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Factors impacting eco-industrial estate development in Thailand: A case study of Amata Nakorn Industrial Estate

Mayumi Yamada and Chanathip Pharino

ABSTRACT—Eco-industrial development and transformation is a green growth strategy for many developing countries. This research aims to identify key factors affecting tenant companies in participating in eco-industrial development in Amata Nakorn industrial estate in Thailand. The research investigated the effects of Japanese enterprises in domestic eco-industrial development. Several attempts have been initiated between the Thai and Japanese governments to transform existing Thai industrial estates into eco-industrial estate. In 2012, the Thai and Japanese governments promoted a development of an eco-conscious industrial estate referred to as a One Stop Service (OSS) model project in Amata Nakorn industrial estate. Past attempts, however, have stalled or presented very little progress. There has been no study to investigate the key factors impacting on the transformation. This study found that key factors impacting the eco-industrial estate development in Thailand were economic, institutional, financial, organizational and socio cultural factors. To promote and transform eco-industrial estate development in the future, the project management needs to achieve high cost reduction, more government involvement and raise the awareness of all stakeholders.

Keywords: eco-industrial estate; sustainable industrial development; Amata Nakorn Industrial Estate; Thailand

Introduction

The Asian economy has experienced the most rapid growth of its history during the last two decades. However, economic growth of the entire industrial area has created environmental challenges and
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Developing countries in Asia promote local industrialization and try to attract foreign investments in the absence of comprehensive sustainable development schemes (Chiu and Yong 2004). As for Thailand, the country needs to speed up its eco-industrial estate development to minimize the environmental pressure caused by increasing industrial activities. The development of eco-industrial estates (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 (Panyathanakun et al. 2013). Moreover, the Department of Industrial Works (DIW) announced that provincial industrial offices including Rayong, Patum Thani, Chonburi, Ayuthaya and Sara Buri and nine industrial zones and parks had been joined to establish an ecological industrial network and planned to establish a sustainable eco industrial complex by 2018 (http://thainews.prd.go.th).

Thailand has received international cooperation on the implementation of eco-industrial estate development strategies from overseas. However, most of the projects have been stalled in the past. There are still many hurdles and difficulties in implementing the concept. Thailand, therefore, needs to develop its own strategy to implement eco-industrial estate development instead of simply adopting the strategy of developed countries. It is the main challenge of this research to identify the key factors affecting eco-industrial estate development in Thailand and to indicate how to promote this development. Amata Nakorn industrial estate is investigated as a case study to identify factors affecting the decisions of tenant companies to participate in an eco-industrial development.

Eco-industrial estate development

There are various terms used to represent the concept of eco-industrial development.

Yong and Zhao (2009) suggested that there are several interchangeable terms for industrial parks, which often vary depending on the scope and type of operations such as industrial parks, industrial districts and industrial zones. The term “eco-industrial park” is widely used among international researchers to identify eco-industrial
development. Some researchers, such as Tudor and Bates (2007), have argued 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 impact. Components of this approach include the 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)

The definition is broadly accepted by international researchers in the eco-industrial development field (i.e., Chertow 2000, and Rosenthal) and it matches the concept of eco-industrial estate development in Thailand. In addition, the Japanese researcher (Momose 1978) studied the development of industrial estates in the 1970s and found 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 terms “industrial park” and “industrial estate” share the same notion. The term eco-industrial estate is applied as defined by the Industrial Estate Authority of Thailand (IEAT). The eco-industrial estate (EIE) was a concept utilized only in developed countries but now the EIE concept is being spread into developing countries as a way of realizing sustainable development. Chiu and Yong (2004) argue that eco-industrial development is beginning to yield positive benefits in developing nations. However, there are still many hurdles and difficulties because the developing countries have different political, economic, environmental and resource constraints than the economies in developed countries (Chiu and Yong 2004, 1038). Chiu and Yong (2004) further emphasize that
developing nations need to revise and craft suitable strategies to put industrial ecology in place, instead of using models that were designed for developed countries.

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Sakr et al. (2011) conducted an extensive literature review on eco-industrial development projects’ experiences around the world. They found critical success and limiting factors for eco-industrial parks: global trends and an Egyptian context. Sakr et al., (2011) examined various industrial symbioses (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 a symbiotic relationship, 2) information sharing and awareness, 3) financial benefits, 4) organizational structure, and 5) legal and regulatory framework (Sakr et al. 2011).

While Sakr et al., analyzed the international experience of waste exchange in the eco-industrial development process, Japanese eco-town experience (the Japanese term for eco-industrial estate) suggests how government initiated eco-town projects and how successfully it was implemented.

