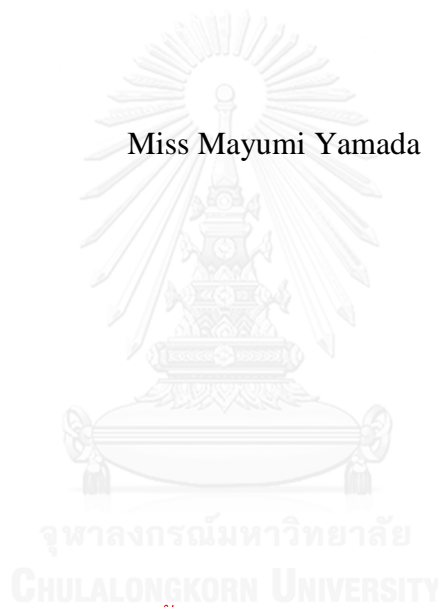


**ECO-INDUSTRIAL ESTATE DEVELOPMENT IN THAILAND
: A CASE STUDY OF AMATA NAKORN INDUSTRIAL ESTATE**

Miss Mayumi Yamada



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กิจกรรมอุตสาหกรรมสีเขียวเป็นกุญแจความสำเร็จสำหรับการพัฒนาที่ยั่งยืน งานวิจัยนี้มีวัตถุประสงค์เพื่อวิเคราะห์สถานการณ์การพัฒนาอุตสาหกรรมเชิงนิเวศในประเทศไทย และเพื่อศึกษาปัจจัยสำคัญที่ส่งผลต่อการพัฒนาอุตสาหกรรมเชิงนิเวศโดยใช้นิคมอุตสาหกรรมอมตะนครเป็นกรณีศึกษา

ตั้งแต่อดีตถึงปัจจุบัน มีความพยายามหลายครั้งระหว่างรัฐบาลไทยและญี่ปุ่นในการปรับเปลี่ยนอุตสาหกรรมที่มีอยู่ของไทยให้เป็นอุตสาหกรรมเชิงนิเวศ เนื่องจากมีโรงงานญี่ปุ่นที่ตั้งในนิคมอุตสาหกรรมอมตะนครและในประเทศไทยอย่างมีนัยสำคัญ อย่างไรก็ตาม ความพยายามก่อนหน้านี้อยู่ในสถานการณ์ที่มีความคืบหน้าเพียงเล็กน้อย และยังไม่เคยมีการศึกษาเกี่ยวกับปัจจัยสำคัญที่ส่งผลกระทบต่อกระบวนการเปลี่ยนแปลงไปสู่นิคมอุตสาหกรรมเชิงนิเวศในประเทศไทย ในช่วงที่มีการดำเนินโครงการ One Stop Service (OSS) project ได้มีการศึกษาปัจจัยส่งผลกระทบต่อโครงการโดยใช้แบบสอบถาม

แบบสอบถามได้ถูกแจกจ่ายไปยังบริษัทผู้เช่าทั้งหมด เพื่อนำผลมาวิเคราะห์ถึงปัจจัยสำคัญสำหรับการพัฒนาดำเนินงานที่มีประสิทธิภาพของ OSS project ผลการวิจัยพบว่าการมีส่วนร่วมในกิจกรรมของรัฐบาลเป็นสิ่งจำเป็นสำหรับการพัฒนาในด้านนี้ ความคาดหวังของผู้เช่าที่สำคัญที่สุดจาก OSS project คือการลดค่าใช้จ่ายในการบริหารจัดการของเสีย และปัจจัยสำคัญที่สุดที่ส่งผลกระทบต่อตัดสินใจใช้ OSS ก็คือ ค่าบริการในการจัดการสิ่งแวดล้อมที่สมเหตุสมผล การมีส่วนร่วมของบริษัทต่างประเทศไม่ได้ส่งผลอย่างมีนัยสำคัญในการตัดสินใจดำเนินการ และโรงงานผู้เช่ายินดีมากกว่าหากภาครัฐบาลเข้ามามีส่วนร่วมในการดำเนินโครงการ โดยสรุป ได้มีการแนะนำหลากหลายกลวิธีเพื่อใช้ส่งเสริมอนาคตของการพัฒนานิคมอุตสาหกรรมเชิงนิเวศในประเทศไทย และอมตะนครบนพื้นฐานของปัจจัยสำคัญและการวิเคราะห์แบบ SWOTs และจากประสบการณ์สังเกตการณ์โครงการจริง

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MAYUMI YAMADA: ECO-INDUSTRIAL ESTATE DEVELOPMENT IN THAILAND: A CASE STUDY OF AMATA NAKORN INDUSTRIAL ESTATE. ADVISOR: ASST. PROF. CHANATHIP PHARINO, Ph.D., pp.

Greening industrial activities is one of a key success for sustainable development. This research aims to investigate the status of eco-industrial estate development in Thailand and to identify the significant factors affecting eco-industrial development using Amata Nakorn Industrial Estate as a case study.

There have been several attempts between Thai and Japanese government to transform existing Thai industrial estates into eco-industrial estate since there is a significant proportion of Japanese factories in Amata Nakorn industrial estate and in Thailand. However, previous attempts have stranded or with very little progress. There have been not studies to investigate the key factors impacting the transformation. Several factors were identified during the One Stop Service (OSS) project implementation by using questionnaire survey.

The questionnaires were distributed to all tenant companies in Amata Nakorn Industrial Estate to identify key factors affecting their decision to participate in eco-industrial project. Key factors were identified for improving potential implementation of OSS project. The research result found out that the government's active involvement is needed for the development. The most important expectation of tenants from OSS project is a cost reduction on waste management and most important factor affecting making decision on using OSS is a reasonable service fee. A foreign company involvement has no significant impact on decision making process.

The tenant factories preferred more involvement of the government in the development of the project. In summary, Strategies to promote future eco-industrial estate development in Thailand and Amata Nakorn were suggested based on key factors and SWOTs analysis and the actual project observation experiences.

Field of Study: Thai Studies

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CONTENTS

	Page
THAI ABSTRACT	iv
ENGLISH ABSTRACT.....	v
ACKNOWLEDGEMENTS	vi
CONTENTS.....	vii
List of Tables	xi
List of Figures	xii
CHAPTER I: INTRODUCTION.....	1
1.1 Background.....	1
1.2 Research questions.....	2
1.3 Research objectives	2
1.4 Scopes of study	2
1.5 Expected outcomes	5
1.6 Background of eco-industrial estate development project in Amata Nakorn industrial estate	5
1.6.1 Background of eco- industrial estate One-Stop service model project	7
1.6.2 One-Stop service project - first period to third period.....	7
1.6.3 Problems in OSS project	13
1.6.4 Why Amata Nakorn Industrial estate?	15
1.6.5 Tenant company visit and interviews within Amata Nakorn industrial estate.....	17
1.7 Factors affecting OSS development in Amata Nakorn Industrial estate	18
1.8 Status of Amata Nakorn industrial estate in environmental management.....	22
1.8.1 Brief history of Amata Nakorn Industrial Estate.....	22
CHAPTER II: LITERATURE REVIEWS	27
2.1 Eco-industrial estate concepts and background.....	27
2.2 Industrial ecology and industrial symbiosis	29
2.3 International experience of eco-industrial estate development and factors Impact on the development	30
2.3.1 Eco-industrial estate development in the USA and the Netherlands.....	31

	Page
2.3.2 Japan's experience on Eco-industrial estate development	33
2.3.3 <i>China's Experience on Eco-industrial estate development</i>	35
2.3.4 <i>Korea's experience on Eco-industrial estate development</i>	38
2.4 Development of Eastern Seaboard region of Thailand and industrial estate development in Thailand	40
2.4.1 <i>Concept of Eco-industrial Estate Development in Thailand</i>	41
2.4.2 <i>Criteria for building eco-industrial estate development</i>	43
CHAPTER III: METHODOLOGY	46
3.1 Research methodology.....	46
3.2 Formulation of key topics in questionnaire	49
3.3 SWOT analysis	50
3.3 Questionnaire preparation/distribution	52
CHAPTER IV: RESEARCH RESULTS AND ANALYSIS	54
4.1 Background of questionnaire respondents	55
4.1.1 <i>Company size and nature of business</i>	55
4.1.2 <i>Job description</i>	57
4.1.3 <i>Working period and experience at the factory</i>	57
4.2. Environmental management in factories and the estate	58
4.2.1 <i>Tenants' perspective on environmental/waste management</i>	58
4.2.2 <i>Tenants' problem 1</i>	59
4.2.3 <i>Tenants' problem 2</i>	60
4.2.4. <i>Tenants' problem 3</i>	61
4.2.5 <i>Tenants' problem 4</i>	62
4.2.6 <i>Tenants' problem 5</i>	63
4.2.7 <i>Tenants' problem 6</i>	64
4.2.8 <i>Tenants' problem 7</i>	65
4.3 Attitude towards environmental management system	67
4.3.1 <i>Tenants' interest in obtaining environmental management certification</i>	67

	Page
4.3.2 In-house environmental management system	68
4.3.3 <i>Efficiency of the in-house management system</i>	69
4.3.4 <i>Law enforcement</i>	69
4.3.5 <i>Motivating factor for environmental certification</i>	70
4.4 Attitude towards environmental management activities.....	73
4.5 Eco-industrial estate transformation in Amata Nakorn industrial estate	74
4.5.1 <i>Organizational decision making factor</i>	75
4.5.2 <i>Stakeholder involvement</i>	75
4.5.3 <i>Facilitator/supporter</i>	76
4.5.4 <i>Components of eco- industrial estate in Amata Nakorns' context</i>	76
4.6. Characteristics and strength/significant factors of Amata Nakorn Industrial estate	77
4.7 Development of One Stop Service (OSS) project from tenant companies' perspectives	84
4.7.1 <i>Willingness to participate in the OSS project</i>	85
4.7.2 <i>One Stop Service additional service options</i>	85
4.7.3 <i>Effective methodology to promote the OSS initiation and implementation</i>	86
4.7.4 <i>Facilitator/supporter</i>	87
4.7.5 <i>Decision making process</i>	88
4.7.6 <i>Three most important expectations from OSS project</i>	91
4.7.7 <i>Best scenario for OSS initiation</i>	92
4.7.8 <i>How OSS will support Amata Nakorn Industrial Estate's future development</i>	93
4.8 Summary of key findings from survey questionnaire.....	94
4.8.1 <i>Factors supporting/hindering the development of OSS</i>	96
4.9 SWOT Analysis on eco-industrial estate development project	100
4.9.1 <i>TOWS MATRIX of OSS project</i>	105
4.10 Recommendation to promote eco-industrial estate.....	105
.....	112

	Page
REFERENCES	112
APPENDIX A: LETTER FROM CHULALONGKORN UNIVERSITY	114
APPENDIX B: ECO-INDUSTRIAL ESTATE DEVELOPMENT QUESTIONNAIRE	115
VITA.....	136



List of Tables

	Page
Table 1.1 Environmental initiatives of Amata Nakorn industrial estate.....	24
Table 1.2 Comparison of Environmental dimension of IEAT and Amata Nakorn industrial estate	25
Table 4.1: Components of eco-industrial estate in Amata Nakorns' context	77
Table 4.2: Percentage of levels of agreement on 15 strength/significant factors	84
Table 4.3: Summary of key findings.....	95



List of Figures

	Page
Figure 1.1: Map of Amata Nakorn Industrial Estate.....	3
Figure 1.2: OSS working team activities	4
Figure 1.4: Business model of waste processor Audit-Inspection.....	8
Figure 1.5: Business Model of Amata Transfer Station	9
Figure 1.6: OSS project (first period)	10
Figure 1.7: OSS project second period	11
Figure 1.8: Amata transfer station.....	12
Figure 1.9: OSS project third period.....	12
Figure 1.3: Environmental dimension and 10 aspects of IEAT criteria for Eco-Industrial Estate	16
Figure 1.10: Map of Amata Nakorn industrial estate & Laem Chabang Deep Seaport etc.,	22
Figure 1.11: Time line of Amata Nakorn industrial estate from the establishment to the present.....	23
Figure 2.1: Framework of eco-town in Japan redrawn by the author	34
Figure 2.2: IEAT Strategy for eco-industrial estate development 2013 to 2016.....	41
Figure 2.3: Concept of Eco-industrial Estate Development in Thailand	42
Figure 2.4: Dimensions and 22 aspects of eco-industrial estate & networks by IEAT	43
Figure 3.1: Work flow of research methodology.....	46
Figure 3.1: TOWS matrix Redraw by author.....	51

	Page
Figure 3.2: Questionnaire preparation/distribution.....	52
Figure 4.1: Company size	56
Figure 4.2: Nature of business of the surveyed tenants	56
Figure 4.3: Working period.....	57
Figure 4.4: Percentage of levels of tenants' agreement on the difficulty in finding waste processor if the amount of waste is small	60
Figure 4.5: Percentage of levels of tenants' agreement on the difficulty in Finding waste processor for specific types of waste.....	61
Figure 4.6: Percentage of levels of tenants' agreement on the tenant does not have technology or skill to separate waste into specific types	61
Figure 4.7: Percentage of levels of tenants' agreement on the tenants put too much time and effort sorting out the wastes	62
Figure 4.8: Percentage of levels of tenants' agreement on having not enough waste storage space	63
Figure 4.9: Percentage of levels of tenants' agreement on the difficulty to find reliable waste processors.....	64
Figure 4.10: Percentage of levels of tenants' agreement on having to use only one waste processor for all types of wastes	65
Figure 4.11: Percentage of levels of tenants' agreement on the current laws and regulations on industrial waste management are too stringent	65
Figure 4.12: Percentage of the tenants who have already certified or planned to obtain any environmental management certification.....	68

Page

Figure 4.13: Percentage of tenants having or not having their own in-house environmental management system	69
Figure 4.14: Percentage of levels of agreement on effectiveness of current environmental laws and regulations to prevent environmental damage caused by business activities.....	70
Figure 4.22: Top 3 very important motivating factors.....	71
Figure 4.23: Percentage of levels of tenants on key benefit for environmental management system	71
Figure 4.24: Top 3 very important benefitting factors.....	72
Figure 4.34: Ranking of important environmental activities of surveyed tenants	73
Figure 4.35: Characteristics and affecting factors of eco-industrial estate transformation	79
Figure 4.37: Levels of agreement on the needs on OSS additional service Options.....	86
Figure 4.38: Percentage of method of effective promotion and announcement of the OSS project.....	87
Figure 4.39: Percentage of appropriate facilitator/supporter for OSS project	88
Figure 4.40: Service fee	89
Figure 4.41: Quality and types of service that brings solution to a problem	89
Figure 4.42: Types of waste that OSS can accept.....	90
Figure 4.43: Foreign company involvement.....	90
Figure 4.44: Amata Nakorn industrial estate as an owner of the OSS	91

	Page
Figure 4.45: Levels of important expectations from OSS projects.....	92
Figure 4.46: Levels of agreement on OSS project will bring positive change in waste management in Amata Nakorn industrial estate	93
Figure 4.47: Levels of agreement on OSS project will be a great advantage and influence the decision of the enterprise to settle into Amata Nakorn industrial estate	94
Figure 4.48: TOWS MATRIX of OSS project	104



CHAPTER I: INTRODUCTION

1.1 Background

The Asian economy has experienced the most rapid increase of its history during the last two decades. However, economic growth of the entire industrial world has generated severe environmental challenges and concerns. ASEAN developing countries moved quickly to encourage local industrialization and attract foreign investment in the absence of comprehensive sustainable development scheme (Chiu and Yong 2004). As for the case of Thailand, the country needs to speed up the eco-industrial estate development in order to minimize environmental pressure caused by industrial activities. The development of Eco-Industrial Estate (EIE) in Thailand commenced in 2000 under the initiative “The Development of Eco-Industrial Estates and Networks” or DEE +NET. Five industrial estates were selected as pilot locations for the introduction of various EIE concepts: the MapTa Phut, Bang Poo, Northern Region, Eastern Seaboard, and Amata Nakorn Industrial Estates (Verawat Panyathanakun et al. 2013). Moreover, The Department of Industrial Works (DIW) announced that provincial industrial offices Rayong, Patum Thani, Chonburi, Ayutthaya and Sara Buri and 9 industrial zones and parks have joined to establish an ecological industrial network with a goal to build sustainable eco industrial complex by 2018. (<http://thainews.prd.go.th>)

Thailand has been receiving an international corporation in implementation of eco-industrial estate development strategies from overseas. However, most of the projects had been banished or stalled in the past. There are still many barriers and difficulties in implementing the concept, since developing countries have different political, economic, environmental and resource constraints compared to economies in developed countries (Chiu and Yong 2004). Thailand therefore needs to develop its own strategies to implement eco-industrial estate development instead of just adopting the strategies used in the developed countries. This research aims to identify the key factors affecting eco-industrial estate development in Thailand and how to

promote the development. Amata Nakorn industrial estate is chosen as a case study to investigate factors affecting decision of tenant companies' participation in an eco-industrial estate development.

1.2 Research questions

1. What is the current state of eco-industrial estate evolution in Thailand?
2. How does a successful eco-industrial estate evolve in developed countries?
3. What factors determine the successful development of eco-industrial estate ?
4. Which factors have high influence to the success of eco-industrial estate development?

1.3 Research objectives

1. To identify and analyze key factors supporting or hindering the success of developing EIE in Thailand.
2. To make a suggestion to transform Amata Nakorn industrial estate into eco-industrial estate

1.4 Scopes of study

This research was carried out in Amata Nakorn Industrial Estate from November/ 2012 to March/ 2013 and the second period of the project; One Stop Service (OSS) trial project started from 1st June 2013 to 15th July 2013 and the third period of the project at Amata transfer station started from 28 April to 9/May in 2014. There are three project phase were described as OSS project first period to phase to third period. The first period of the project was under the project of Thai and Japanese government and 2nd and 3rd period of the projects were continued independently between Amata Nakorn industrial estate and Japanese companies. Time table of the project was decided between the involved parties. For that reason, the project time table has three different periods.

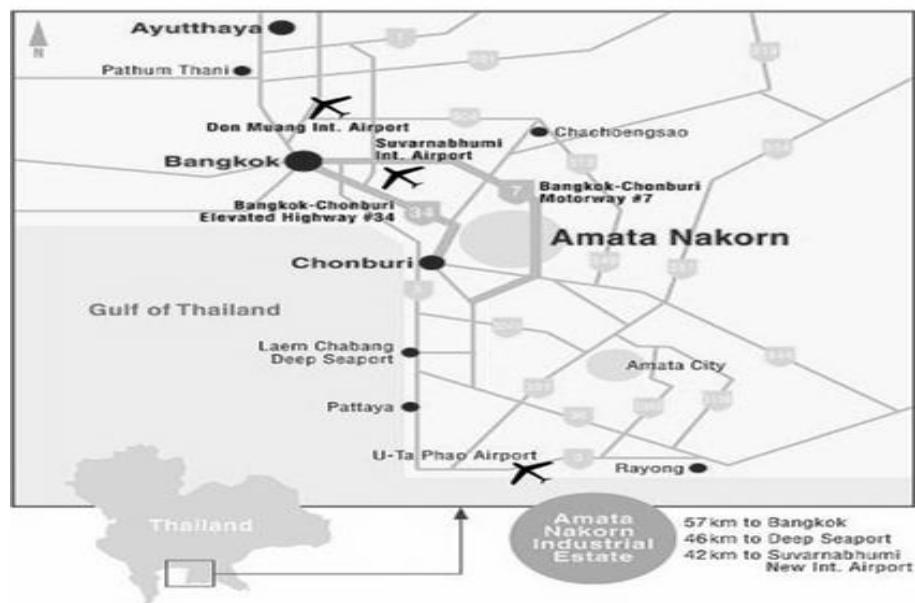


Figure 1.1: Map of Amata Nakorn Industrial Estate (source: <http://www.siamsteri.co.th/>)

Amata Nakorn Industrial estate is located in the eastern seaboard region comprised of Chachoengsao, Chonburi and Rayong provinces and located in Chonburi province 57 km from Bangkok between Bangna-Trad Elevated Expressway and Bangkok – Chonburi Motorway. **(Figure1.1)** The location suits for the industrial estate development because of its proximity to Bangkok also to Laem Chabeng Deep sea port. There are various industrial estate located in Eastern Seaboard regions such as; Map Ta Phut industrial estate, Laem Chabang Industrial estate and eastern seaboard industrial estate.

There are currently 3 industrial estates in Chachoengsao province, 8 industrial estates in Chonburi province and 12 industrial estates in Rayong Province. (Industrial Estate Authority of Thailand (IEAT) 2012)

The core project members of the OSS project team consist of four members, two Thai from Amata facility service, one Japanese (the author) and one Japanese expert from E-kansai working team. The OSS preparation office is located on the second floor of Amata Facility Service office in the Amata Nakorn industrial estate. OSS working team gathers at least three times a week (every Tuesday, Wednesday and

Thursday) during the first period of the project. OSS project member visits total of twenty-one Japanese and non-Japanese tenant companies located within Amata Nakorn industrial estate. Some of these companies were previously interviewed in a preliminary study called “Expert dispatched program which took place in April 2012. The twenty-one companies were selected and divided into three groups by the number of employees: small, medium and large by Amata Facility Service. The study does cover the non-Japanese owned factories. However, the number is expected to be quite small. The nature of OSS working team and over 60% of tenant companies within Amata Nakorn Industrial Estate are Japanese companies, therefore the significant number of factories in the research will be the Japanese tenant companies.



(Factory visit)

(Regular meeting)



(Meeting with Dr. Sirakarn of DIW)

(MOU signing ceremony)

Figure 1.2: OSS working team activities

The second period of the project started from 1st June to 15th July 2013, the OSS working team, Amata Facility Service, Thai local waste processor and environmental related companies from Japan will work together to evaluate the possibility of starting waste recycle to cement materials. The third period of the project started on 28 April to 9/May 2014. The project aimed to increase the recycle rate at waste transfer station in Amata Nakorn industrial estate.

1.5 Expected outcomes

1. Understanding about key factors impacting the success rate of eco-industrial estate development in Thailand
2. A guideline and strategies to promote eco-industrial estate in Thailand

1.6 Background of eco-industrial estate development project in Amata Nakorn industrial estate

Thailand has been experiencing rapid economic growth with increasing environmental burden. That environmental burden could create difficulties in economic development in the future. Existing Thai industrial estates are conventional type of industrial estates. It was not designed to protect or prevent environmental problems. Amata Nakorn industrial estate is a biggest industrial estate in Thailand which accommodates over 500 tenant companies within the estate (Ministry of Economy Trade and Industry (METI) 2010). Mitsubishi UFJ research and consulting estimated that the amount of hazardous waste generated in Amata Nakorn industrial estate is 101,346 tons in 2009 which is higher than the country's average made Amata Nakorn industrial estate a top hazardous waste generator in Thailand (Ministry of Economy Trade and Industry (METI) 2010).

As a solution for this environmental threat, Eco-Industrial Estate and Networks was formalized by Industrial Estate Authority of Thailand (IEAT) in 2000. IEAT has set up criteria for eco-industrial development. There are 5 dimensions and 22 aspects to be considered in eco-industrial estate development (Industrial Estate

Authority of Thailand (IEAT) 2012). As of today, there is no industrial estates fully complying all the criteria set by IEAT. From this perspective, eco-industrial estate development has not yet fully accomplished in Thailand.

The eco-industrial estate concept was first developed by Indigo Development (Indigo Development 2001b). Later Indigo development introduced EIP concept to US-EPA in 1993. Since then, eco-industrial estate development projects have grown worldwide. Eco-industrial estate aims to improve the economic performance of the participating companies while minimizing their environmental impacts and complying with environmental regulations (Indigo Development 2001b). Successful eco-industrial estate development will lead to sustainable economic development.

Thailand began to accept foreign direct investment to boost economy and most of the foreign direct investment went into the industrial estates in Thailand. Mrs. Atchaka Sibunruang, Secretary General of the BOI, said in the press release that foreign direct investment (FDI) from January to July 2012 attracted Bt332.2 billion, an increase of 62 percent from Bt205.2 billion of the same period in 2011. During that period, Japan remained the top investor with 474 projects worth Bt210.8 billion, an increase of 120 per cent from Bt.97.3 billion last year (Press Release BOI 7.Sep 2012).

There are 48 industrial estates in operation across 15 provinces. Many of the foreign manufactures are using latest technology for manufacturing. Thailand on the other hand, needs to put a great effort in improving the quality of waste processors as well as the technologies of waste treatment. Regardless of the sizes of the businesses, most of all the manufactures have concerns with the current waste management system. Japanese government has been working with Thai authorities to introduce Japanese environmental expertise to Thailand. Japan has successfully solved scarce resource problems and landfill problems by introducing eco-town concept across Japan. After 16 years since the first eco-town was established, there are 26 eco-towns all over Japan. (Ministry of Economy 2012) There have been few attempts by the Japanese government to transform existing Thai industrial estates into eco-industrial

estate. However, previous attempts have stranded or banished. There has been no study to investigate why the transformation had not happened yet. As of 2013 February, there is one on-going project called development of eco-conscious industrial estate, One Stop Service (OSS) model project at Amata Nakorn industrial estate.

1.6.1 Background of eco- industrial estate One-Stop service model project

Japanese Ministry of Economy, Trade and Industry (METI) has started feasibility study on eco-industrial estate transformation in industrial estate in Thailand since 2009. From 2010, METI studied the possibility of cooperation with three locations in Thailand, namely Chonburi province, Amata Nakorn Industrial estate and Rayong province. In 2010, the MOU was signed between METI, Department of Industrial Works (DIW) and Amata Corporation to conduct feasibility study on transforming Amata Nakorn industrial estate into eco-conscious industrial estate. In April 2012, METI organized training program on “Industrial Waste Recycling in Thailand” in Japan and also “Expert dispatched program for the development of One Stop Service in Amata Nakorn Industrial Estate. Seventeen factories within Amata Nakorn Industrial Estate were being studied. In November 2012, the MOU was signed to study the possibility of commercialization of One Stop Service (OSS) model between DIW, AMATA Corporation, METI and working group under METI called E-Kansai working team (comprised of Japanese environmental companies). One Stop Service aims to provide solution for waste management problems found in tenant companies within Amata Nakorn industrial estate.

1.6.2 One-Stop service project - first period to third period

This research was carried out in Amata Nakorn industrial estate through the first period from November/2012 to March/2013 and the second period; One Stop Service (OSS) trial project starting from 1st June 2013 to 15th July 2013 and the third period trial project at waste transfer station from 28 April to 9/May in 2014.

The first period of the OSS project started in the mid November in 2012. By December 2012, OSS working team visited seventeen factories within Amata Nakorn industrial estate in order to decide what functionality OSS should have. After several meetings, Japanese expert came up with three service models to begin with. First is small-lot waste collection, second is temporally storage of waste and third is audit-inspection of local waste processors. These three models were chosen based on the feedback from seventeen tenant companies and both side Thailand and Japan agreed with three business models as OSS functions to start with.

I. One Stop Service Model

Below are the details of OSS business functions

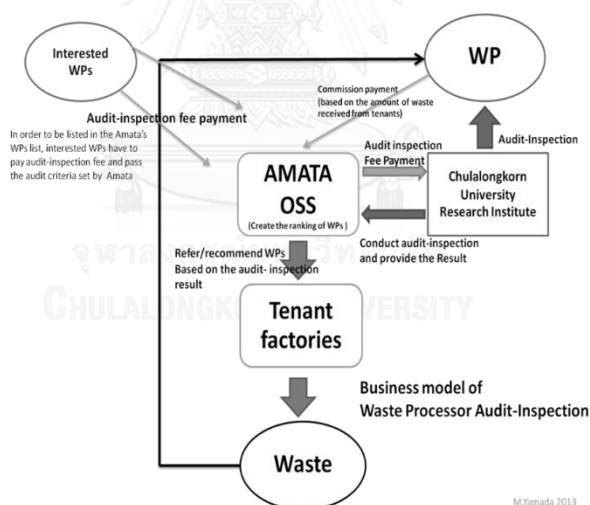


Figure 1.4: Business model of waste processor Audit-Inspection

Figure 1.4 describes the first model of audit-inspection business model. The OSS working team found that the tenant companies have doubted about the quality assurance of the actual practice of waste disposal of some waste processors. Therefore, audit-inspection of waste processors will help tenants to choose good waste processors to avoid mishandling of wastes.

Second, Figure 1.5 describes the second business model of waste transfer

station. Tenant companies especially small and medium size had problem in keeping a small amount of waste as it takes up a space to store within their factory. Therefore, OSS team came up with the idea to have a yard to collect and store waste on behalf of tenants so that existing waste processors can come and collect the waste at the transfer station instead of going to each tenant factory.

Third, Figure 1.5 also describes the audit inspection of local waste processors. However, this business function was canceled as Thai government already has the inspection program to monitor local waste processors.

