
73	Exedy (Thailand)	AMN	CBR	1994	100	33	525
74	Exedy Engineering Asia	AMN	CBR	2013	80	0	20
75	Exedy Friction Material	AMN	CBR	1997	316	8.23	477
76	Ezaki Industrial (Thailand)	AMN	CBR	2007	40	0	30
77	Faltec Srg Global (Thailand)	GAT	CCS	2010	662.7	0	
78	Faurecia Emissions Control Technologies	ESI	RYG	2013	300		
79	Fcc (Thailand)	AMN	CBR		60	51	
80	Flomax Filtration	AMC	RYG	2002	250	100	200

81	Fmp Group (Thailand)	ESI	RYG	1998	250	0	75
82	Fuji Technical Industrial		CBR	2004	5		
83	Fujino (Thailand)	HES	RYG	2013	30	0	
84	Fukui Byoba (Thailand)	AMC	RYG	2013	80	0	
85	Fukuju Industry (Thailand)	HES	RYG	2013	230	0	
86	Furukawa Automotive Systems	PT1	CBR	2006	154	0	36
87	G.S. Electech (Thailand)	AMN	CBR	2003	49	0	60
88	Gates Unitta (Thailand)	ESI	RYG	2002	605	0	130
89	General Motors (Thailand)	ESI	RYG	1997	6450	0	200
90	Getriebe-Schaefer (Thailand)	ESI	RYG	2001	11.75	0	7
91	Gkn Driveline (Thailand)	ESI	RYG	1997	325	0	106
92	Goto Plastic (Thailand)	AMN	CBR	2010	82		
93	G-Tekt Eastern	ESI	RYG	1996	507.4	0	280
94	Gunma Seiko (Thailand)	PT3	CBR	2013	58	0	21
95	Hal Aluminum (Thailand)	HES	CBR	2013	700	0	
96	Halla Climate Control (Thailand)	ESI	RYG	1996	270	0	200
97	Hanil Forging (Thailand)	ESI	RYG	2007	276.83	0	
98	Hayashi Telempu (Thailand)	AMN	CBR	1994	370	0	420
99	Hicom automotive Plastics (Thailand)	ESI	RYG	2002	488	0	55
100	Hino Motors Manufacturing (Thailand)	AMN	CBR	2004	2500	0	348
101	Hino Powertrain Manufacturing (Thailand)	AMN	CBR	2011	180		
102	Hirooka (Thailand)		CCS	2011	60	0	
103	Hirosei (Thailand)	ESB	CBR	2013	327	0	
104	Hirotec Manufacturing (Thailand)	ESI	RYG	2012	444	0	16

105	Hiruta & Summmit	PT2	CBR	2009	280	0	550
106	Hitachi Automotive Systems Asia	GAT	CCS	1995	517	0	505
107	Hitachi Automotive Systems Chonburi	AMN	CBR	1994	100	66.7	166
108	Hitachi Chemical Asia (Thailand)	GAT	CCS	2010	2180	0	
109	Hitachi Chemical Asia (Thailand)	GAT	CCS	2010	2180	0	
110	Hitachi Metals	AMN	CBR	2004	518.7	0	217
111	Honda Lock Thai	AMN	CBR	1996	160	5	550
112	H-One Parts Sriracha	PT1	CBR	2010	1200	0	390
113	Hori Glass (Thailand)	ESI	RYG	2008	40	0	
114	Hosei Brake (Thailand)	AMC	RYG	2014	324	0	
115	Howa (Thailand)	AMN	CBR	2010	300		
116	Iac Manufacturing (Thailand)	PT1	CBR	2006	54		30
117	Ichikoh Industries (Thailand)	AMC	RYG	2008	960	0	
118	Inergy Automotive Systems (Thailand)	ESI	RYG	1999	650	0	180
119	Inoac Automotive (Thailand)	AMN	CBR	2003	270	0	800
120	Interpart Industries (Thailand)	AMC	RYG	2007	20		
121	Ishimitsu Industry (Thailand)	PT2	CBR	2012	40	0	
122	Isi Automotive (Thailand)		CBR	2011	28.7	0	
123	Isuzu Motors (Thailand)	GAT	CCS	1966	300	0	422
124	Itoh Seiko (Thailand)	AMN	CBR	2011	160		
125	Iwai Manufacturing (Thailand)	GAT	CCS	2012	70	0	
126	Iwct	GAT	CCS		402.9		222
127	J. Filter	AMN	CBR	2012	160	5	69
128	J.V. (Thailand)	AMN	CBR	2002	20.41		60
129	Japan Work System (Thailand)	AMN	CBR	2012	76	0	
130	Jatco (Thailand)	AMN	CBR	2012	4500	0	
131	Jfe Container (Thailand)	ESI	RYG	2014	20	0	
132	Jibuhin (Thailand)	AMN	CBR	1990	345	13.74	530
133	Johonson Controls & Summit Interiors	HES	RYG	1999	245.9		
134	Jtekt (Thailand)		CCS	1966	2772.6	3.79	1728
135	Jtekt Automotive (Thailand)	ESI	RYG	1996	620	5	1037
136	K2 Allied Component	ESI	RYG	2013	25	0	
137	Kanpatsu (Thailand)	AMN	CBR	2002	54.17	0	160
138	Kawasaki Motors Enterprise (Thailand)		RYG	1997	1900	0	1539
139	Khitkan	GK	RYG	1997	546.6	0	69
140	Kiriu Thailand	HES	RYG	2006	1360	5	550

