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EDITOR's NOTE

Globalization and the coming of the ASEAN Economic Community (AEC) are increasingly influencing how people run their businesses. Every industrial sector has to find ways to catch up with rapidly changing trends and new customer demands. Many have been looking for ideas to develop and create new products or services in order to serve customer needs. The focus for the industrial sector has been on sector strategies, product development and productivity improvement, cost reduction, and green product improvement. The aim is to enable industrial operations to stay in business, allow them to compete, and expand where relevant into global markets. Industry development strategies are grounded within the body of research knowledge that embraces technology, management, industrial strategy, standards and policy.

This volume of the Unisearch Journal presents examples of such research that holds promise to enhance Thailand's industrial potential in term of productivity, diversity and competitiveness. The aims are to improve international competition, as well as enhance market access, investment and expansion into neighboring countries and further afield. We also feature an interview with a former Commissioner of the Energy Regulatory Commission who provides valuable insights into the significance of Chulalongkorn University's collaboration with industry. Applied research, piloting and scale-up undertaken through university-industry research collaboration has proven highly successful as a driver of research that is directly relevant to the challenges faced by Thai industries. By providing a growing pool of knowledge and empirical evidence, such initiatives help drive effective implementation of market as well as technological innovations, and in doing so support the nation's social and economic improvements along a trajectory which will be sustainable as well as competitive over the long term.

The Editorial Board

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ARTICLE

Geoffrey Whiteway

Manufacturing cost reduction in food packaging industry by cleaner technology

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Introduction

During the 1970's, environmental problems resulting from discharge of industrial waste were handled by 'end of pipe' methods. However, this approach later fell from favour, as they did not address the problem at source. Since 1980, the focus of industrial waste management has shifted towards addressing pollution at source, and incorporating principles of sustainable development. Approaches such as Cleaner Technology, Life Cycle Assessment and Eco-design gained popularity among both public and private sectors as more rational, cost-effective and sustainable solutions.

Thailand's food packaging industry represents a significant share of the country's manufacturing sector. The industry is resource- and energy- intensive and responsible for a range of environmental problems, including pollution of wastewater and solid waste disposal.

Food packaging process

Three categories of food packaging processes are considered in this study: metal cans, rigid plastic, and flexible plastic. The processes are briefly described below:

(1) Metal can: Metal cans for food products are constructed either as two-piece or three-pieces cans. After cutting the coil of metal (steel or aluminum) into sheets, the cut sheets are coated with food-grade lacquer and printed if necessary. The sheets are also used to produce can ends (lids) and can bodies.

In lid production, the cut sheets are stamped into round blanks. The edge of the blank is then curled before applying a liquid-lining compound around the inside of the curl. The lids are then oven-heated to cure the lining compound, and finally inspected and packed into sleeves.

The can body is manufactured by cutting small blanks from the metal sheets, then rolling the metal into a cylindrical shape. The edges are pressure-welded and the can body is coated with lacquer. The can bodies are then heated to ensure even coating of lacquer over the whole can. Next, the top and bottom edges of the can body are flanged and necked-in, and the body is made into a bead formation. Lastly, one end is mechanically seamed-on to the bottom of the can body before leakage testing and palletizing.

For the two-piece can, the cut sheet is cut into a circular blank and drawn into a shallow can (cup) with the desired dimensions. The cup is then formed with a flange in the upper wall. The final step is to test the

1 3
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Figure 1: Metal can processing
Photographed by: Dr. Sathit Niamsuwan, March 2013

Figure 2: Processing for box with lid
Photographed by: Dr. Sathit Niamsuwan, March 2013

Figure 3: Processing for plastic zipped bags
Photographed by: Dr. Sathit Niamsuwan, May 2013

leakage of the finished cups before palletizing.

(2) Rigid plastic: This type of packaging is produced by vacuum thermoforming, producing food packaging such as boxes with lids and trays.

The production process begins with heating the rolled plastic sheet until it weakens. The weakened sheet is then formed against the mold using a vacuum. The formed sheet is then cut off into the finished product by a die cutting method. Finally, the product is blown by compressed air to remove dust before packing.

(3) Flexible plastic: The plastic in this type is manufactured using the blown film extrusion method. The flexible plastic can be used as laminated film, zipped bags, and T-shirt bags.