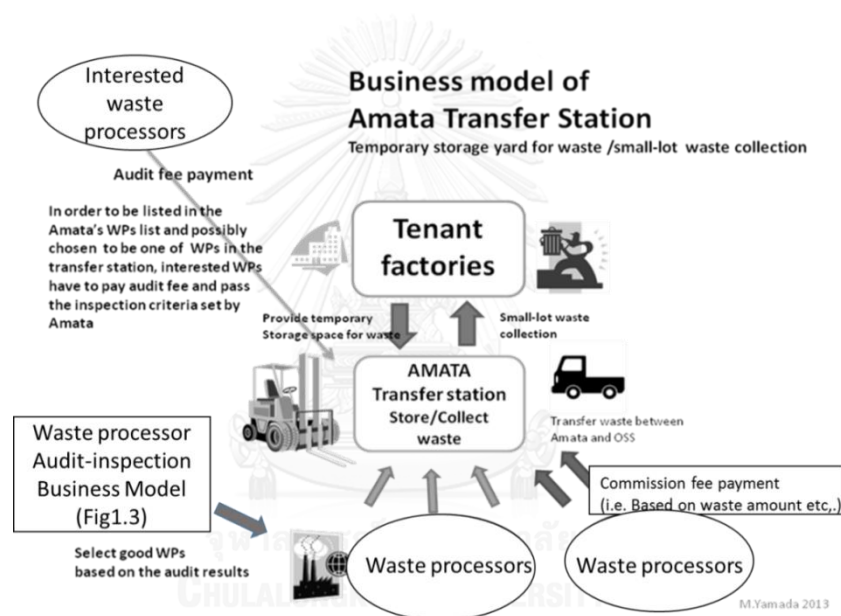


Figure 1.5: Business Model of Amata Transfer Station

II. OSS preparation office first period (12 Nov 2012 to 13 March 2013)

From January 2013, the OSS working team visited other seven tenant factories and two waste processors. After initial step of interviewing twenty-one factories and two waste processors were completed, the OSS working team discussed how much investment is needed to commercialize the OSS business model in Amata Nakorn industrial estate.

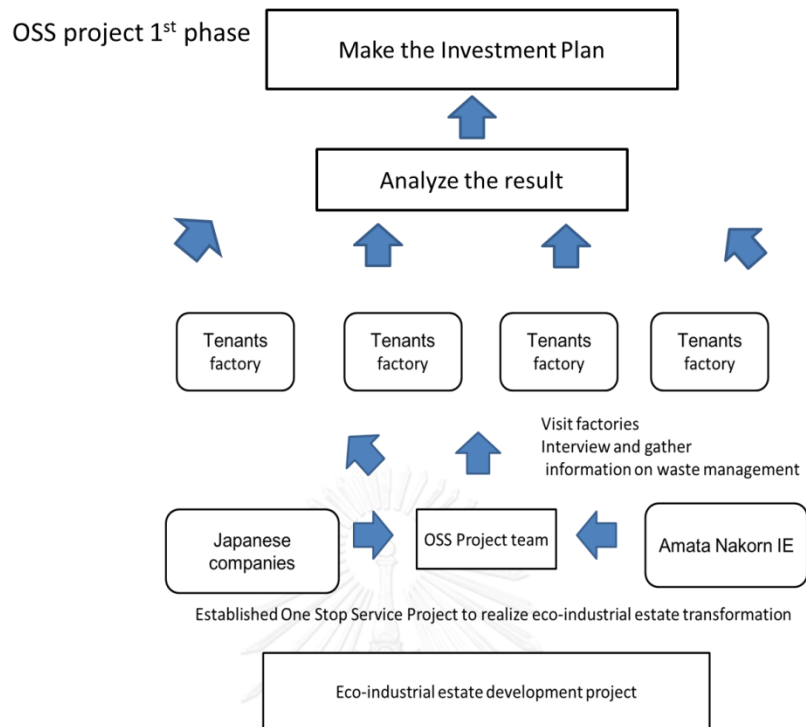


Figure 1.6: OSS project (first period)

By the end of the OSS first period, it reached conclusion that it is difficult to commercialize the OSS project because of the financial constraints such as the initial investment cost on OSS facilities. The OSS project under Thai and Japanese government was ended here. However, the Japanese side had difficulty in accepting the outcomes.

III. OSS Trial Project - Second Period (1st June 2013 to 15th July 2013)

There was a discussion between Amata Nakorn industrial estate and Japanese company to continue the OSS project privately. In this research, it described as “OSS Trial Project Second Period”. After the first period, Amata Nakorn industrial estate came up with the idea of inviting Thai local waste processor to join the project and adding waste recycle business in OSS business model. OSS team set a condition and a target as follows; Japanese team will visit and try to convince tenant companies in Amata Nakorn industrial estate to change the existing waste processor to use the OSS

waste recycle service. The Japanese team committed to provide the total of 1000 tons of wastes which can be used as cement materials. Thai waste processor committed to produce high quality cement at low cost.

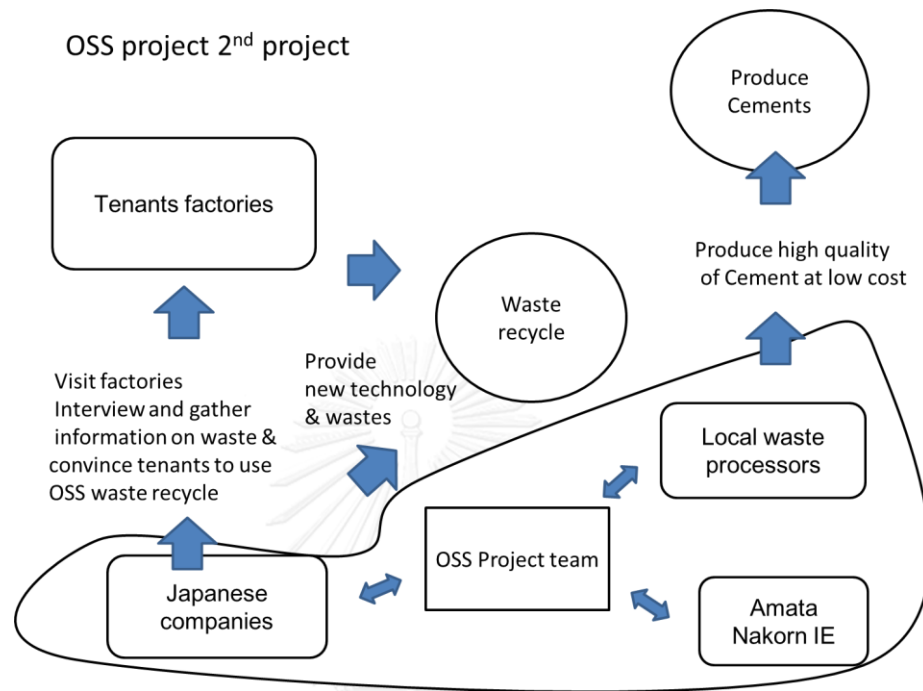


Figure 1.7: OSS project second period

After the trial period, three parties evaluated each other and make decision whether three parties can tie the business relationship and start to operate One Stop Service functions together. There were some difficulties and obstacles while working with three companies therefore the project was ended.

IV. OSS Trial Project Third Period (28 April 2014 to 9 May in 2014)

After the second period of the project, Amata Nakorn industrial estate and the Japanese company commenced waste recycle trial project at Amata transfer station (figure 1.8) in Amata Nakorn industrial estate to explore the business opportunities together. The project began in 28/ April to 9/May in 2014. The project aimed to increase the recycle rate of wastes that were transferred at Amata transfer station. The business model is described in figure 1.9



Figure 1.8: Amata transfer station

OSS project 3rd phase

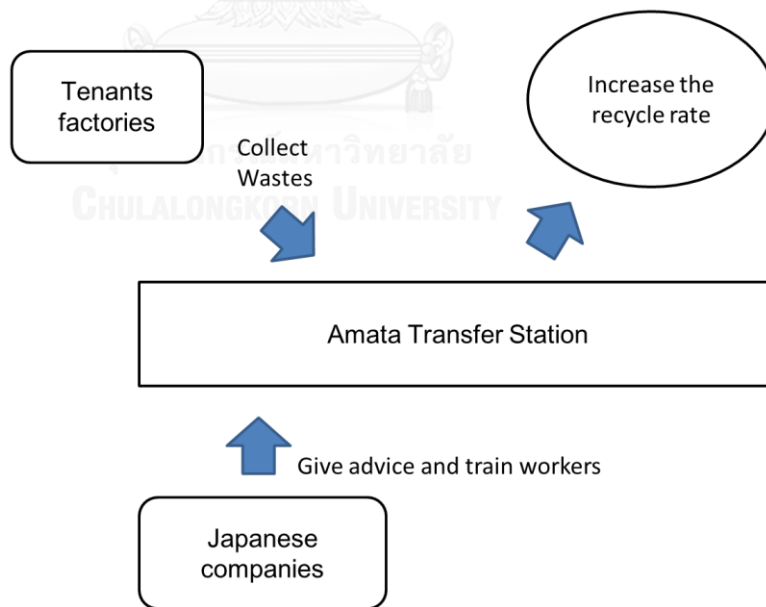


Figure 1.9: OSS project third period

The trial proved that the Japanese method of Kaizen (improvement in English) which enabled to increase the recycle rate without any investment in new equipment or adding extra workers. This technique requires gathering of waste at the front of the factory and assigning each worker to collect certain types of wastes as a group. The Japanese company also instructed to change the way of placing wastes from mountain shape to flat shape and change the workers movement. The Japanese company applied their know-how to improve the work efficiency of workers at waste transfer station. Within two weeks of trial period, the recycle rate had increased to 19% where the original recycle rate was at 10%. After the trial, both parties had a meeting and talked about the result. Further discussion was scheduled to make business plan between two parties.

1.6.3 Problems in OSS project

It is very important to be noted that there was a gap in the purpose of project participation between Japanese OSS working team member and Amata Nakorn industrial estate. Japanese goal was to sell their environmental technologies to Amata Nakorn industrial estate and establish the company and run the business together. This was the goal of the Japanese participants.

On the other hand, Amata Nakorn industrial estate simply wanted to improve and strengthen the waste management within the estate and this idea matches the original intention of the eco-industrial estate development project in Amata Nakorn industrial estate. Amata Nakorn industrial estate was not clearly notified or explained the purpose of the OSS participation of the Japanese side. It seems like the Japanese side did not pay attention to what Amata Nakorn industrial estate really want to accomplish by the eco-industrial estate development project. This gap created distrust against Japanese side.

The Japanese side had a few years of preparation period to study how to

promote Japanese environmental technologies and its related companies into Thailand under the umbrella of eco-industrial estate development project. It was clearly stated in their report published in 2010 called “feasibility study on the development of sustainable economy in Bangkok Thailand in 2010“in Japanese language. In that report, the METI studied how Kansai regions of Japan can export their environmental technologies from Japan under the eco-industrial estate development project in Thailand and Amata Nakorn was chosen for its business potentiality in waste recycle business (more detail in section 1.6.4)

Problems in OSS project operations:

Aside from the Japanese hidden plan of OSS project for Amata Nakorn Industrial estate, the actual OSS project between Amata Nakorn and Japanese side started from scratch. The actual OSS project team needed to find out tenant companies’ problems on waste management and develop the business plan and execute it.

Culture and communication issues for EIP development In Amata Nakorn industrial estate

Japanese company’s involvement in eco-industrial estate development is actually an advantage for Thailand in a sense that Thailand will have an opportunity to study about new technology or/and know-how. However, language barrier and cultural differences limit Japanese expert’s ability to exercise their expertise in the project. For Thai project members, it also reduced their opportunity and quality of learning experience.

Cultural/communication issues affected throughout the One Stop Service (OSS) project especially at the 1st period of the project. The initial period was the most important phase for the OSS business planning.

Communication issues were seen during the project. The language barrier existed throughout the project. From daily communications to formal meetings were

conducted through the presence of interpreters which made both parties sometimes difficult to understand or communicate with each other.

During the OSS 1st phase project, the Japanese companies were unable to have a full understanding about waste laws and regulations or had limited access to wastes related data. The Japanese company had to rely on Thai side to do the information gatherings.

1.6.4 Why Amata Nakorn Industrial estate?

Amata Nakorn industrial estate was chosen over Eastern Seaboard industrial estate by the Japanese government for this OSS project. The METI Kansai report in 2010 stated that the Japanese government set three conditions to select industrial estate. These conditions are;

1. The company must have financial ability as well as the operational ability to realize and promote wastes business.
2. The company/industrial estate must be generated enough wastes/resources within the estates to establish the business and maintain the business operations.
3. The company/industrial estate must be recognized by public and has influence over business communities.

The METI report concluded the reason of choosing Amata Nakorn industrial estate as

1) Management team of Amata Nakorn industrial estate is well motivated and interested in the project and

2) Amata Nakorn industrial estate is currently operating subsidiary company to manage wastes within the estate so that the information gathering could be done smoothly.

3) Amata Nakorn is a biggest industrial estate and accommodates more than 500 tenant companies and over 300 tenants out of 500 are Japanese companies

4) Amata Nakorn industrial estate is established in 1989 and well recognized in Thailand and also selected for Eco-Industrial Estate Development (EIED) project

by IEAT.

Furthermore, in the report, the concept of eco-industrial estate of Thailand was mentioned and compared to the Japanese eco-town concept. Thai concept of eco-industrial estate is aimed to establish sustainable co-existence of industry and community. IEAT established specification of standard and criteria for eco-industrial estate and networks under 5 dimensions and 22 aspects. Under environmental dimension, there are 10 aspects (figure 1.3).

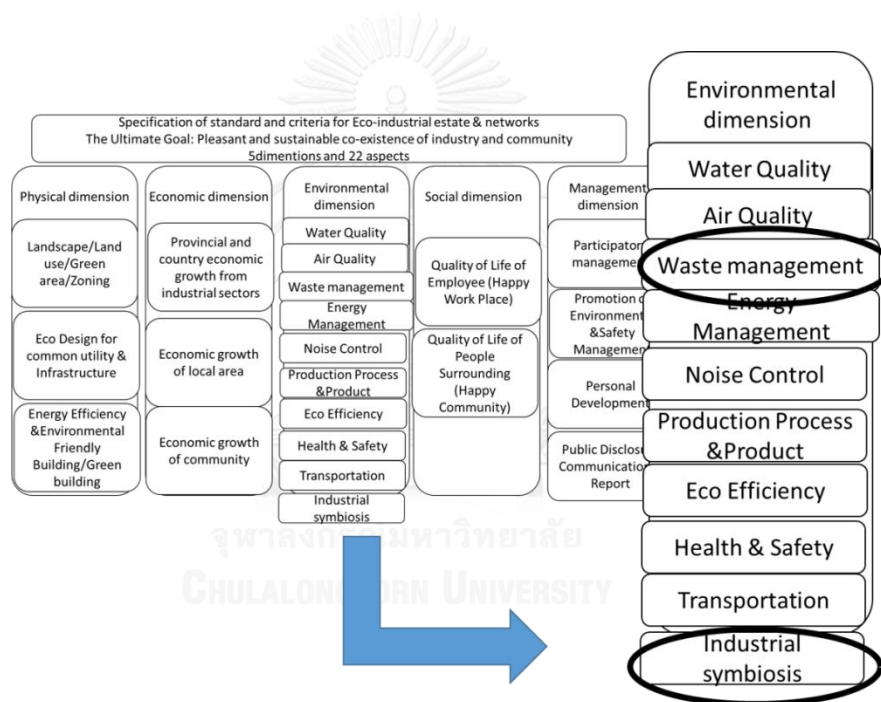


Figure 1.3: Environmental dimension and 10 aspects of IEAT criteria for Eco-Industrial Estate (Arranged and redraw by author: Source: Power Point Presentation: Development of Eco-industrial estate: Technical Panel Discussion 6 by Mr.Somchint Pilouk Deputy Governor of IEAT)

As the figure 1.3 suggest that the Thai eco-industrial estate does not mainly focus on the waste management/recycle aspect like Japanese recycle oriented eco-town concept. There are other dimensions and aspects need to be developed as a whole.

The METI report clearly stated to warn that the concept of Thai eco-

industrial estate is different from Japan. However, the METI report further stated and drew the potential Japanese model of eco-town to be implemented in Amata Nakorn industrial estate such as RF (Reclaiming Fuel) plant technology which generates fuel from wastes developed by the Japanese company who is a member of OSS project. It is not clear whether the Thai side was notified or discussed this fact in advance. It is doubtful whether Amata Nakorn industrial estate or any industrial estates in Thailand would consider investing in those advanced technologies which need to be custom made in Japan and no one in Thailand could operate or maintain the technology without extensive training from the manufacturer. MoU signed on June 2012 stated that the Amata Corporation is in charge of the OSS business plan development and the Japanese side will support the development by providing necessity technology or know-how and so forth. However for the actual project, the Japanese side initiated the project and created the business plan. The reason for this change is unknown.

The Japanese government and Japanese company had their own business plan and idea of the OSS project for Amata Nakorn industrial estate long before the project initiation.

1.6.5 Tenant company visit and interviews within Amata Nakorn industrial estate

Furthermore, Japanese side had difficult time making an appointment with Japanese president of Japanese tenant companies in Amata Nakorn industrial estate. The reason is that even though this OSS project started as the government project, the Japanese expert is an employee of Japanese company and for tenant companies, this is one of many sales calls they receive on daily basis. So this could be one of the reasons why the tenants were reluctant to meet with OSS members. It was not possible to have enough interviews with the tenant companies so Thai project member helped to make appointments and met with the Thai staff who deals with the environmental matters within the organization.

The OSS working team visited 21 tenant companies in Amata Nakorn industrial estate and two waste processors. All the interviews were initiated by the

Japanese expert. First few company visits were conducted solely by Japanese expert and the author. Because the initial purpose of the company visit and interviews were to meet Japanese Managing Directors of Japanese tenants companies in Amata Nakorn industrial estate. As aforementioned, There was a difficulty in making an appointment with MDs and discuss about the current situation and waste problems because some MDs were unfamiliar about environmental management within the organizations. After a few company visit, the project team changed strategy to visit tenant companies with both Thai and Japanese project members. The interviews normally lasted around one hour or more. The Japanese expert introduced the OSS plan and asked what kind of environmental problems tenants' company currently face and what kind of function the OSS business model should have and so forth. The interview had mixed responses. Some interviewed tenants showed high interest while other tenants showed little interest saying they had seen similar projects and had similar interviews but nothing had happened after that.

1.7 Factors affecting OSS development in Amata Nakorn Industrial estate

During the OSS project, several barriers were being identified from the observation. These factors are;

- 1) Institutional factors (regulatory/governmental)
- 2) Financial factors
- 3) Organizational decision-making factors
- 4) Inter-organizational factors
- 5) Cultural/communication factors
- 6) Economic factors
- 7) Political factors
- 8) Technology and information factors
- 9) Socio-cultural factors.

Each factor is explained as follows:

1) Institutional factors (regulatory/governmental):

The OSS team found the regulatory barrier on industrial waste which slows down or reduces the opportunities for waste utilization. The following concerns were found during the OSS project;

I. Environmental regulatory

The OSS business model concerned with the movement of industrial estates within the estates. Current laws and regulations regulating the movement therefore, existing laws and regulations would prevent OSS business model from happening.

II. Government /institution involvement

The OSS project was started between the two government Thailand and Japan however, there was not much support were seen during the project operation.

III. Lack of master plan for eco-industrial estate

There is no clear instruction or guideline to set up waste management function of eco-industrial estate. It is difficult to set a baseline or benchmark to determine what makes eco-industrial estate.

2) Financial factors:

There are financial barriers on the initial investment cost and the operation cost. The cost for commercializing the OSS project is too high.

3) Organizational decision-making factors:

While OSS is conducted by administrative or management level, final decisions will be made by the top managements. Top management usually does not have time to participate nor study the project really well. Therefore, there will be a delay in decision making process and it resulted in the delay in the project.

I. Lack of capacity to commit long-term business partnerships

OSS project is run by the private enterprises. OSS project was considered as high risk business as the concept was new and unfamiliar to Thai side. Therefore, it was difficult to commit long-term business partnership at the early stage of the project.

4) Inter-organizational factors:

Amata Nakorn industrial estate is a collection of tenant companies. Those tenants usually do not interact or engage any activities together. Cooperation and trust between companies are needed to develop overtime in order to conduct activities such as waste exchange. Furthermore, lack of interest of the tenant companies and lack of commitment of stakeholders can be a significant factor for the project initiation. For example, during the OSS project, the OSS project became additional workload for some project members and it was hard for them to commit only on the OSS project.

In addition, there was a shortage of skilled human resources for special project like OSS project.

5) Cultural/communication factors

Since the OSS project was run by the project members from two different countries; Thailand and Japan. Issues in communication problems and difference in business conducts were noticed during the project.

6) Economic factors

Unclear price and no standardized market price for wastes were seen during the interview to tenant companies. Since the waste disposal or treatment fees varies among each waste processors, if OSS project cannot offer the competitive price to tenant companies, the tenants will not be interested in the OSS business

model. Further discount on waste treatment and disposal fee of waste processors will also be a crucial factor for the OSS business operation.

7) Political factors

Political instability of Thailand could affect the policy changes in the environmental regulations and political dispute could affect any project.

8) Technology and information factors

There were lack of transparency on information and data available on wastes. It is possible to find the data of certain types of wastes from the governmental institutions but information was limited. The OSS team found out that the information regarding wastes (i.e. waste amount, types of waste and actual treatment cost etc.) were difficult to obtain. Unavailability of the information affected the development of the project

9) Socio-cultural factors

Lack of social acceptance/lack of environmental concern from both tenant companies and local communities will be an important factor for successful implementation of the project. During the OSS project company visit, all of the visited tenant companies seemed to have high awareness in environmental issues. However, in practice, there is no guarantee that all of the tenant companies will support the project. A location where the OSS facilities are installed might be very sensitive issues among the tenant companies.

The purpose of this study is to find out significant factors that drive the success of the eco-industrial estate project in Thailand. This research aims to explore the existing research and studies of eco-industrial estate and it further examines the country experiences on establishing the eco-industrial estate. The author investigated the factors on the One Stop Service project at Amata Nakorn

industrial estate as a case study. Based on the findings, the author will make a suggestion to develop eco-industrial estate in Thailand. The author participates and observes the OSS project as a project member of Amata facility service and study how the actual project is conducted. This challenge will be the beginning of eco-industrial estate evolution era in Thailand and detailed research will help future transformation of industrial estates in Thailand as well as the neighboring countries.

1.8 Status of Amata Nakorn industrial estate in environmental management

1.8.1 Brief history of Amata Nakorn Industrial Estate

Amata Nakorn industrial estate was established in 1989 and located in Chonburi province. Amata Nakorn industrial estate consisting of 4,120 hectares (25,000 rai, 10,400 acres) and located 57 Km from Bangkok and 42 Km from Suvarnabhumi International Airport and 46 Km from Laem Chabang Deep Sea Port. (<http://www.amata.com>)



Figure 1.10: Map of Amata Nakorn industrial estate & Laem Chabang Deep Seaport etc.,. (Source <http://www.amata.com/site/inside.php?m=locations&p=1>)

Amata Nakorn industrial estate extended its business with the government's policy "The fifth National Economics and Social development plan" (1982-1986) to develop eastern seaboard region and promoting foreign investment into the region. According to Amata Facility service, Amata Nakorn industrial estate accommodating 550 factories within the industrial estates as of 2014.

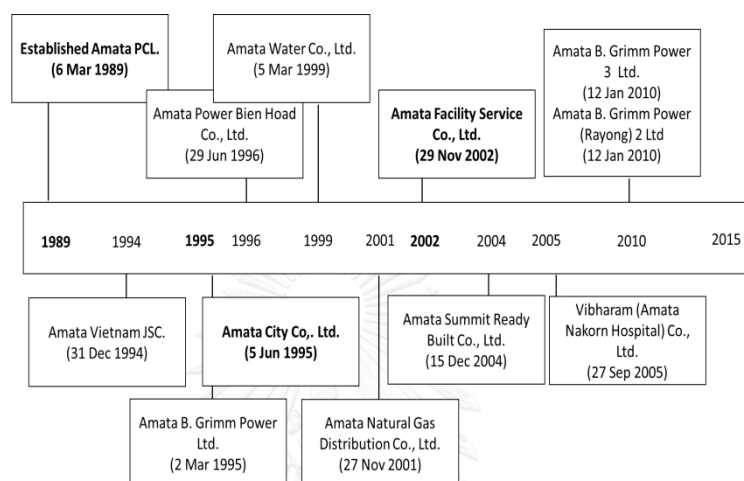


Figure 1.11: Time line of Amata Nakorn industrial estate from the establishment to the present
(Produced by author based on Sustainable development Report 2014 Amata Corporation, 1)

Figure 1.11 describes environmental initiatives of Amata Nakorn industrial estate. Amata Nakorn industrial estate is taking environmental matters very seriously and Amata Nakorn industrial estate trying to improve more. This is one of the reasons why Japanese environmental related companies interested in investing eco-industrial estate development. The environmental initiatives are mentioned in company website. The company has a policy called "zero-discharge" waste management program for waste water. 40% of the reused waste water is used to water green areas, 30% is used to generate power and another 30% is reused as the regular water supply. Furthermore, Amata Nakorn industrial estate runs waste transfer station. Each day 85 tons of solid waste is collected and 70% is burned to produce electric power and 20% is used for sanitary land fill and another 10% is recycled. (Table 1.1)

Table 1.1: Environmental initiatives of Amata Nakorn industrial estate
 (Source: <http://www.amata.com/site/inside.php?m=services&p=9>)

Water	Zero-discharge waste management program for waste water treats and reuses 74,700 cubic meters of waste water per day 40% is used to water green areas 30% is used at on-site power generating facilities 30% is recycled to be used as part of the regular water supply
Solid waste management and sustainable energy producing	Amata's waste transfer station (85 tons of solid waste is collected at Amata's waste transfer station) 70% produce 1.5 MW of electric power per day 20% sanitary land fill; 10% recycled
Energy savings Lighting	LED installation on street lighting

Amata Nakorn has been granted several environmental awards from Thai governmental institutions in the past such as EIA Monitoring Awards 2014 and eco-champion award from IEAT in 2014. The eco-champion award is revised to comply with the IEAT's eco-industrial estate criteria 5 dimensions and 22 aspects to establish sustainable co-existence of industry and community.

Amata Nakorn industrial estate was awarded as eco-champion class 3 which makes Amata Nakorn industrial estate as eco-town under the new certification program set by IEAT. (More details about IEAT 5 dimensions and 22 aspects and eco champion program can be find in chapter2)

As for the environmental practice, Amata Nakorn industrial estate follows environmental dimensions of IEAT. Table1.2 describes what aspects Amata Nakorn

industrial estate already have or working on, according to 10 aspects under IEAT's environmental dimension.

Table 1.2: Comparison of Environmental dimension of IEAT and Amata Nakorn industrial estate

10 aspects of Environmental dimension of IEAT	Environmental activities of Amata Nakorn Industrial estate
Water quality	Zero-discharge waste management program for waste water Environmental monitoring and control center to monitor waste water quality
Air quality	Environmental monitoring and control center
Waste management	<ul style="list-style-type: none"> ● Amata's waste transfer station ● Waste date management Center in Industrial estate level ● Environmental monitoring and control center for waste quality
Energy Management	<ul style="list-style-type: none"> ● LED installation on street lighting and generating energy from waste
Noise Control	<ul style="list-style-type: none"> ● Environmental monitoring and control center
Production process & product	X
Eco-efficiency	<ul style="list-style-type: none"> ● IEAT waste management award to promote 3Rs in tenant companies in Amata Nakorn industrial estate in 2014
Health and Safety	<ul style="list-style-type: none"> ● Safety and Environmental in Industrial estate club ● Fully integrated Flood Management system
Transportation	<ul style="list-style-type: none"> ● Traffic Control System Management
Industrial symbiosis	X

Note: X indicated there is no information or No activities found in Amata Nakorn industrial estate

The above table suggests, Amata Nakorn industrial estate need to work on “Industrial symbiosis” concerning resource utilization; (i.e. waste recycle/waste exchange and 3R) as a next target to cover the 10 aspects of environmental dimension along with the waste management of industrial estate. As “production process & product” concerns more about tenant companies themselves not the industrial estate operator, this can be a next target after industrial symbiosis/waste management.



CHAPTER II: LITERATURE REVIEWS

2.1 Eco-industrial estate concepts and background

Attention for eco-industrial estate (EIE) development projects had grown enormously among national and regional governments and industries in many countries. It is believed that a well-planned, functioning EIE has the potential to both benefit the economy and substantially relieve environmental pressure in and near the location of its development (R.R. Heeres, Vermeulen, and Walle 2004). Currently, in North America and Europe, there exist many eco-industrial development projects and many of their outputs are quite promising (Chiu and Yong 2004). On the other hand, in developing countries, eco-industrial development is relatively a new concept. Developing countries will continue to serve as testing grounds for the concept and will continue to confront the difficult challenges of sustainability (Chiu and Yong 2004).