141	Kobatech (Thailand)	PT1	CBR	2002	200	0	351
142	Kodaka	AMC	RYG	2013	40	0	
143	Kokusan Parts (Thailand)	PT2	CBR	2007	57	0	147
144	Komatsu Seiki (Thailand)	HES	RYG	2002	140	0	750
145	Kondo Jig (Thailand)	AMN	CBR	2013	7.5	0	
146	Konsei (Thailand)	AMN	CBR	1996	60	13.67	343
147	Kosen Fibertec (Thailand)	PT1	CBR	2003	100	0	
148	Kotobukiya Feltol (Thailand)		CBR	2005	150	45	
149	Koyo Joint (Thailand)		CCS	2002	520	51	143
150	Kpn Sakaguchi	AMN	CBR	1997	25	10	96
151	Kyb (Thailand)	AMN	CBR	1996	200	51	400
152	Kyb Steering (Thailand)	AMN	CBR	1996	150	0	85
153	Kyokuyo Industrial (Thailand)	AMN	CBR	2002	350	0	750
154	Kyoritsu Seiki (Thailand)	PT1	CBR	2011	100	0	
155	Kyowa Casting (Thailand)	HES	RYG	2011	150		
156	Kyowa Precision (Thailand)	AMN	CBR	2012	19	0	
157	Lear Automotive (Thailand)	ESI	RYG	1998	312.5		115
158	Lifan Manufacture (Thailand)	AMC	RYG	2009	51	0	
159	Linex International (Thailand)	AMN	CBR	1996	12.2	51	
160	Lucas Varity (Thailand)	ESI	RYG	1999	450	0	160
161	M&K Precision (Thailand)	HES	RYG	2011	54	0	
162	M&T Allied Technologies	ESB	RYG	2002	370	2.5	99
163	Magna Automotive (Thailand)	AMN	CBR	2009	90		
164	Mann&Hummel (Thailand)	HES	RYG				
165	Marui Sum (Thailand)		CCS	1994	12	51	54
166	Marutech (Thailand)	PT1	CBR	2012	5	0	8
167	Maruyasu Industries (Thailand)	ESB	RYG	1997	303	0	470
168	Matsuda Denki (Thailand)	AMC	RYG	2012	260	0	96
169	Matsui Eastern (Thailand)	ESB	RYG	2003	100	0	100
170	Matsumoto Kosan (Thailand)	PT1	CBR	2012	78	0	50
171	Mazda Powertrain Manufacturing	ESB	CBR	2013	6567	0	
172	Mc Metal Service Asia	AMN	CBR	1997	430	0	170
173	Mc Metal Service Asia	AMN	CBR	2014	430	0	170
174	Mermaid Maritime	LCB	CBR	1982	50	70	150
175	Mie Seiki (Thailand)	PT1	CBR	2011	100	0	27
176	Misawa (Thailand)	AMN	CBR	2000	3.6		

177	Mitoyo Rubber (Thailand)	AMN	CBR	2012	50	0	
178	Mitsubishi Electric Thai Auto-Parts	SEI	RYG	1996	400	0	800
179	Mitsubishi Motors (Thailand)	LCB	CBR	1987	7000	0	4000
180	Mitsubishi Turbocharger Asia	AMN	CBR	2008	5128		
181	Mitsui Kinzoku Catalysts		RYG	2013	300		
182	Mitsui Siam Components	SEI	RYG	1995	210	10	1510
183	Miyaki (Thailand)	AMC	RYG	2012	80	0	
184	Miyama Industry (Thailand)	AMN	CBR	2008	200	0	
185	Miyama Precision (Thailand)	PT3	CBR	2013	100	0	
186	Mizuki (Thailand)	HES	RYG	2012	100	0	
187	Mk Kashiyama (Thailand)	HES	RYG	2012	80	0	25
188	Mmth Engine	LCB	CBR	1988	20	0	560
189	Molten Asia Polymer Products	SRC	CBR	1994	120	39	246
190	Moriroku Technology (Thailand)	PT1	CBR	2010	250		
191	Nadaka Precision (Thailand)		CCS	2011	35	0	
192	Nakagawa Sangyo (Thailand)	ESI	RYG	2003	170	0	180
193	Nakagawa-Apm (Thailand)	AMC	RYG	2007	20	0	110
194	Nakamura Precision (Thailand)	ESI	RYG	2014	73.4	0	
195	Narumi (Thailand)	HES	RYG	2010	200	0	100
196	Nation Tech Enterprise		CBR	2009	7.7		68
197	Nemoto Works (Thailand)	ESI	RYG	2013	10	0	9
198	New Thai Wheel Manufacturing	AMC	RYG	2010	500	0	
199	Ngk Spark Plugs (Thailand)	AMN	CBR	2005	450	0	
200	Nhk Spring (Thailand)	WEL	CCS	1963	410	4.69	1465
201	Nhk Spring (Thailand)	ESB	RYG	1963	410	4.69	1317
202	Nhk Spring (Thailand)		CCS	1963	410	4.69	198
203	Nichias (Thailand)	WEL	CCS	1997	15		115
204	Nichidai (Tahiland)	AMN	CBR	2009	333	0	
205	Nichidai Asia	AMN	CBR	2008	4.5	0	
206	Nichiyu Forklift (Thailand)	AMC	RYG	2011	445		
207	Nidec Eyesys (Thailand)	AMN	CBR	2011	339	0	24
208	Nihon Parts (Thailand)	PT1	CBR	2011	100	20	
209	Nihon Plast (Thailand)	AMC	RYG	2004	230	0	64
210	Nihon-Isued (Thailand)	AMN	CBR	2010	27.4	0	
211	Nikki Fron (Thailand)	AMN	CBR	2010	35.6	0	60
212	Nippa (Thailand)	PT3	CBR	2011	220	0	

213	Nisshinbo Commercial Vehicle Brake	ESB	RYG	2013	270	0	
214	Nisshinbo Somboon Automotive	ESB	RYG	1996	732	2.9	220
215	Nisshinbo Somboon Automotive	HES	RYG	2013	732	2.9	
216	Nisshin Kiko (Thailand)	SEI	RYG	2012	15	0	
217	Nisshin Manufacturing (Thailand)	AMC	RYG	2003	175		430
218	Nitigura (Thailand)		CBR	2001	20	0	16
219	Nittan (Thailand)	AMN	CBR	1997	100	41.5	179
220	Nitto Matex (Thailand)	AMN	CBR	2001	973	0	261
221	Nsk Bearings Manufacturing (Thailand)	AMN	CBR	2001	650	25.1	830
222	Nt Seimitsu (Thailand)	ESI	RYG	2002	205.55	0	69
223	Ntpt	PT1	CBR	2012	700	0	
224	O-Cast Thai	PT2	CBR	2004	122.2		
225	Off Road Accessories	ESB	RYG	2005	370	0	130
226	Ogura Cluch (Thailand)	AMC	RYG	2008	300		
227	Ogusu (Thailand)	PT2	CBR	2010	500	0	200
228	Ohkuma Ind. (Thailand)	PT1	CBR	2011	50	0	
229	Ohlins Asia	AMN	CBR	2012	25	0	
230	Ohmi (Thailand)	AMC	RYG	2011	30	0	
231	Oiles (Thailand)	AMC	RYG	2002	72	19	
232	Ondo Shinsho (Thailand)		RYG	2013	600	0	
233	Otics (Thailand)	AMC	RYG	2012	200	0	
234	Oyt	ESB	RYG	2007	100	0	99
235	Pacific Autoparts (Thailand)	WEL	CCS	2014	220	25	
236	Pacific Industries (Thailand)	WEL	CCS	1989	360	25	200
237	Pbr Automotive (Thailand)	ESB	RYG	1998	80	0	25
238	Phoenix Sj (Thailand)		CBR	2006	112.3	0	120
239	Prixcar Services (Thailand)	ESB	RYG	2002	2		
240	Pullthana Part&Mold	WEL	CCS	1995	15	100	
241	Riken Technology (Thailand)	AMN	CBR	2012	64	0	
242	Rivatec (Thailand)	PT1	CBR	2012	40	0	25
243	Roki (Thailand)	SEI	RYG	1995	100	43.25	77
244	S.K.Auto Interior	GAT	CCS	1996	90	80	89
245	S.P.Shimada Works		CBR	2012	40	51	
246	Saic Motor-Cp	HCI	CBR	2013	2494	49	500
247	Sakura Industry (Thailand)	HCI	CBR	2013	250	25	
248	Samtech (Thailand)	PT3	CBR	2011	340	0	60