The process for manufacturing laminated film comprises three main parts. In the first part, plastic granules are melted by externally applied heat and then extruded through a circular die, emerging as a bubble. The cooled bubble is collapsed and flattened into a film by nip roller before rolling. The second part is to print text and graphics on to the plastic film. The final part is to produce a laminate comprising multiple layers of plastic films; these are usually assembled using adhesive or other adhesive chemicals and heat, and then pulled onto a windup roller.

The production process for both zipped bags and T-shirt bags consists of film production and film printing, as for laminated film production. The rolled flat films are pre-sealed and cut off into the desired final bag size and shape.

Cleaner technology

Cleaner technology (CT) is a strategy to deploy techniques to maximize resource use efficiency and minimize waste discharge. Using a systematic data collection and audit process, CT allows root causes of inefficiency and waste to be pinpointed, and proper solutions identified to optimize use of human resources, processes, management, as well as technology. CT addresses problems at their source, offers practical implementation options, and promotes continuity improvement, leading to cost savings in manufacturing, improved waste management and reduced environmental impact.

Thus, the application of CT to industrial sectors aims to minimize or prevent pollution and waste, increase resource use in all industrial processes, and minimize risks and hazards to humans and the environment.

CT options for the food packaging industry

Several widely-used industrial processes used in the food packaging industry are highly energy-intensive. Uninsulated heaters and inefficient air compressors increase production costs and contribute to a larger environmental footprint. In metal can production, drying of the lacquer coating on metal sheets is fuel-intensive both for heating the oven, and for air removing during an unloading condition at the oven.

Furthermore, in the metal can and flexible plastic manufacturing processes, a range of chemicals are used for lacquer coating and ink printing. Significant chemical loss from evaporation is frequently seen owing to uncovered containers or baths. Not only does this reduce efficiency and increase costs; potentially harmful volatile organic compounds (VOCs) may be released into the air, leading to elevated health risks for workers.

CT options provide guidelines and practices to improve production efficiency by improving/changing workflows and instructions, improving/changing machinery or equipment technology, as well as maximizing reuse and recycle of consumables. The CT options typically implemented in the food packaging industry are summarized in Table 1, and briefly described in the following sections.

(1) Install air gun and high-efficiency air nozzle, revise working time and adjust the pressure set point for air compressors

This entails use of an air gun to replace blowing using an open tube during the air blowing process after die cutting. High-efficiency air nozzles designed for laminar flow in the compressed air can further reduce pressure loss in the compressed air system. Following installation, the pressure set point for four air compressor units can be readjusted in a cascade arrangement instead of an equal arrangement. Together, these methods can generate savings of up to 41% in electricity use.

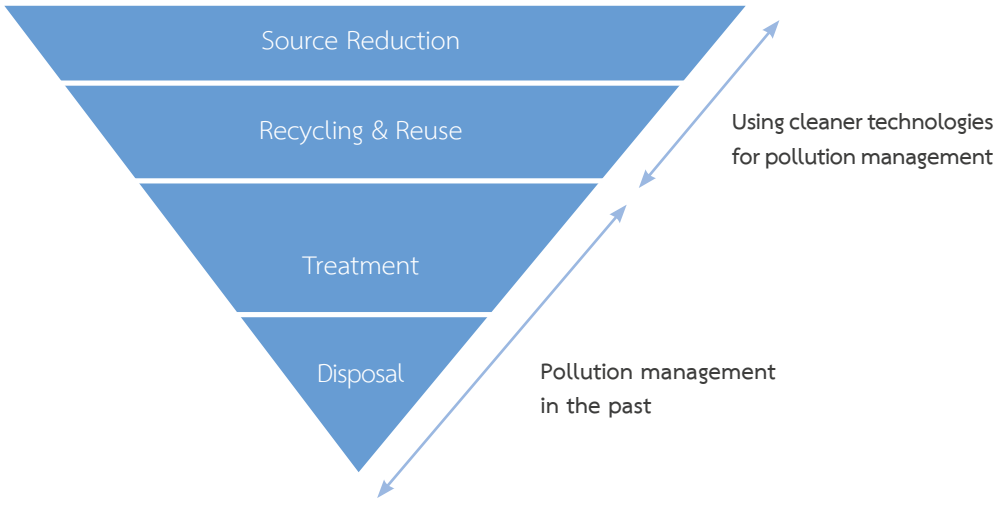

Figure 4: Environmental problem management strategy
Source: Department of Industrial Works, Ministry of industry (2013)