Japan was the first to introduce several recycling orientated, economic and society programs such as the eco-town project (Chiu and Yong 2004). Eco-town was first evolved in Japan in 1997 for two reasons. One was to revitalize the local economy and the second was to solve waste problems. The Global Environment Center Foundation (GECF) of Japan examines eco-town experience in the research paper “Legal and Other Support Systems for Eco-Towns in Japan” (Global Environment Center Foundation 2006). GECF concluded that Japanese central and local government played an important role in establishing eco-town by providing 1) an attractive subsidy package, 2) legislative support, and 3) awareness building in business and society and 4) companies’ commitment on eco-town project. The success of the eco-town project was also backed by increased social awareness as society started to see environmental problems through the mass-media of the industrialization period.

One Stop Service (OSS) model project

The Japanese Ministry of Economy, Trade and Industry (METI)
started a feasibility study on eco-industrial estate transformation in industrial estates in Thailand since 2009. From 2010, METI studied the possibility of cooperation with three locations in Thailand including Chonburi province, Amata Nakorn industrial estate and Rayong province. In 2010, a MOU was signed between METI, the Department of Industrial Works (DIW) and Amata Corporation to conduct a feasibility study on transforming Amata Nakorn industrial estate into an eco-conscious industrial estate. In April 2012, METI organized a study group to study the current situation of waste management of tenant companies within the estate. Seventeen factories within the Amata Nakorn industrial estate were studied. In November 2012, a MOU was signed to study the possibility of commercialization a One Stop Service (OSS) model between DIW, AMATA Corporation, METI and a working group under METI called E-Kansai working team. The One Stop Service aims to provide a solution for waste management problems found in tenant companies within the Amata Nakorn industrial estate.

**Research methodology**

This research examined factors that have had a significant influence on the One Stop Service project at Amata Nakorn industrial estate. The methodology utilized in this study includes: information and data through hand-on company visits during the OSS project participation. In addition to the company visits, the author also distributed survey questionnaires to all the tenant companies in Amata Nakorn industrial estate to conduct factor analysis. The duration of the OSS project covered November 2012 through March 2013. The research questionnaire was distributed between April 2014 and August 2014. The survey questionnaire respondents were asked to evaluate the degree of importance/significance of each factor. Factor analysis identifies key factors that are significant and those with less significance to the project. Factor analysis of the OSS project was conducted on the data derived from the questionnaire survey and statistical analysis was performed to obtain the result for each question. The respondents were asked to evaluate the degree of importance/significance of each factor. Then, the key factors were identified from statistical analysis.

The survey questionnaire was developed based on interviews
Factors impacting eco-industrial estate development during the tenant company visits to Amata Nakorn Industrial estate during the OSS project. During the company visit with OSS project members, several issues were identified. Based on the findings, the 7 sections of the survey questionnaire were developed as follows:

- Background of questionnaire respondents
- Problems of environmental management in factories and the estate
- Tenants’ attitude towards the environmental management system
- Tenants’ attitude towards environmental management activities
- Components of an eco-industrial estate in Amata Nakorn Industrial Estates’ context
- Characteristics and strength/significant factors of Amata Nakorn Industrial estate
- Status of the One Stop Service (OSS) project

All questions were evaluated and ranked on a scale of 1 to 5 to identify the degree of importance or agreement to each statement. The first section covers the background of the respondents. In the second section, questions were asked to identify current problems in environmental management in tenant factory and the estate. In the third section, Tenants’ attitude towards environmental management system, questions were asked to measure the environmental awareness of the tenant companies and to understand what motivated tenants to pursue an environmental certification program like ISOs. In the fourth section, tenants were asked to evaluate what kind of environmental activities within their organization was beneficial to their overall environmental performance. The fifth section covered questions aimed at understanding tenant’s attitudes towards eco-industrial estate transformation in Amata Nakorn industrial estates. In the sixth section, questions were asked to identify whether the tenants agreed or disagreed with the given 15 factors which may be considered as strength/significant factors affecting eco-industrial estate transformation in Amata Nakorn industrial estate. The last section included questions developed to measure tenants’ willingness to participate in the OSS project.

The questionnaire survey was conducted between April 2014 and August 2014. The survey intended to motivate tenants to pay more attention to and recognize the benefits of eco-industrial estate devel-
opment. The questionnaires were distributed on behalf of Amata Facility Service directly to factories in the industrial estate. There were 50 responses returned from the 550 tenant companies that the questionnaires were distributed to in the Amata Nakorn industrial estate. The responses were extremely diverse in the sense that they were from various types of factory throughout the entire industrial estate. The analysis attracted many interesting observations.