249	San-en (Thailand)	AMN	CBR	2011	35	0	30
250	Sango Thai Automotive Parts		CCS	2013	110		250
251	Sania (Thailand)	TFD	CCS	2011	20		
252	Sanko Kiki (Thailand)		CBR	2003	20		
253	Sanoh Industries (Thailand)		RYG	2000	146.25	20	65
254	Sanyo Engineering (Thailand)	ESB	RYG	2013	9.6	0	
255	Schaeffler Manufacturing (Thailand)	AMC	RYG	2011	82		
256	Sei Thai Electric Conductor	AMC	RYG	2012	1710	0	
257	Seimitsu Thai	ESB	RYG	2002	360	0	359
258	Senior Aerospace (Thailand)	PT1	CBR	2005	40.5	2	143
259	Senko Global Logistics (Thailand)	PT2	CBR	2014	182	51	
260	Serenity Shipyard		CBR	2001	15	0.01	35
261	Sew Eurodrive (Thailand)	AMN	CBR	1997	130	0	32
262	Shigeru (Thailand)		RYG	2007	20	0	10
263	Shimizu Metal Stamping	PT3	CBR	2013	55	0	
264	Shin Yama (Thailand)		CBR	2005	4.8	67.5	70
265	Shinba Iron Works (Thailand)	AMN	CBR	2008	250		
266	Shinsei Kogyo (Thailand)		CBR	2002	80	48	286
267	Shinsei Koki (Thailand)	HCI	CBR	2014	100	0	
268	Shinwa Motor Parts	PT2	CBR	2012	40	0	
269	Shiroki Corporation (Thailand)	AMN	CBR	2002	374	0	33
270	Showa Autoparts (Thailand)	PT2	CBR	2006	800	24	345
271	Showa Regional Center (Thailand)	AMN	CBR	2009	52.5	0	51
272	Shun Gin Technology (Thailand)		CBR	2004	104.11	0	78
273	Siam Adler	LCB	CBR	1994	80	50	50
274	Siam Akebono	PT2	CBR	2012	80		
275	Siam Calsonic	AMN	CBR	1996	189	51	
276	Siam Chuyo	HES	RYG	2002	135	0	150
277	Siam Fukazawa		CBR	2012	12	0	22
278	Siam Kochi		CBR	2007	10		
279	Siam Kyosan Denso	AMN	CBR	2003	338	30	505
280	Siam Mabuchi	AMN	CBR	2003	20		
281	Siam Ndk	AMN	CBR	2003	27	0	1200
282	Siam Ngk Spark Plug	AMN	CBR	1977	10	24	330
283	Siam Nsk Steering Systems	WEL	CCS	1996	190	50	107
284	Siam Riken Industrial	AMN	CBR	1973	33	51	780

285	Siam Sanyokiki	AMN	CBR	2008	25	0	
286	Siam Taisei Industry	PT1	CBR	2010	10	0	
287	Siam Toyota Manufacturing	AMN	CBR	1987	850	4	4300
288	Smr Automotive System	HES	RYG	2010	530		
289	Snc Sound Proof	AMN	CBR	1994	50	51	70
290	Sparktek	AMN	CBR	2013	1040	0	
291	Sriracha Aviation	SHP	CBR	2000	55	100	
292	Srn Sound Proof	AMN	CBR	1994	100	40	310
293	Ssm Automation		RYG	2011	1100		
294	Stars Technologies Industrial	ESB	RYG	2003	1200	0	750
295	Sumiden Hyosung Steel Cord	AMC	RYG	2011	1130	0	400
296	Sumino Aapico (Thailand)	AMN	CBR	2013	200	49	
297	Sumitomo Electric Sintered Components	AMN	CBR	1998	500	60	120
298	Summit Ansei Auto Parts	LCB	CBR	1997	60	50	90
299	Summit Auto Body Industry	ESB	RYG				
300	Summit Auto Body Industry	LCB	CBR				
301	Summit Fujikiko Kurata Manufacturing	ESB	RYG	2006	315	46.16	200
302	Summit Hirotani Sugihara	HES	RYG	2013	155	60	
303	Summit Keylex (Thailand)	HES	CBR	2013	770	49	
304	Summit Kurata Manufacturing	LCB	CBR	1996	90	49	150
305	Summit Laemchabang Auto Body Work	LCB	CBR		150	100	615
306	Summit Laemchabang Auto Body Work	ESB	RYG		150	100	615
307	Summit Laemchabang Auto Body Work	LCB	CBR	1994	150	100	700
308	Summit Otsuka Manufacturing	AMN	CBR	2004	60	49	
309	Summit Showa Manufacturing	LCB	CBR	1994	80	51	196
310	Summit Whetron Electronics	AMN	CBR	2002	72	51	150
311	Summit Automotive	AMN	CBR	2004	18	0	
312	Sunchirin Industry (Thailand)	AMN	CBR	1999	130	0	176
313	Suzuki Motor (Thailand)	HES	RYG	2011	5682	0	
314	Synergy W Precision	AMN	CBR	2013	108	0	
315	Sysmak	PT2	CBR	2007	30	0	30
316	T.I.T. International		RYG	1999	350.78	0	200
317	T.S.K. Forging	AMN	CBR	1997	424.9	0	360
318	T.S.K. Forging	AMN	CBR		160	0	
319	Tada Press (Thailand)	AMC	RYG	2011	57		
320	Taiyo Giken (Thailand)	RIP	RYG	1996	80	0	400