Table 1: CT options implemented in the food packaging industry

CT options	Investment cost (Baht)	Cost saving (Baht/year)	Payback period
1. Install air gun with high-efficiency air nozzle; revise working time and adjust pressure set point for air compressor	39,500	290,093	2 month
2. Equip with high-efficiency air nozzle instead of open tube	281,217	3,336,216	1 month
3. Redesign compressed air piping system	42,458	686,380	Less than 1 month
4. Reduce pressure for compressed air production coupled with installing pressure boosters at required points	511,365	1,170,876	6 month
5. Install ducts for air compressor to remove waste heat to surrounding	9,000	3,840	2 year and 5 month
6. Install the duct at condensing unit of chiller to remove the waste heat to surrounding	9,000	5,880	1 year and 7 month
7. Insulate the heater of vacuum-thermoforming machinery	25,680	323,192	1 month
8. Insulate ovens for lid thermal curing	21,400	15,295	1 year and 5 month
9. Install lids on solvent baths, tanks, and ink circulating tanks	2,000	65,535	Less than 1 month
10. Install evaporating and condensing machine for solvent recovery	192,600	102,712	1 year and 11 month
Total	**1,134,220**	**6,000,019**	

(2) In metal-can manufacture, equip with high-efficiency air nozzle instead of open tube blowing

As in (1), high-efficiency air nozzles to replace open tube blowing can generate savings of up to 9% in metal can production, which uses compressed air for many purposes such as expanding metal sheets, moving cans and dust removal.

3) Redesign the compressed air piping system

Redesigning the piping system to link between two loops of compressed air system helps balance the load and avoids compressor operation without load. The redesign allows the user to rearrange the operational program with a weekly switch for air compressor at each loop. This option can produce electricity savings of up to 33%.

(4) Reduce pressure in compressed air system, coupled with installing pressure boosters at required points

The option proposes installation of pressure boosters for the drawing process for production of two-piece cans. It requires compressed air at higher pressure (8 bars) than for other processes in metal can production. Implementation of this measure can reduce electricity use by 13%.

(5) Install ducts for air compressors to remove waste heat to surroundings

The option involves installation of ducts to efficiently remove waste heat generated by compressed air production. The ducts prevent recirculation of waste heat to the air inlets; high inlet temperature leads to excessive electricity use by the compressor. This option can achieve electricity savings of about 1%.

(6) Install the duct at condensing unit of chiller to remove the waste heat to surrounding

The option proposes installation of ducts at the condensing units of chillers to remove waste heat produced by refrigerant condensation to the surroundings. It prevents waste heat from returning to the air inlet,

Figure 5: High-efficiency air nozzle
Photographed by: Dr. Sathit Niamsuwan, August 2013

Figure 6: Pressure booster
Photographed by: Dr. Sathit Niamsuwan, August 2013

reducing efficiency. Higher temperatures at the air inlet cause the refrigerant to condense at higher temperature, decreasing its cooling efficiency. Implementation of this option can generate savings in electricity consumption by the chiller of up to 10%.

(7) Insulate the heater of vacuum-thermoforming machinery

The option reduces heat loss at the heater wall of vacuum-thermoforming machinery operating at a temperature of 221°C, by installation of high temperature resistance fiberglass insulation. Insulation as recommended can save up to 27% in electricity costs.

(8) Insulate oven walls for lid thermal curing

The option reduces heat loss from the oven wall during lid thermal curing, by insulating with fiberglass, as in (7) above. Although in this case surface temperatures reach only 66°C, heat loss through the wall is still significant. This option can achieve electricity savings of up to 12%.

(9) Install lids on solvent bath and tanks, and ink circulating tanks

The option reduces evaporative loss of volatile solvents, simply by covering the tanks. In addition, this measure reduces solvent odors and health risks associated with VOCs in the working area. This option is highly effective and can prevent up to 98% of solvent loss.

(10) Install evaporating and condensing machine for solvent recovery

The option recovers solvents mixed with ink, whilst reducing the volume of hazardous waste that must be disposed of. The solvent separation and recovery process can recover 96% of the original solvent.

Conclusion

This study has contributed recommendations for eight food packaging industry plants, achieving cost savings in both electricity consumption and chemical use amounting to approximately 6 million Baht annually, whilst reducing emissions of greenhouse gases by 994 tons CO2 eq./year.

Acknowledgements

This article is part of the research project *"Propagating cleaner technology: CT for food packaging industry"* funded by the Department of Industrial Works, Ministry of Industry, 2013.