Since the success of Kalundborg industrial symbiosis project/eco-industrial estate in Denmark and the introduction of industrial ecology concept, the planned eco-industrial park development project has grown all over the world. (R.R. Heeres, Vermeulen, and Walle 2004). The Kalundborg eco-industrial estate was not planned or designed by either government or enterprises as an eco-industrial estate development. They gradually evolved over a number of decades when the participants discovered that the establishment of energy and waste exchanges resulted in economic benefits for all parties involved (R.R. Heeres, Vermeulen, and Walle 2004). In recent years, several research identified past successful case of industrial estate development through spontaneous action of enterprises to build a network of industrial symbiosis, can be designed thorough the implementation of policy by the government. In Kalundborg eco-industrial estate, the spontaneous approach was possible because of the active interaction and communication among community and enterprises were existed. This literature review focus on the latter experience of policy-led eco-industrial estate development approach because in recent years, communication

between the enterprises were seen less and it is not realistic to wait until industrial estate transform itself into eco-industrial estate.

There are various terms used to represent the concept of eco-industrial development; eco-industrial estate (EIE) or eco-industrial park(EIP), eco-industrial networks (EIN), networked eco-industrial parks, integrated eco-industrial parks(Chiu and Yong 2004). The term “eco-industrial park” is widely used among international researchers to identify eco-industrial development. Some researchers such as Tudor (2007) argues that one of the best definitions of an EIE has been provided by the USEPA (United States Environmental Protection Agency). It defined EIE as,

“A community of manufacturing and service businesses seeking enhanced environmental and economic performance by collaborating in the management of environmental and reuse issues. By working together the community of businesses seeks a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only. The goal of an EIP is to improve the economic performance of the participating companies while minimizing their environmental impacts. Components of this approach include green design of park infrastructure and plants (new or retrofitted); cleaner production, pollution prevention; energy efficiency; and inter-company partnering. An EIP also seeks benefits for neighboring communities to assure that the net impact of its development is positive (Lowe, 2001).”

This definition is broadly accepted by international researchers in the eco-industrial development field (i.e. Chertow, Rosenthal) and it matches the concept of eco-industrial estate development in Thailand. Therefore, USEPA’s eco-industrial estate definition will be applied in this research. In addition, Japanese researcher (Meiji University Research Institute 1978) studied development of industrial estate in 1970s that the term “industrial park” is commonly used in the USA while the term “industrial estate” is widely used in England. It further noted that the term “industrial park” and “industrial estate” shares the same notion. In this research, the term eco-industrial estate is applied as Industrial Estate Authority of Thailand (IEAT) uses the

term “eco-industrial estate”.

2.2 Industrial ecology and industrial symbiosis

Eco-industrial parks are a major application of the industrial ecology (IE) and industrial symbiosis (IS) concepts (Veiga and Magrini 2009). These two concepts are the key concepts underlying the eco-industrial estate development. Veiga argues that Industrial ecology (IE) has emerged over the past years as a potential guide to create opportunities for improving environmental and business performance, and for restructuring the industrial system in compatible fashion with notions of sustainability. Frosch and Gallopoulos (1989) defined industrial ecology as,

“IE looks at the flows of natural resources from extraction through manufacturing, product use, reuse, and return to the environment and examines the combined effect of all these steps on the environment.” (Frosch and Gallopoulos 1989).

Furthermore, Chertow defined industrial symbiosis (IS) as,

“Industrial symbiosis, as part of the emerging field of industrial ecology, demands resolute attention to the flow of materials and energy through local and regional economies. Industrial symbiosis engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and/or by-products. The keys to industrial symbiosis are collaboration and the synergistic possibilities offered by geographic proximity.” (Chertow 2000).

The concept of eco-industrial estate (EIE) used to be the only concept of developed countries in the past but now the EIE concept is being spread in developing countries as a way to realize sustainable development. Chiu and Yong argues that there is some encouraging evidence that eco-industrial development is beginning to yield positive benefits in developing nations. However, there are still many barriers and difficulties because the developing countries have different political, economic, and environmental and resource constrains than the economies in developed countries

(Chiu and Yong 2004). They further emphasize that developing nations need to revise and craft suitable strategies to put industrial ecology into place, instead of using the models developed for developed countries.

2.3 International experience of eco-industrial estate development and factors Impact on the development

Problems of industrial pollution and economic down-turn were seen behind the development of eco-industrial estate in some countries. Later the governments see the opportunity in economic revitalization through the eco-industrial estate development.

Sakr et al conducted extensive literature review on eco-industrial development projects' experiences around the world. They examined various industrial symbiosis (waste exchange) experiences worldwide and identified the critical driving and limiting factors for EIPs. The key success factors were identified as

- 1) The creation of symbiotic relationship
- 2) Information sharing and awareness
- 3) Financial benefits
- 4) Organizational structure
- 5) Legal and regulatory framework (Sakr et al. 2011).

International researchers are investigating the eco-industrial estate development around the world and studies on Asian countries are increasing trend. This section explore some of the international experiences from the existing studies; Western (USA and the Netherlands) experiences in eco-industrial estate development, Japanese eco-town experience (Japanese term of eco-industrial estate), Chinese experience and progress in eco-industrial estate development and Korea's experience in eco-industrial estate development.

2.3.1 Eco-industrial estate development in the USA and the Netherlands

Heeres et al compared the USA and Dutch eco-industrial estate development project and research result identified Dutch's case is more successful than the USA. Factor behind successful development for Dutch was

1) The active participation of companies. The companies located close to the project are willing to invest, money and other resources in the development. (R.R. Heeres, Vermeulen, and Walle 2004).

2) The presence of association played very important role to be an effective platform to educate and inform companies of the potential benefits that can be achieved through the project participation. The association functioned as a communication platform between participants (R.R. Heeres, Vermeulen, and Walle 2004).

There are factors which made different outcomes such as objectives, initiator, public participation, financing, local champions and material exchange. The details are as follows;

a) Objectives

Most noticeable difference was the objective the project. Study mentioned the American objective focused on the creation of family wage jobs for local population. The economic factor was more valued than the environmental factor of the project. In the Dutch cases the projects are initiated to improve both economic and environment of participated companies. These differences affected the outcomes of the project.

b) Initiator

For Initiator of the project, in the Netherlands, entrepreneurs'/employers' association took initiatives on the project development and worked closely with the government. On the other hand, the research identified in the USA, the local or

regional government initiates the project and the local/regional government seemed passive throughout the project. The research stated this passiveness comes from the industry's distrust toward the government project in the USA.

c) Public participation

As for the public participation, more active participation of local community and NGOs were seen in the development in the USA than in the Neverland's. The US project management encourages community involvement in the project development to exchange ideas for the development. In the Netherlands, the community involvement is not encouraged and the development process is limited to the government and participated companies. The study did not state which case was more benefitted the project development.

d) Financing

More financial participation in eco-industrial estate development were seen in Dutch case than US case. As American development project is normally the government initiated project and the government bear the cost. While the Dutch project, the project were initiated by the companies and the government so the planning cost is shared 50% for the government and other 50% for the companies. Heeres et al. recommended that the project should not be initiated solely by the government, the companies should financially committed to the project development.

e) Local champions

In both cases, USA and the Netherlands, the local champions or anchor tenants were absent. For Dutch case, there is no need for tenant to fill the role of local champions because the association acts as the local champion to lead the project. The research did not mention the absence of the local champions affected the final result of the project development.

f) Material exchanges

The study identified that the establishment of material exchanges are not the most important features of an (initial) EIP development. (R.R. Heeres, Vermeulen, and Walle 2004). In Dutch cases, the development was focused on pollution prevention project with utility sharing. Dutch case identified such projects is low risk projects with a potentially substantial economic and environmental benefit. After the project was successfully implemented, the project can move further and implement more high-risk activities in the development.

Heeres et al. suggested that the above six factors were the important factor that the future eco-industrial estate development project should take into consideration.

2.3.2 Japan's experience on Eco-industrial estate development

Japanese eco-town was first evolved in Japan in 1997 for two reasons. One is to revitalize local economy and second is to solve waste problems.

Japanese eco-town concept promote designed symbiosis networks based on eco-town program developed by the government.

After the bubble economy collapsed in Japan in 1990s, there was an urgency to remodel social and industrial structure and construct environmental conscious town through cooperation between the government, industries and local communities. Japanese eco-town project was based on zero-emission and 3R concepts (reduce, reuse and recycle). After 15 years since the first eco-town was established in Japan, there are 26 eco-towns all over Japan. (Ministry of Economy Trade and Industry (METI) 2010). There are four factors which supported eco-town development in Japan. These factors are;

- (1) Well-designed eco-town project initiated by the national and the local governments with attractive subsidy by both METI (Ministry of Economy, Trade and Industry) and MOE (Ministry of Environment).
- (2) The government's legislative support for eco-town development.
- (3) Companies commitment in eco-town project.
- (4) Social awareness and initiatives to the environmental activities.

Figure 2.1 explains the roles of the national and the local government in well-designed eco-industrial town project. The national government implements fundamental policies and support systems. The national government approves or disapproves the plan submitted by local governments. The national government offers two types of subsidies; hardware and software subsidies. The hardware subsidy is for construction of recycle and reuse facilities and subsidize 1/3 of the total project cost. The software subsidies is for eco-industrial town planning and maximum of 50% of the cost is subsidized. The local governments played central role to create the eco-industrial town action plan. The action plan should take an advantage of the local characteristics and meet certain standard of originality and innovativeness. The plan also has to connect local citizens and local industries to participate. METI and Ministry of Environment jointly approved 26 eco-towns all over Japan. (Global Environment Center Foundation (GEC) 2006)

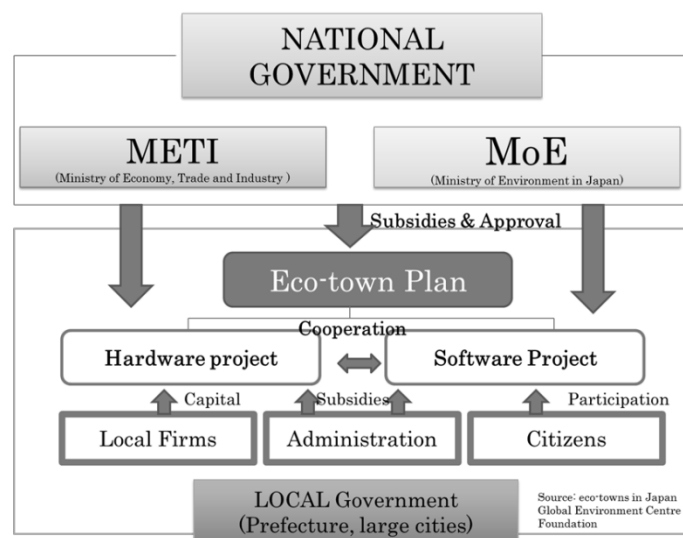


Figure 2.1: Framework of eco-town in Japan redrawn by the author,

(Source: GECF 2006)

2.3.3 China's Experience on Eco-industrial estate development

China has more than 1500 industrial estates and there was a conflict between economic growth and natural resource shortages with heavy pollution. Now China faces very serious environmental concerns such as chemical oxygen demand (COD) and sulfur dioxide (SO₂) emissions reduction, and reduction of solid waste and hazardous waste generation. (Tian et al. 2014) As a solution for this, China applied the eco-industrial estate concept of developed countries to solve these problems. Chinese government proposed two programs namely, EIP (Eco Industrial Park) demonstration project and CE (Circular Economy) program and later two programs were renamed as National Pilot EIP Program (NPEIPP) and National Pilot Circular Economy Zone Program (NPCEZP) respectively.

Chinese demonstration EIP program is an economic- and environmental-driven initiative rather than solely an environmental program (Shi, Tian, and Chen 2012).

Based on two programs, two different management systems have been formed and all together 60 zones approved, including 1 national demonstration EIPs and 45 national trial EIPs (Shi, Tian, and Chen 2012). As of May 2013, 20 development zones had been accredited as the national demonstration EIPs in China, while another 61 ones listed as trial EIPs. (Tian et al. 2014) Most of the Chinese national demonstration EIPs are based on retrofitting of well-developed economic development zone and high-tech development zones (Shi, Tian, and Chen 2012).

In China, the Park Administrative Authority (PAA) takes the responsibility for EIP development. Technologies and capability barriers are two key issues for EIP development (Zhu et al. 2015). Zhu et al. further identified that the tenant companies develop their own environmental technologies to deal with the environmental problems; however, the internal capabilities to develop and control energy use and pollution reduction remains difficult.

Progress of Eco-industrial estate in China

In China, there are continuing research on eco-industrial development is in progress to answer how the development effort in environmental activities in eco-industrial development, such as environmental management, industrial symbiosis, energy saving and emission reduction are actually effective in figures.

Reduction of air pollution has been one of the major targets of environmental protection in China for a long time. The central government had imposed a mandatory policy to reduce COD and SO₂ emissions by 10% over the past 11th Five-Year Plan period (2006 to 2010), and continued to enforce a mandatory of 8% abatement for both COD and SO₂ between 2011 and 2015. Pursuing a significant reduction of waste emissions both in quantity and intensity is a significant hallmark of the Chinese national demonstration EIP program. (Shi, Tian, and Chen 2012)

After 10 years of Chinese national demonstration eco-industrial park program, Tian et al assessed the economic and environmental performance of 17 national demonstration eco-industrial parks in China. The research indicated that there was a significant improvement in economic and environmental performance. Most of the 17 eco-industrial parks achieved decrease in pollution emission intensity, resource consumption intensity. However, fresh water consumption, solid waste generation production, and waste water generation still need improvement and further reduction. (Shi, Tian, and Chen 2012)

Detailed results were showed in the research;

11 out of the 17 EIPs accomplished 25% reduction on average on COD emissions. 8 out of the 17 EIPs accomplished decrease in solid waste generation. Two EIPs achieved 74% and 51% reduction respectively. However, other two industrial estates resulted in increase in waste generation by 164% and 125% respectively.

Tian et al. identified the important supporting aspects in eco-industrial development in China as follows;

a) Laws

The laws played important role for Chinese EIPs. The Chinese government imposed the Cleaner Production Law to enterprises to regulate the amount of pollution emissions. According to this law, the enterprises having pollution emissions exceeding certain level must carry out cleaner production audits mandatorily (Shi, Tian, and Chen 2012)

b) Energy audit

Cleaner production audit, ISO 141001 certification and energy audit are very popular to improve the environment performance within the organization.

c) Infrastructure sharing

Some of the enterprise exercise infrastructure sharing such as cogeneration of heat and power (CHP), to reducing both the amount and intensity of SO₂ emissions. Fifteen EIPs equipped with CHPs, therefore, infrastructure sharing plays key part in EIP development in China.

d) Energy savings

Energy-savings at the firm level were necessary for eco-industrial development. Chinese enterprises are making effort in energy saving practice by installing the technologies such as waste heat recovery, green lighting such as using LED and upgrading equipment.

The study also found out five industrial estates accommodating more fortune Global 500 companies than others produce lower level of pollution. The reason is that the Fortune Global 500 companies have their own environmental policy and strict

regulation within their organizations than other companies. However, most of other companies still need improvement in environmental performance especially in reducing pollutant emissions and solid waste generation.

Furthermore, China also understands that they need to develop different strategies to transform different types of industrial estate into eco-industrial estate. For example, a coal-chemicals industrial park in Inner Mongolia, are planning to implement EIPs from the scratch (Shi, Tian, and Chen 2012). There is no one concept of eco-industrial estate fit into all the industrial estates even within the same country.

Tian et al. thinks there is still a long way ahead of Chinese industrial estates to transform eco-industrial estate and the lesson from this Chinese national demonstration EIP program will make a meaningful contribution to the newly established EIPs and disadvantages found in the previous development will help the authorities to improve the EIP development plans. (Shi, Tian, and Chen 2012)

2.3.4 Korea's experience on Eco-industrial estate development

In Korea, Ulsan city was selected to be a special industrial district in 1962 as Korean government plans to develop heavy industry such as oil refiner and automobile manufacture. Several industrial complexes were established without paying much attention to the environmental issues at that time. As a result, large amounts of pollutants were discharged and damaged local communities. As a result, Korean government decided to improve the quality of the environment and solve environmental problems in the industrial park and government established EIP master plan in 2005. The Korea National Cleaner Production Center (KNCPC) affiliated to the Korea Institute of Industrial Technology (KITECH) has started a 15 year, 3-phase EIP master plan with the support of Ministry of Commerce, Industry, and Energy (MOCIE)(Park et al. 2008)

Kim (2007) investigated the actual development of an eco-industrial park in South Korea in the Macheon Industrial Park of Jinhae, Gyeongnam. Kim identified barriers are the sharp gaps between the expectation of EIPs from the stakeholders and the original intention of EIPs. There was a problem of odor and the EIP project

unsuccessfully deals with the needs of stakeholders to solve odor problem because of technical, economic, and social obstacles. Furthermore, the government applies regulation-based approach rather than incentive program which could be the reason the project was unsuccessful. Furthermore, Kim mentioned that the public authorities lack clear vision and strategies toward the development (Kim 2007). Kim argued the Korean government need to participate more actively for successful EIP development in the future.

Other study investigated eco-industrial estate development project in Ulsan Korea. Behera et al. (2012) examined framework for the effective expansion of symbioses in the industrial complexes. Behera et al. stated that the development of self-organized symbioses has been more successful in the past toward eco-industrial estate development. However, without the effective communication method between the enterprises, systematic approach such as developing Ulsan EIP center in 2007 to design the symbioses is effective.

Based on this framework, the Ulsan EIP center has so far facilitated forty symbioses, out of which thirteen networks are currently in operation, twenty are under negotiation and/or design, and seven are under feasibility investigation/evaluation. (Behera et al. 2012). For Ulsan EIP project, an academic researcher plays very important role in bring people and organization together into the project and also encourage building a good relationship among participants.

Behera et al. believes the development of ‘designed’ symbiosis networks seemed to be durable and resilient as they are technically possible, economically feasible, environmentally neutral or positive and socially adaptable (Behera et al. 2012). The research recommended similar approach by developing center to promote symbiosis networks elsewhere to help develop eco-industrial estate.

2.4 Development of Eastern Seaboard region of Thailand and industrial estate development in Thailand

The economic growth slowed down in the late 1970s in Thailand. There was an urgent need for change in economic strategy in agricultural export to manufacturing export. Eastern Seaboard Development Program became a national priority during the premiership of Prem Tinsulanond (Gavin Shatkin 2004). At that time the government started to change economic strategy to manufacturing export and Eastern Seaboard was chosen because of its ideal location. The Thai government promoted the Fifth National Economic and Social Development Plan with the support from Japanese government in 1980s to develop Eastern Seaboard region. As a result of such development, a deep-sea port were built at Laen Chabeng and U-thapao Airport was redeveloped. The Industrial Estates Authority of Thailand (IEAT) has developed 12 industrial estates in the region (Gavin Shatkin 2004)

The result of these developments has created rapid industrialization, and the Developed Bangkok-Chonburi highway more than 100 kilometers from central Bangkok to Rayong province.

The three Eastern Seaboard provinces Eastern Seaboard provinces have received some \$40 billion in FDI since the initiation of the project, including almost \$20 billion during the period from 1995 to 2000, and that 460,000 jobs have been created.(JICA) 2000)

a) Status of Eco-Industrial Estate in Thailand

The development of eco-industrial estate (EIE) in Thailand commenced in 2000 under the initiative “The Development of Eco-Industrial Estates and Networks” or DEE +NET. Five industrial estates were selected as pilot locations for the introduction of various EIE concepts: the MapTa Phut, Bang Poo, Northern Region, Eastern Seaboard, and Amata Nakorn Industrial Estates (Verawat Panyathanakun et al.

2013). Moreover, the Department of Industrial Works (DIW) announced that the provincial industrial offices; Rayong, Patum Thani, Chonburi, Ayutthaya and Sara Buri and 9 industrial zones and parks have joined to establish an ecological industrial network and plan to establish sustainable eco-industrial complex by 2018 (<http://thainews.prd.go.th>).

2.4.1 Concept of Eco-industrial Estate Development in Thailand

IEAT has a vision of becoming ASEAN's top three organization in development and management of industrial estate and building the eco-industrial town with equilibrium and sustainability (**figure 2.2**)

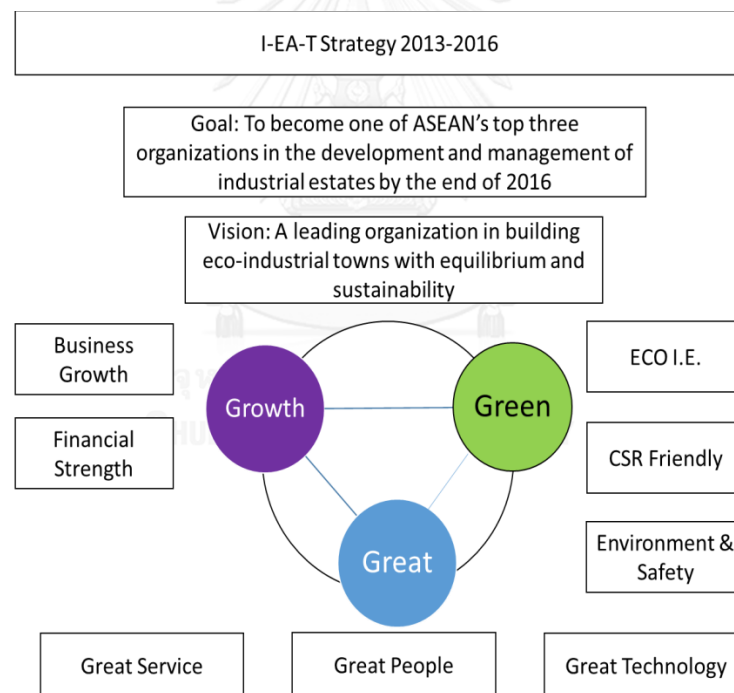


Figure 2.2: IEAT Strategy for eco-industrial estate development 2013 to 2016
(Source: redrew by author: Annual report 2014, downloaded IEAT, 20)

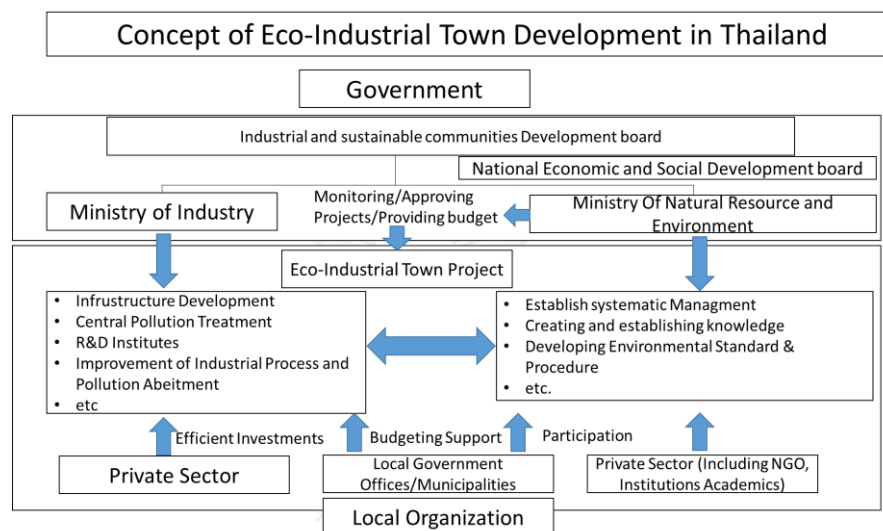


Figure 2.3: Concept of Eco-industrial Estate Development in Thailand

Redraw by Author Source: Next step for eco-industrial estate development in Thailand by Verapong Chaiperm Deputy Governor (industrial port), Industrial Estate Authority of Thailand.

Figure 2.3 describes the concept of eco-industrial estate in Thailand. IEAT applied some of the basic concept of Japanese eco-town into Thai concept. Thai concept focuses on the co-existence of sustainable industry and community. There are some similarities in the Japanese eco-town concept and Thai concept as IEAT used Japanese concept as example to develop the framework.

Furthermore, according to the Bangkok post issued on 30/Jan/2014, IEAT hired German consultant to help develop eco-industrial estate. German consultant stated most challenging part of his job is to explaining the concept of eco-industrial

estate as no model exists. IEAT takes several approaches to explore the best possible way to develop the best eco-industrial estate development concept for Thailand.

2.4.2 Criteria for building eco-industrial estate development

Thai concept of eco-industrial estate is covering broader aspect while international experience focus on resource utilization and pollution control. From this perspective, Thailand cannot just apply international experience of eco-industrial estate development to realize IEAT’s concept of eco-industrial estate. International experience will benefit to improve some aspects of environmental dimension of eco-industrial estate in Thailand but Thailand need to find their own way for other aspects of eco-industrial estate development.

IEAT has set a goal to transform all the existing industrial estate into eco-industrial town by 2019. (IEAT report) In year 2014 IEAT reviewed the criteria for eco-industrial estate (5 dimensions and 22 aspects).

IEAT has set up criteria for eco-industrial development. There are 5 dimensions and 22 aspects to be considered in eco-industrial estate development (figure 2.4).

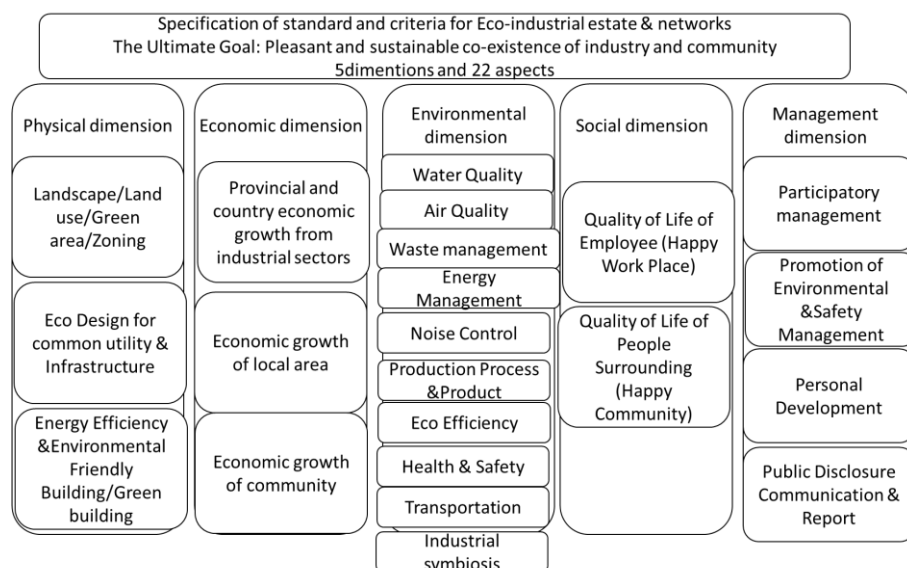


Figure 2.4: Dimensions and 22 aspects of eco-industrial estate & networks by IEAT
 (source: redraw by author: P.P. Presentation: Development of Eco-industrial estate:
 Technical Panel Discussion 6 by Mr.Somchint Pilouk Deputy Governor of IEAT
https://www.unido.org/fileadmin/user_media_upgrade/Media_center/2013/News/Green_Industry_Conference/Somchint_Pilouken_.pdf

Thai Concept of Eco-industrial estate not only on environmental management. Environmental dimension emphasizes on efficient utilization of resource and energy in production process, promotion of environmentally-friendly products and waste reduction. Physical dimension focuses on how to improve infrastructure, public utilities and facilities. Economic dimension aims to promote local and provincial economy. Social dimension focuses on the well-being of individuals in the organization and community. Management dimension focus on the effective management of the industrial estate.

Furthermore, IEAT developed environmental award program for eco-industrial estate development in 2012. The award program has three levels; Eco-Champion, Eco-Excellency and World Class.

In 2014, IEAT revised and reviewed some indicator of the requirement for Eco-Champion and also changed Eco-Champion, Eco-Excellency and World Class award program into one Eco-Champion award with three different levels to reflect with aforementioned 5 dimensions and 22 aspects.

Eco Champion award is given to the industrial estate which demonstrates outstanding effort to protect environment and support local communities.

IEAT prepares master plan for each applicants. For the masterplan preparation, the IEAT invites local stakeholders to discuss and share ideas to develop master plan which is acceptable with local communities.

In 2014, 12 industrial estate applied and all of the 12 industrial estate were certified as eco-champion class 3 (3 indicated the highest rank) by IEAT. The certified industrial estate included the Northern Region, Bang Pu, Eastern Seaboard (Rayong), Laem Chabang, Amata Nakhon, Nong Khae, Bang Chan, Samut Sakhon, Amata City, Lat Krabang, Bang Phli and Bang Pa-in Industrial Estates. (Industrial Estate Authority of Thailand (IEAT) 2012).

IEAT is also working on to develop eco-center at Map ta Put industrial estate. The eco-center aimed to distribute and share information on eco-industrial estate operations and also to distribute the eco-town concept around the regions and provide the learning enter for both local and international levels to promote eco-town concept. For this project, IEAT signed MOU with a city of Kitakyushu of Japan. Kitakyushu city has a history of suffering heavy industrial pollution problem in the past and with their expertise, Map Ta Put.

Eco-industrial estate development in Thailand is a trial and error stage. Thailand need to prioritize which dimensions of eco-industrial estate should be developed first and need further investigation on problems in industrial estate and nearby communities. Having very broad concept of eco-industrial development concept as oppose to other countries will make more difficult for Thailand to develop a roadmap and transform existing industrial estate into eco-industrial estate.

CHAPTER III: METHODOLOGY

This research employs following approach to examine aforementioned research questions.