321	Taiyo Giken (Thailand)	AMN	CBR		80	0	
322	Taiyo Packing (Thailand)	AMN	CBR	2014	60		
323	Takata-Toa	WEL	CCS	1994	200	10	1200
324	Takebe (Thailand)	AMN	CBR	2005	365	0	870
325	Takeda Industry (Thailand)	HES	RYG	2012	250	0	
326	Tanchong Industrial Services	WEL	CCS	1997	12	51.03	
327	Tanchong Industrial Services	WEL	CCS	1997	12	0	
328	Tbkk (Thailand)	AMN	CBR	1990	205	8.5	
329	Tachnomeiji Rubber (Thailand)	AMN	CBR	2003	105	5	
330	Temco Autoparts	GAT	CCS	2005	14	0	30
331	Tenneco Automotive (Thailand)	AMN	CBR	2000	142	0	66
332	Tfo Tech (Thailand)	AMN	CBR	2003	300	0	150
333	Thai Arrow Products		CCS	1963	570	10	
334	Thai Asahi Denso	GK	RYG	1997	75	51	233
335	Thai Auto Pressparts	AMC	RYG	2001	400		
336	Thai Beyonz	AMC	RYG	2012	400	0	100
337	Thai Delica	PT2	CBR	2008	30	0	
338	Thai Forging Parts	AMN	CBR	2008	120		
339	Thai Ikeda Mfg	PT1	CBR	1995	100	0	140
340	Thai Kjk	PT2	CBR	2010	215	0	
341	Thai Metaltech	AMC	RYG	2011	150	0	
342	Thai Mihara	PT1	CBR	2010	17	0	60
343	Thai Miyake Forging	AMC	RYG	2013	200	0	41
344	Thai Motor Chain	AMC	RYG	2001	275	100	143
345	Thai Nippon Seiki	AMN	CBR	1995	406.5	6.15	1120
346	Thai Precision Products	AMN	CBR	2013	200	0	
347	Thai Rebirth	PT1	CBR	2010	130		
348	Thai Sankyo	PT1	CBR	2011	10	0	
349	Thai Sanwa	AMN	CBR	2014	80		
350	Thai Seat Belt	AMN	CBR	1994	60	34	530
351	Thai Shizuka Accessory	PT1	CBR	2002	15	0	36
352	Thai Steel Cable	AMN	CBR	1978	268.5	73	1300
353	Thai Summit Engineering		CBR	1988	258.5		15
354	Thai Summit Engineering	HES	RYG		258.5		7
355	Thai Summit Harness Public	LCB	CBR	1993	50	100	900
356	Thai Summit Laemchabang Autoparts	LCB	CBR	1994	60	100	80

357	Thai Summit Meiji Forging	ESB	RYG	2010	600	55	
358	Thai Summit Mitsuba Electric	HES	RYG	1993	100	51	300
359	Thai Summit Pk Corporation	ESB	RYG	1989	150	50	350
360	Thai Summit Pkk Bangpakong	AMN	CBR	1996	100		120
361	Thai Summit Pkk	LCB	CBR	1994	300	50	560
362	Thai Summit Rayong Autoparts Industry	ESB	RYG	2010	750	100	
363	Thai Tazm Trading	PT1	CBR	2011	2	51	
364	Thai Tonex	PT2	CBR	2008	45		
365	Thai-Ishe Automotive Rubber Craft	AMN	CBR				
366	Thk Rhythm (Thailand)	ESB	RYG	2007	350	0	40
367	Ti Automotive Roh (Thailand)	AMN	CBR			0	
368	Toacs (Thailand)	AMN	CBR	1994	400		120
369	Togo Seisakusyo (Thailand)	ESB	RYG	2002	100.5	0	133
370	Tohoku Manufacturing (Thailand)	PT1	CBR	2011	280	0	
371	Tokai Rika (Thailand)	AMC	RYG	1997	340	0	1500
372	Tokai Trim (Thailand)	PT2	CBR	2012	2	0	250
373	Tokai Roki (Thailand)	AMN	CBR	2010	303	0	111
374	Tokai Roki (Thailand)	GAT	CCS	2010	303	0	111
375	Tong Na Mnufacturing Corporation	AMC	RYG	2003	36		
376	Topura (Thailand)	HES	RYG	2012	421.3	0	
377	Toshima (Thailand)	PT1	CBR	2012	100	10	
378	TACT	ESB	CBR	2013	376.9	0	32
379	Toyoda Gosei Asia	AMN	CBR	2001	824	0	132
380	Toyota Boshoku Asia	GAT	CCS	2001	69.3	0	6
381	Toyota Boshoku Gateway	GAT	CCS	1997	250	0	600
382	Toyota Boshoku Siam Metal	AMN	CBR	2002	350	0	480
383	Toyota Motor Thailand		CCS	1962	7520	52	13500
384	Toyota Motor Thailand	GAT	CCS	1962	7520	52	13500
385	Toyota Tsusho Forklift	AMN	CBR	2008	370	51	
386	Toyotomi Auto Parts (Thailand)	TFD	CCS	2011	1250	20	265
387	Toyu Industries (Thailand)	ESB	RYG	2012	40	0	
388	Trex Thairung	AMC	RYG	2014	300	55	
389	Trimotive Asia Pacific	AMN	CBR	2005	31.8		
390	Tris (Thailand)	RIP	RYG	1996	55	0	52
391	Triumph Motorcycles (Thailand)	AMN	CBR	2001	1175	0	
392	Triumph Structures (Thailand)	AMC	RYG	2009	298.5	0	