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ARTICLE

National Agro-Pro Industry Alliance

Head of Cent
Department of Food Science and Technolo

Introduction

Thailand exports agricultural and processed agricultural products worldwide. In 2013, export values of the processed agricultural products alone were more than 900 billion baht and more than 800,000 workers are employed in this industry. The agro-processing industry is a top source of income to the country, after the electronics and automobile sectors. However, supplies and prices of agricultural products fluctuate and have low monetary value despite their high production costs. Moreover, agricultural areas of Thailand have been decreasing due to housing development and urbanization.

Strengthening the country's agricultural sector and enhancing food and energy security are key development strategies prioritized under the 11th National Economic and Social Development Plan (2012-2016). The 11th Plan also focuses on increasing the value of agricultural commodities throughout the supply chain. Local institutions and research and development organizations are, therefore, encouraged to collaborate with the private sector on R&D in order to address these challenges and to share knowledge and technological innovations with farmers and entrepreneurs. Creative-based knowledge, innovations, and environmentally friendly production technologies carry potential to create added value for agricultural and food products.

Formerly known as the Office of Agro-Processing Industry, the Industry Cluster 2 Bureau operates as part of the Department of Industry Promotion, Ministry of Industry, and is responsible for promoting and developing the food and agro-processing industry to enhance its competitive capacity. The Bureau has therefore launched the National Agro-Processing Industry Alliance (NAPIA) as part of the Thailand Food Valley project. The project aims to create value added to agricultural products throughout the supply chain and widens the choice of processed agricultural products by building on research into packaged food products for industrial production. It also facilitates market expansion for processed agricultural products. The main goals are to provide consultation and product development to more than 10 small and medium enterprises (SMEs) operating in the food industry sector. Each participating SME succeeded in inventing at least 1 product prototype ready for scale-up.

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e : NAPIA

Assoc. Prof. Jirarat Anantagool, Ph.D.
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ogy, Faculty of Science, Chulalongkorn University

Ideas for Product Development

NAPIA helps participating SMEs develop their existing products by creating added value, product differentiation, and in commercial strategies to satisfy market demand. NAPIA provides consultation services for SMEs both in theory and through hands-on training in order to create added value, differentiate product lines, and widen product choice to satisfy market needs. Each enterprise receives at least 10 six-hour input sessions. The sessions included presentations on study results of research regarding downstream, midstream, and upstream food industries that could be built on to create creative products in terms of quality, safety, shelf-life, type and character of product, taste, and product design. All these elements were analyzed to establish correspondence with market demand, lead to identification of new value-added products and/or improvements to existing products. The new products also widened choice of processed agricultural products to respond to changing demands of consumers and retailers.

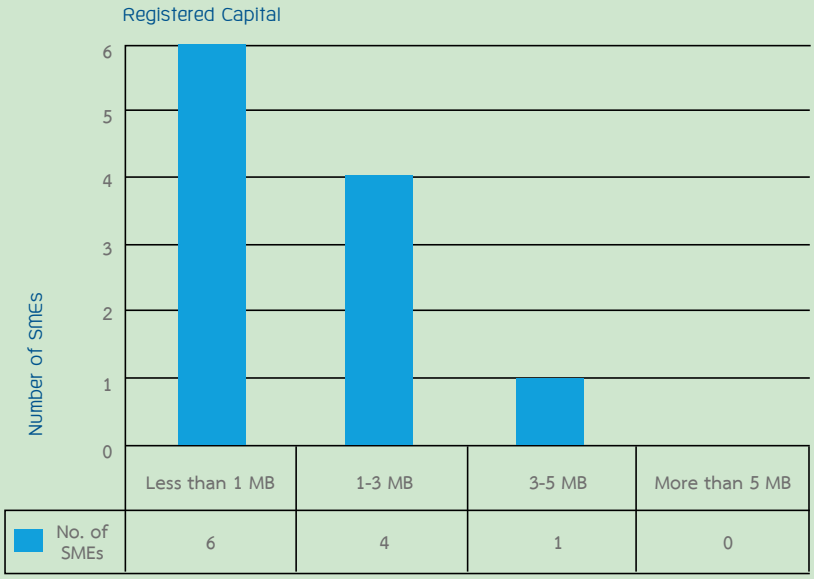

Figure 1: Registered capital of participating SMEs (fiscal year 2013)
Source: Project Surveys