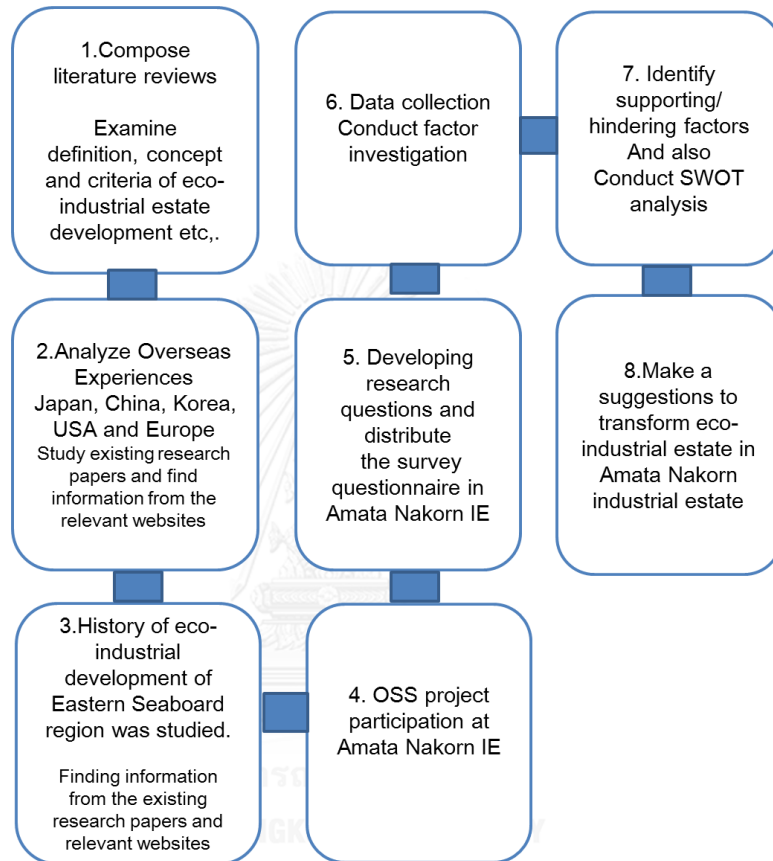


Figure 3.1: Work flow of research methodology

3.1 Research methodology

For this study, the following method will be applied.

(1) **First**, the literature reviews identify the definitions and concepts of eco-industrial estate. Relevant research papers, publications and information from the Thai government (i.e., Development of industrial works and IEAT etc.) will be analyzed in order to get in depth information of eco-industrial development. It further

examines that the development and implementation stage of eco-industrial estate, what factors impacted the development and roles of stakeholders. Source of information will come from existing research papers, publications and government websites.

It further identified concept of eco-industrial estate development in Thailand and criteria for Thai eco-industrial estate were investigated

(2) **Second**, it further examines the status and international experience of eco-industrial estate development. Five countries will be featured namely, Japan, USA, Europe (the Netherlands), China and Korea. The data will be gathered from the research database as well as the government website of each country.

(3) **Third**, the history of eco-industrial development of Eastern Seaboard region will be studied. This information will be collected from the relevant research papers, publications and websites of IEAT and Ministry of Economy, trade and Industry of Japan. In addition, the interview to IEAT officers will be conducted.

(4) **Forth**, One Stop Service (OSS) project at Amata Nakorn industrial estate will be used as a case study and research and information gathering were conducted while the author was participating the OSS project (Nov/2012 to March/2013, 1/June/2013 to 15/July 2013, 28/April to 9/May/2014). The information were collected through the company visits during the OSS project participation and the author also distribute the survey questionnaire to all the tenant 550 companies in Amata Nakorn industrial estate to investigate factors.

The company information of Amata Corporation, Amata facility service and also the history, management policy and operation strategy was examined from the company website and booklet. Other key issues such as business operation and current status of eco-industrial estate development and collaboration with international investors were also studied on-site.

(5) **Fifth**, research questionnaire was distributed from April 2014 to August 2014. The OSS project aims to establish One Stop Service (OSS) center within Amata Nakorn industrial estate. OSS aims to strengthen waste management and improve waste utilization by providing solutions to tenant companies.

The first period of the OSS project started in November 2012 through March 2013 and the second period of the project One Stop Service (OSS) trial project started from 1 June 2013 to 15 July 2013. Third period of the project aimed to increase recycle rate of wastes started on 28 April to 9 May 2014.

(6) **Sixth**, factor investigation of OSS project was conducted by the data derived from a questionnaire survey and the result was identified by using statistical result. In each question, the respondents were asked to evaluate the degree of importance/significance to factors. Investigation of factors identifies key factors that are supporting or hindering the project. Thailand needs to develop its own strategy for eco-industrial development. Research questionnaire was developed based on interviews while the author was attending the OSS project. By investigating factors, Amata Nakorn industrial estate will be able to find out what factor support/hinder the OSS/eco-industrial estate development project. Therefore, this research investigates factors to examine OSS project at Amata Nakorn industrial estate.

(7) **Seventh**, the statistical result derived from the survey questionnaire identifies key factors supporting and factors hindering the success of developing eco-industrial estate in Amata Nakorn industrial estate. By using these factors and research participation experience and observation, the author conducted SWOT analysis and TOWS analysis to generate strategies for eco-industrial estate development in Amata Nakorn industrial estate.

(8) **Eighth**, make suggestions to transform Amata Nakorn industrial estate into eco-industrial estate by using the research results as well as the observation and experience from the author's participation to the OSS project.

3.2 Formulation of key topics in questionnaire

The survey questionnaire was developed based on the interviews during the tenant factory visits in Amata Nakorn Industrial estate during the OSS project first period described in chapter1. During the company visit with the OSS project members, several issues were identified. Based on the findings, the author created 7 sections as follows,

- 1) Background of questionnaire respondents
- 2) Problems of environmental management in factories and the estate
- 3) Tenants' attitude towards environmental management system
- 4) Tenants' attitude towards environmental management activities
- 5) Components of Eco-industrial estate in Amata Nakorn Industrial Estates' context
- 6) Characteristics and strength/significant factors of Amata Nakorn Industrial estate
- 7) Status of One Stop Service (OSS) project

All questions are measured by 5 scales and 1 to 5 scales used to identify the importance/agreement to each statement. In the first section, the background of the respondents were asked such as what is the nature of business of your company, what is the job description of respondents and how long have the respondents working for the current position and so forth.

In the second section, the questions were asked to identify the current problems in environmental management in tenant factory and the estate. The questions regarding waste management and waste processors were asked to identify

the problems. For example, the questions like whether the tenant factory is having difficulty in finding waste processor for specific types of wastes or other questions like if the tenants are having difficulty in finding reliable waste processors were being questioned.

In the third section, the questions were asked to measure the environmental awareness of the tenant companies and to understand what motivate tenants to pursue the environmental certification program like ISOs.

In the fourth section, tenants were asked to evaluate what kind of environmental activities within their organization is beneficial to their overall environmental performance.

In the fifth section, the questions were asked to understand tenant's attitudes towards eco-industrial estate transformation in Amata Nakorn industrial estates.

In the sixth section, the questions were asked to identify whether the tenants agree or disagree with the given 15 factors which may be considered as strength/significant factors that affect eco-industrial estate transformation in Amata Nakorn industrial estate.

In the seventh section, the questions were asked to measure tenants' willingness of participation to OSS project. The question was further asked whether the additional service option is needed for OSS, what is the effective promotion and announcement method and who should be a facilitator and a supporter to the OSS project and so forth.

3.3 SWOT analysis

SWOT analysis and TOWS analysis were conducted to generate strategies for eco-industrial estate development in Amata Nakorn industrial estate.

A SWOT analysis was originated from the business management literature and was adopted in the 1980s by public administration across area as regional development and municipal planning (Markovska, Taseska , and Pop-Jordanov 2009). By considering these strengths, weaknesses, opportunities and threats, a project coordinator can deal more effectively with the problems that are likely to come up, and look at ways and means of converting the threats into opportunities, and off-setting the weaknesses against the strengths. This analysis could be undertaken for any idea, organization, person, product, program or project (Johnson et al., 1989).

The result of Strength, Weaknesses, Opportunities and Threats were examined by the methods is called TOWS Matrix (TOWS is another way of saying SWOT) as shown figure 3.1. The TOWS Matrix illustrates how the external opportunities and threats facing a particular corporation (or project) can be matched with that company's internal strengths and weaknesses to result in four sets of possible strategic alternatives (Wheelen and Hunger 2000).

TOWS Matrix: (Source: p112. Strategic Management Business Policy)

EXTERNAL FACTORS (EFAS) 	INTERNAL FACTORS (IFAS) Strengths(S) List internal strengths here	Weaknesses (W) List internal weaknesses here	
	Opportunities (O) List external Opportunities here	SO Strategies Generate strategies here that use strengths to take advantage of opportunities	WO Strategies Generate strategies here that take advantage of opportunities by overcoming weaknesses
	Threats (T) List external threats here	ST Strategies Generate strategies here that use strengths to avoid threats	WT Strategies Generate strategies here that minimize weaknesses and avoid threats

Figure 3.1: TOWS matrix Redraw by author
 (Source: Strategic Management Business Policy, 112)

In the TOWS Matrix, first, list the Opportunities in (O), Threats in (T), Strength in (S) and the Weaknesses in (W). After that process, series of possible strategies will be generated based on particular combination of the four sets of strategic factors. These are SO strategies, ST strategies, WO strategies and WT Strategies.

TOWS matrix is only one of many ways to generate alternative strategies. Another approach could be taken into consideration for this research. Furthermore, it is important to mention that SWOT analysis has its limitations. SWOT produces too many ideas and factors however it does not identify which factor is the most and least important. SWOT can help us identify Strength, Weakness, Opportunity and Threat but it does not provide solutions.

The outcomes of SWOT analysis will be studied further to suggest the guideline of future eco-industrial estate development in Amata Nakorn industrial estate

3.3 Questionnaire preparation/distribution

The 550 set of survey questionnaires were prepared and 200 set were prepared as a backup as recommended by Amata facility service. The survey questionnaire was distribute to all the 550 tenant companies in Amata Nakorn industrial estate on behalf of Amata Facility Service through April 2014 to August 2014.



Figure 3.2: Questionnaire preparation/distribution

Survey questionnaires were distributed during the waste award seminar in Amata Facility Service on 1st and 2nd of April/2014. The remaining questionnaires were distributed on later date. There are 50 responses returned from the 550 tenant companies.

CHAPTER IV: RESEARCH RESULTS AND ANALYSIS

This chapter explains the research results and the statistical result derived from the survey questionnaire identifies key factors supporting and factors hindering the success of developing eco-industrial estate in Amata Nakorn industrial estate. Understanding how tenant companies make decisions will help OSS project team for planning effective strategies to promote eco-industrial estate in Thailand.

The questionnaire survey was designed to identify key factors by using the tenant companies' opinions on eco-industrial estate development. Because the success of eco-industrial estate transformation cannot be accomplished without corporation and participation of the tenant companies in Amata Nakorn industrial estate, therefore, insight observation of current situation, needs, and suggestion from tenant companies are essential to be identified to set up a practical implementation plan toward efficient eco-industrial estate development. The survey outcomes will identify factors affecting the initiation of eco-industrial estate development in Thailand.

Through detailed observation, each section examines which factor is important for making a progress on eco-industrial development. The best possible scenario for initiation of the green project can eventually be drawn by understanding the relationship between the factors and the tenants.

The questionnaire survey was conducted through April 2014 to August 2014. The survey was also intended to motivate tenants to pay more attention and recognize the opportunity from eco-industrial estate development. The questionnaires were distributed on behalf of Amata Facility Service directly to all the factories in the industrial estate. There are 50 responses returned from the 550 tenant companies that questionnaire were distributed in Amata Nakorn Industrial Estate. The number of response is rather highly diverse in the sense that they are from various types of factories though out the entire industrial estate. Although, the return rate

approximately is close to 10%. The analysis revealed many interesting observations. The response rate was quite low at the beginning period of the data collection. Fortunately, with the help from staffs of Amata Facility Service, the total of 50 responses came back by the end of August 2014.

4.1 Background of questionnaire respondents

In this section, the information of the respondents is presented to provide better understanding of the surveyed tenant companies' background.

4.1.1 Company size and nature of business

The tenants' factory was divided in to 3 sizes. The size was categorized based on the size of factory land areas; small (less than 5 rai), medium (larger than 20 rai), large (more than 20 rai). As shown in figure 4.1, among all case studies, there are 40% in small size, 46% in medium size, and 12% in large size. Majority of the factories are in medium size-scale.

Furthermore, nature of business of the surveyed tenant companies would affect the potential for collaboration whether they are from same type of industry or in a supply chain. There are various types of industries in Amata Nakorn industrial estate. It consists of automobile, steel/metal/plastic, electronics, chemical related and consumergoods/healthcare. (http://www.amata.com/Japan/industrial_amatanakorn_fact_sheet.html)

Questionnaire respondents comprise of automobile (32%), steel/metal/plastic (26%), electronics (24%), consumer goods/health care (4%) and others (e.g. service) (16%). The details can be found in Figure 4.2.

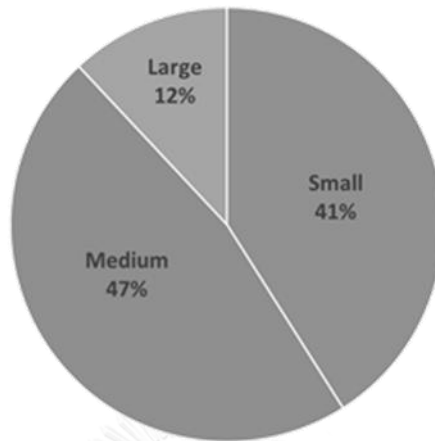


Figure 4.1: Company size
Note: Small (less than 5 rai), Medium (larger than 20 rai) and Large (more than 20 rai)

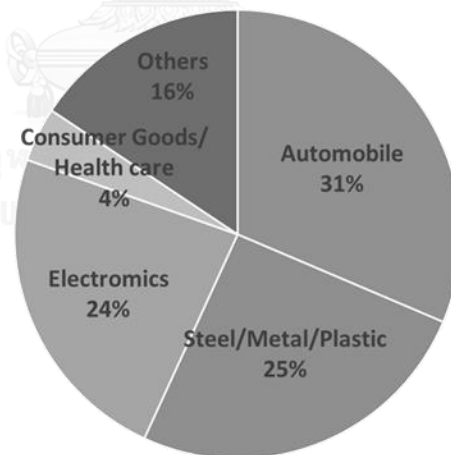


Figure 4.2: Nature of business of the surveyed tenants

4.1.2 Job description

The job description of the respondents is significantly diverse which varies 19 different kinds of jobs. Those are; factory manager 4%, HR, accounting officer 4%, safety officer 19%, quality control 4%, supervisor 11%, environmentalist 4%, general admin 11%, ISO officer 4%, BOI officer 4%, general affair 4%, import and export assistant manager 4%, logistics and warehouse control 4%, knowledge management manager 4%, chief 4%, plant manager 4%, manager 4%, QA and QC assistant manager 4% and senior supervisor 4%. Safety officer, supervisor, general administrations are among the top position to take charge of the green factory issues. Many of the tenant companies do not have environmental section in the company therefore the job description varies.

4.1.3 Working period and experience at the factory

Average working period or experience at the organization of the respondents ranged from 1 month to 15 years. Nearly a half of the respondents (24/50 respondents) had worked with the current position for less than three years. 36% had worked more than 3 years and 9 percent (4/50) of the respondents had worked with their company for more than 10 years. (figure4.3)

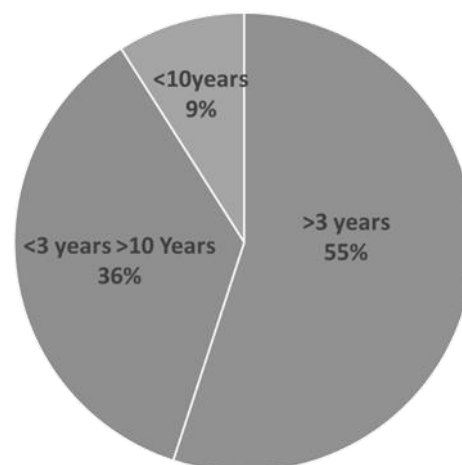


Figure 4.3: Working period

4.2. Environmental management in factories and the estate

4.2.1 Tenants' perspective on environmental/waste management

Waste management is one of the prime concerns for many of the businesses today. Well managed industrial and hazardous wastes will reduce the unseen risks in business operations such as polluting the environment or illegal waste dumping by contracted waste processors. During the tenant companies' interview in the first period of the OSS project, several problems and concerning issues were identified as below;

- 1) Difficulty in finding waste processors to take care of a small amount of specific/ hazardous waste
- 2) Unable to find a waste processor for specific types of waste
- 3) Limited technology or skills to separate combined-type of waste into different types
- 4) Spend so much time and energy in sorting out the wastes
- 5) Do not have enough space for waste storage
- 6) Some waste processors are unreliable
- 7) Prefer to use only one reliable waste processor for all types of waste for convenience.
- 8) Stringency of current laws and regulations on industrial wastes

Based on above findings of concerns, the early stage of the OSS business model (figure1.4) was developed by OSS team members. Since the interview with the tenant companies are quite limited in numbers. The survey questions were formed and asked to tenant companies to confirm if the proposed business model will solve the problems and cover the needs of tenant companies.

4.2.2 Tenants' problem 1

(Difficulty in finding waste processor to take care of a small amount of specific/hazardous waste)

The question was asked whether the companies are having difficulty in finding waste processor for a small amount of specific/hazardous waste. The total of 58% of the tenants either strongly agreed/agreed that they have difficulty in finding waste processors for small amount of specific/hazardous waste (see figure 4.4).

The interview to the tenant companies in the OSS project 1st period identified several issues relating small amount of waste. The tenant companies need to pay transportation fee together with the waste disposal fee. Since most of the waste disposal site is located far away from the industrial estates, paying transportation fee for small amount of wastes become too expensive. From the interview, OSS team found out that one company uses waste processor for certain types of wastes only twice a year. The waste processor is reluctant to come and collect small amount of wastes so the tenants had to ask waste processors to come and collect when they come nearby factories and when the tenants have accumulated enough amount of the wastes. OSS team also found that one company contacted other companies to dispose certain types of wastes at the same time so the waste processors will be able to collect certain amount of wastes in one trip. It can be assumed that small and medium companies may have established a group to cooperate and gather the small amount of waste and spread the cost of disposal. In this sense, small and medium sized companies are more flexible and capable of co-existing with the other companies.

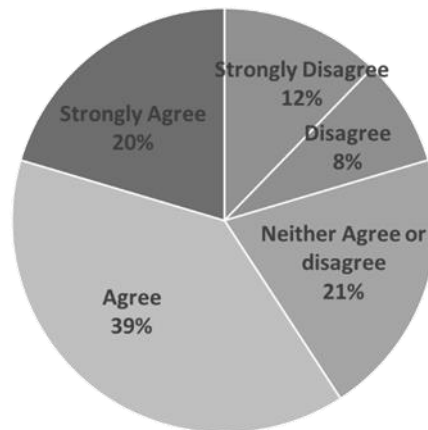


Figure 4.4: Percentage of levels of tenants' agreement on the difficulty in finding waste processor if the amount of waste is small

4.2.3 Tenants' problem 2

(Unable to find a waste processor for specific types of waste)

There are 10% of the respondents strongly agreed that the companies having difficulty in finding waste processor for specific types of waste (see figure 4.5). The nature of business of those respondents mostly belongs to steel/metal/plastic and the rest belong to electric and service sectors. Furthermore, there are 24 % of the companies who agreed in this statement. They are mostly from small companies and the nature of business tops steel/metal/plastic followed by automobile and electronics. On the other hand, there are 46% of the companies are either having less or no difficulty in finding waste processor for specific types of waste. The nature of business of those companies is steel/metal/plastic followed by automobile and electronics. Those 10% who strongly agreed with the statement probably handling specific types of chemicals or materials since majority of their business belong to steel/metal/plastic. Another reason could be as both types and numbers of Thai industries expanded and new technologies are introduced, there may be changes in types of wastes. However, the existing waste processors are not catching up with the change. This could be one of the important reasons why the tenant factories have difficulty in finding waste processors.

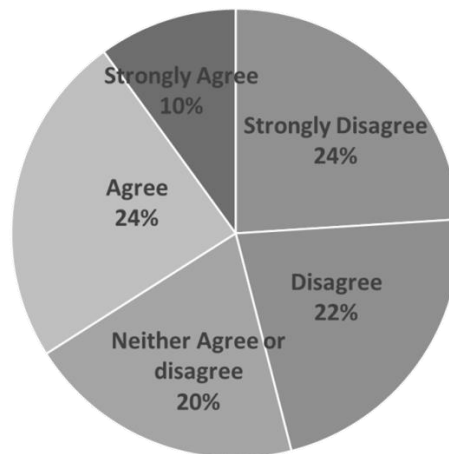


Figure 4.5: Percentage of levels of tenants' agreement on the difficulty in finding waste processor for specific types of waste

4.2.4. Tenants' problem 3

(Limited technology or skills to separate combined-type of waste)

OSS team had found out that the some industrial waste is combined with more than one substance is difficult to separate one another. One company mentioned that waste processor will not accept combined types of waste or will charge more for disposal.

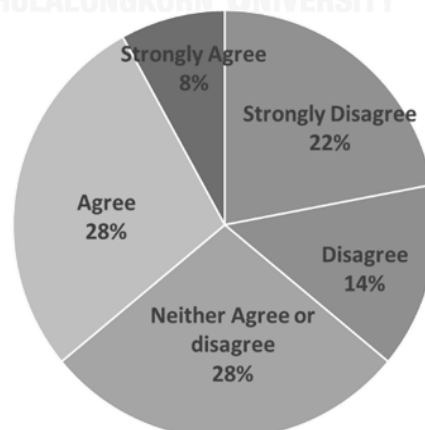


Figure4.6: Percentage of levels of tenants' agreement on the tenant does not have technology or skill to separate waste into specific types

Furthermore, waste separation is time consuming and it may take time and take additional manpower to do so. The survey result shows that nearly half of the respondents agreed that waste separation process is time consuming.

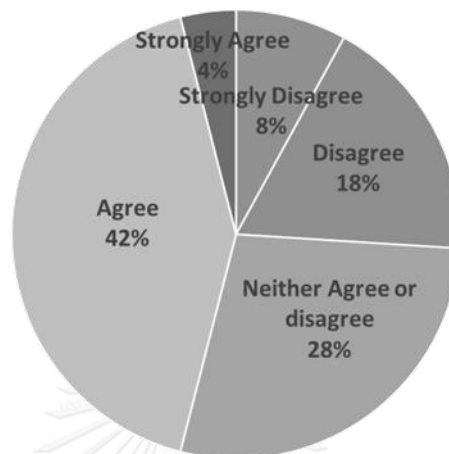


Figure 4.7: Percentage of levels of tenants' agreement on the tenants put too much time and effort sorting out the wastes

4.2.5 Tenants' problem 4

(Do not have enough space for waste storage)

Many of the companies hope to reduce cost for waste disposal. Renting additional yards to store waste is critical in financial point of view. However, as the business grows, some companies face such issues. From the survey response, the total of 30% agreed and 36% disagreed that they do not have enough space for waste storage in their premises. Another 34% of the respondents answered as neither agree or disagreed with the statement. The situation of the tenant companies varies from one another. Some tenants already have enough space to store the wastes and some tenants may not produce a lot of wastes from production process. Industrial productivity may change depending on the economic situations which may influence the amount of wastes produced throughout the year.

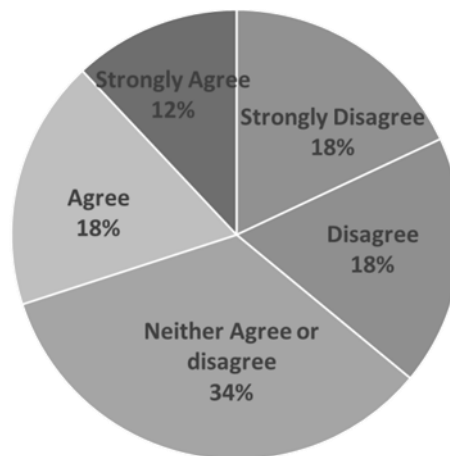


Figure 4.8: Percentage of levels of tenants' agreement on having not enough waste storage space

4.2.6 Tenants' problem 5

(Finding reliable waste processor)

During the company visit, some of the tenants mentioned that they find it difficult to find reliable waste processors. Therefore, in the survey questionnaire, the question was asked whether it is difficult to find a reliable waste processor for tenant companies. From the survey responses, there are 2 % of tenants strongly agreed and 26% agreed that they have difficulty in finding reliable waste processors. On the other hand, nearly 50 % of surveyed tenants answered that they do not have problems in finding reliable waste processors. It can be assumed that the Department of Industrial Works (DIW) introduced "Waste Processor Ranking Project" and published the guideline called "standard of good practice for industrial waste management industries" in 2012. The guideline was published to encourage and support the waste management industries to have the standard of good practice while handling the wastes. The ranking system helps tenant companies to find reliable waste processors. The only concern is that the ranking system does not cover all the waste processors and all types of wastes. The respondents who strongly agreed with this statement may have encountered mishandling of waste or illegal dumping of wastes by unreliable waste processors.

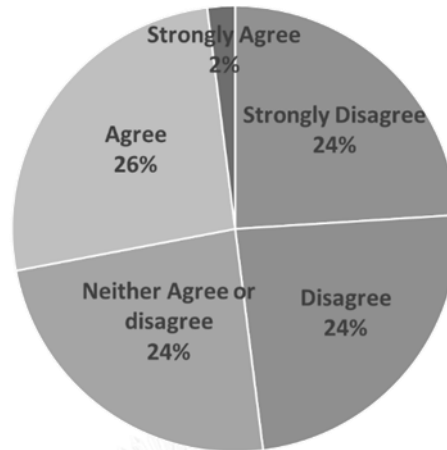


Figure 4.9: Percentage of levels of tenants' agreement on the difficulty to find reliable waste processors

4.2.7 Tenants' problem 6

(Choice of using only one waste processor)

The One Stop Service (OSS) project aimed to provide one stop service for waste management for tenants' convenience. The question was asked to identify whether the tenants will find it convenient to use only one waste processor if such services are provided. 42% of the survey respondents agreed that they preferred to use only one waste processor. Total of 36% either strongly disagreed or disagreed to use only one waste processor for waste disposal. The percentage shows some tenant companies find it uncomfortable or inconvenient to use only one waste processor. Further research is needed to find reasons.

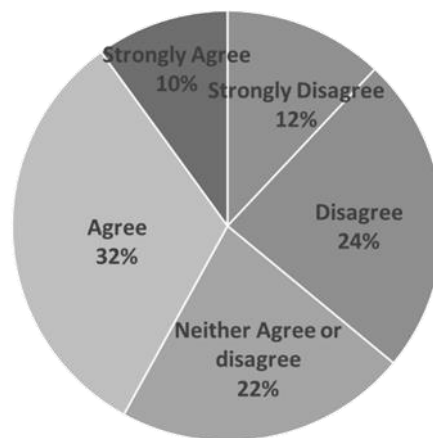


Figure 4.10: Percentage of levels of tenants' agreement on having to use only one waste processor for all types of wastes

4.2.8 Tenants' problem 7

(Stringency of current laws and regulations on industrial waste)

The tenants were asked whether the current laws and regulations on industrial waste are strict enough to regulate and control industrial waste. Nearly a half of the respondents (46%) think that the current laws and regulations on industrial waste management are not stringent enough while 28% agreed that the current laws and regulations on industrial waste management are too stringent. There are 26% of the tenants neither agree nor disagree with that.

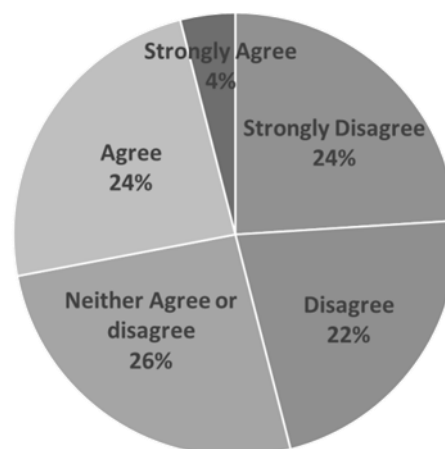


Figure 4.11: Percentage of levels of tenants' agreement on the current laws and regulations on industrial waste management are too stringent

The result shows that nearly half of the tenant companies are aware that the current laws and regulations on industrial wastes are not stringent enough. Therefore, if the OSS can set the high standard and strict regulation on managing industrial wastes, the OSS will gain trust and competitive advantage over other waste processors and tenants will feel confident to use the OSS services.

From the eight findings, the most significant problems that the tenant companies either strongly agreed or agreed on were 1) difficult to find WP for small amount of specific types of waste and 4) Spend so much time and energy in sorting out the wastes.

