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# Factors for Success in Eco-Industrial Town Development in Thailand

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***Abstract*—**Nowadays, Ministry of Industry has given an attention to develop Eco-industrial towns in Thailand. Eco-industrial towns are a way of demonstrating the application of industrial ecology and are subjects of increased interest as government, business and society. This concept of Eco-industrial town is quite new in Thailand. It is used as a way of achieving more sustainable industrial development. However, many firms or organizations have misunderstood the concept and treated with suspicion. The planning and development of Eco-industrial towns is a significant challenge for the developers and public agencies. This research then gives an attempt to determine current problems of being Eco-Industrial towns and determine success factors for developing Eco-Industrial towns in Thailand. The research starts with giving knowledge about Eco-industrial towns to stakeholders and conducting public hearing in order to acquire the problems of being Eco-industrial towns. Then, factors effecting the development of Eco-Industrial town are collected. The obtained factors are analyzed by using the concept of IOC. Then, the remained factors are categorized and structured based on the concept of AHP. A questionnaire is constructed and distributed to the experts who are involved in the Eco-industrial town project. The result shows that the most significant success criterion is management teams of industrial parks or groups and the second most significant goes to governmental policies.

***Keywords*—**AHP, Eco-industrial town, success factors, Thailand.

## I. Introduction

RECENTLY, people are becoming more and more conscious about the deterioration of today's global environment. Some buzz words, such as global warming, pollution, shortage of oil, extinction of species, have frequently been used in the news headlines and major subjects of political disputations. Environmental thinking has recently focused on a consciousness of the intimate and critical relationships between human actions and the natural world, and reflects limits in the current reliance on command-and-control regulation in much of the industrialized world [1]. Industrial development has had an important role in the economic growth of many countries [2].

Ministry of Industry has a policy of development Eco-Industrial towns in five provinces as models for Thailand's industries. To enable them to move toward green manufacturing, permanent Secretary for Industry, Atchaka Sibunruang, said that the five provinces were selected for the Eco-Industrial town prototypes including Samut Prakan, Samut Sakhon, Rayong, Chachoengsao, and Prachin Buri. The study also involves nine industrial areas, namely the IRPC's production complex in Rayong; Bagkadi Industrial Park in Pathum thani; 304 Industrial Park in Prachin Buri; Sahapat Industrial Park Siracha in Chonburi; Sahapat Industrial Park Kabin Buri in Pachin Buri; Rojana Industrial Park in Ayuthaya; IPP Industrial Community in Rayong; Hemaraj Rayong Industrial Land in Rayong, and Hemaraj Saraburi Industrial Land in Saraburi. This research is in line with the Thailand's strategies, which focus on Eco-industrial town development. First, this research starts with acquiring the current problems of being Eco-industrial town by conducting public hearing. Before doing public hearing, well-prepared information and training were giving to stakeholders who would involve in public hearing. Then, the factors effecting the success of becoming Eco-industrial town are studied. Experts are utilized to examine the obtained factors by using the concept of IOC (index of item objective congruence). AHP (Analytic Hierarchy Process) structure is constructed, and questionnaire based on the concept of AHP is generated. This paper then gives an attempt to determine success factors of Eco-Industrial Town Development in Thailand by using Analytic Hierarchy Process (AHP) approach. Finally, discussions are given.

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## II. The Concept of Eco-Industrial Towns

The Eco-Town Project was created in 1997 under Japan's Ministry of International Trade and Industry (currently the Ministry of Economy, Trade and Industry, or METI). It was founded on the basic concept of zero emissions. In essence, this concept is about ultimately reducing waste generation to zero, by taking the waste arising in citizen lifestyles and industrial activities, and utilizing it to the greatest extent possible as raw materials in other industries.

The Eco-town project has two objectives: 1. to stimulate local economies by nurturing the growth of environmental industries that take advantage of the industrial capabilities in each region and 2. to create integrated systems, which are in harmony with the environment, and to involve industry, the public sector and consumers with the aim of creating a resource –recycling society in a given region. A number of key features of being Eco-towns include 1. Strong legislation, shifting the market towards a sound material-cycle society, 2. National and local governments are spearheading the drive to bring together industry clusters to be more sustainable, 3. Increasing product research and development—in both public and private sectors, including universities, 4. Large and rapidly expanding eco-business market, domestically and

internationally, 5. Strong focus on environmental technologies and ESTs, and innovative/cutting-edge solutions to solve environmental problems and 6. Focus on energy conservation, material development and integrated waste management are also features of Eco-towns [3]. Fig. 1 shows the relationship between Eco city/Eco town and Eco Industrial Town.