Figure 2: Number of employees employed by SMEs participating in the project (fiscal year 2013)
Source: Project surveys

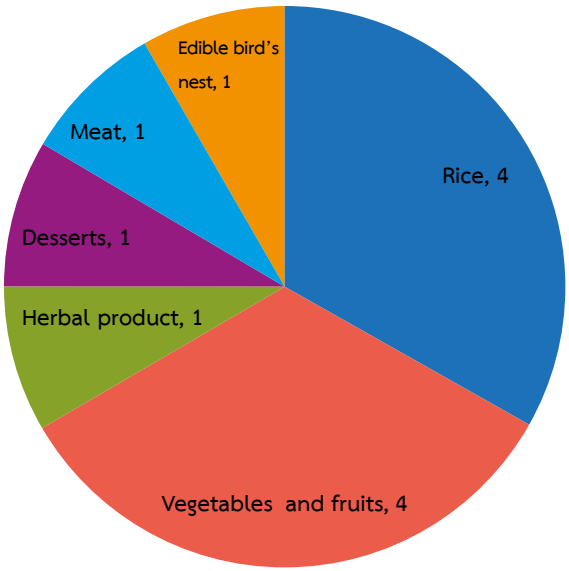

Figure 3: Categorization of agro-processing products (fiscal year 2013)
Source: Project surveys

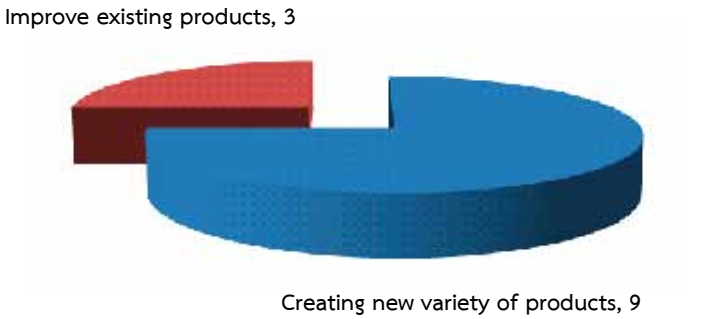

Figure 4: Goals of SMEs participating in the project (fiscal year 2013)
Source: Project surveys

In this regard, product development ideas are promoted, based on four concepts: Reduce, Reuse, Recycle, and Shelf-life extension:

- Reduce: acquiring fewer resources for production processes, using less imported food components, additives or harmful preservatives
- Reuse: reusing resources in manufacturing processes, such as developing a method to reuse preserving syrup or designing reusable packages for final products
- Recycle: developing new products from recyclable waste from manufacturing processes, creating added value and reducing waste from the food processing industry
- Shelf-life extension: developing products with a longer shelf life, thus increasing incomes for SMEs by reducing storage and spoilage costs.

Project Results

There was a total of 11 agro-processing SMEs paricipated in the project. Most were small enterprises with registered capital of less than 1 MB (54.4%); none had registered capital exceeding 5 MB (Figure 1). 90.9% of participating SMEs had fewer than 20 employees (Figure 2). Among the 11 SMEs, 33.3% desired to develop their rice products and 33.3% desired to develop vegetable or fruit products. 75% wanted to improve their products in terms of variety (Figure 3); the remainder wanted to improve product quality and shelf life. The project helped to develop or improve 12 new products, as shown in Table 1.