The high percentage of tenants agreed on 1) difficult to find WP for small amount of specific types of waste. The small lot collection of waste which is described as one of the OSS service option in Chapter 1 (figure 1.5) will attract tenants to use that service. Furthermore, the tenants find sorting out of wastes are time consuming. As the OSS function does not include waste separation in the OSS business model in Chapter 1, waste separation should be considered one of the service option in the OSS business model. The waste separation function will meet the demand of tenant companies if the OSS could collect mixed wastes and separate wastes at the OSS facilities into different types and do every transaction for tenants, the tenants will be able to save time as well as manpower for waste separation process. The concerning issues for this business model is the regulation on handling industrial/hazardous wastes. Therefore the governmental support will be needed to realize this business model.

The choice of using only one waste processor received less than 50% of the agreement from the tenants. If OSS can prove efficiency and reliability of the OSS service, The OSS business would succeed and expand its users.

4.3 Attitude towards environmental management system

In this section, the questions about environmental certification system such as International Organization for Standardization (ISO) were asked to measure the environmental awareness of the tenants and identify what motivate tenants to be certified by environmental certification systems. Better understanding about motivating factors can be applied to promote the OSS project in Amata Nakorn industrial estate.

There are over 19,500 International Standards issued by ISO. Those standards cover almost every industry. There are environmental related ISOs and that covers sustainable development, energy efficiency and renewable, climate change and water. Similar to the ISO 9001, environmental management system like ISO 14001 became very important in the business world and some companies require business partners to pursue the certification before doing businesses. The environmental certification act as a proof of evidence that shows certified companies is reliable to do business with. The OSS project aims to receive same level of respect as the environmental ISOs. The OSS wants to provide the confidence and the sense of security for responsible waste management method for the users.

4.3.1 Tenants' interest in obtaining environmental management certification

The questions are asked to find out how many tenants are already certified or planning to be certified by the environmental management certification system. From the survey result, high percentage (72%) of responded tenants is either certified or planning to obtain environmental management certification like ISO 14001.

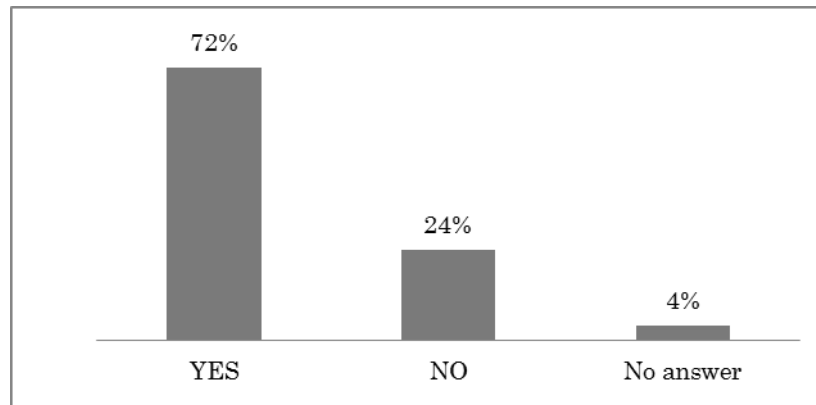


Figure 4.12: Percentage of the tenants who have already certified or planned to obtain any environmental management certification

According to the data from Thai industrial standard institutes, there are 355 ISO14001 certified companies in Eastern Seaboard regions including Chonburi, Chachoengsao, Samut Prakan and Rayong provinces. (<http://app.tisi.go.th/cgi-bin/syscer/14000pv.pl>) As Amata Nakorn industrial estate is located in the Eastern Seaboard regions, it can be assumed that the responded tenants have high awareness/motivation in the environmental management certification program. That implies there may be a potential for the OSS project or similar to receive attention from those tenant companies with high awareness/motivation in the environmental management.

4.3.2 In-house environmental management system

Tenant companies in Amata Nakorn industrial estate are mostly international companies. Their parent company has their own environmental standard in their country and often asks their subsidiary company to follow or create new standard. The survey found that 80% of the tenant companies have their own in-house environmental management system.

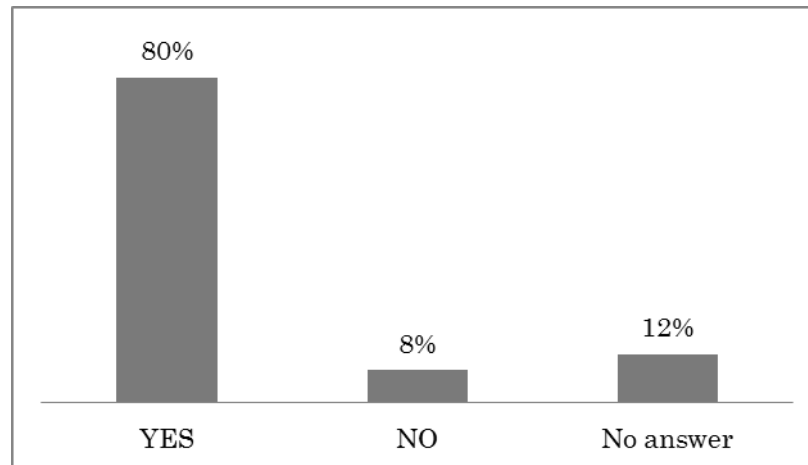


Figure 4.13: Percentage of tenants having or not having their own in-house environmental management system

4.3.3 Efficiency of the in-house management system

Further question was asked to those 80% who answered “yes” in the previous question to find out whether the in-house environmental management system is efficient within their organizations. The total of 76% answered their in-house environmental management system are efficient.

4.3.4 Law enforcement

To understand how tenant companies see the current environmental laws and regulations help prevent environmental damage caused by business activities, total of 62% of the respondents either strongly agree/agree that the current environmental laws and regulations are effective to prevent environmental damage caused by business activities. There are other 38% of the respondents think that the current laws and regulations are not effective enough. It can be surmised as close to 40 % of the tenants may have experienced or may have heard the incidents that damaged environment by business activities.

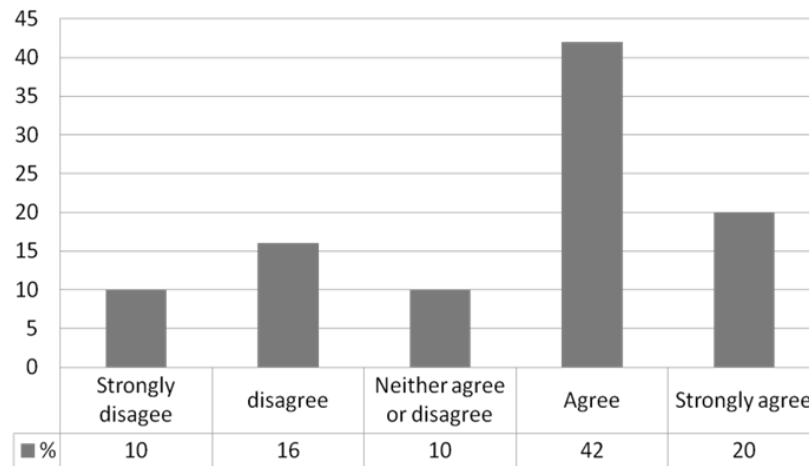


Figure 4.14: Percentage of levels of agreement on effectiveness of current environmental laws and regulations to prevent environmental damage caused by business activities. Note: No answer 2%

4.3.5 Motivating factor for environmental certification

Furthermore, respondents were asked to rate the importance of motivating factor upon seeking the environmental certification. By understanding what motivating factor affected the decision of obtaining environmental certification, these motivating factors will be helpful to understand more about tenant companies in terms decision making process and these factors could apply to promotion period of OSS/eco-industrial development project.

Seven factors were presented to rate the degree of motivation to the survey respondents as shown in figure 4.15 to 4.21. in Appendix 3

- 1) Improvement in environmental management
- 2) Improvement in company image
- 3) Marketing advantage
- 4) Requirement from the suppliers/consumers
- 5) Cost savings
- 6) Achieving compliance
- 7) Reducing unseen risks

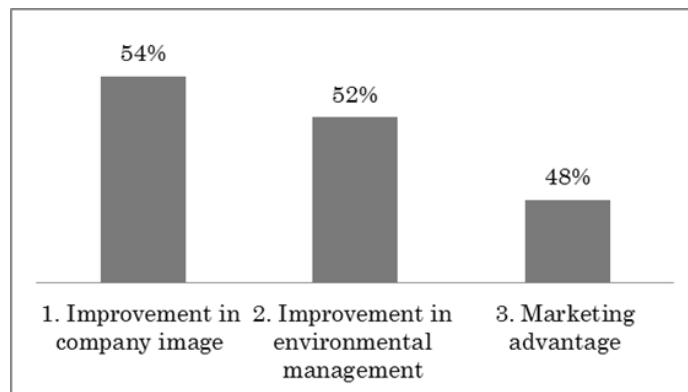


Figure 4.22: Top 3 very important motivating factors

Figure 4.22 shows top three very important motivating factors out of seven factors. The figure 4.23 was created by using only statistics of very important factors from figure 4.15 to figure 4.21. That is why the each factor values high percentages.

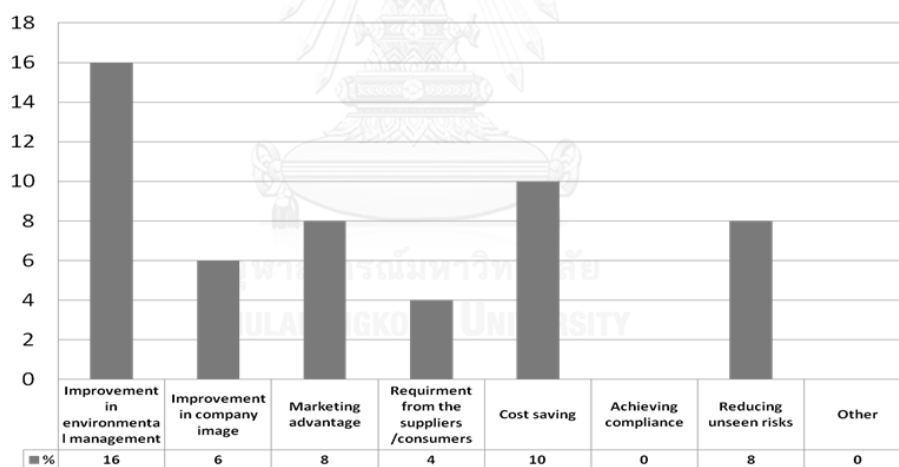


Figure 4.23: Percentage of levels of tenants on key benefit for environmental management system

The top three very important motivating factors are; 1.improvement in company image 2.improvement in environmental management and 3.marketing advantage. Furthermore, the survey respondents were asked to choose only one key benefits from the seven motivating factors (figure 4.23), the respondents chose improvement in environmental management as a top key benefitting factor followed

by 2.cost savings and 3.marketing advantage/reducing unseen risks such as breaking the environmental laws or regulations without having to realize it.(figure 4.24).

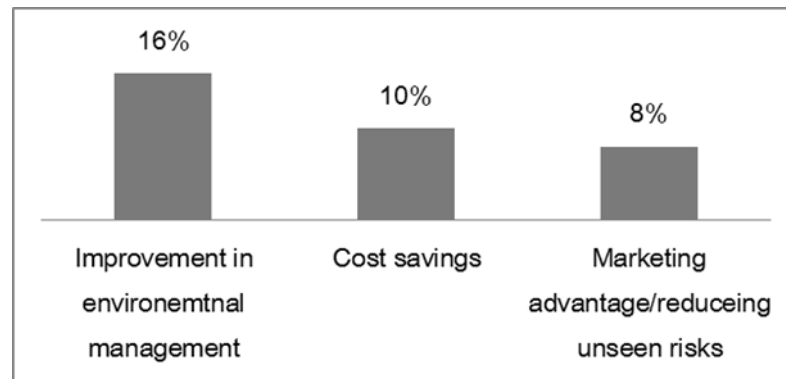


Figure 4.24: Top 3 very important benefiting factors

Surveyed tenants understand that environmental certification brings both marketing and environmental benefits, as ISO is recognized worldwide. It can be assumed if the eco-industrial estate development/OSS project could provide both environmental benefit and marketing benefit/advantage. The tenants will be motivated to be a part of the development activities. Amata Nakorn industrial estate should be able to explain the benefits/ incentives during the promotion period of the project.

OSS itself needs to be certified by the environmental management certification system to prove their standard as well. OSS should promote themselves and let people know what OSS can offer and how the OSS can help to improve the waste management of tenant companies.

The tenant companies are motivated by improvement in both company image and environmental management and the tenant companies would like Improvement in environmental management and cost savings as a benefit. From the third period of OSS trial project in chapter 1, the Japanese companies improve the waste recycle rate without any additional investment in new equipment or facilities. The OSS needs to work with various expert to study and lower the operation cost and waste management cost so that the OSS can provide the service at lower fee to the tenant companies.

4.4 Attitude towards environmental management activities

In this section, the surveyed tenants were asked what kind of environmental activities within their organization is beneficial to their overall environmental performance. The surveyed tenants were asked to scale the importance of nine environmental activities. These activities include; 1) Water savings, 2) Energy savings, 3) Reuse of process water, 4) Waste reduction, 5) Reuse of materials, 6) Use of eco-friendly materials, 7) Use of recycled materials, 8) Use of local materials and 9) Control of the chemical sources of indoor pollution.

The following figures show the degree of importance ranking by case studies on each factor and presented in percentage in each topic. Each factor valued as important/very important around 80% or more. In order to understand what factor is more important than others, only very important factors from figure 4.25. to figure 4.33 (in Appendices 3) are listed in the figure 4.34.

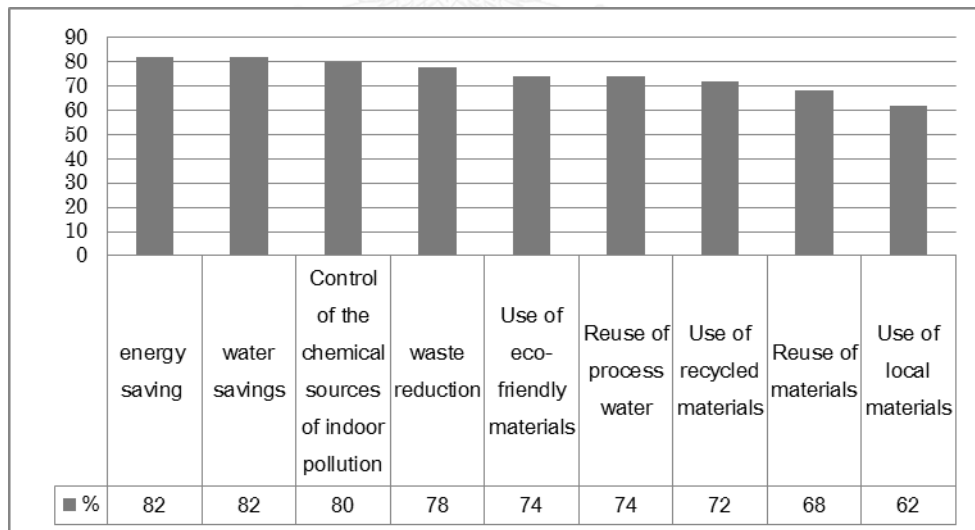


Figure 4.34: Ranking of important environmental activities of surveyed tenants created by the total of important and very important factor from the figure 4.25 to figure 4.33

The above figure is created from the result of nine environmental activities (figure 4.25 to figure 4.33) in which describes the ranking of factors rated as very important and important by the survey respondents. The top rated factors are energy saving and followed by water savings, control of the chemical sources of indoor pollution and waste reduction. There are two main characteristics that can be observed from the data.

The three factors; energy savings, water savings and waste reduction describes the surveyed tenants see the benefit of environmental activities in cost reduction/cost savings. These three environmental activities will directly affect the bills and the result will be apparent in figures. These activities do not require initial investment to start with. Managers can educate their own employees to save electricity and water and reduce wastes. Second important factor control of the chemical sources of indoor pollution will directly affect human health if it is not controlled well. That could be the reason it ranked in second. Other five activities; use of eco-friendly materials, reuse of process water, use of recycled materials, reuse of materials and use of local materials need more than educating their own employees. It requires minimal to large initial investment. For example, use of eco-friendly materials, use of recycled materials and use of local materials may cost more than the ordinary materials. The tenant companies have to bear extra cost if they are willing to use the environmental conscious materials. Therefore, the result shows that cost reduction and cost saving are significant factors in environmental activities.

4.5 Eco-industrial estate transformation in Amata Nakorn industrial estate

In order to understand tenant's attitudes towards eco-industrial estate transformation in Amata Nakorn industrial estates, respondents were first asked whether eco-industrial estate is needed for future development of Thai industry. All of the respondents chose either strongly agreed or agreed with the need of eco-industrial estate development in Thailand. 68 % of surveyed tenants believed that

Amata Nakorn industrial estate can achieve eco-industrial transformation. Other 8% of respondents showed no confidence in achieving eco-industrial estate transformation. The fact is that more than a half of the respondents support and believe Amata Nakorn industrial estate can achieve eco-industrial estate transformation.

The surveyed tenants showed positive response upon joining the eco-industrial estate transformation project. The surveyed companies were asked to indicate the willingness to participate by using number 1 to 5 and the total of 78% of the respondents showed strong to very strong willingness of number 4 and 5 in joining the project. Only 3 % came back with the negative response of not joining the project.

4.5.1 Organizational decision making factor

It is essential to understand how decisions are made within the organizations and who make the decisions. Surveyed tenants were asked what factor would affect the decision making process whether to join or not to join the project. 22% said approval from the top management is the most significant factor that affects decision making process. Second important factors, content of the project and participation cost weigh 10%. From these answers, the decisions are more likely depends on top management and the content and participation cost will be a key factor in decision making process. The content of the project need to fit the interest or requirement of the tenants to support decision making process.

4.5.2 Stakeholder involvement

Stakeholder involvement often influences the participants' trust and gain confidence in the project. Surveyed tenant companies were asked how each stakeholder involvement would affect the eco-industrial estate development in Amata Nakorn industrial estate. This question was asked to find out who has got the authority and ability to realize the project from the tenants' perspective. 76% of the respondents think the national government or agency like Industrial Estate Authority

of Thailand (IEAT) has a power to influence the eco-industrial estate development project. In addition, 58% thinks local community involvement and 54 % thinks involvement of the tenant companies in Amata Nakorn industrial estate will affect the transformation process. Responded tenants believe that the government involvement will make it possible to realize eco-industrial estate transformation. The respondents are also aware that the success depends on the participation and corporation of the tenant companies as well as the involvement of the local communities.

4.5.3 Facilitator/supporter

Surveyed tenants were asked who should be the facilitator/supporter for eco-industrial estate development project. Majority of the respondents (72%) answered IEAT should become the facilitator. 26% answered representatives from tenant companies in Amata Nakorn industrial estate should become the facilitator for the project. Therefore, Amata Nakorn industrial estate should seek cooperation from IEAT and show the tenants that Amata Nakorn industrial estate is running the project with IEAT to gain more confidence on the project.

4.5.4 Components of eco- industrial estate in Amata Nakorns' context

Tenants were asked what sorts of functions/components are essential in eco-industrial estate development in Amata Nakorn Industrial estate. There are total of 13 functions/components that respondents were asked to rate on. These 13 components are reflected to the 10 aspects of environmental dimensions of IEAT specification for eco-industrial estate. The survey result showed all of the 13 functions/components are considered as important. Top three important components of eco-industrial estate concept are; adaptation of sustainable energy followed by establishing waste recycle center and control of the chemical sources of indoor and outdoor pollution. The details of 13 functions/components are shown in table 4.1.

Table 4.1: Components of eco-industrial estate in Amata Nakorns' context

	Very unimportant	unimportant	Neither	Important	Very important	No answer
1.Adaptation of sustainable energy	0%	2%	2%	28%	<u>68%</u>	0%
2.Establishing waste disposal site and treatment facility	0%	0%	8%	34%	<u>56%</u>	2%
3.Establishing waste recycle center	0%	0%	8%	24%	<u>66%</u>	2%
4.Establishing waste storage/transfer yard	2%	0%	12%	26%	<u>58%</u>	2%
5.Establishing waste water treatment plant for special type of industries	4%	0%	10%	28%	<u>58%</u>	0%
6.Establishing waste exchange facility and online exchange market	0%	2%	20%	34%	40%	4%
7.Creation of new business on waste market	0%	0%	8%	46%	42%	4%
8.Use of electric vehicles	0%	0%	24%	42%	28%	6%
9.Creation of more green areas	0%	2%	10%	28%	<u>56%</u>	4%
10.Creation of new job opportunities	0%	2%	8%	34%	50%	6%
11.Establishing eco-learning facilities	0%	0%	18%	32%	44%	6%
12.Use of eco-friendly products	0%	2%	6%	34%	<u>56%</u>	2%
13. control of the chemical sources of indoor & outdoor pollution	2%	0%	4%	30%	<u>60%</u>	4%

4.6. Characteristics and strength/significant factors of Amata Nakorn Industrial estate

Understanding own strength and weakness will be the advantage in project/business planning for Amata Nakorn industrial estate. SWOT (Strength/Weakness/Opportunities/Threat) of Amata Nakorn industrial estate was

briefly discussed by OSS team including staff from Amata Nakorn industrial estate and 15 factors were identified during the OSS project first period.

Surveyed companies were asked whether they agree or disagree with the given 15 factors which may be considered as strength/significant factors that affect eco-industrial estate transformation in Amata Nakorn industrial estate.

These factors include;

- 1) Number of tenant
- 2) Financial ability
- 3) Commitment of the management team
- 4) Good business relationship with tenant companies
- 5) Geographic location
- 6) Cooperation from international investors and international governments
- 7) Cooperation from the national governments/agencies
- 8) Cooperation from universities/research institutes
- 9) Variety of industry type in Amata Nakorn Industrial Estate
- 10) Economic/Social condition
- 11) Political condition
- 12) Commitment of participating tenants
- 13) Stringency in environmental laws/regulations
- 14) Increasing awareness of environmental issues
- 15) Cooperation between the tenant companies

From the survey result, 70% of the respondents strongly agreed commitment of the management team is the most significant characteristics/affecting factors of Amata Nakorn industrial estate. The increasing awareness of environmental issues (58%) is the second most significant, followed by stringency in environmental laws/regulations (56%), cooperation from the national governments/agencies (54%) and commitment of participating tenants (52%) see figure 4.36. The factor which gains least vote is cooperation between the tenant companies (2%). The result of 15 factors is described in the Table 4.2.

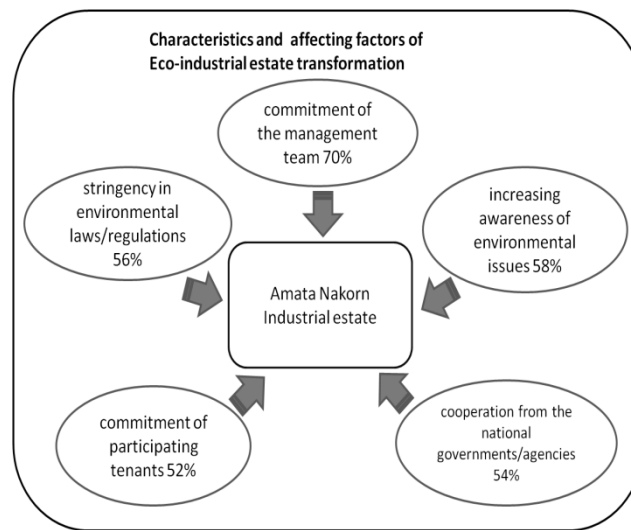


Figure 4.35: Characteristics and affecting factors of eco-industrial estate transformation

Each factor is analyzed with the survey result as below;

1) Number of tenant

Amata Nakorn Industrial Estate is the biggest industrial estate in Thailand which accommodates 550 factories within the estate. The number of tenants can be a significant factor for any project implementation. 30% of the tenants agreed and 28% of the tenants strongly agreed that the Number of tenant is significant factor for Amata Nakorn industrial estate.

2) Financial ability

Amata Nakorn Industrial estate is operated by Amata PCL and their market capitalization is about 16 billion baht as of July 2015. Their financial statement (<http://amata.listedcompany.com/financials.html>) shows Amata Nakorn industrial estate is maintaining a good financial record. This may change depends on the economic situations and company's business performance in the future though.

There is 38% tenants agreed financial ability as very significant/strength factor and 42% thinks significant/strength factor. The financial ability of Amata Nakorn industrial estate is the strength/significant factor for Amata Nakorn Industrial estate.

3) Commitment of the management team

In the business world today, most of the decisions are made at the top of the hierarchy, the commitment of the management team will be a key factor for successful project implementation. 70% of the respondents agreed commitment of the management team is very significant factor for Amata Nakorn industrial estate.

4) Good business relationship with tenant companies

The environmental project will only be successful with the participation and cooperation of the tenant companies. There are 48% of the tenants agreed that the good business relationship between Amata Nakorn industrial estate and tenant companies is the strength/significant factor for Amata Nakorn Industrial Estate.

5) Geographic location

Amata Nakorn Industrial Estate located in Eastern Seaboard region of Thailand as described in Chapter1. There are other industrial estates in Eastern Seaboard region such as Amata city located in Rayong province. The location is an advantage of Amata Nakorn industrial estate to create a chain of inter-relationship with other industrial estate. 44% of surveyed tenant companies strongly agreed that the geographic location is the strength for Amata Nakorn industrial estate.

6) Cooperation from international investors and international governments

Amata Nakorn industrial estate is the center of attention especially from Japan. As a large number of the tenant companies are Japanese companies which made

Amata Nakorn industrial estate more attractive to Japanese investors and the Japanese government. 48% of the surveyed tenants strongly agreed cooperation from international investors and international governments is the strength/significant factor of Amata Nakorn industrial estate.

7) Cooperation from the national governments/agencies

Thai government also has strong tie with the Amata Nakorn Industrial estate to establish eco-industrial estate for many years. 54% of the surveyed tenants strongly agreed that the cooperation from the national governments/agencies is a very significant factor for Amata Nakorn industrial estate.

8) Cooperation from universities/ research institutes

Amata Nakorn industrial estate has been closely working with Chulalongkorn University research institute in the past and the MOU was signed to conduct the research for industrial wastes. 42% of the tenant companies strongly agreed and 36% agreed the cooperation from the universities/research institutes is the strength/significant factor for Amata Nakorn industrial estate.

9) Variety of industry type in Amata Nakorn Industrial Estate

Amata Nakorn industrial estate consists of variety of manufacturers which enable to develop the wide range of network such as waste exchange network or information exchange network. 48% of the tenants strongly agreed variety of industry type is the strength/significant factor for Amata Nakorn industrial estate.

10) Economic/Social condition

Economic and social condition will definitely speed up or down the environmental project. The country like China and Japan, the government speeds up the economic development in the past and end up with the environmental problems.

Then society started to show concern over the environmental degradation. 48% of the responded tenants strongly agreed economic/social condition is the strength/significant factor for Amata Nakorn industrial estate

11) Political condition

Political condition often triggers the political chaos in Thailand and the question is asked whether the political condition would affect the operation of Amata Nakorn industrial estate. 32% of the respondents strongly agreed that the political condition is significant factor to Amata Nakorn industrial estate. There are only 8% of the respondents either strongly disagree or disagree with the statement.

12) Commitment of participating tenants

How committed each participants are the probably one of the most important supporting factor for Amata Nakorn industrial estate. 52% agreed that the commitment of participating tenants is the significant factor to Amata Nakorn industrial estate. No respondents rated this factor as very unimportant/unimportant. The tenants must be aware of their commitment will play very important role in the project.

13) Stringency in environmental laws/regulations

Most of the time, stringency in laws /regulations will leads to a proper handling of wastes. At the same time, it may tightens the movement of wastes. More than half of the respondents (56%) strongly agreed and another 28% agreed that is a strength/significant factor for Amata Nakorn industrial estate. There are 6% of the survey respondents disagreed that that is a strength/significant factor to Amata Nakorn industrial estate. Stringency in laws/regulations could also be a barrier to certain environmental project. Flexibility of laws/regulations is essential for successful implementation of the project.

14) Increasing awareness of environmental issues

As a trend of society moves toward eco-conscious, there will be a demand from people and society to have better living and working environment both good for the nature and the human societies. Increasing awareness to the environment will help people to pay more attention in our environment and which encourage people to join the environmental project. 58% of the tenants agreed that increasing awareness is a strength/significant factor for Amata Nakorn industrial estate.

15) Cooperation between the tenant companies

This factor is the only factor that the respondent strongly agreed only on 2%. There are 26% of the tenants agreed cooperation between the tenants factories are strength/significant factor but there are 24% of the respondents who strongly disagree and 24% of disagree with the statement. In this regards, tenants may think that the cooperation between the tenant companies does not really exist at the moment.