393	Trw Fuji Serina	AMN	CBR	1979	309.4		195
394	Trw Steering&Suspension	ESB	RYG	1998	450	0	160
395	Ts Vehicle Tech	WEL	CCS	2003	37	100	
396	Tsubaki E&M (Thailand)	AMN	CBR	2011	35	0	12
397	Tsubakimoto Automotive (Thailand)	AMN	CBR	2002	100	0	138
398	TT Assembly (Thailand)	GAT	CCS	2004	40	51	
399	TT Assembly (Thailand)		CCS	2004	40	51	
400	TT Assembly East	HES	RYG	2011	17	51	
401	Ty Optics (Thailand)	WEL	CCS	2014	160	14	
402	Uchimura (Thailand)	AMN	CBR	2001	68		
403	Union Autoparts Manufacturing	SEI	RYG	1982	300	2	700
404	United Auto	GAT	CCS	2006	200	100	
405	Unithai Shipyard and Engineering		CBR	1990	1680	51	800
406	Unithai-Solid Coating		CBR	2001	35	20	102
407	Unity Industrial	SCR	RYG	1997	1000	10	470
408	Univance	PT2	CBR	2011	142	0	100
409	U-Shin (Thailand)		RYG	2000	1419	0	
410	Usui International (Thailand)	AMN	CBR	2000	123	0	1100
411	Valeo automotive (Thailand)		RYG	1996	490	6.12	
412	Valeo Compressor (Thailand)	ESI	RYG	1996	100	40	106
413	Valeo Compressor Clutch (Thailand)	ESI	RYG	1996	480		
414	Valeo Niles (Thailand)	AMN	CBR	1997	280	0	150
415	Valeo Siam Thermal Systems	AMN	CBR	1974	150	61	234
416	Valqua Industries (Thailand)	MTP	RYG	1989	126.8	4.2	120
417	Vantech M.F.		CBR	2007	10	0	
418	Visteon Automotive Electronics	HES	RYG	2013	105	0	22
419	Walbro (Thailand)	AMN	CBR	2002	17		
420	Walker Exaust (Thailand)	AMN	CBR	2001	80		
421	Yahagi (Thailand)	AMN	CBR	2003	100	0	26
422	Yamada Somboon	SEI	RYG	1994	150	27	630
423	Ypmt	AMN	CBR	1990	490	0	418
424	Yamasei thai	ESI	RYG	1996	70	0	400
425	Yamato Eastern	PT2	CBR	2010	100		
426	Yamato Filter (Thailand)	PT2	CBR	2010	97	0	
427	Yanagawa Techno Forge (Thailand)	ESI	RYG	1989	182	26	398
428	Yanfeng (Thailand)	AMC	RYG	2013	30	0	

429	Yarnapund Daiso (Thailand)	AMN	CBR	2004	20	30	25
430	Yasufuku Polymers (Thailand)	AMN	CBR	2012	30	0	
431	Yasunaga (Thailand)	AMC	RYG	2012	300	0	140
432	Y-Ogura Automotive (Thailand)	HES	RYG	2012	1400	0	
433	Yokoyama Kogyo (Thailand)	HES	RYG	2012	263	0	160
434	Yorozu (Thailand)	ESI	RYG	1996	1800	0	650
435	YorozuEngineering Systems	ESI	RYG	2002	65	0	61
436	Yuan Sin Wasadu Kosang Utsahakam		CBR		100	51	62
437	Yuasa Sato (Thailand)	AMC	RYG	2013	140	0	22
438	Zf Lemforder (Thailand)	ESI	RYG	2002	12	0	30
439	Zongshen Machenery Manufacturing	AMC	RYG				
440	Tokai Tekko (Thailand)	AMN	CBR	2012	40	0	

Source: Factory Directory in Thailand, IEAT

APPENDIX E: FACTORIES IN RELEVANT SUPPLY-CHAINS

Petrochemical Industry (in PTT, SCG Supply-chain)

No	Name	PTT	SCG	Others	PTT (%)	SCG (%)	Function	IE	Capital	YEAR
1	PTTGC	■			48.89	1.49	U/I/D	MTP	29636	2007
2	PTTPE	■			100%		U	MTP		
3	IRPC	■			38.5		U/I/D	(Maptaphut)	13000	1978
4	MOC		■			67%	U	(Maptaphut)		
5	ROC		■			64%	U	(Maptaphut)	17	
6	TPX	■			100%		U			
7	HMC	■			41%		U/D	MTP	800	1983
8	SPRC			CHEVRON	5.41		U	MTP	13000	1992
9	BST		■			45%	U/D	MTP	1173	1994
10	EXXONMOBIL			■			U	(MUANG)		
11	TOC GLYCOL	■			100%		I	ESI		
12	TPC		■			91%	I/D	MTP	730	1966
13	Vinythai	■			24.98%		I/D	MTP	9322	1988
14	MTP HPPO		■		??	??	I	ASI		
15	Aditya Birla			■			I/D	MTP	1700	1992
16	Advance Biochemical	■			24.98%		I	MTP		
17	PTT Asahi	■			48.50%		I	(Huaypong)		
18	Thai MMA		■			47%	I/D	MTP	1300	1997
19	SSMC		■			50%	I			
20	PTT Phenol	■			100%		I	(Maptaphut)		
21	Indorama			■			I/D	ASI	4727	2003
22	Siam Mistui		■		??	??	I	ESI	2800	1995
23	TPT			■			I	MTP	15000	1991
24	Continental Petrochemical			■			I/D	BLE	540	1987
25	Bayer			■			I/D	MTP	7411	1992