The concept of Eco-Industrial development has been applied to nine industrial parks in Thailand since 2009. The Eco-Industrial development reports show the uses of five development dimensions including 20 factors. The five development dimensions are physical, economic, environmental, social, and management dimensions. Detailed factors are shown in Fig. 2.




Fig. 1 The relationship between Eco-Town and Eco-Industrial Town

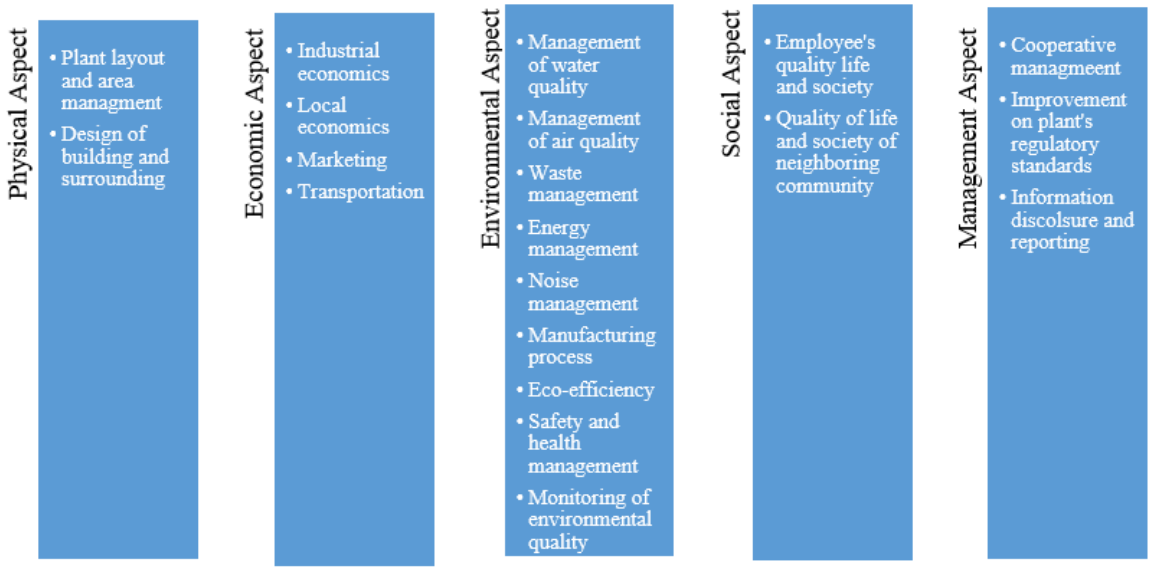



Fig. 2 The concept of Eco-industrial development: 5 dimensions 20 factors

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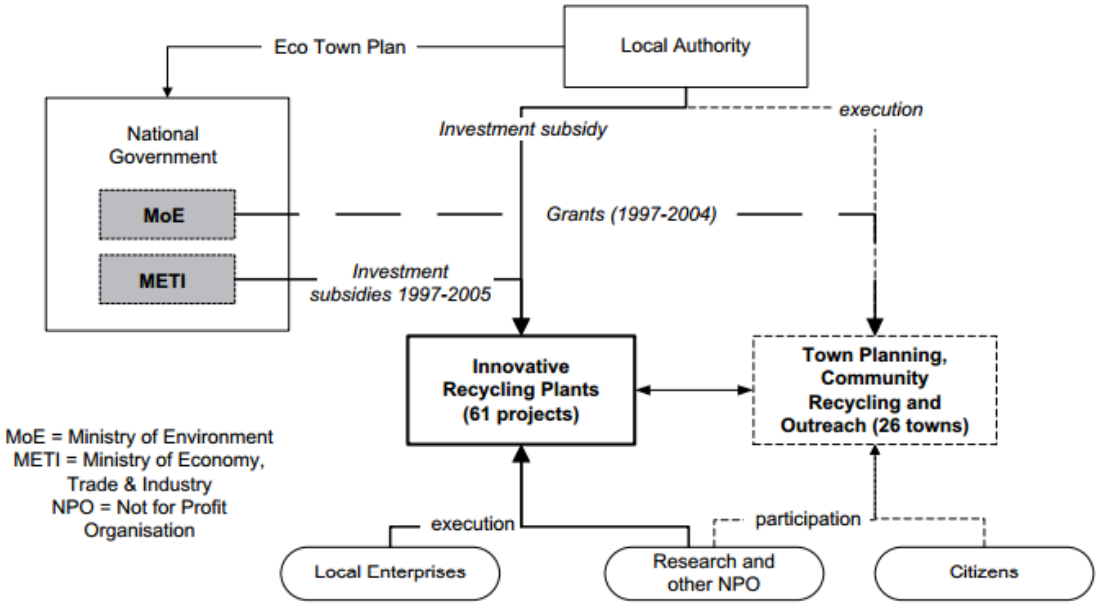



Fig. 3 Operation of the National Eco-town program [4]

TABLE I
FIVE MAIN CURRENT PROBLEMS OF BECOMING ECO-INDUSTRIAL TOWNS

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Bad smell | Dust | Traffic | Lack of water | Dust and smell | Dust and smell | Dust and smell | Dust and smell | Water pollution |
| 2 | Information lacking | Noise | No use of 3Rs | Information lacking | Traffic | Water pollution | Traffic | Water pollution | Dust and smell |
| 3 | Water pollution | Lack of water | Water pollution | Traffic | Water pollution | Community cooperative | Water pollution | Information lacking | Noise |
| 4 | Traffic | Job vacant | Dust and smell | Dust and smell | Noise | Information lacking | Low green area | Traffic | Information lacking |
| 5 | Not green transportation | Traffic | Information lacking | Low economics | Road damaged | Not green transportation | Information lacking | Community cooperative | Traffic |

## III. CURRENT PROBLEMS OF BECOMING ECO-INDUSTRIAL TOWN IN THAILAND

Stakeholders in all five provinces and nine industrial areas were trained in the concepts and benefits of becoming Eco-industrial towns. After giving them knowledge, public hearings were conducted in all five provinces and nine industrial areas. About 30-50 people per industrial areas participated in the public hearings. It was found that the main problem was environmental problems, especially air quality in terms of bad smell and dust. Stakeholders stated that the main reason was lack of the governmental monitoring and