Table 4.2: Percentage of levels of agreement on 15 strength/significant factors

	Strongly disagree	disagree	Neither agree or disagree	Agree	Strongly agree	No answer
1.Number of tenants	2%	0%	36%	30%	28%	4%
2.Financial ability	0%	0%	16%	42%	38%	4%
3.commitment of the management team	0%	0%	6%	20%	<u>70%</u>	4%
4.Good business relationship with tenants factories	0%	2%	14%	32%	48%	4%
5.Geographic location	0%	2%	22%	26%	44%	6%
6.Cooperation from international investors and international governments	0%	0%	14%	34%	48%	4%
7.Cooperation from the national government/agencies	0%	0%	10%	36%	<u>54%</u>	0%
8.Cooperation from universities/ research institutes	0%	2%	16%	36%	42%	4%
9.Variety of industry type in Amata Nakorn Industrial Estate	0%	2%	14%	34%	48%	2%
10.Economic/Social condition	0%	4%	4%	42%	48%	2%
11.Political condition	4%	4%	24%	34%	32%	2%
12.Commitment of participating tenants	6%	0%	10%	28%	<u>52%</u>	0%
13.Stringency in environmental laws/regulations	6%	0%	10%	28%	<u>56%</u>	0%
14.Increasing awareness of environmental issues	4%	0%	8%	28%	<u>58%</u>	2%
15.Cooperation between the tenant companies	24%	24%	24%	26%	2%	0%

4.7 Development of One Stop Service (OSS) project from tenant companies' perspectives

The details about the OSS project are explained in Chapter 1. One Stop Service project started as a part of the eco-industrial estate development project. The project was designed to fulfill the needs and find solutions for tenants' existing concerns and problems in waste management. The success of the OSS project implementation will be very important for the further development of eco-industrial estate not only in Amata Nakorn industrial estate but also all the other industrial estates in Thailand.

The success of the OSS project will largely depend on the tenant companies in Amata Nakorn industrial estate and it is difficult to predict the success of the project implementation. Therefore, the questions were asked to understand the tenant companies and to create best scenario for successful OSS initiation. The questions were asked to measure the tenants' willingness of participation, whether the additional service option is needed for the OSS, what are the effective promotion and announcement method and choice of facilitator and supporter to the OSS project.

4.7.1 Willingness to participate in the OSS project

It is hard to predict how many tenants will actually use the OSS service. It is important to understand at the very early stage whether the tenant companies are interested in participating in the OSS project. In the very first question, the tenants were asked their willingness to participate in the OSS project. Most of the response showed high rate of willingness to the OSS project participation. A half of the respondent showed very strong willingness and another 1/4 of the respondents showed strong willingness to join the OSS project. None of the tenants showed low willingness to participate in the project.

4.7.2 One Stop Service additional service options

The existing OSS project plans to offer transfer/store/collect general/industrial wastes. The tenants were asked whether the OSS should have additional service options and what the additional service should be like. 46% of the respondents

answered that they prefer to have the additional OSS service options and 48% answered no need.

The tenants commented in the questionnaire that the additional service options such as providing training on how to classify/sort wastes and providing training/seminar on environmental related issues are beneficial. Other respondents suggested that the OSS should act as a waste consultant. The OSS may need to consider adding up more service options to cover the needs of the tenant companies in the future.

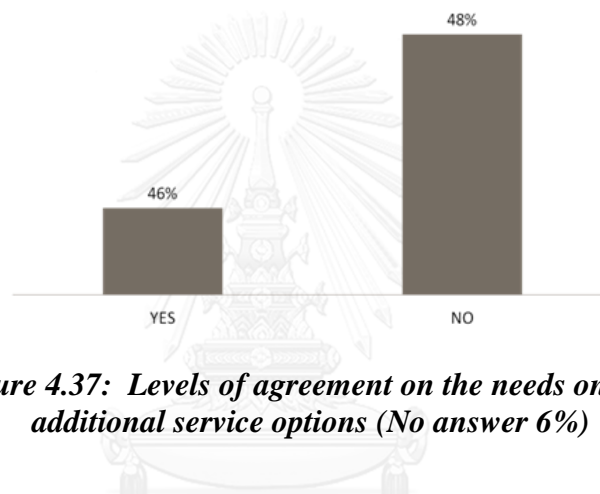


Figure 4.37: Levels of agreement on the needs on OSS additional service options (No answer 6%)

4.7.3 Effective methodology to promote the OSS initiation and implementation

Further question was asked to find out the best possible approach to inform OSS project to the tenants in Amata Nakorn industrial estate. As Amata Nakorn industrial estate accommodate 550 tenant companies and it is important to inform everyone efficiently. 60% answered information session would be the best way to inform about the OSS project followed by email (34%) and newsletter (24%). Therefore, OSS project should be promoted by information session follow up by email announcement. Detailed answers can be found in the figure4.39.

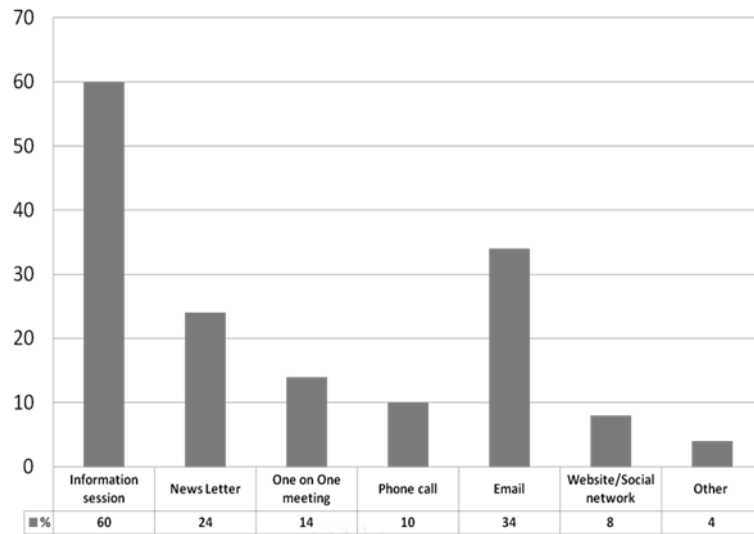


Figure 4.38: Percentage of method of effective promotion and announcement of the OSS project

4.7.4 Facilitator/supporter

Further questions were asked to choose the appropriate facilitator/supporter for the OSS project. Facilitator plays very important role in the project. There were some concerns during the OSS preparation period. Since the OSS project was run by Japanese and Thai enterprises and both group had different thought at some stage. The project needed someone from the outside who can help both groups to solve problems and make decisions. Therefore, the presence of facilitator is a key factor for the effective project operation. 72% chose Industrial Estate of Authority of Thailand (IEAT) is the most appropriate facilitator/supporter for the OSS project followed by representatives from tenant companies in Amata Nakorn industrial estate (26%) and local environmental related companies (10%).

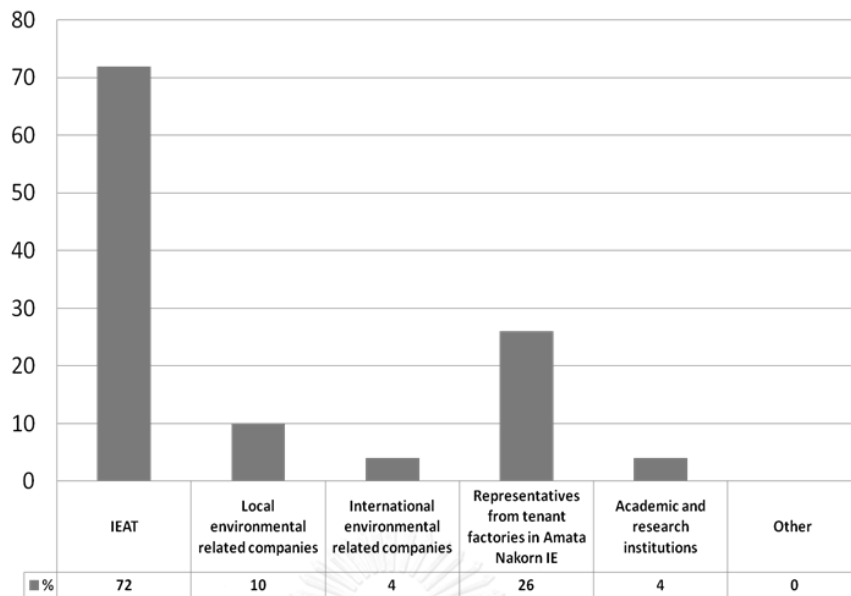


Figure 4.39: Percentage of appropriate facilitator/supporter for OSS project

4.7.5 Decision making process

Understanding how tenants make decisions will help the OSS project team for planning effective promotion strategies. The questions were asked to identify the factors which affect tenants' decision making process. By finding out affecting factors, OSS team will be able to understand what factor will strongly affect or create barriers for tenants' decision making process. The surveyed tenants were asked to rank from 1 to 5 to each element listed by its importance, assuming 5 indicated the highest position and 1 indicate the lowest position.

The survey result showed that the Service fee (36%) ranked the most important factor in decision making process followed by Quality and types of services that brings solution to a problem (30%) These two factors could be considered as the significant factors in decision making process.

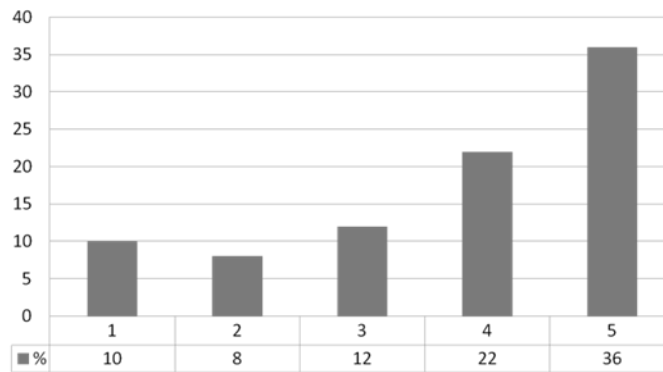


Figure 4.40: Service fee Note: 5 indicated the most significant/important and 1 indicate the least significant/important (No answer/12%)

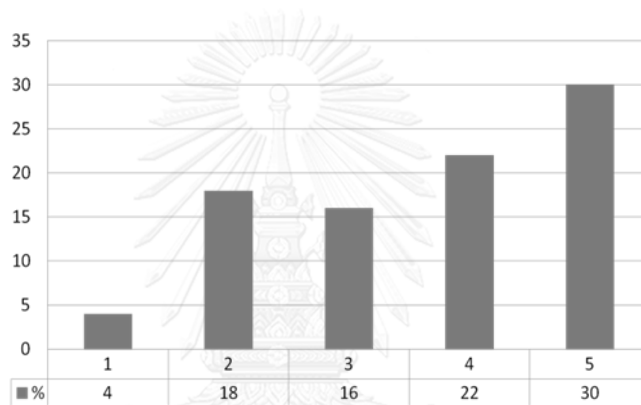


Figure 4.41: Quality and types of service that brings solution to a problem Note: 5 indicated the most significant/important and 1 indicate the least significant/important (No answer 10%)

On the other hand, foreign company involvement marked 22% (figure 4.43) at the level of importance of 1. That implies the tenants put less weight on the factor in the decision making process. Furthermore, types of waste that OSS can accept marked 12% (figure 4.42) at the level of importance of 5 and also marked at 14 % at the level of importance of 1.

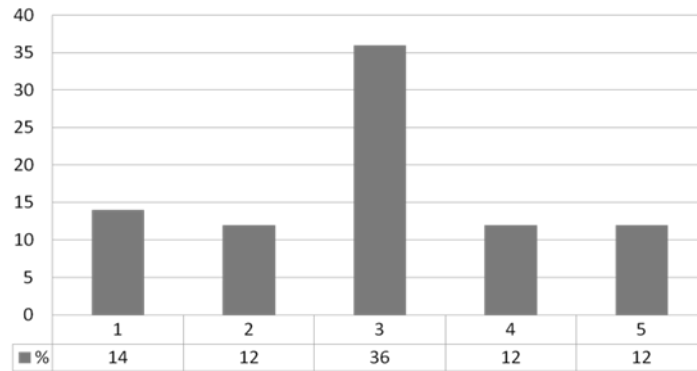


Figure 4.42: Types of waste that OSS can accept
Note: 5 indicated the most significant/important and 1 indicate the least significant/important (No Answer 14%)

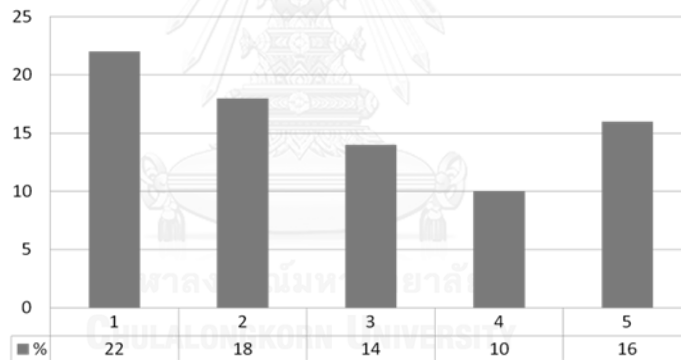


Figure 4.43: Foreign company involvement
Note: 5 indicated the most significant/important and 1 indicate the least significant/important (No Answer 20%)

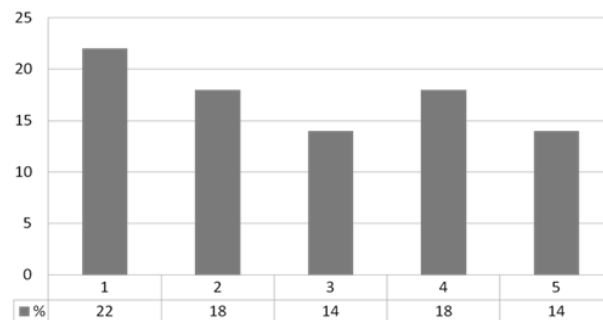


Figure 4.44: Amata Nakorn industrial estate as an owner of the OSS
Note: 5 indicated the most significant/important and 1 indicate the least significant/important (No Answer 14%)

From the survey result, OSS project needs further research about the current service fees in which tenants currently pays for existing waste processors and set the attractive fee for the OSS service. Furthermore, the OSS should make sure to provide high quality service and provide solution to tenants' existing problems.

4.7.6 Three most important expectations from OSS project

Furthermore, the tenants were asked to choose three most important expectations from OSS project. The top three factors are 1.cut down the cost of waste management (82%), 2. eliminate regal issue/future risks over waste related issues (70%), 3. reduce time and work load that the tenants spent on waste management (50%).

The tenant companies want to cut down the cost on waste management. It became very clear that if OSS could successfully reduce waste management fees, there is a high chance that the tenants would use the OSS service. As for the second important factor, OSS should act as a consultant to eliminate legal/future risks over waste related problems. The difficulty is that the most of the tenants expect consulting services for free of charge. OSS needs to consider the business model and how to finance them.

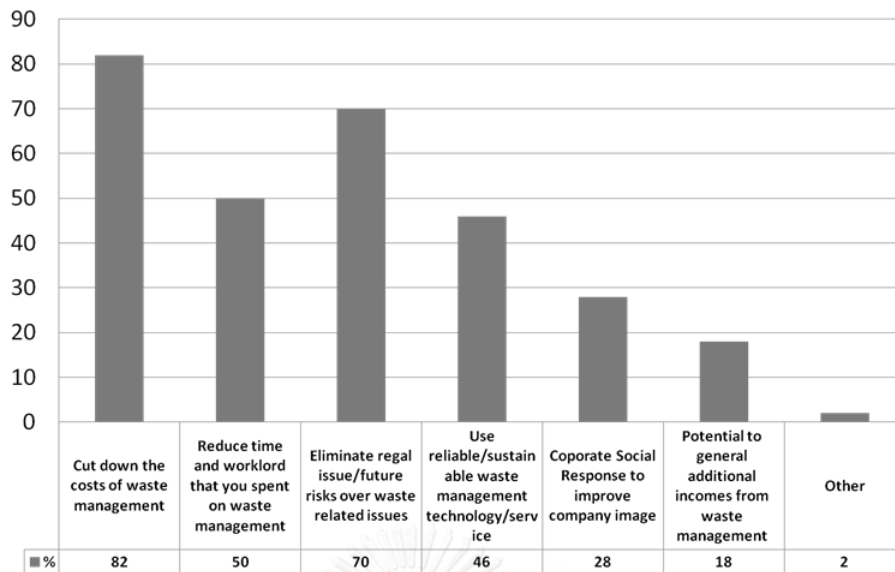


Figure 4.45: Levels of important expectations from OSS projects

4.7.7 Best scenario for OSS initiation

The best scenario for OSS initiation is to; first promote the OSS project by organizing information session along with email and publishing newsletter. In information session, provide QA session to answer all the questions that the tenants may have regarding the OSS. The information session should target the management level as well as the staff who is responsible for the environmental management within the organizations. During the information session, the OSS team should be able to identify what benefit the tenants will receive by using the OSS. After the information session, it is also essential to reach the management one more time to follow up their decision making process. Tenants are interested in especially cost reduction on waste management and elimination of unseen risks on waste management. As for the OSS partners, OSS should ask the governmental institutions like IEAT to be a facilitator/supporter for the project.

4.7.8 How OSS will support Amata Nakorn Industrial Estate's future development

66% of the respondents strongly agreed and 34% agreed that the realization of OSS project will bring a positive change in waste management.

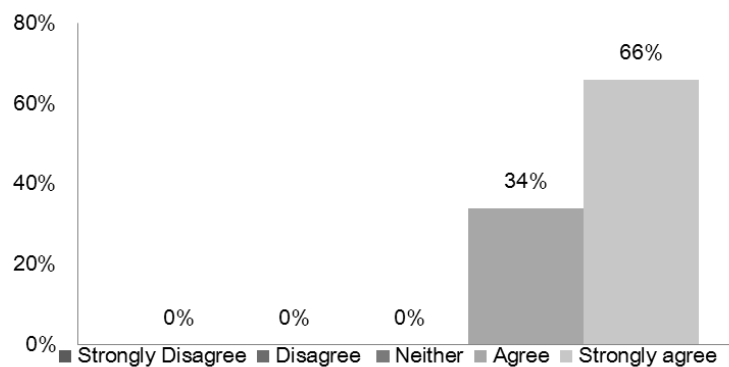


Figure 4.46: Levels of agreement on OSS project will bring positive change in waste management in Amata Nakorn industrial estate

The surveyed tenants are also asked whether the project like OSS will be a great advantage and that influence the decision of the prospect enterprises to settle into Amata Nakorn industrial estate. The 63% of the respondents strongly agreed and 26% agreed with the statement. From the result, the realization of the environmental project like OSS will be a strong marketing advantage for Amata Nakorn industrial estate.

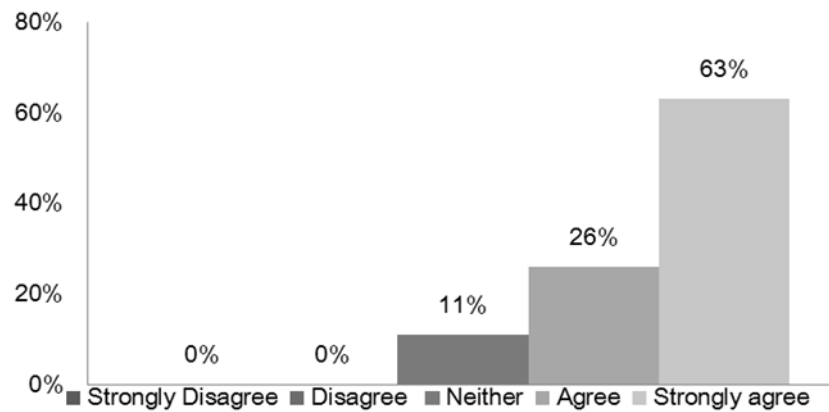


Figure 4.47: Levels of agreement on OSS project will be a great advantage and influence the decision of the enterprise to settle into Amata Nakorn industrial estate

4.8 Summary of key findings from survey questionnaire

Table 4.3: describes some of the key findings that can influence the future development of eco-industrial estate.

Table 4.3: Summary of key findings

4.2 Environmental management in factories and the estate.	<ul style="list-style-type: none"> ● Tenant's problems in waste issues <ol style="list-style-type: none"> 1) Difficulty in finding waste Processors for small amount of specific types of waste 2) Spend so much time and energy in sorting out the wastes
4.3 Tenant's attitude toward environmental management system	<ul style="list-style-type: none"> ● What motivate tenants factories to participate environmental activities The activities which can improve; <ol style="list-style-type: none"> 1) Company image 2) environmental management 3) Marketing a dvarantage
4.4 Environmental management activities	<ul style="list-style-type: none"> ● Identify what environmental activities can be considered as important function for eco-industrial estate model. <ol style="list-style-type: none"> 1) Energy savings 2) Water savings 3) Control of chemical sources of indoor pollution 4) Waste reduction
4.5 Components of eco-industrial estate	<ul style="list-style-type: none"> ● Identify what functions/ components Amata <u>Nakom</u> industrial estate should have for eco-industrial estate transformation from the tenants' perspectives <ol style="list-style-type: none"> 1) Adaptation of sustainable energy 2) establishing wastes recycle center 3) control of the chemical sources of indoor and outdoor pollution
4.6 Characteristics of Amata <u>Nakom</u> industrial estate	<ul style="list-style-type: none"> ● What is the strength/significant factor of Amata <u>Nakom</u> industrial estate from the tenants' perspectives <ol style="list-style-type: none"> 1) Commitment of the management team 2) Increasing awareness of environmental issues 3) Stringency in environmental laws/regulations 4) cooperation from the national government/agencies
4.7 Status of OSS project	<ul style="list-style-type: none"> ● What affect the decision making process <ol style="list-style-type: none"> 1) Service fee 2) quality and types of service that brings solutions to a problem 3) Foreign company involvement no significant impact on the decision making process ● Expectations on the OSS project <ol style="list-style-type: none"> 1) cut down the cost of waste management, 2) eliminate legal issue/future risks over waste related issues, 3) reduce time and work load that the tenants spent on waste management ● How OSS will benefit Amata <u>Nakom</u> IE Tenants believe that the eco-industrial estate development will be an advantage for Amata <u>Nakom</u> industrial estate in marketing and business perspectives

4.8.1 Factors supporting/hindering the development of OSS

From the survey response, the important factors were identified from the tenant perspectives. Factors are as follows;

- 1) Economic factors
- 2) Institutional factors (regulatory/governmental),
- 3) Financial factors
- 4) Organizational factors
- 5) Socio-cultural factors
- 6) Cultural/communication factors
- 7) Technology and information factors

In the earlier section (1.7) identified factors affecting the OSS preparation project from the authors' observation. Below results were the conclusions of supporting/hindering factors observed from both sides.

1) Economic factor

Majority of respondents agreed that the cost reduction/service fee of OSS is a significant factor for tenant companies to decide whether to use the OSS service. Economic factor can be supporting factor if the OSS could realize the cost reduction or provide the waste management at lower fee. However, OSS team found out that since the waste disposal or treatment fee varies among each waste processor, if OSS service cannot offer the competitive price to tenant companies, the tenants may not be interested in using the OSS. Therefore, the economic factor can be neither supporting nor hindering factor which depends on the service fee that the OSS will be able to offer to the tenant companies.

2) Institutional factors (regulatory/support)

a) Environmental regulatory

The OSS team found the regulatory barrier on industrial wastes which slows down or reduces the opportunities for waste utilization during the preparation period of the project. The following concerns were found during the OSS project. Existing laws and regulations would prevent some of the OSS business functions from happening. From the survey responses, the tenant companies showed interest in the OSS business model such as collection of small amount of specific types of wastes and sorting out of wastes on behalf of the tenants. There are strict regulations on hazardous wastes and each type of wastes are regulated by different regulations. It is also difficult to find out how much and what kind of wastes can be collected together or stored together within the industrial estate. This regulatory barrier will make it difficult to realize and hinders the development process of the OSS project/eco-industrial estate development.

b) Support from the governmental institution/enterprise

Majority of the respondents prefer the involvement of the governmental institution/enterprise like IEAT to be a facilitator or supporter for the OSS project. In the OSS project preparation period, the government's involvement was seen less. The presence of the government will encourage the tenant companies to participate and the OSS project will gain more confidence from the participants. For that reason, support from the government are supporting factor for the eco-industrial estate development.

3) Financial factors (Initial investment/operation cost)

The OSS project first period was funded partially by the Japanese government. After the first period, the decision had to be made to commercialize the OSS project between private sectors. The initial investment cost and the operation

cost of the OSS business model became financial barriers for realization of the OSS project. Because the OSS project team concluded that the realization of OSS is not possible from financial perspectives. OSS business was not going to generate enough profit to cover the operation cost and the investment cost. Therefore, the financial factor hinders the development.

4) Organizational factors (Commitment of the management team)

70% of the respondents agreed commitment of the management team is very significant factor for Amata Nakorn industrial estate. Amata Nakorn industrial estate is recognized from Thai government and business communities as a leader in the industrial estate development and its commitment to solve environmental issues within the estate. This is the strength of Amata Nakorn industrial estate.

For the OSS project, most of the decisions are made at the top of the hierarchy, the commitment of the management team of all stakeholders will influence the decisions of the project implementations. The OSS project was planned to operate by private local and international enterprises. There were risks to commit long-term business partnership at the beginning of the project because of uncertainty in the project realizations. There are differences in each management team of each stakeholder. For example, one was eager to start the project but the other was cautious about the taking further steps. Differences in levels of commitment hinder the development of the project.

a) Lack of work commitment and shortage of human resources

Furthermore, the lack of work commitment and shortage of human resources were seen among OSS project team members. This was because the OSS project became additional workload for some members and it was hard for them to commit only on the OSS project. The project members had other business tasks which reduced time and frequencies of the meetings for the OSS project. Moreover, there was a shortage of skilled human resources for special project like OSS. Because the project

and concept was new. Therefore, the different levels of commitment of the management team /the project members were hindering factors for the development.

5) Socio-cultural factors (Social acceptance/awareness)

From the survey results, responded tenants have high awareness in environmental issues and showed positive responses for participating in the OSS project. Social acceptance/environmental concern from both the tenant companies and the local communities will be an important supporting factor for successful implementation of the project. However, in the actual practice, there is no guarantee that all of the tenant companies will support the project. It is difficult to evaluate if the tenant companies and other stakeholders truly understood the concept of OSS/eco-industrial estate development in the early stage because the concept is new and unfamiliar to most of the stakeholders. Thus, socio-cultural factor is either supporting or hindering factor for the development.

6) Cultural/communication factors

Since OSS project is involved two countries, Thailand and Japan. There were some difficulties in communication and there were difference in understanding between the two parties. Difference in business culture and the presence of language barrier were identified throughout the project. From daily communications to formal meetings were conducted through the presence of interpreter. It took sometimes to get use to communicate through third person and participants needed extra efforts in communication. Beyond the communication barriers, there were differences in business conducts. Both parties needed time to get to know each other and adjust the way of doing things. Cultural difference and communication barrier were a hindering factor for the development.

7) Technology and information factors

There were lack of transparency on information and data available on wastes. It is possible to find the data of certain types of wastes from the governmental institutions but the access and the amount of information is limited. The OSS team found out that the information related wastes (i.e. waste amount, types of waste and actual treatment cost etc.) are difficult to obtain. How much wastes and what kind of wastes each factory dispose per year is the essential information in waste related business. As most of the manufactures does not wish to disclose waste information as it concerns confidentiality of their products and production process, the only possible way to obtain such information is to ask tenant companies one by one. There is no guarantee that the tenants are willing to give out waste data especially to private enterprises. During the OSS preparation period the OSS team couldn't obtain enough information on wastes. Therefore, the information factor hinders the OSS project. Thus, obtaining necessary information in a short period of time is a significant factor for the successful development.

4.9 SWOT Analysis on eco-industrial estate development project

The survey results and the identified factors are further examined to identify strategies for eco-industrial estate development in Thailand. The methodology of SWOT analysis is described in Chapter 3. The data obtained from the questionnaire survey and observation and experience from the project participation was used to conduct the SWOT analysis. Below are the SWOTs factors identified from the research.

Strengths

S1: Trust and reputation in Amata's company brand

Amata Nakorn industrial estate is recognized from the Thai/foreign governments and business communities as a leader in the industrial estate development. Amata is committed to solve environmental issues within the estate as

described in Chapter1. Amata Nakorn industrial estate also works closely with the IEAT for eco-industrial estate development project. 70% of the surveyed tenant companies strongly agreed that the highly committed management team is the strength of Amata Nakorn industrial estate. Cooperation from the government 54% and commitment of the participating tenant companies 52% also received the high rate of the agreement. The high percentage of agreement shows tenants' trust in Amata Nakorn industrial estate and make use of this strength to develop eco-industrial estate is essential for Amata Nakorn industrial estate.

S2: High percentages of Japanese tenant companies in Amata Nakorn industrial estate

As over 60% of the tenant companies are Japanese companies in Amata Nakorn industrial estate, this high percentage may benefit Amata Nakorn industrial estate for eco-industrial development. In the literature review, Chinese experience revealed that the industrial estate which accommodates more fortune global companies had less environmental impact in the industrial estate. Japanese companies from SMEs to large enterprises committed to pay serious attention to environmental management and have high awareness toward environmental management. The research result also identified 72% of tenant companies already obtain or planning to obtain ISO standards and also 80% of the tenant companies have their own in-house environmental system to manage environmental issues within the organization. Most of the Japanese tenant companies are committed to avoid environmental degradation caused by business activities in Thailand. Therefore, the project like eco-industrial estate development is favored by Japanese enterprises as the concept is familiar and as long as the project improve their business and environmental performance, the companies are likely participated in the project. Therefore, high number of Japanese tenant companies in Amata Nakorn industrial estate can be considered as strength and benefit to Amata Nakorn industrial estate.