Table 1: 12 value added products from 11 SMEs participating in the project

Products	SMEs	Product Features
Dehydrated Sweetened Preserved Mango (Low Sugar) 	Thai Delicate Taste R&D Center, Part., Ltd., Muang, Nonthaburi	Product type: value added product Dehydrated sweetened preserved mango: the product texture is dry, not sticky to touch, yet remains soft.
Soft Candy 	Yong Ku Far Fruit Candy Co., Ltd., Chom Thong, Bangkok	Product type: value added product When originally produced, quality deteriorated after being stored for a period of time. The product became hard and dry. After adjusting the recipe, it could be stored longer and retain its original quality.
Instant Rice Noodle (Soya Sauce Flavor) 	Siam Paradise Food., Co., Ltd., Muang, Chonburi	Product type: new product This product is instant rice noodle seasoned with soya bean sauce, sterilized by high temperature with non-preserving chemical. Minimum storage at room temperature is 1 year.
Chicken Ball (Sweet Basil Flavor) 	Saha P.S. Inter Food Co., Ltd., Chatuchak, Bangkok	Product type: new product This newly improved product is chicken ball seasoned with sweet basil. Adjusted recipe makes the food more resisted to high temperature preserving process. This ready-to-eat product can be stored at room temperature for at least 1 year.
Chili Sauce and Ketchup with Gac 	Arharn Aryurawatr Co., Ltd., Nakhon Pathom	Product type: new product This new product is a chili sauce and ketchup with gac added as a new ingredient. Gac contains high beta-carotene and lycopene which have powerful anti-oxidant and health benefits.
Healthy Noodle 	Khun Pom, Bang Khla, Chachoengsao	Product type: new product This new product contains jasmine rice, Hom Nin rice (black fragrant rice) or germinated brown rice flour. Wheat flour is partly substituted with rice flour in this recipe, reducing import requirements.
Malithai Fruit Pie 	Khun Pom, Bang Khla, Chachoengsao	Product type: new product This new product is a fruit pie stuffed with sweetened preserved fruit, such as mango, pineapple and strawberry. The pie crust is made uses red jasmine rice, Hom Nin rice (black fragrant rice) or germinated brown rice flour.

Products	SMEs	Product Features
Milk Pellets and Milk Candy 	Chokchai Farm Produce Co., Ltd., Pak Chong, Nakhon Ratchasima	Product type: new packaging design This product is improved in packaging. Originally, after storage for a period of time, the product absorbed moisture and became rancid. Improving the packaging by adding an oxygen absorber in the packaging, shelf life can be extended up to 4 months.
Herbal Juice Healthy Drink 	CCN International Co., Ltd., Bang Kae, Bangkok	Product type: value added product This product's formula and packaging are reformed to improve appearance. The product is a herbal juice containing various herbs. It is condensed, and has a healthy green of herbal juice with no dregs.
Tamarind and Gac Juice 	Tammary Co.,Ltd., Muang, Petchabun	Product type: value added product This new product is a combination of sour tamarind juice (cooking tamarind) or instant tamarind juice which is common in the market. This tamarind juice is supplemented with gac, increasing anti-oxidant levels and giving the product a laxative property.
Seasoned Grilled Sticky Rice Cake 	Sriwisoot Organic Group Germinated Rice Mill, Warinchamrab Ubonratchathani	Product type: new product This product is a seasoned grilled sticky rice cake made of organic Hang rice (dehydrated young sticky rice), sterilized by high temperature. It has a long life storage (at least 1 year) at room temperature.
Bamboo Shoot with bamboo grass 	Thai Paradiso Food Part., Ltd., Photharam, Ratchaburi	Product type: new product This product is boiled bamboo shoot with Ya Nang (a kind of cooking herb, common in north eastern cuisine), preserved by high temperature. It contains no chemical additives and has a long shelf-life at room temperature.

Source: Outcome of NAPIA Product Development

Acknowledgements

This article is part of the result project *"Creating Value-added/differences and varieties for Agro-Processing Products"* as part of the National Agro-Processing Industry Alliance (NAPIA) funded by the Industry Cluster 2 Bureau (formerly known as the Office of Agro-Processing Industry), Office of Agro-Processing Industry, Department of Industry Promotion, Ministry of Industry.

Thailand's Potential as a Regional Trade Center for Minerals in ASEAN

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Introduction

The integration of ASEAN Economic Community (AEC) in 2015 will transform ASEAN into a single market and production base with 600 million consumers. Each country has its own unique strengths and resources; with multilateral cooperation and effective management, the region will see a bright future for development.

The study investigated the status of minerals used in 8 industries including gems and jewelry; precious metals; fertilizers and chemicals; base minerals; construction; cement; ceramic, glasses and float glasses; and fuel. The study was conducted in 10 ASEAN countries including Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Vietnam, and Thailand. The purpose of this study was to contribute to greater understanding of the status quo and future prospects, in order to prepare Thailand to attract investment flows in these sectors, and support the country's future establishment as a regional trade hub for mineral and downstream industries.

Background

Figure 1 shows the conceptual framework for a regional trade hub for minerals, with enhanced trade by supply chain actors, both upstream and downstream, focusing on Thailand.