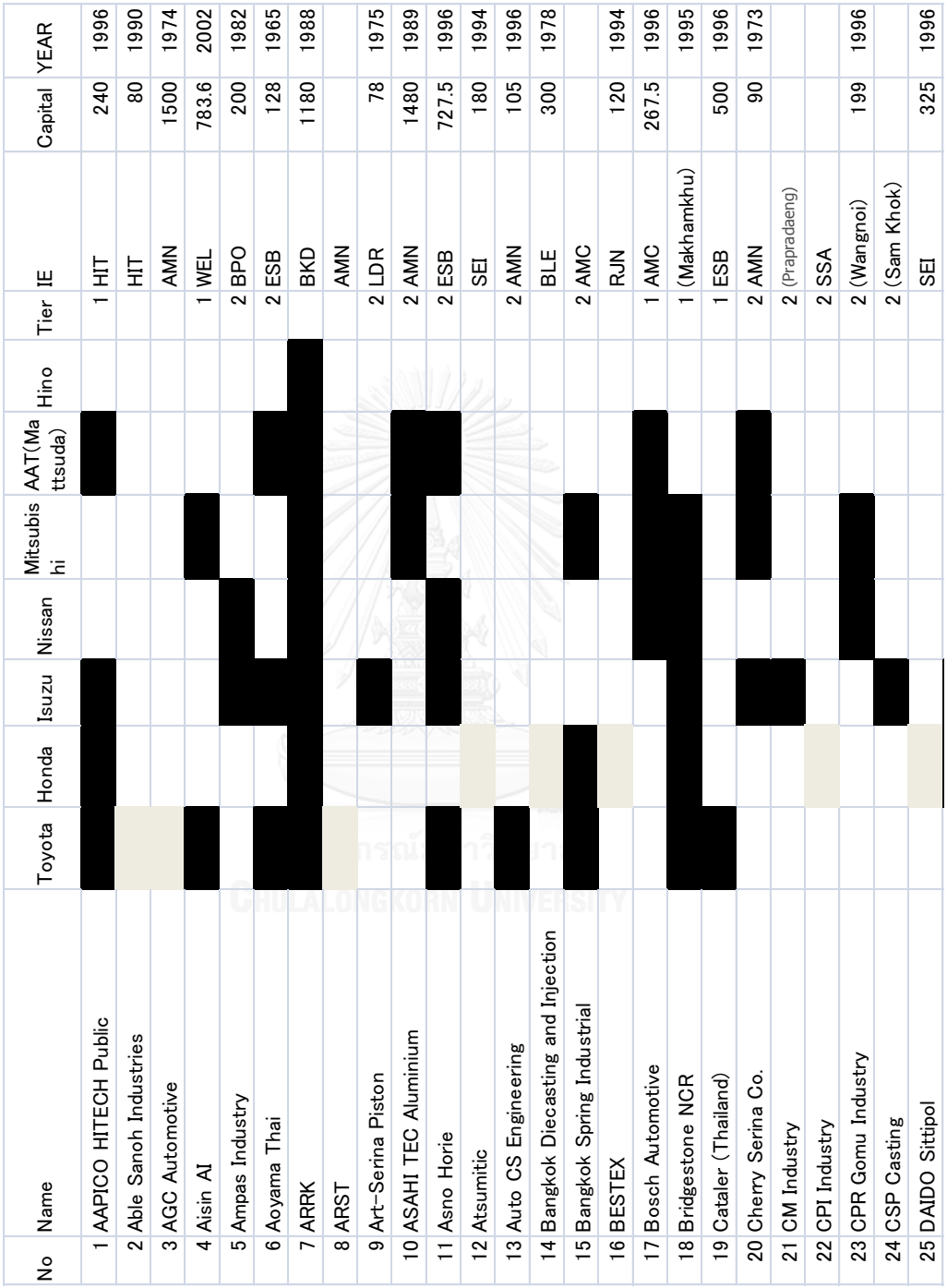
26	UBE Chemical			[redacted]			I	(MUANG)	722	2011
27	BPE	[redacted]			100%		D	MTP	3000	1994
28	TPE		[redacted]			100%	D	MTP	1100	1990
29	SPE		[redacted]			50%	D	MTP	3300	
30	SSLC		[redacted]			50%	D	MTP	325	1993
31	TPI Polene			[redacted]			D	(MUANG)		
32	TPC Paste Resin		[redacted]			91%	D	MTP	1753	1998
33	TPP		[redacted]		??	??	D	MTP	2400	1994
34	Cytec						D	ESI	1241	
35	Diforce Chemel			[redacted]			D			
36	Siam Chemical			[redacted]			D	BPO	120	1974
37	Thai Mitsui Speciality Chemical			[redacted]			D	WEL	318	1997
38	Thai Polyset			[redacted]			D	BPO	30	1994
39	Thai Urethane			[redacted]			D	(Bangsaothong)	100	1985
40	TOA Chemical			[redacted]			D			
41	Thai Acrylic Fibre			[redacted]			D	(Kaengkhoi)		
42	Thai Synthetic Rubber			[redacted]			D	(MUANG)	1106	1995
43	BST Elastomer		[redacted]			45%	D	MTP	1400	1996
44	Styrolution			[redacted]			D			
45	Thai ABS	[redacted]			IRPC:99.99%		D			
46	Zeon			[redacted]			D	ESI	350	1996
47	Migh Dhl			[redacted]			D			
48	Siam Polystylene		[redacted]			50%	D			
49	Thai Styrenic	[redacted]			Main Share		D			
50	Asia Fibre			[redacted]			D	BPO	1000	1970

51	Siam Tyre Cord			[redacted]			D				
52	Thai Baroda						D				
53	Thai Indo Kordsa						D				
54	Thai Polymer						D	(BANGPLEE)	402	1989	
55	Thai Taffeta						D				
56	Toray						D	(BANGKHEN)	2000	1963	
57	Bangkok Polyester						D	(NIKOM PATTA	1235	1994	
58	Chiempattana						D	(PHOTHARAM)	140.5		
59	Kangwal						D	(Khaoyoi)	2153.8		
60	Polyplex						D	SEI		2003	
61	Sunflag						D				
62	Teijin						D	(KLONGLUANG	548.22	1967	
63	Thai PET Resin						D	ESI	900	2002	
64	Thai Polyester						D				
65	Thai Shinkong						D	MTP	1798.3		
66	South City						D				
67	Thai Chemical						D	(PRASAMUTCH	24	1971	
68	Sand and Soil Industry						D				
69	Thai Urethane						D	(Bangsaothong)	100	1985	
70	UR Chemical						D	(BANGPLEE)			
71	Siam Chemical						D	BPO	120	1974	
72	TPAC						D				
73	Thai Ethanolamine	[redacted]			100%		D				
74	Thai Ethoxylate				??	??	D				
75	Dow Chemical			[redacted]			D				

76	IRPC Polyol						D				
77	Dynea						D	BPO	35	1997	
78	Ethernal Resin						D				
79	Star Plus						D	(BANNKAE)	480		
80	TOA Dovechem						D				
81	Vanachai						D	ESI	150	1996	

Source: PTIT, Jyukagaku Kogyo Tsushinsha

Automotive Industry (in Japanese Car Maker Supply-chain)