Figure 1 (left). Questionnaire distribution.
Figure 2 (above). Regular meeting of the OSS project members.
Figure 3 (below). Tenant company visit.


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Results and discussion

This section explains the research results and the statistical results derived from the survey questionnaire. It identifies key factors supporting and hindering the success of developing an eco-industrial estate in Amata Nakorn industrial estate. The results help provide a better understanding of how to promote eco-industrial estates in Thailand, the OSS team being able to understand what factor strongly affect or create barriers to tenants’ decision making process toward eco-industry development.

Problems of environmental management in factories and the estate

The survey identified tenant companies problems in waste management. There are two major problems. 58 percent of the tenant companies either strongly agreed or agreed that it was difficult to find waste processors (WP) for small amounts of specific types of waste and a total of 46 percent of tenants companies either strongly agreed or agreed that sorting out of waste is time consuming. Waste separation should be considered one of the service options in the OSS business model. The waste separation function would meet the demands of tenant companies if the OSS could collect mixed waste and separate waste at the OSS facilities into different types and conduct every stage of the disposal; the tenants would then be able to save time as well as manpower in waste managements.

Tenants' attitude towards the environmental management system

Questions about the environmental certification system, such as the International Organization for Standardization (ISO) were asked to measure the environmental awareness and motivating factor of tenants to be certified by environmental certification systems. Better understanding about the motivating factors can be applied to promote the OSS project in Amata Nakorn industrial estate. The results suggested that the tenant companies were motivated by activities which can improve; 1. the company image (54 percent), 2. environmental management (52 percent) and 3. Marketing advantage (48 percent). If the OSS project successfully improved these factors identified by participating tenant companies, the OSS would not only be able to improve waste management but also to increase the corporate
value of the OSS users.

Tenants’ attitude towards environmental management activities

The surveyed tenant companies were asked what kind of environmental activities within their organization were beneficial to their overall environmental performance. The surveyed tenants were asked to scale the importance of nine environmental activities. The top rated factors were energy saving (82 percent), followed by water savings (82 percent) and control of the chemical sources of indoor pollution (80 percent) and waste reduction (78 percent).

The three factors; energy savings, water savings and waste reduction describes what the surveyed tenants see as beneficial environmental activities in cost reduction/cost savings. These three environmental activities 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 waste.

Components of eco-industrial estates in the Amata Nakorn Industrial Estates’ context

Tenants were asked what sorts of function/component are essential in eco-industrial estate development in Amata Nakorn Industrial estate. There are a total of 13 functions/components that respondents were asked to rate. The survey result showed all of the 13 functions/components are considered to be important. The top three important components of the eco-industrial estate concept are; adaptation of sustainable energy 68 percent followed by establishing waste recycle centres 66 percent and control of the chemical sources of indoor and outdoor pollution 60 percent.

Characteristics and strength/significant factors of Amata Nakorn Industrial estate

Understanding one’s own strengths and weaknesses will be an advantage in project/business planning for Amata Nakorn industrial estate. 15 factors which may influence eco-industrial estate development were identified during the OSS project participation.

Surveyed companies were asked whether they agreed or disagreed with the given 15 factors. From the survey result, 70 percent of the
respondents strongly agreed that the commitment of the management team is the most significant characteristic/affecting factor of Amata Nakorn industrial estate. The increasing awareness of environmental issues (58 percent) is the second most significant, followed by stringency in environmental laws/regulations (56 percent), cooperation from the national government/agencies (54 percent) and commitment of participating tenants (52 percent).

**Status of the One Stop Service (OSS) project**

The success of the OSS project will largely depend on the tenant factories in Amata Nakorn industrial estate and it is hard to predict how many tenants will actually use the OSS service. The tenants were asked about their willingness to participate in the OSS project. Most of the responses showed a high rate of willingness. A half of the respondents showed a very strong willingness and another 1/4 of the respondents showed a strong willingness to join the OSS project.

Further questions were asked to find out the best possible approach to advertise the OSS project to the tenants in Amata Nakorn industrial estate as the estate accommodates 550 tenant companies and it was important to inform everyone efficiently. 60 percent answered information sessions would be the best way to announce about the OSS project followed by email (34 percent) and a newsletter (24 percent). Questions were asked to choose the appropriate facilitator/supporter for the OSS project and 72 percent chose the Industrial Estate of Authority of Thailand (IEAT) as the most appropriate facilitator/supporter for the OSS project.