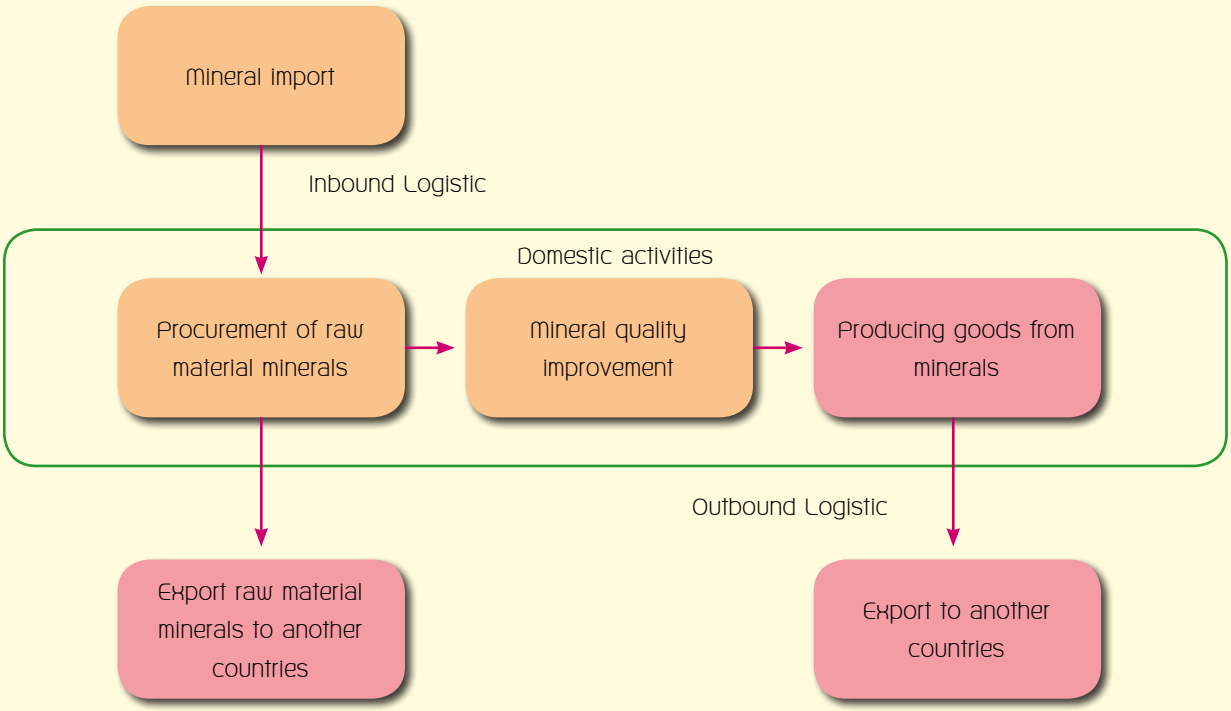

Figure 1: The concept of a regional trade hub

Wayne Grayson

Opportunity analysis for Thailand to become the regional trade center for minerals

This analysis applies the principle that in order to achieve the status of a regional mineral trade center, the country's endowment factors as well as the market characteristics of the mineral itself must be taken into account, as explained below.

1) Factors supporting Thailand as a regional trade center for minerals

(1) Thailand offers a large market for downstream industrial products, both for domestic consumption and export.

(2) Unique quality improvement technology, value-adding design, and products that meet market demand.

(3) Thailand's mineral product standards are accredited in the global market.

(4) Thailand can serve as a price reference source for the regional and global market.

(5) Other supportive factors for international trade include:

(5.1) The country's strategic location at the center of the region offers major transportation advantages for importing and exporting raw material minerals and finished products

(5.2) Efficient logistics that can generate major savings in costs of transport and procurement of ores and raw materials

(5.3) A supportive regulatory and tax regime for importing and exporting raw material minerals and products

2) Marketing characteristics of each mineral

In this study, groups of minerals can be categorized by their characteristics as follows:

(1) Common industrial minerals refer to minerals used in large volumes and for similar purposes. These inexpensive minerals include rocks, soil, sands, clay, limestone, and quartz. Due to their low price and high transportation costs, the main consumers of these minerals are domestic buyers or nearby countries, making it hard for Thailand to become a regional center for this category of minerals.

(2) Standardized industrial minerals refer to minerals with limited availability, which can, therefore, justify transportation costs and enter international trade. When the source country does not improve the quality of the minerals domestically, but instead exports them to improve the quality in the country of use or to a country with a strategic location, the latter can be promoted to become a regional trade center for this category of minerals.