inefficient law enforcement. The second problem was physical aspect in terms of traffic, especially in rush hours. The third problem was information discloser and reporting among governmental agencies, industries, and neighboring communities. It resulted in lack of the neighboring communities' contributory. Details of current problems are shown in Table I. Five main current problems were considered in each industrial area. Nine industrial areas were utilized.

## IV. FACTORS RELATING ECO-INDUSTRIAL TOWN SUCCESS

Curriculum of provincial industrial office on 16 July 2012 in the title of Eco Industrial Town in Thailand showed that the sections related to Eco-Industrial towns are governmental policy and budget, industrial and investment section, community section, and research and educational institutes. The full report of Eco-Industrial development project in 2015 states that there are three sections; governmental section, industrial section, and community section, involving in Eco-Industrial development. Similar to Berket et al. [4], Fig. 3 shows the operation of the national eco-town program. It can be seen that the sections related to Eco-town program include government, plants, and community.

Morikawa [5] gives the four primary factors of emergence of Eco-Industrial projects in Japan. The four factors are environmental, political, economic, and geographic/social factors. The environmental factors include waste problems, limited natural resources, and air pollution and $CO_2$ emissions. The political factor comprises government as a major promoter and stakeholder, waste management legislation, Eco-town projects, and zero emission research imitative. Economic factor contains economic incentives and competitiveness, and image improvement and public relations. Lastly, geographic/ social factor embraces close mental and physical proximity and rising awareness. The full report of Eco-Industrial development project in 2015 states that the factors involving in Eco-Industrial development project include resource, law and regulation, knowledge, corporation, and vision, mission, objective, and strategies of both governmental and industrial

sectors.