S3: Geographic location of Amata Nakorn industrial estate (Proximity to Bangkok, infrastructure and other industrial estates)

Geographic location of Amata Nakorn industrial estate is described in chapter 1 and the development of Eastern Seaboard region is described in Chapter 2. As the government's economic plan promoted the industrialization in the Eastern Seaboard area because of proximity to Bangkok and to other infrastructures such as deep sea ports. Several industrial estates including Amata Nakorn industrial estate were developed. There are 8 industrial estates in Chonburi province and 12 in Rayong province. (IEAT Annual report 2014) The Proximity to Bangkok, infrastructure and other industrial estates are the strength of Amata Nakorn industrial estate.

Weaknesses

W1: Economic factor (OSS service Fee)

This weakness only applies if Amata Nakorn industrial estate plans to establish OSS business on their own and plan to act as waste processor. The fee for the waste management within OSS service has to be competitive over other existing waste processors.

W2: Environmental regulatory

Environmental regulatory hinders the movement of industrial waste within the industrial estate. Modification of environmental regulatory is required for realization of waste management and utilization within the industrial estate in the future.

W3: Lack of financial support for the development (Initial investment cost and operation cost)

In Thailand, there are not subsidies offered to eco-industrial estate development. As international experience of USA and the Netherlands suggested, the government and enterprise should share the initial investment. Without the financial

support from the government, the eco-industrial estate development will remain difficult from financial perspectives.

W4: Lack of experience in eco-industrial estate development

This eco-industrial estate is a new project for Thailand. Amata Nakorn industrial estate need following aspect into the development.

- 1) Information and data to support the development
- 2) Skilled human resources and expert for the development
- 3) Facilitator or anchor tenants to bring the tenants together and promote the development among stakeholders

Opportunities

O1: Increasing the attractiveness from Japanese/foreign government and investors on eco-industrial estate development project

As this study identified Japanese interest in the eco-industrial estate development project is increasing trend. Amata Nakorn industrial estate will have more opportunities and receive support to work with the Japanese/foreign project members for eco-industrial estate development

O2: Amata Nakorn industrial estate to be a first eco-industrial estate in Thailand

Amata Nakorn industrial estate is seriously committed to environmental management as described in Chapter 1 and with the continuing effort, Amata Nakorn industrial estate could be the first eco-industrial estate in Thailand.

Threats

T1: Changes in waste flow as the result of eco-industrial estate development may cause problems with existing waste processors and other stakeholders in Thailand.

As the waste business concerns with the local communities and people who depends their lives on waste business, the changes in waste flow or amount of waste will greatly affect the existing waste processors and other stakeholders. Therefore, the changes in waste flow will be a threat to stakeholders and troubled stakeholders will be a threat to Amata Nakorn industrial estate.

T2: Social resistance to eco-industrial estate development

Tenant companies or local residents may not accept the concept of eco-industrial estate and its related facilities to be installed within the estate. In the survey questionnaire, some respondent commented such concerns. Therefore, the project should be well explained and promoted to tenant companies before the project initiation. In addition, the project should have both economic and environmental aspect for participated tenants and communities to be benefitted by the project participation. Various international studies pointed out that this will increase the acceptance rate for the project from the tenant companies and local stakeholders.

T3: Foreign company's participation in eco-industrial estate development project may reduce the benefit of local waste processors

Any business should anticipate the worst case scenario and it is important to plan ahead and take prevention measurement. Participation of foreign enterprise may either benefit or become a threat to local environmental businesses or industrial estates. There is not much previous study examining international cooperation eco-industrial estate development project. Therefore, the information is limited however, from the OSS project experience, if the goals of local and international parties did not match, the result will be unproductive.

4.9.1 TOWS MATRIX of OSS project

The SWOTs factors were identified in the previous section. In this section, SWOTs factors will be examined and generate strategies using the TOWS Matrix.

<p style="text-align: center;">Internal Factors</p> <p style="text-align: center;">External Factors</p>	<p>Strengths (S)</p> <p>S1: Trust in Amata's company brand</p> <p>S2: High percentages of Japanese tenant companies in Amata Nakorn industrial estate</p> <p>S3: Geographic location of Amata Nakorn industrial estate</p>	<p>Weaknesses (W)</p> <p>W1: Economic factor (OSS service Fee)</p> <p>W2: Environmental regulatory</p> <p>W3: Lack of financial support for the development</p> <p>W4: Lack of experience in eco-industrial estate development</p>
	<p>Opportunities (O)</p> <p>O1: Increasing attention from foreign government and investors</p> <p>O2T1: opportunity to be a first eco-industrial estate in Thailand</p>	<p>SO strategy</p> <p>Use strengths to take advantage of Opportunities</p>
<p>Threats (T)</p> <p>T1: Changes in waste flow may cause problems with existing waste processors</p> <p>T2: Social resistance to eco-industrial estate development</p> <p>T3: Foreign company's participation in eco-industrial estate development project may reduce the benefit of local waste processors</p>	<p>ST strategy</p> <p>Use strength to avoid threats</p>	<p>WT strategy</p> <p>Minimize weaknesses and avoid threats</p>

Figure 4.48: TOWS MATRIX of OSS project

Figure 4.48 explains the relationship of each SWOTs factors and SO, WO, ST and WT strategies are identified by TOWS Matrix. The details can be found in the methodology. The four strategies are identified to help develop eco-industrial estate in Amata Nakorn industrial estate.

4.10 Recommendation to promote eco-industrial estate

Important factors and four strategies have been identified from analyzing the result of research questionnaire done by the tenant companies in Amata Nakorn industrial estate. The results have been analyzed to make suggestions to transform Amata Nakorn industrial estate into eco-industrial estate. 4 strategies and following action plans are recommended to Amata Nakorn industrial estate.

1) SO strategy

Use Amata brand to transform into eco-industrial estate and take advantage of attentions from both international and local government and investors to realize the development.

Action plan:

- Form a committee to evaluate proposed international project before participation
- Gain technological and knowledge support from international project participation

Amata Nakorn industrial estate gained their business strength over years of experience in industrial estate development and economic situation/trend favored Amata Nakorn industrial estate to develop dramatically after starting operation.(see 1.8) Amata Nakorn industrial estate now receive attention from both locally and internationally for eco-industrial estate development because of the companies brand and other geographic factors and number of Japanese tenant companies, favours Amata Nakorn industrial estate over other industrial estates These strength of Amata Nakorn industrial estate should be utilized and take more advantages of the opportunities to develop first eco-industrial estate in Thailand.

The tenants addressed in the questionnaire survey that that the cost reduction/cost savings are the key factors in environmental development project. However, reducing the cost for waste management is not an easy task. In the third period of OSS trial project mentioned in chapter 1, the Japanese company improved waste recycle rate without any additional investment in new equipment or in facilities. Amata Nakorn industrial estate should take full advantages by project participation and learn know-how from the international project participation.

However, foreign company project participation also has down side. As this study described the OSS project had other purpose to implement the environmental technology of Japanese company into Amata Nakorn industrial estate. In order to avoid such misunderstandings in the future, Amata Nakorn industrial estate and Thai local environmental related business should get together to evaluate project offered by foreign(Japanese) government/investors. The committee should be formed by Amata Nakorn industrial estate, government/institutions and local enterprises such as waste processors to evaluate whether the project will benefit in Thailand or whether the project can be planned locally without international participants.

Question should be asked whether proposed technology (if any) will benefit the estate or such technology should be implemented or can be provided by Thai companies and so forth. For international project, the objectives of the project must be clearly identified and discussed and make sure there is no hidden agenda in the project. The project needs to be modified to fit the needs of all the stakeholders in Amata Nakorn industrial estate.

2) ST Strategy

Take advantage of geographic location of Amata Nakorn industrial estate and invite stakeholders from broader regions to work together and raise awareness of potential waste management project

Action plan:

- Invite participants from Bangkok and other Eastern Seaboard area for widen the opportunities
- Increase awareness and motivate tenant companies to participate eco-industrial estate development

Amata Nakorn industrial estate should take an advantage of geographic location and invite local environmental companies/local waste processors/tenant companies/academics and government both from Bangkok as well as Eastern Seaboard regions to work together and raise awareness of potential waste management project under the eco-industrial estate development. Amata Nakorn industrial estate will have better idea about waste management in broader scale and by working with various stakeholders, Amata Nakorn industrial estate could avoid future conflict with the environmental companies/local waste processors/tenant companies.

Information session for environmental companies/local waste processors must be organized to promote and deepen the understanding of concept of eco-industrial estate development project. The information session provide the opportunities for both environmental companies and Amata Nakorn industrial estate to explore the business opportunities together and avoid any future misunderstandings or conflicts.

Furthermore, before or in the earlier project initiation stage, awareness building activities by open seminars, emails and news letters are essential for the tenant companies to learn and deepen the understanding about eco-industrial estate development project. The survey result identified this method is effective to announce and promote eco-industrial estate development to tenant companies.

In addition, IEAT have developed master plan and developed 5 dimensions and 22 aspects for eco-industrial estate development. The IEAT could stage the campaign with Amata Nakorn industrial estate to promote IEAT master plan together with the concept of OSS project to let people know what it is and how it will benefit the tenant companies.

Furthermore, the information session should target the management level as well as the staff who is responsible for the environmental management within the organizations. As the survey identified management team is the decision maker in the organization. During the information session, Amata Nakorn industrial estate should be able to identify what benefit (in both economic and environmental perspectives)

tenant companies would receive by participating the eco-industrial estate development project.

3) WO Strategy

Opportunity of Amata Nakorn industrial estate to be a first eco-industrial estate in Thailand may bring the subsidy or financial support or regulatory flexibility from the government and also business opportunities from the local environmental related companies

Action plan:

- Ask for financial support for eco-industrial estate development
- Accept more local project and work with local environmental related companies

Opportunity of Amata Nakorn industrial estate to be a first eco-industrial estate in Thailand may bring the subsidy or financial support or regulatory flexibility from the government. That is expected to overcome the weakness of financial difficulties on initial investment cost and operation cost and regulatory barriers on waste movement in industrial estate. Moreover, potentiality of Amata Nakorn industrial estate attract local environmental businesses, Amata's lack of experience in the eco-industrial development can be overcome by accepting local project to support the eco-industrial development.

Financial support from the government is essential as the environmental related business doesn't make a lot of profit within the short period of time and the environmental technologies are expensive to implement. From the international experience of eco-industrial estate development, countries like Japan and the Netherlands had partial subsidies to cover the initial cost for the development. The financial support widens the opportunities and increases the success rate for eco-

industrial estate development in various countries. Therefore, the government should provide financial support for the eco-industrial estate development.

4) WT Strategy:

Establish eco-industrial development working group in industrial estate level and inviting skilled human resources from local waste processors and tenant companies to strengthen the ability and quality of working group to overcome the weakness and realize the development.

Action plan:

- Establish eco-industrial development working group in Amata Nakorn industrial estate and find an anchor tenant or act as a leader of the working group
- Invite waste processors or environmental related companies to join the group to improve the quality of the working group
- Build a database from the data offered by the working group

Establish eco-industrial development working group in industrial estate level and invites skilled human resources to join the working group from local waste processors and tenant companies to join the development and build a good working relationship to avoid future conflicts. In addition, weakness in data and information acquisition can be minimized by inviting tenant companies to participate in working group and provide support to solve their existing problem in exchange for providing data on wastes and other necessary data for the development.

During the OSS project, there was a shortage of skilled manpower to develop the plan. Therefore, minimizing weakness in lack of skilled human resources for eco-industrial estate development by establishing eco-industrial development working group and inviting skilled human resources from local waste processors and tenant

companies are considered as beneficial to Amata Nakorn industrial estate. By working together, all the stakeholders can build work relationship and that experience could prevent from future conflict.

Furthermore, acquired data should be collected and build a data base in the future to provide efficient support system. The government together with eco-industrial development working group should establish the center to provide necessary information as well as the support for existing industrial estates and stakeholders. The center should also provide the consultation service to help existing industrial estate to transform eco-industrial estate in the future.



REFERENCES

English

- (JICA), Japan International Cooperation Agency. 2000. Annual Evaluation Report 2000
- Amata. *Facilities & Environment: Maintaining the Environment* Amata [cited August 5, 2015. Available from <http://www.amata.com/site/inside.php?m=services&p=9>.
- Amata. 2014. Sustainable Development Report 2014.
- Behera, Shishir Kumar, Kim. Jung-Hoon, Sang-Yoon Lee, Sangwon Suh, and Hung-Suck Park. 2012 "Evolution of "designed" Industrial Symbiosis Networks in the Ulsan Eco-Industrial Park: "Research and Development into Business" as the Enabling Framework." *Journal of Cleaner Production* no. 29-30 (29-30):103-112.
- Chertow, Marian R. 2000. "Industrial Symbiosis: Literature and Taxonomy." *Annual Review of Energy and the Environment* no. 251 (1):313-337.
- Chiu, Anthony S.F., and Geng Yong. 2004. "On the Industrial Ecology Potential in Asian Developing Countries." *Journal of Cleaner Production* no. 12 (8):1037-1045.
- Cote, Raymond P., and E. Cohen-Rosenthal. 1998. "Designing Eco-Industrial Parks: A Synthesis of Some Experiences." *Journal of Cleaner Production* no. 6 (3):181-188.
- Frosch, Robert A., and Nicholas E. Gallopoulos. 1989. Strategies for Manufacturing. *Scientific American* 94-102.
- Gavin Shatkin. 2004 "Globalization and Local Leadership: Growth, Power and Politics in Thailand's Eastern Seaboard " *International Journal of Urban and Regional Research* no. 28 (3):11-26.
- Geng, Yong, and Zhao Hengxin. 2009. "Industrial Park Management in the Chinese Environment." *Journal of Cleaner Production* no. 17 (14):1289-1294.
- Gibbs, David, and Pauline Deutz. 2007. "Reflections on Implementing Industrial Ecology through Eco- Industrial Park Development." *Journal of Cleaner Production* no. 15 (17):1683-1695.
- Global Environment Center Foundation (GEC). 2006. *Legal and Other Support Systems for Eco-Towns in Japan*. Japan Global Environment Center Foundation (GEC).
- Indigo Development. 2012. *Eco-Industrial Park Handbook for Asian Developing Nations* 2001a [cited January 9, 2012 2012]. Available from <http://www.indigodev.com/Handbook.html>.
- Indigo Development. 2012. *Eco-Industrial Parks (EIP)* 2001b [cited January 9, 2012 2012]. Available from <http://www.indigodev.com/Ecoparks.html>.
- Kim, Heungsoon. 2007. "Building an Eco-Industrial Park as a Public Project in South Korea. The Stakeholders' Understanding of and Involvement in the Project." *Sustainable Development* no. 15 (6):357-369.

- Markovska, N., V. Taseska , and J. Pop-Jordanov. 2009. "SWOT Analyses of the National Energy Sector for Sustainable Energy Development." *Energy* no. 34:752-756.
- Park, Hung-Suck, Eldon R. Rene, Soo-Mi Choi, and Anthony S.F. Chiu. 2008. "Strategies for Sustainable Development of Industrial Park in Ulsan, South Korea-From Spontaneous Evolution to Systematic Expansion of Industrial Symbiosis." *Journal of Environmental Management* no. 87 (1):1-13.
- R.R. Heeres, R.R., W.J.V. Vermeulen, and F.B. de Walle. 2004. "Eco-Industrial Park Initiatives in the USA and the Netherlands: First Lessons." *Journal of Cleaner Production* no. 12 (8-10):985-995.
- Sakr, D., L. Baas, S. El-Haggar, and D. Huisinigh. 2011. "Critical Success and Limiting Factors for Eco-Industrial Parks: Global Trends and Egyptian Context " *Journal of Cleaner Production* no. 19 (11):1158-1169.
- Shi, Han, Jinping Tian, and Lujun Chen. 2012. "China's Quest for Eco-Industrial Parks, Part I." *Journal of Industrial Ecology* no. 16 (1):8-10.
- Srivastava, P.K., K. Kulshreshtha, C.S. Mohanty, Pushpangadan P., and A. Singh. 2005. "Stakeholder-based SWOT Analysis for Successful Municipal Solid Waste Management in Lucknow, India " *Waste Management* no. 25:531-537.
- Tian, Jinping, Wei Liu, Binjie Lai, Xing Li, and Lujun Chen. 2014. "Study of the Performance of Eco-Industrial Park Development in China." *Journal of Cleaner Production* no. 64:486-494.
- Tudor, Terry, Emma Adam, and Margaret Bates. 2007. "Drives and Limitations for the Successful Development and Functioning of EIPs (Eco-Industrial Parks): A Literature Review." *Ecological Economics* no. 61 (2):199-207.
- Veiga, Lilian Bechara Elabras, and Alessandra Magrini. 2009. "Eco-Industrial Park Development in Rio de Janeiro, Brazil: A Tool for Sustainable Development." *Journal of Cleaner Production* no. 17:653-661.
- Verawat Panyathanakun, Supawan Tantayanon, Charit Tingsabhat, and Kitikorn Charmondusit. 2013. "Development of Eco-Industrial Estates in Thailand: Initiatives in the Northern Region Community-Based Eco-Industrial Estate." *Journal of Cleaner Production* no. 51 (7):71-79.
- Wheelen, Thomas L., and J. David Hunger. 2000. *Strategic Management and Business Policy*. 7th ed: Prentice Hall International, Inc. .
- Zhu, Qinghua, Yong Geng, Joseph Sarkis, and Kee-Hung Lai. 2015. "Barriers to Promoting Eco-Industrial Parks Development in China: Perspectives from Senior Officials at National Industrial Parks." *Journal of Industrial Ecology* no. 19 (3):457-467.

Japanese

- Meiji University Research Institute. 2012. *Momose Hideo. Kougyou Danchi No Shiteki Tenbou-Sono Igito Seisaku* Meiji University Research Institute 1978 [cited December 15,2012 2012]. Available from https://m-repo.lib.meiji.ac.jp/dspace/bitstream/10291/8336/1/seikeironso_46_5-%206_85.pdf.

Ministry of Economy, Trade and Industry (METI). *Thai Chonburi ni okeru jyunkangata kankyou hatten ni muketa jigyouka kanousei chousa houkokusho* 2012. Available from http://www.meti.go.jp/meti_lib/report/2011fy/E003759.pdf.

Ministry of Economy Trade and Industry (METI). 2010. Thai Bangkok Chiikini Okeru Jyunkangata Keizaino Hatten Ni Muketa FS Chousa.

Thai

Industrial Estate Authority of Thailand (IEAT). 2012. *Criteria of Eco-Industrial Estate* Bangkok Industrial Estate Authority of Thailand (IEAT)



APPENDIX



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

APPENDIX A: LETTER FROM CHULALONGKORN UNIVERSITY

ศธ 0512.23.15/



ศูนย์ไทยศึกษา
คณะอักษรศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย
ปทุมวัน กรุงเทพฯ 10330

มีนาคม 2557

เรื่อง ขออนุญาตเก็บข้อมูล
เรียน ท่านผู้ประกอบการในนิคมอุตสาหกรรมอมตะนคร

ด้วยนางสาวมา유มิ ยามาอะ นิสิตในหลักสูตรปริญญาตรีบัณฑิต สาขาวิชาไทยศึกษา คณะอักษรศาสตร์ ซึ่งขณะนี้อยู่ในระหว่างการเก็บข้อมูลเพื่อเขียนวิทยานิพนธ์เรื่อง “การพัฒนา นิคมอุตสาหกรรมเชิงนิเวศในประเทศไทย: การศึกษาของนิคมอุตสาหกรรมอมตะนคร” (ECO-INDUSTRIAL ESTATE DEVELOPMENT IN THAILAND: STUDY OF AMATA NAKORN INDUSTRIAL ESTATE)

ในการนี้ ใ้คร้ขออนุญาตสัมภาษณ์ เก็บข้อมูล และขอถ่ายภาพ เพื่อประกอบการศึกษาวิจัย ให้สมบูรณ์ชัดเจนยิ่งขึ้น

จึงเรียนมาเพื่อโปรดพิจารณาอนุญาต และขอขอบคุณมา ณ โอกาสนี้ หากท่านมีข้อสงสัยประการใด โปรดติดต่อศูนย์ไทยศึกษาตามที่อยู่ปรากฏด้านบน หรือ โทรศัพท์ 02 018 4862

ขอแสดงความนับถือ

(ศาสตราจารย์ ดร.ศิริพร ณ ถลาง)
ผู้อำนวยการศูนย์ไทยศึกษา

APPENDIX B: ECO-INDUSTRIAL ESTATE DEVELOPMENT QUESTIONNAIRE

แบบสอบถามการพัฒนานิคมอุตสาหกรรมเชิงนิเวศ

Objectives of the questionnaire (วัตถุประสงค์ของแบบสอบถาม)

This questionnaire has been prepared for Ph.D. dissertation entitled “ECO-INDUSTRIAL ESTATE DEVELOPMENT IN THAILAND: A STUDY OF AMATA NAKORN INDUSTRIAL ESTATE”.

The project aims to examine and analyze a practical model to transform Amata Nakorn and Amata City Industrial Estate into Eco-industrial Estate.

There is an ongoing project called development of eco-conscious industrial estate, One Stop Service (OSS) model project at Amata Nakorn and Amata City Industrial estate by Amata facility Service and overseas investors to speed up the eco-industrial transformation. The main objective of OSS model project is to understand the current issues of waste management of tenant factories and facilitate to improve the waste management of tenants. One Stop Service (OSS) project is planning to transfer/store/collect general/industrial wastes from the tenants in Amata Nakorn Industrial Estate.

แบบสอบถามนี้ถูกจัดทำขึ้นเพื่อการตรวจสอบวิจัยหลักสูตรปริญญาเอก (PhD) เรื่อง การพัฒนานิคมอุตสาหกรรมเชิงนิเวศในประเทศไทย : กรณีศึกษาของนิคมอุตสาหกรรมอมตะนคร โครงการนี้มุ่งหมายที่จะตรวจสอบและวิเคราะห์รูปแบบการปฏิบัติเพื่อเปลี่ยนแปลงไปนิคมอุตสาหกรรมอมตะนครและอมตะซิตี้ไปสู่นิคมอุตสาหกรรมเชิงนิเวศ(คือ นิคมอุตสาหกรรมที่เป็นมิตรต่อสิ่งแวดล้อม)

มีโครงการต่อเนื่องที่เรียกว่าการพัฒนานิคมอุตสาหกรรมเชิงนิเวศ(Eco Industrial Estate), โครงการต้นแบบ One Stop Service (OSS) ในนิคมอุตสาหกรรมอมตะนครและอมตะ

ที่ดี โดยฝ่ายบริการสิ่งอำนวยความสะดวกของอมตะและผู้ลงทุนต่างชาติ เพื่อเพิ่มความเร็วในการเปลี่ยนแปลงไปสู่อุตสาหกรรมเชิงนิเวศ(Eco-industrial) วัตถุประสงค์หลักของ OSS model project คือการเข้าใจในสถานการณ์ปัจจุบันของการจัดการขยะของโรงงานผู้เช่าและอำนวยความสะดวกในการพัฒนาการจัดการขยะของผู้เช่า โครงการ One Stop Service (OSS) คือการวางแผนในการเคลื่อนย้าย / จัดเก็บ / รวบรวมขยะทั่วไปและขยะอุตสาหกรรมจากผู้เช่าในนิคมอุตสาหกรรมอมตะนคร

This questionnaire will act as a tool to find out a best possible approach to realize OSS project into action. Your answers are highly appreciated. The collected data will be used for the following objectives:

- To create a model for successful implementation of OSS project in Amata Nakorn Industrial Estate
- To understand the environmental related issues from tenants perspective.
- To identify the barriers in implementing OSS model project in Amata Nakorn Industrial Estate from tenants perspective.

The questionnaire is divided into the following sections:

- Section1. General questions
- Section2. One Stop Service (OSS) Project

แบบสอบถามนี้จะทำหน้าที่เป็นเครื่องมือในการหาวิธีการที่เป็นไปได้ที่ดีที่สุดในการทำให้โครงการ OSS เป็นจริง ขอขอบพระคุณอย่างสูงต่อการตอบคำถามของคุณ ข้อมูลที่รวบรวมนี้จะถูกนำไปใช้เพื่อจุดมุ่งหมายดังต่อไปนี้:

- เพื่อสร้างต้นแบบในการดำเนินงานที่ประสบความสำเร็จของโครงการ OSS ในนิคมอุตสาหกรรมอมตะนคร
- เพื่อเข้าใจในสภาพแวดล้อมที่เกี่ยวข้องกับปัญหาจากมุมมองของผู้เช่า

- เพื่อแยกแยะอุปสรรคต่อความสำเร็จของ OSS model project ในนิคมอุตสาหกรรม
อมตะนครจากมุมมองของผู้เช่า

แบบสอบถามนี้ถูกแบ่งออกเป็น 2 ส่วนดังต่อไปนี้:

- ส่วนที่ 1. คำถามทั่วไป
- ส่วนที่ 2. One Stop Service (OSS) project

Confidentiality

Please note that all data collected will be kept confidential and you/your company name will not be identified in any report. If you have questions about participating in this questionnaire or have question at later date, please do not hesitate to contact Ms. Mayumi Yamada by calling 081-809-8905 or sending an e-mail to mayuliy@gmail.com

ความน่าเชื่อถือ

ข้อมูลที่จัดเก็บนี้ทั้งหมดจะถูกเก็บไว้เป็นความลับ ชื่อของท่าน และชื่อบริษัทของท่านจะไม่ถูกเผยแพร่ในรายงานใดๆทั้งสิ้น ถ้าท่านมีคำถามเกี่ยวกับการร่วมตอบแบบสอบถามนี้ หรือมีคำถามใดๆ กรุณาติดต่อนางสาวมายุมิ ยามะดะ ที่เบอร์ 081-809-8905 หรือ e-mail mayuliy@gmail.com

Please fill in the blanks (กรุณาเติมในช่องว่าง)

Company Name: ชื่อบริษัท:	
Questionnaire filled by (Name): ตอบแบบสอบถามโดย (ชื่อผู้ตอบ) :	
Job title: ตำแหน่งงาน:	

Gender: เพศ:	<input type="checkbox"/> Male ชาย <input type="checkbox"/> Female หญิง
Email address: อีเมล:	
How many months/years at your present position? ท่านทำงานในตำแหน่งนี้มากี่เดือน/ปี?	
Breif description of your duties รายละเอียดหน้าที่โดยสรุป	
Nature/Type of industries ประเภทของอุตสาหกรรม	<input type="checkbox"/> Automotive <input type="checkbox"/> Steel/ Metal/ Plastic <input type="checkbox"/> Electronics <input type="checkbox"/> Consumer Goods, Healthcare <input type="checkbox"/> Other(Specify).....
Size of your enterprise (ขนาดของพื้นที่ น้อยกว่า 5 ไร่ เล็ก , 5 ถึง 20 ไร่ กลาง =, มากกว่า 20 ไร่ = ใหญ่)	<input type="checkbox"/> Small เล็ก <input type="checkbox"/> Medium กลาง <input type="checkbox"/> Large ใหญ่

Section 1: General questions

Please choose and mark the number that fit the most to your opinion

The aim of this section is to identify your perspectives on eco-industrial estate development and on other environmental issues.

ส่วนที่ 1 : คำถามทั่วไป

กรุณาเลือกและทำเครื่องหมายในหมายเลขที่เหมาะสมกับความเห็นของท่านที่สุด

เป้าหมายของส่วนนี้เพื่อทำความเข้าใจเกี่ยวกับมุมมองของท่านต่อการพัฒนานิคมอุตสาหกรรมเชิงนิเวศและปัญหาสิ่งแวดล้อมอื่นๆ

6. Environment policy of your company นโยบายสิ่งแวดล้อมของบริษัทท่าน				
1	2	3	4	5
7. Financial gain from the project participation ผลประโยชน์ทางธุรกิจและการเงินจากการเข้าร่วมโครงการ				
1	2	3	4	5
8. Learning opportunities from the project participation โอกาสในการเรียนรู้จากการเข้าร่วมโครงการ				
1	2	3	4	5
9. Gift/Incentives ของกำนัล/แรงจูงใจ				
1	2	3	4	5
10. Participation cost (if any) ค่าใช้จ่ายในการเข้าร่วม (ถ้ามี)				
1	2	3	4	5

11. Project owner (in this case Amata Facility Service) เจ้าของโครงการ (AFS)				
1	2	3	4	5
12. Number of participants จำนวนผู้เข้าร่วม				
1	2	3	4	5



1-5. In your opinion, Which factor from the previous question is the most important for your participation? Please choose one factor from 1~12. And write the number down in the space provided.