Furthermore, questions were asked to identify the factors which affected the tenant decision making process about using the OSS. By finding out the influencing factors the OSS team would be able to understand what factor would strongly affect or create barriers to the tenants’ decision making process. The survey result showed that 36 percent ranked the Service fee as the most important factor in the decision making process followed by Quality and type of service that brings a solution to a problem at 30 percent. These two factors could be considered as significant factors in the decision making process for tenant companies. The research also found that the most important expectation of tenants from the OSS project was a cost reduction in waste management at 82 percent. The majority of respondents agreed
that the cost reduction/service fee of the OSS was a significant factor in tenant companies deciding whether to use the OSS service.

The results also highlight the gaps between the OSS project team and the tenants. The OSS project emphasized the involvement of Japanese companies and implementing Japanese expertise to solve waste management problems. However, foreign company involvement ranked 22 percent in level of importance. This implies that the tenant companies put less weight on this factor in the decision making process. The tenant companies preferred more involvement by governmental agencies. From the survey result, the OSS project needs further research done on the current service fees where tenant companies currently pay for existing waste processors and set attractive fees for the OSS service.

Factors supporting/hindering the development of OSS

From the survey response, some important factors were identified from the tenant companies’ perspectives. These 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. These factors were also studied from the authors’ observation in the project participation. The results below are the conclusions of supporting/hindering factors observed from both sides.

Economic factor

The majority of respondents agreed that the cost reduction/service fee of the OSS was a significant factor in tenant companies deciding whether to use the OSS service. Economic factors could be a supporting factor if the OSS could realize the cost reduction or provide the waste management at a lower fee. However, the OSS team found out that since the waste disposal or treatment fee varies among each waste processor, if the OSS service could not offer a competitive price to tenant companies, the tenants would not be interested in using the OSS. Therefore, the economic factor was neither a supporting nor hindering factor depending on the service fee that the OSS would be able to offer for the tenant companies.
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**Institutional factors (regulatory/support)**

a) Environmental regulatory. The OSS project team found regulatory barriers on industrial waste which slows down or reduces 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 functions from happening. From the survey responses, the tenant companies showed interest in the OSS business model for the collection of small amounts of specific types of waste and sorting out of waste on behalf of the tenants. There are strict regulations on hazardous wastes and each type of waste is regulated by different regulations. It is also difficult to find out how much and what kinds of waste can actually be collected together or stored together within the industrial estate. These regulatory barriers would make it difficult to realize the OSS project/eco-industrial estate development.

b) Support from governmental institutions/enterprises. The majority of respondents preferred the involvement of governmental institutions/enterprises such as IEAT to be a facilitator or supporter of the OSS project. In the OSS project preparation period, government involvement was seen less. The presence of the government would encourage the tenant companies and the OSS project would gain more confidence from the tenant companies. For that reason, support from the government is a supporting factor for eco-industrial estate development.

**Financial factors (initial investment/operation cost)**

The OSS project’s first period was funded by the Japanese government. After the first period, a decision had to be made to commercialize the OSS project in the private sector. There were financial barriers on the initial investment cost and the operation cost of the OSS business model because the OSS project team concluded that the realization of OSS is not possible from a financial perspective. The OSS business was not going to generate enough income to cover the operational costs and the investment costs. Therefore, the financial factor hindered the development.
Organizational factors (commitment of the management team)

70 percent of the respondents agreed that commitment of the management team was a significant factor for Amata Nakorn industrial estate. Most of the decisions are made at the top of the hierarchy and the commitment of the management team to all stakeholders influences the decisions on the project’s implementation. The OSS project was planned to be operated by private enterprise. There were risks in committing to a long-term business partnership at the beginning of the project because of uncertainty in the project’s realization. There were differences in business decisions for each stakeholder, for example, one was eager to start the project but another was cautious about taking further steps. Differences in levels of commitment hindered the development of the project.

Lack of work commitment and shortage of human resources. Furthermore, lack of work commitment and shortage of human resources were seen during the OSS preparation process. This was because the OSS project became an additional workload for some members and it was hard for them to commit only to the OSS project. The project members had other business tasks which reduced the time and frequency of the meetings for the OSS project. There was a shortage of skilled human resources for special projects like the OSS as well because the project and concept was new for every member. Therefore, the different levels of commitment of the management team/the commitment of the project members were hindering factors for the OSS/eco-industrial estate development.