No	Name	Toyota	Honda	Isuzu	Nissan	Mitsubishi	AAT(Mattsuda)	Hino	Tier	IE	Capital	YEAR
1	AAPICO HITECH Public	■	■	■			■		1	HIT	240	1996
2	Able Sanoh Industries									HIT	80	1990
3	AGC Automotive									AMN	1500	1974
4	Aisin AI	■				■			1	WEL	783.6	2002
5	Ampas Industry			■	■				2	BPO	200	1982
6	Aoyama Thai	■		■			■		2	ESB	128	1965
7	ARRK	■	■	■	■	■	■	■		BKD	1180	1988
8	ARST									AMN		
9	Art-Serina Piston			■					2	LDR	78	1975
10	ASAHI TEC Aluminium					■	■		2	AMN	1480	1989
11	Asno Horie	■		■	■		■		2	ESB	727.5	1996
12	Atsumitic									SEI	180	1994
13	Auto CS Engineering	■							2	AMN	105	1996
14	Bangkok Diecasting and Injection									BLE	300	1978
15	Bangkok Spring Industrial	■	■			■			2	AMC		
16	BESTEX									RJN	120	1994
17	Bosch Automotive				■	■	■		1	AMC	267.5	1996
18	Bridgestone NCR	■	■	■	■	■			1	(Makhamkhu)		1995
19	Cataler (Thailand)	■	■						1	ESB	500	1996
20	Cherry Serina Co.			■		■	■		2	AMN	90	1973
21	CM Industry			■					2	(Prapradaeng)		
22	CPI Industry								2	SSA		
23	CPR Gomu Industry				■	■			2	(Wangnoi)	199	1996
24	CSP Casting			■					2	(Sam Khok)		
25	DAIDO Sittipol									SEI	325	1996

26	DAISIN		■	■					1	NIE	249	2000
27	DANA Spicer			■					1	ESB	1084	1984
28	Delphi Automobile System			■					1	ESB	509	1997
29	Delta-TR						■		2	AMC	300	2007
30	Denso (Thailand)	■	■	■	■	■	■		1	AMN	200	1995
31	Dyna Metal						■		2	WEL	200	1973
32	ECHO Autoparts								2	BPI	120	2002
33	Enkei Thai	■	■	■	■	■	■		2	BLE	400	1987
34	EXEDY Friction Material									AMN	316	1997
35	FCC									AMN	60	
36	Feltol Manufacturing	■		■					2	BPO	35	1989
37	Fortune Parts			■					2	(LamLukka)	3200	2004
38	F-Tech									RIA	850	2006
39	Fujisah	■		■					2	(Chomburi)		
40	Fujitsu Ten	■							1	RIR	400	
41	General Seating						■		1	ESB		
42	GKN Driveline								1	ESB	325	1997
43	GKN Driveshafts	■	■				■		1	ESB	325	1997
44	GKN Toyoda									BPI	520	2002
45	Gold Press Industry			■					1	(Ongkarak)		
46	GOODYEAR	■								(Lklongluang)	74	1994
47	G-Techt									HIT		
48	G-Techt Eastern								1	ESB		
49	Hayashi Telempu	■	■	■		■	■		1	(Muang)	370	1994
50	HICOM Automobile Plastic	■					■		1	ESB	488	2002

51	Hino Motors Manufacturing								1	AMN	2500	2004
52	Honda Access								1	(Sukhumvit66)		
53	Honda Foundry									(Muang)	380	2003
54	HONDA Lock Thai								1	AMN	160	1996
55	H-One Parts									(U-Thai)		1994
56	IHI Turbo									AMN	260	2002
57	INGRESS Autoventures								1	ESB	240	1996
58	Inoue Rubber								1	(Wangnoi)	200	1969
59	International Casting									AMC	785	2003
60	International Rubber Parts								2	(Bang Khunthian)		
61	Isuzu Engine Manufaturing								1	LDR	200	1987
62	Izumi Piston Manufacturing								1	BGC		
63	Jibuhin								2	AMN	345	1990
64	JIDECO									HES		2001
65	Johnson Controls & Summit Interiors								1	HES	245.9	1999
66	JTEKT									BPI	2773	1966
67	JTEKT Automobile									ESB	620	1996
68	Kallawis Auto Parts								1	WEL		
69	Keihin									NTR	210	1989
70	Keihin Auto								2	RIA	650	1994
71	KEIHIN Metal									NIE	28.7	1989
72	KLK Iundustry								2	(Klongsamwa)		1983
73	Koyo Joint								1	BPI	540	2002
74	Koyo Manufacturing								1	BPI		
75	Koyo Steering								1	BPI		

76	KURASHIKI Siam Rubber									2	(Srimahosod)	153	1996
77	KYB										AMN	200	1996
78	Mahajak Autoparts Co.									2	(Nong Jok)	500	1989
79	Mahle Engine Components									2	BGC	30	1972
80	Mahle Siam Filter Systems									2	BLE		
81	Matsushita Battery										(Muang)	955	1997
82	MC Aluminum (KORAT)									2	BPI		
83	Michelin Siam									1	SCI	2117	1990
84	Mitsubishi Electric Thai									1	SEI	400	1996
85	MMth Engine									1	LCB	20	1988
86	MUSASHI AUTO Parts										3I1	200	1995
87	Nagata									2	(Srimahaphot)		
88	New Somthai Motor									2	BLE		
89	NHK SPRING									1	ESB	410	1963
90	NIHON PLAST										AMC	230	2004
91	Nippon Paint									1	AMN	308	1994
92	Nissan Diesel										LDR	1900	1987
93	Nissan Powertrain									1	(Bangsaotong)		1987
94	NISSIN Brake										SRE	145.7	2000
95	Nissin BT									2	(Sri Maha Phot)		
96	NITTAN										AMN	100	1997
97	NSK Bearings									2	AMN	650	2001
98	NTN Manufacturing									2	PT1	1311	
99	Ogihara									2	LDR	372	1989
100	PMK-Central Glass									1	(Krathumban)		1979

101	Pongpara								2	(Krathumban)		
102	Pongpara Cordan Rubber	■		■	■	■		■	2	(Krathumban)	200	1979
103	Premier CE Co.				■				1	BGC		
104	Radicon		■			■			2	AMN	206	1992
105	Robert Boschu			■					1	AMC		
106	Sanko Gosei								1	RIA	350	1996
107	SEBT	■	■	■						(Ban Khai)	247.3	2000
108	Showa Auto									PT2	800	2006
109	Siam Aisin	■							2	3I1	680	1996
110	Siam Calsonic			■					1	AMN	189	1996
111	Siam Denso Manufacturing	■		■					2	AMN	4158	2002
112	Siam DK Technology						■		2	(Muang)		
113	Siam Ebisu			■	■			■	2	(Saphansung)		
114	Siam Engineer Body Car			■					2	(Nakhon Pathom)		
115	Siam Furukawa	■							1	SIL	240	1992
116	SIAM Goshi									SEI	180	1993
117	Siam GS Battery	■		■		■			1	BPO	71.4	1966
118	SIAM Hitachi Automotive		■	■	■				1	AMN		1994
119	Siam Kayaba	■			■				2	(Muang)		
120	Siam Metal Technology			■	■				2	ESB	617	1998
121	SIAM NGK Spark PLUG								2	AMN	10	1977
122	Siam NSK Steering Systems	■	■				■			BPI		
123	Siam Riken Industial		■		■	■	■		2	AMN	33	1973
124	Siam Toyota Manufacturing	■							1	AMN	850	1987
125	SIAM Yachiyo									3I1	230	1997