ตามความเห็นของท่าน จากคำถามข้างต้น บั๊จจัยข้อใดที่สำคัญที่สุดสำหรับการเข้าร่วมของท่าน? กรุณาเลือกบั๊จจัยจาก 1~12. และเขียนตัวเลขบั๊จจัยที่เลือกในช่องด้านล่าง

< Factor No. >



1-6. How each stakeholder involvement would affect the Eco-industrial transformation? Please rate. การมีส่วนร่วมของผู้มีส่วนได้เสียแต่ละส่วน สามารถส่งผลต่อการเปลี่ยนแปลงอุตสาหกรรมเชิงนิเวศได้อย่างไร? กรุณาให้คะแนน				
3. Neither positively affect				
1. Very negatively affect← 1. ส่งผลลบอย่างมาก←	nor negatively affect		→5. Very positively affect →5. ส่งผลดีอย่างมาก	
1. National government or agency like Industrial Estate Authority of Thailand (IEAT) รัฐบาลไทยหรือหน่วยงานอย่างการนิคมอุตสาหกรรมแห่งประเทศไทย (IEAT)				
1	2	3	4	5
2. foreign government/ foreign company รัฐบาลต่างชาติ/บริษัทต่างชาติ				
1	2	3	4	5
3. research institute or university involvement สถาบันการวิจัยหรือการมีส่วนร่วมของมหาวิทยาลัย				
1	2	3	4	5
4. Local environmental related companies บริษัทที่เกี่ยวข้องด้านสิ่งแวดล้อมในท้องถิ่น				
1	2	3	4	5
5. International environmental related companies บริษัทที่เกี่ยวข้องด้านสิ่งแวดล้อมระหว่างประเทศ				
1	2	3	4	5

ความร่วมมือจากมหาวิทยาลัย/สถาบันวิจัย				
1	2	3	4	5
9. Variety of industry type in Amata Nakorn Industrial Estate ความหลากหลายของประเภทอุตสาหกรรมในนิคมอุตสาหกรรมอมตะนคร				
1	2	3	4	5
10. Economic/Social condition สภาพทางเศรษฐกิจ/สังคม				
1	2	3	4	5
11. Political condition สภาพทางการเมือง				
1	2	3	4	5
12. Commitment of participating tenants ความมุ่งมั่นของผู้เช่าที่เข้าร่วม				
1	2	3	4	5
13. Stringency in environmental laws/regulations ความเข้มงวดทางกฎหมาย / ข้อบังคับด้านสิ่งแวดล้อม				
1	2	3	4	5
14. Increasing awareness of environmental issues การรับรู้ที่เพิ่มขึ้นของปัญหาสิ่งแวดล้อม				
1	2	3	4	5
15. Cooperation between the tenant factories ความร่วมมือระหว่างโรงงานผู้เช่า				
1	2	3	4	5

1-8. In your opinion, what are the important functions/components for Eco-Industrial Estate? ตามความเห็นของท่าน อะไรคือหน้าที่/ส่วนประกอบสำคัญสำหรับนิคมอุตสาหกรรมเชิงนิเวศ?				
1.Very unimportant ← 3.Neither important nor unimportant →5.very important				
1.ไม่สำคัญเลย← 3.ไม่ทั้งสำคัญและไม่สำคัญ →5.สำคัญมาก				
1. Adaptation of sustainable energy การปรับตัวของพลังงานที่ยั่งยืน				
1	2	3	4	5

2. Establishing waste disposal site and treatment facility การสร้างพื้นที่กำจัดของเสียและสิ่งอำนวยความสะดวกในการจัดการ				
1	2	3	4	5
3. Establishing waste Recycle center การจัดตั้งศูนย์การนำขยะกลับมาใช้ใหม่ (Waste Recycle Center)				
1	2	3	4	5
4. Establishing waste storage/transfer yard การสร้างลานจัดเก็บ/ถ่ายโอนของเสีย				
1	2	3	4	5
5. Establishing waste water treatment plant for special type of industries การสร้างโรงงานบำบัดน้ำเสียสำหรับอุตสาหกรรมประเภทพิเศษ				
1	2	3	4	5
6. Establishing waste exchange facility and online exchange market การสร้างสิ่งอำนวยความสะดวกในการแลกเปลี่ยนขยะและตลาดแลกเปลี่ยน online				
1	2	3	4	5
7. Creation of new business on waste market การสร้างธุรกิจใหม่ในตลาดสิ่งของเหลือทิ้ง				
1	2	3	4	5
8. Use of electricvehicles การใช้พาหนะระบบไฟฟ้า				
1	2	3	4	5
9. Creation of more green areas การสร้างพื้นที่สีเขียวมากขึ้น				
1	2	3	4	5
10. Creation of new job opportunities การสร้างโอกาสงานใหม่ๆ				
1	2	3	4	5
11. Establishing eco-learning facilities การสร้างสิ่งอำนวยความสะดวกในการเรียนรู้ด้านนิเวศวิทยา				
1	2	3	4	5
12. Use of eco-friendly products/materials การใช้ผลิตภัณฑ์/วัสดุที่เป็นมิตรกับสิ่งแวดล้อม				
1	2	3	4	5
13. Control of the chemical sources of indoor and outdoor pollution การควบคุมแหล่งที่มาของสารเคมีที่เป็นมลพิษทั้งในร่มและกลางแจ้ง				
1	2	3	4	5

1-9. Do you have company's own in-house environmental management system? ท่านมีระบบการจัดการสิ่งแวดล้อมภายในของบริษัทเองหรือไม่?

1. YES How efficient are the system?

มี เป็นระบบที่มีประสิทธิผลเพียงไร?

1.Very inefficient ← 3.Neither →5.very efficient
1.ไม่มีประสิทธิภาพเลย← 3.ไม่ทั้งนั้น →5.มีประสิทธิภาพมาก

1	2	3	4	5
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2. NO ไม่มี

1-10. In your opinion, current environmental laws and regulations are strict enough to prevent environmental damage caused by business activities?

ตามความเห็นของท่าน กฎหมายและข้อบังคับด้านสิ่งแวดล้อมที่มีอยู่ในปัจจุบัน เข้มงวดพอที่จะป้องกันความเสียหายด้านสิ่งแวดล้อมที่เกิดจากกิจกรรมทางธุรกิจได้หรือยัง?

1.Strongly disagree← 3.Neither agree nor disagree →5.Strongly agree
1.ไม่เห็นด้วยอย่างมาก← 3. ไม่ทั้งเห็นด้วยและไม่เห็นด้วย →5.เห็นด้วยอย่างมาก

1	2	3	4	5
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1-11. Have you already certified or planned to obtain any environmental management certification such as ISO 14001?

ท่านได้รับหรือกำลังวางแผนในการขอรับการรับประกันการจัดการด้านสิ่งแวดล้อม อย่างเช่น ISO 14001 หรือไม่?

1. YES Please continue to answer next question (1-12).
ใช่ กรุณาตอบคำถามต่อไปนี้ (1-12).

2. NO Please go to question 1-14
ไม่ ไม่ใช้กรุณาไปที่คำถาม1-14

1-12. What was/is the motivation of seeking certification? อะไรคือสิ่งที่ / เป็นแรงจูงใจในการแสวงหาการรับรอง?				
1. Very unimportant ← 1. ไม่สำคัญเลย←		3. Neither important nor unimportant 3. ไม่ทั้งสำคัญและไม่สำคัญ		→5. very important →5. สำคัญมาก
1. Improvement in environmental management การพัฒนาการจัดการสิ่งแวดล้อม				
1	2	3	4	5
2.Improvement in company image การปรับปรุงภาพลักษณ์ของบริษัท				
1	2	3	4	5
3.Marketing advantage ความได้เปรียบด้านการตลาด				
1	2	3	4	5
4.Requirement from the suppliers/consumers การร้องขอจากผู้ผลิต/ ผู้บริโภค				
1	2	3	4	5
5.Cost savings ประหยัดค่าใช้จ่าย				
1	2	3	4	5
6.Achieving compliance ประสบความสำเร็จในการปฏิบัติตาม				
1	2	3	4	5
7.Reducing unseen risks ลดความเสี่ยงที่มองไม่เห็น				
1	2	3	4	5
8.Other (please specify) อื่นๆ (กรุณาระบุ)				
1	2	3	4	5

⊕

1-13. In your opinion, What is the key benefit obtained from Environmental management system like ISO?
ตามความเห็นของท่าน อะไรคือผลประโยชน์สำคัญที่สุดที่ได้จากระบบการจัดการสิ่งแวดล้อม เช่น ISO?
Please choose one factor from 1~8 from previous question 1-12 and put number in the provided space below.
กรุณาเลือก หนึ่งปัจจัย จาก 1~8 ข้อคำถามที่ 1-12 และเขียนตัวเลขลงในช่องว่าง

Factor no. < >

1-14. In your organization, what and how benefits from these environmental management activities are important?
ในองค์กรของท่านผลประโยชน์อะไรจากกิจกรรมการจัดการสิ่งแวดล้อมเหล่านี้มีความสำคัญมากน้อยเพียงใด?

-2. Very unimportant ← -2. ไม่สำคัญเลย←	0. Neither important nor unimportant 0. ไม่ทั้งสำคัญและไม่สำคัญ	→2. very important →2. สำคัญมาก
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1. Water saving ประหยัดน้ำ				
1	2	3	4	5
2. Energy saving ประหยัดพลังงาน				
1	2	3	4	5
3. Reuse of process water การนำมาใช้ใหม่ของน้ำในกระบวนการ				
1	2	3	4	5
4. Waste reduction การลดของเสีย				
1	2	3	4	5
5. Reuse of materials การนำวัสดุกลับมาใช้ใหม่				
1	2	3	4	5
6. Use of eco-friendly materials การใช้วัสดุที่เป็นมิตรกับสิ่งแวดล้อม				
1	2	3	4	5
7. Use of recycled materials การใช้วัสดุที่นำกลับมาใช้ใหม่				
1	2	3	4	5
8. Use of local materials การใช้วัตถุดิบในท้องถิ่น				
1	2	3	4	5
9. Control of the chemical sources of indoor pollution การควบคุมแหล่งของสารเคมีที่เป็นมลพิษในอาคาร				
1	2	3	4	5

1-15. How would you agree or disagree following statements? คุณเห็นด้วยหรือไม่เห็นด้วยกับถ้อยแถลงต่อไปนี้อย่างไร?				
1. Strongly disagree← 1.ไม่เห็นด้วยอย่างมาก←		3. Neither agree nor disagree 3. ไม่ทั้งเห็นด้วยและไม่เห็นด้วย		→5. Strongly agree →5.เห็นด้วยมาก
1. You find it difficult to find a waste processor if the amount of specific/hazardous waste is generated in small amounts ท่านพบว่ามันยากที่จะบริหารจัดการของเสีย ถ้าจำนวนของเสียเฉพาะประเภทหรือของเสียอันตรายนั้นน้อยมาก				
1	2	3	4	5
2. You cannot find a waste processor for specific types of waste ท่านไม่สามารถหาบริหารจัดการของเสียสำหรับขยะเฉพาะประเภท				
1	2	3	4	5
3. You do not have technology or skill to separate waste into different types ท่านไม่มีเทคโนโลยีหรือทักษะในการคัดแยกของเสียออกเป็นประเภทแตกต่างกัน				
1	2	3	4	5
4. You need to put too much time and effort sorting out the waste ท่านจำเป็นต้องใช้เวลาและความพยายามมากในการจัดการของเสีย				
1	2	3	4	5

5. Your company does not have enough waste storage space in your premises บริษัทของท่านไม่มีพื้นที่จัดเก็บของเสียที่เพียงพอในสถานที่ของท่าน				
1	2	3	4	5
6. You cannot find a reliable waste processor ท่านไม่สามารถหาบริษัทจัดการของเสียที่เชื่อถือได้				
1	2	3	4	5
7. You prefer to use only one waste processor for all wastes ท่านชอบที่จะใช้บริษัทจัดการของเสียเพียงเจ้าเดียวสำหรับของเสียทั้งหมดมากกว่า				
1	2	3	4	5
8. You think that the laws and regulations on industrial waste management are too stringent. ท่านคิดว่ากฎหมายและข้อบังคับในเรื่องการจัดการของเสียอุตสาหกรรมมีความเข้มงวดมากเกินไป				
1	2	3	4	5

1-16. In your company, who has the decision-making power to decide whether to join or not to join the environmental related project? ในบริษัทของท่าน ใครคือผู้มีอำนาจในการตัดสินใจเข้าร่วมหรือไม่เข้าร่วมในโครงการที่เกี่ยวข้องกับสิ่งแวดล้อม? Please rate the decision making power where 5 has the most decision-making authority กรุณาให้คะแนนการตัดสินใจ โดย 5 เป็นผู้มีอำนาจสูงสุดในการตัดสินใจ				
1.Environment division ส่วนงานสิ่งแวดล้อม				
1	2	3	4	5
2.Executive level ระดับผู้บริหาร				
1	2	3	4	5
3.Other (please specify) อื่นๆ (กรุณาระบุ) _____				
1	2	3	4	5

Section 2: One-Stop Service (OSS) project

Please choose and mark the number that fit the most to your opinion

The aim of this section is to identify willingness to participate and how tenants understand about One Stop Service (OSS) project.

กรุณาลืออกและทำเครื่องหมายในหมายเลขที่เหมาะสมกับความเห็นของท่านที่สุด

เป้าหมายของส่วนนี้ เพื่อชี้บ่งความตั้งใจในการเข้าร่วมและระดับความเข้าใจของโรงงานในนิคมฯเกี่ยวกับโครงการ One-Stop Service (OSS)

2-1. Would you be willing to participate, if Amata Nakorn Industrial Estate is going to operate One Stop Service (OSS) center to transfer/ collect/ store general/industrial/hazardous wastes from your factory? Please mark your willingness by choosing one number from 1 to 5, assuming that 5 ranks at the highest position.

ท่านเต็มใจเข้าร่วมไหม ถ้านิคมอุตสาหกรรมอมตะนครจะเปิดศูนย์ One Stop Service (OSS) center เพื่อขนย้าย / รวบรวม/ จัดเก็บขยะทั่วไป, ขยะอุตสาหกรรมและขยะอันตรายจากโรงงานของท่าน? กรุณาทำเครื่องหมายแสดงความตั้งใจของท่านโดยเลือกหมายเลขจาก 1 ถึง 5 โดยสมมติให้ 5 อยู่ในระดับความเต็มใจที่สูงที่สุด

1	2	3	4	5
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2-2. Aside from transfer/collect/store general/industrial/hazardous waste, does OSS need additional service menu to meet your need?

นอกเหนือจากการขนย้าย / รวบรวม / จัดเก็บ ขยะทั่วไป, ขยะอุตสาหกรรมและขยะอันตรายแล้ว ทาง OSS จำเป็นต้องเพิ่มรายการบริการที่ตรงกับความต้องการของท่านอีกหรือไม่?

Yes (Please specify)

จำเป็น (กรุณาระบุ) _____

No

ไม่จำเป็น

2-3. Prior to the project initiation, what would be the most effective way to approach you and discuss with you about the OSS project? Please choose one. (✓)
 ก่อนที่จะเริ่มต้นโครงการ, วิธีไหนจะเป็นวิธีที่จะเข้าถึงคุณและได้สนทนากับคุณเกี่ยวกับโครงการ OSS ได้อย่างมีประสิทธิภาพที่สุด ? (✓)

1. □ Information session การประชุม ข้อมูล	2. □ News Letter จดหมาย ข่าว	3. □ One on One meeting การพบ เป็นการ ส่วนตัว	4. □ Phone call โทรศัพท์	5. □ Email	6. □ Website /Social Network (Facebook, etc)	7. □ Other Please specify in Notes/ Comments อื่นๆ กรุณาระบุใน หมายเหตุ / ความคิดเห็น
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Notes/comments หมายเหตุ/ความคิดเห็น

๕

2-4. Who should be a facilitator/supporter of OSS project? Please choose one. (✓)
 ใครที่น่าจะเป็นผู้อำนวยความสะดวก/ผู้สนับสนุนของโครงการ OSS?
 กรุณาเลือก 1 ข้อ (✓)

1. Industrial Estate Authority of Thailand
 การนิคมอุตสาหกรรมแห่งประเทศไทย

2. Local environmental related companies
 บริษัทที่เกี่ยวข้องกับสิ่งแวดล้อมท้องถิ่น

3. International environmental related companies

บริษัทที่เกี่ยวข้องกับสิ่งแวดล้อมต่างประเทศระหว่างประเทศ

๒4. **Representatives from tenant factories in Amata Nakorn IE**

ตัวแทนจากโรงงานผู้เช่าใน Amata Nakorn IE

๒5. **Academic and research institutions**

สถาบันการศึกษาและการวิจัย

๒6. **Other (please specify in the field notes/comments)**

อื่นๆ (กรุณาระบุเป็นสาขา ในหมายเหตุ/ความคิดเห็น)

Notes/comments หมายเหตุ/ความคิดเห็น

2-5. Which element influences the decision of using or not using the One Stop Service?

(Please rank from 1 to 5 to each elements listing them by importance order, assuming that 5 ranks at the highest position)

องค์ประกอบไหนที่มีอิทธิพลต่อการตัดสินใจใช้หรือไม่ใช้ One Stop Service?
(กรุณาจัดลำดับความสำคัญ เลือกให้คะแนน 1 ถึง 5 ของแต่ละองค์ประกอบโดยจัดลำดับตามความสำคัญ, สมมติให้ 5 เป็นลำดับสูงสุด)

() 1. Service fee ค่าบริการ

() 2. Quality and types of service that brings solution to a Problem คุณภาพและประเภทของบริการที่นำไปสู่การแก้ปัญหา

() 3. Types of waste that OSS can accept

ชนิดของของเสียที่ OSS ยอมรับได้

() 4. Foreign company involvement

การมีส่วนร่วมของบริษัทต่างประเทศ

() 5. Amata Nakorn IE as an owner of the OSS

Amata Nakorn IE ในฐานะเป็นเจ้าของ OSS

() 6. Other (please specify in the field notes/comments)

อื่นๆ (กรุณาระบุเป็นสาขาใน หมายเหตุ/ความคิดเห็น)

Notes/comments หมายเหตุ/ความคิดเห็น

<p>2-8. Do you think that the project like OSS will be a great advantage that influences the decision of the enterprises to settle in Amata Nakorn Industrial Estate? ท่านคิดว่าโครงการในลักษณะของ OSS จะนำการสร้างข้อได้เปรียบอย่างมากและจงใจให้บริษัทหรือโรงงานอื่นๆมาตั้งในนิคมอุตสาหกรรมอมตะนคร</p>				
1. Strongly disagree←		3. Neither agree nor disagree	→5. Strongly agree	
1.ไม่เห็นด้วยอย่างมาก←		3. ไม่ทั้งเห็นด้วยและไม่เห็นด้วย	→5.เห็นด้วยมาก	
1	2	3	4	5

Please give any additional suggestions to help transforming our industrial estate to become **Eco-industrial estate**.

กรุณาให้ความเห็นและข้อเสนอแนะที่ท่านคิดว่าจะช่วยในการเปลี่ยนแปลงในนิคมอุตสาหกรรมของเราให้เป็นนิคมอุตสาหกรรมนิเวศน์ (สีเขียว)

After completing this questionnaire, please drop the original to Amata Facility Service or send the scanned document to;

หลังตอบแบบสอบถามนี้เสร็จสิ้นแล้ว กรุณาส่งต้นฉบับที่ *Amata Facility Service* หรือกรุณาส่งเอกสารสแกนไปที่ thadaporn@amata.com **By 25 April 2014**
Ms. Thadaporn Damrongphum (Phone) +66 38 939007 # 822

Thank you so much for your participation.
 ขอขอบคุณเป็นอย่างสูงสำหรับการมีส่วนร่วมของท่าน

APPENDIX C

Figures

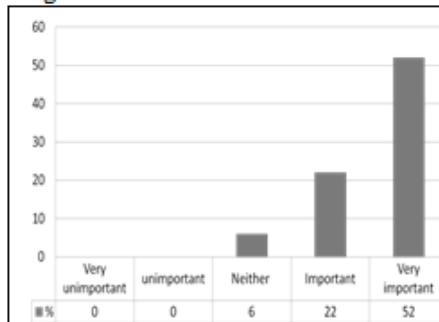


Figure4.17 Percentage of levels of tenants on importance in environmental management.

Note: No answer 20%

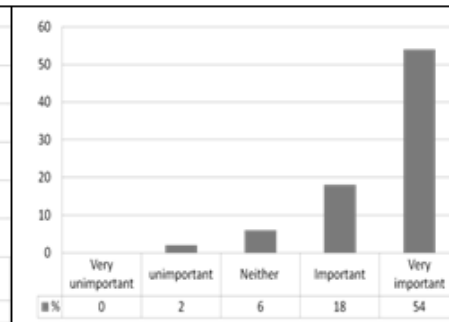


Figure4.18 Percentage of levels of tenants on importance in company image.

Note: No answer 20%

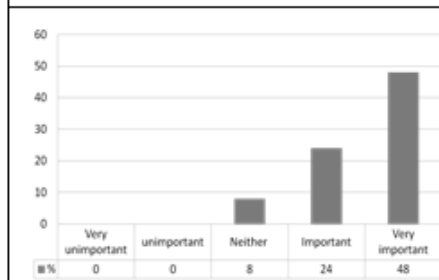


Figure4.19 Percentage of levels of tenants on importance in marketing advantage.

Note: No answer 20%

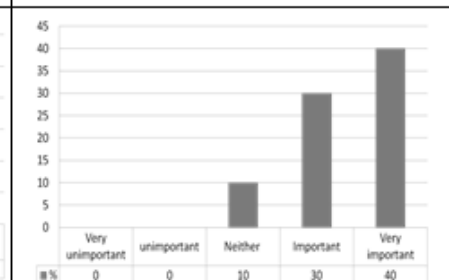


Figure4.20 Percentage of levels of tenants on importance in requirement from the suppliers/consumers.

Note: No answer 20%

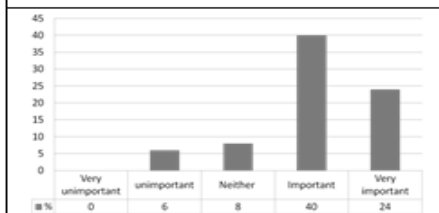


Figure4.21 Percentage of levels of tenants on importance in cost savings.

Note: No answer 22%

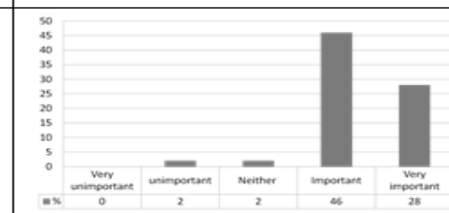


Figure4.22 Percentage of levels of tenants on importance in achieving compliance.

Note: No answer 22%

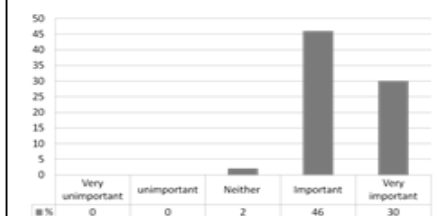


Figure4.23 Percentage of levels of tenants in importance in achieving unseen risks.

Note: No answer 22%

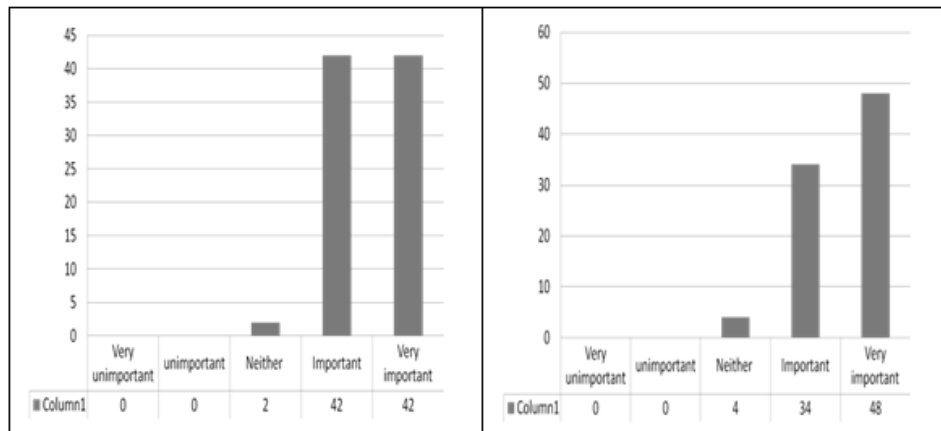


Figure 4.25 water savings

Figure4.26 Energy savings

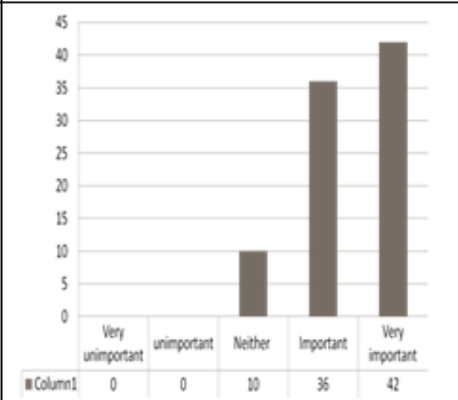
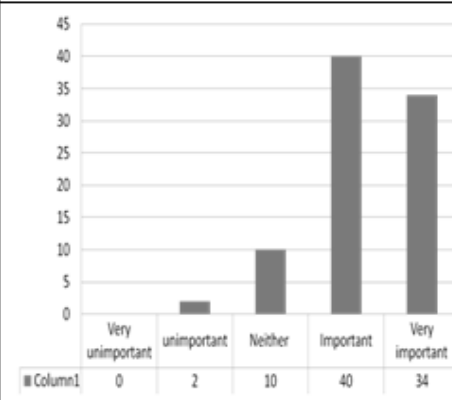


Figure4.27 Reuse of process water

Figure4.28 waste reduction

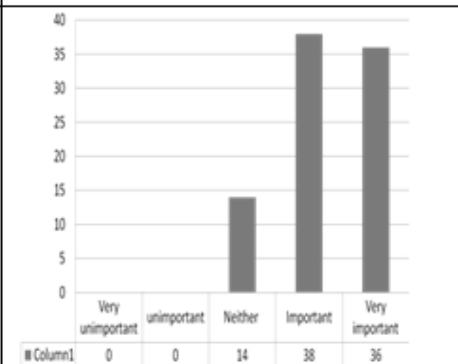
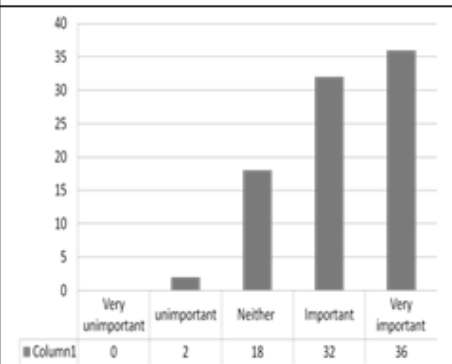


Figure4.29 Reuse of materials.

Figure4.30 Use of eco-friendly materials.

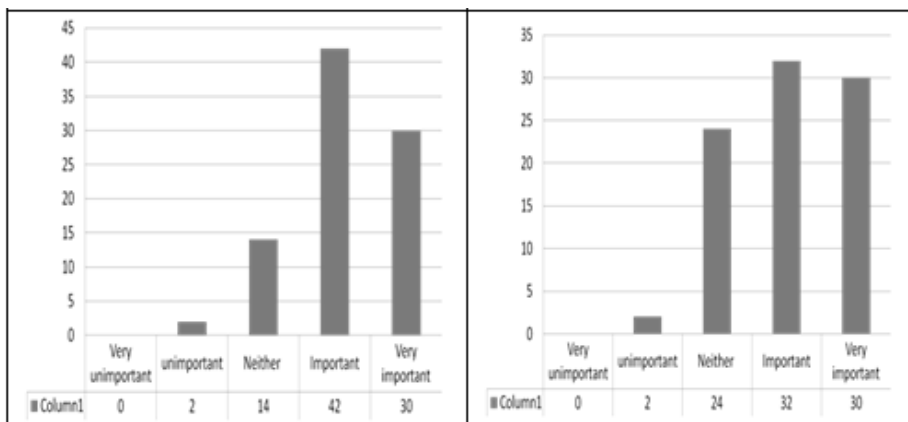
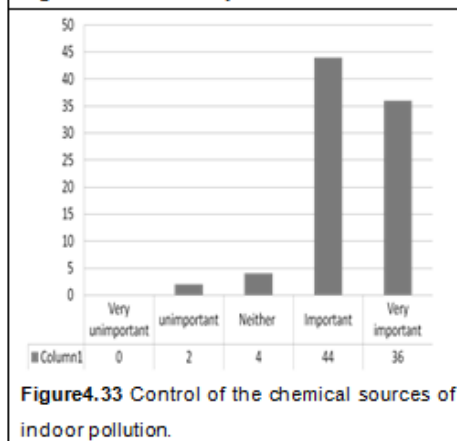


Figure4.31 Use of recycled materials.

Figure4.32 Use of local material.



VITA

Mayumi Yamada was born in Tokyo, Japan. In 1997, during her high school years, she joined high school exchange program to study in New Zealand for 1 year. That experience motivated her to study abroad and also made her interested in Asia-Pacific regions and later environmental issues in ASEAN regions.

She received Master of Science in Environmental Natural Resource Economics from Faculty of Economics, Chulalongkorn University in 2007, and she enrolled for Ph.D. program in Thai Studies program, Faculty of Arts, Chulalongkorn University in 2010.