Socio-cultural factors (social acceptance/awareness)

Social acceptance/environmental concerns from both tenant companies and local communities were important supporting factors for the successful implementation of the project. However, in the actual practice, there was no guarantee that all of the tenant companies would support the project. It is difficult to evaluate whether the tenant companies truly understood the concept of OSS/eco-industrial estate development in the early stage because the concept was new and unfamiliar to most of the stakeholders. Thus, socio-cultural factors would be a hindering factor if the majority of the people did not accept the project.
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Cultural/communication factors

Since the OSS project involved two countries, Thailand and Japan there were some difficulties in communication and there were differences in understanding between the two parties. Differences in business culture and the language barrier were identified throughout the project. From daily communication to formal meetings were conducted through an interpreter and it took some time to get used to communicating through a third party and participants needed extra effort in communication. Beyond the communication barrier, there was a difference in business conduct. Both parties needed time to get to know each other and adjust to another way of doing things. Cultural difference and the communication barrier were a hindering factor for the development.

Technology and information factors

There was a lack of transparency on information and data available on waste.

It was possible to find data on certain types of waste from the governmental institutions but access to that information and the amount was limited. The OSS team found that information related to waste (i.e. waste amount, types of waste and actual treatment cost etc.) was difficult to obtain. How much waste each factory disposes of per year is essential information in waste related business. The only possible way to obtain such information was to ask the factories one by one. There was no guarantee that the tenants would be willing to give out the information and also visiting each tenant factory was time consuming. During the OSS preparation period the OSS team could not obtain enough information on waste. Therefore, the information factor hindered the OSS project development. Thus, obtaining necessary information in a short period of time is a significant factor for the successful development.

Recommendations to promote the eco-industrial estate

Several important factors have been identified from analyzing the results of the research questionnaire done by tenant companies in Amata Nakorn industrial estate. In order to realize eco-industrial
estate transformation; Amata Nakorn industrial estate and the government need;
1. More awareness and understanding on eco-industrial estate development from the tenant companies and environmental related companies
2. A database to get necessary information on waste related issues to develop plans
3. Sufficient capital to build necessary facilities and operate OSS businesses
4. Skilled human resources and experts to help implement and operate the OSS
5. The adjustment of laws and regulations to support the OSS project.

Amata Nakorn industrial estate needs to promote more about the eco-industrial estate development and educate tenants about environmental issues. It is essential to develop a basic understanding of the importance of sustainable development and tenants’ involvement in the project so that in the actual eco-industrial development project the tenant will have enough knowledge and understanding for project participation.

The best approach for OSS initiation of the Amata Nakorn industrial estate is to promote the OSS project by organizing information sessions along with email and publishing newsletters. The information session should target the management level as well as the staff who are responsible for the environmental/waste 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 especially in cost reduction in waste management and the elimination of unseen risks in waste management. As for the OSS partners, the OSS should ask governmental institutions like IEAT to get involved as a facilitator/supporter and reveal their existence in front of the tenants. As well as increasing awareness of the tenants companies, Amata Nakorn industrial estate and the government should work closely and develop a database on waste to provide necessary information for stakeholders and set up a centre/office to provide efficient support for the eco-industrial estate development.
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Furthermore, technological support from overseas/local experts on waste management and a study of know-how on eco-industrial estate development from the overseas experiences will be needed. The government should train specialists in eco-industrial estate development and invite overseas/local experts to train experts for the eco-industrial estate development project. Furthermore, the government should allocate a sufficient budget for eco-industrial estate development and set up subsidies/incentives for eco-industrial estate development.

Conclusion

This research identified significant factors affecting the decision of tenant companies to participate in eco-industrial development in Amata Nakorn industrial estate. The service fee ranked as the most important factor in the decision making process of tenant companies followed by quality and type of services that would bring about a solution to the problem. Furthermore, expectations for the OSS project were identified as reduction of costs in waste management and the elimination of legal concerns/future risks over waste related issues. The results indicated that tenant companies prefer more involvement by the Thai government and foreign companies’ involvement had a less significant effect on the decision making process. The majority of respondents preferred the involvement of Thai governmental institutions/enterprises like IEAT to be a facilitators or supporters of the OSS project. The presence of the government would encourage the tenant companies and the OSS project would gain more confidence from the tenant companies. For future eco-industrial estate development, the project management needs to achieve greater cost reduction, more government involvement and to raise the awareness of all stakeholders. The research findings hopefully will help to support the actual development of eco-industrial estates and encourage the eco-industrial estate transformation in Amata Nakorn industrial estate in the very near future.
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