126	Siam Zexel				■	■	■				AMN		
127	SK Auto Interior	■	■	■			■			2	GTC		1995
128	SNN Tools & Dies				■					2	(Bangbor)	135	1989
129	Somboon Advance Technology	■		■		■	■	■	■	1	ESB		
130	Somboon Malleable Iron	■	■	■	■	■	■	■	■	1	AMC		1975
131	Somboon Somic	■	■	■						1	ESB	300	1997
132	Srithai Auto Seats	■			■					2	BPO	12	1989
133	STB Textiles Industry										LCB	240	1995
134	Steel Case										(Muang)	82.2	1996
135	Summit Auto Body Industry		■			■				1	ESB		
136	Summit Autoseats Industry					■				1	BLE		
137	Summit Kurata Manufacturing					■				2	LCB	90	1996
138	Summit Showa Manufacturing		■			■				1	LCB	80	1994
139	Summit Steering Wheel				■	■				1	BLE		
140	SYK Spare Parts		■							2	(Phra Pradaeng)		
141	T. Krungthai Industries	■			■					1	BLE	214	1973
142	Takata TOA	■	■			■	■	■		1	WEL	200	1994
143	Tanaka Precision									2	NTR	200	1996
144	TBKK									2	AMN	205	1990
145	Thai Arrow Products	■								1	(Bangkhla)	570	1963
146	Thai Automotive Industry				■					1	(Bangsaothong	1400	1987
147	Thai Autoworks Co	■								1	(Baanpho)		1988
148	Thai Bridgistone	■	■	■	■					1	AMN	6921	2000
149	Thai Chanathorn Industry			■		■				2	BLE	46	1982
150	Thai Decal Co.	■					■			1	(Prapadaeng)	110	1988

151	Thai DNT Paint MFG		■			■			2	LCB	85	1969
152	Thai Engineering Products	■		■					1	NIE	85	1985
153	Thai Honda Manufacturing		■						1	LDR	150	1965
154	Thai Kikuwa Industries		■						2	AMN	20.72	1991
155	Thai Koito	■	■	■	■		■	■	1	BLE	365	1986
156	Thai Marujin									SRN	846.4	1995
157	Thai MATTO NS									AMN	100	1997
158	Thai Mitsuwa PCL		■						1	(Muang)	199.5	1987
159	Thai NIPPON Seiki		■			■			1	AMN	406.5	1995
160	Thai NOK									AMN	720	1989
161	Thai Parkerizing	■				■			2	GTC	28	1979
162	Thai Radiator MFG			■					2	(Ratchathewi)		
163	Thai Rung Union Car			■	■				2	(Nongkhangphlu)		
164	Thai Safety Glass Comapany	■	■	■	■	■			1	BPK		
165	Thai Seat Belt	■							1	AMN	60	1994
166	Thai Stanley Electric Public		■	■		■			1	(Muang)	383	1980
167	Thai Steel Cable	■	■	■	■	■	■		2	AMN	268.5	1978
168	Thai Storage Battery			■					1	BPO	200	1989
169	Thai Summit Autobody	■	■	■		■			1	BLE		
170	Thai Summit Autoparts	■	■	■	■				2	BLE	62	1977
171	Thai Summit Autoseats					■				BLE		
172	Thai Summit Harness		■	■	■	■			1	LCB	50	1993
173	Thai Summit Laemchabang	■	■			■	■		1	LCB	60	1994
174	Thai Summit Mitsuba Electirc		■			■			2	HES	100	1993
175	Thai Summit PKK			■		■	■	■	2	ESB	150	1989

176	Thai Summit Showa									LCB	80	1994
177	Thai Toyo DENSO									HTK	111	1997
178	Thai YANAGAWA									3I1	361	2014
179	Thai Yang Kitipaisan								2	(Prapradang)		
180	The Siam United Steel								1	ESB	9000	1995
181	TigerPoly								1	RIA	290	1994
182	TOACS								1	AMN	400	1994
183	Tokai Rika								1	AMC	340	1997
184	Toyoda Gosei								1	AMN	400	1994
185	TOYODA Gosei Rubber								1	(Kratoomban)	600	2000
186	Toyoda Machine Works								1	ESB		
187	Toyota Boshoklu Gateway								1	GTC	69.3	2001
188	TRW Steering & Suspension									ESB	450	1998
189	TS Tech									HRS	800	2015
190	Visteon								1	ESB	562	1996
191	Wichien Dynamic Industry								1	(Lat Lum Kaeo)		
192	Yamada Somboon								1	SEI	150	1994
193	YANAGAWA Techno Forge									SEI	182	1989
194	Yarnapund Public								2	BLE	620	1956
195	Yongkee Co.								1	(Sattru Phai)		
196	Yorozu								1	ESB	1800	1996
197	YS Pund									WEL	1414	1996
198	YS Tech								1	3I1	226	2002
199	Yuasa Battery								1	GTC		
200	Zexel Valeo Commpressor								1	(Bhuldang)		

Source: Industrial Research Institute, Asia Industry Research Institute

VITA

Mr. Kensuke Yamaguchi was born on 6 March 1981 in Tokyo, Japan. He graduated with a Bachelor of Arts in Behavioral Science, and Master of Arts in International Cooperation, both from the University of Tokyo in 2003 and 2005, respectively. After graduation until the present, he has worked for Institute of Energy Economics, Japan (IEEJ), Central Research Institute of Electric Power Industry (CRIEPI), and Research Institute for Humanity and Nature (RIHN) as well as the University of Tokyo. In 2013, basing on a collaborative project between Chulalongkorn University and the University of Tokyo, he started his doctoral education at Thai Studies Center, Faculty of Arts, Chulalongkorn University.