TABLE II
SELECTED SUCCESS FACTORS

| Main factors | Sub-factors |
|---|---|
| Governmental section | Governmental support on resources |
| | Corporations among government, private sector, and community. |
| | Laws and regulations |
| | Knowledge given to industrial and community sections |
| Industrial section | Law and regulation in practices |
| | Resource readiness |
| | Level of Eco-industrial significance |
| Community section | Knowledge |
| | Management corporation |

All related factors are considered in this paper. Five experts, who are in the areas of Eco-Industrial projects, are utilized to select the considered success factors. The selected factors, shown in Table II, would be focused to analyze in the next section by using AHP.

TABLE III
AHP RESULT

| Main factors | Sub-factors | Scores |
|---|---|---|
| Governmental section (49.57%) | Governmental support on resources | 27.26% |
| | Corporations among government, private sector, and community. | 23.56% |
| | Laws and regulations | 32.11% |
| | Knowledge given to industrial and community sections | 17.07% |
| Industrial section (30.03%) | Laws and regulation in practices | 60.12% |
| | Resource readiness | 25.15% |
| | Level of Eco-industrial significance | 14.73% |
| Community section (20.40%) | Knowledge | 42.34% |
| | Management corporation | 57.66% |

TABLE IV
SUCCESS FACTORS IN DESCENDING ORDERS

| Sub-factors | Scores |
|---|---|
| Laws and regulation in practices | 18.06% |
| Laws and regulations | 15.92% |
| Governmental support on resources | 13.51% |
| Management corporation | 11.76% |
| Corporations among government, private sector, and community. | 11.68% |
| Knowledge given to industrial and community sections | 8.64% |
| Knowledge | 8.46% |
| Resource readiness | 7.55% |
| Level of Eco-industrial significance | 4.42% |

## V. AHP APPLICATION TO DETERMINE SUCCESS FACTORS OF IMPLEMENTING ECO-INDUSTRIAL TOWNS

Based on the selected factors shown in Table II, AHP based questionnaire is constructed. Nine experts from the nine industrial areas give the survey.

AHP is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. It was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then [6]. It has particular application in group decision making, and is used around the world in a wide variety of decision situations. This research is also utilized AHP to analyze the success factors of becoming Eco-industrial towns. The result of the study shows that the highest significant sector goes to governmental section with 49.57%. The second and third significant sectors go to industrial sector (30.03%) and community sector (20.40%), respectively. In the governmental section, law and regulations related to Eco-Industrial town gives the highest factor with 32.11%. The second and third highest success factors go to governmental support on resources (27.26%) and corporations among government, private sector, and community (23.56%), respectively. The last success factor is knowledge given to industrial and community sections (17.07%). In the industrial section, the highest score goes to law and regulation in practices (60.12%). The second and third success factors are resource readiness (25.15%) and level of Eco-Industrial significance (14.73%). Lastly, in the community section, the success factors are orderly management corporation (57.66%) and knowledge (42.34%).

By multiplying the main factors with sub-factors, the result shows weights of sub-factors. Table IV shows individual weights of sub-factors. It can be seen that the key success factors of developing Eco-industrial town are laws and regulations, governmental supports, corporations, knowledge, resource readiness and level of Eco-industrial significance in descending order.

## VI. RESULTS AND DISCUSSIONS

Based on the result shown in the previous section, it can be seen that without governmental supports, Eco-Industrial town project cannot succeed. The main support from government should be given to appropriate laws and regulations. This need conforms with the laws and regulations in practices of industrial section. That means whenever government has proper laws and regulations to raise Eco-Industrial town and industries behave them, the Eco-Industrial town project may get ahead. Cooperation among government, industries, and communities is significant. It can be seen that there are high scores of corporation in governmental sections and community section. This means that lack of corporation among them leads to unsuccessful development of Eco-industrial town. Next, resource readiness is very important. The score shows that experts give interests in government support on resources and also resource readiness. The government should pay attention in resources and find a means to make resources ready for industries in order to obtain Eco-Industrial town. Obtaining knowledge to governmental, industrial and community sections are less important. Further, by emphasizing the success factors explained earlier, the current problems could be eliminated or alleviated.

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