(3) Specific grade industrial minerals refer to industrial minerals that require technology to improve quality of the minerals produced and serve a certain group of customers. Access to the latest technology is, therefore, a key factor for these minerals. In many cases source countries have the minerals but cannot improve their quality to meet market demand, or the market is in countries where there is high demand for the mines. In addition, the ability to set the quality and price is also essential to maintaining the country's status as a center, even in the face of changing business factors. Minerals in this group include precious gems such as diamond and colored stones.

(4) Metals refer to mineral products traded as commodities. The quality of metals is more or less the same in every country. The marketing characteristics of processed metals include mid-level products with reference prices set by the global market. The market is sophisticated, well-understood and reliable in regard to pricing and market mechanism management is essential. Key markets are the London Metal Exchange (LME) and New York Mercantile Exchange. The key factor for the metals market would be a reliable marketing mechanism and could be referenced to global prices.

The study result indicates that of all categories of minerals, Thailand has a good opportunity to become a regional center for gems and jewelry, categorized as 'standardized industrial minerals'. The industry requires uniqueness and quality improvement of the minerals to meet the needs of specific markets. Indeed, today Thailand already enjoys a large domestic market for gems and jewelry, to meet both domestic and export demand. Existing technology and workforce skills for improving quality are highly developed and unique. Moreover, Thailand's gem industry successfully adds value and is well accepted in the global market. Other supportive factors mentioned above (such as location, logistic infrastructure and regulatory framework) also contribute to this success in market development.

For precious metals such as gold and silver, Thailand has a medium level opportunity because it has a large downstream industrial market linked to the gem and jewelry industry. However, the pricing and quality standard are determined by the global market while gold and silver, unlike gems and jewelry, do not possess unique differentiating characteristics; Thailand does not have product standard organizations recognized by the global market, as compared with UK's London Bullion Metal Association.

Potash and rock salt could see significant opportunities in the future because of Thailand's large potash deposits. Demand from domestic industry and from neighboring countries is buoyant because the fertilizer industry needs a constant supply of potash. However, production of potash in Thailand is not yet successful today due to controversy over social and environmental impacts on local communities.

Other industrial minerals such as tin, zinc, lead, mercury, iron, marble, limestone, marl, clay, quartz, feldspar, lignite are common industrial minerals are cheap and commonly found. There is therefore very limited opportunity for Thailand to become a regional trade center for this category of minerals.

Strategy Suggestions

According to the above analysis of opportunities for each mineral group, sectorial strategy should focus on minerals for which Thailand can be immediately driven to become a regional center. The groups are gems and jewelry, gold, and silver. The strategy should include the following:

1) Improve raw material management efficiency and sustainable production processes

2) Launch marketing campaigns to add value in the gems and jewelry industry, in order to expand to the global market

JJ Harrison

3) Improve State regulatory mechanisms and develop infrastructure to enhance capabilities of business operators

4) Improve skills and knowledge of human resources in the gems and jewelry industry to international standards

5) Establish a cooperative network among business operators and State agencies related to the gems and jewelry industry

6) Create connection between gold alloys produced from gold mines and gold bullion used for trading

7) Encourage gold mines in Thailand to be certified according to the LBMA standard

8) Coordinate with gold mines from other countries in the region to provide raw material supplies for gold mines in Thailand.

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ARTICLE

Thai Industrial Development Strategies in the Andaman Coastal Area to Link Neighbouring Countries

Sirichet Sangkaman, Ph.D.
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Introduction

Intensifying economic recession in the United States and Europe is increasingly affecting other countries, especially those whose economies are dependent on exports. Many countries have responded by developing their domestic and regional markets with an emphasis on strength hening trade with neighbouring countries.

Though Thailand is one of these countries that rely on exports, it enjoys great advantages in terms of its geographical location at the centre of Southeast Asia, and because of its land borders with Indo-China. To the west or towards the Andaman Sea, Thailand has a long land and sea border with Myanmar, whose natural resources are still plentiful. With Myanmar's continuing path towards economic liberalization attracting massive new foreign investment, the country has put great effort into infrastructure development, development of an industrial production base, and logistics systems, especially for water transport. Foremost among these would be the example of Dawei Deep Sea Port & Industrial Estate Project that will link the Middle East with Southeast Asia. It is expected that over time, this area will emerge as a major global trading route and investment centre. It would therefore benefit Thai industries to have a western border link with Myanmar or on the Andaman Sea side. Through Myanmar, this could be a link to third countries such as those in the Middle East, Bangladesh, India, and the southern parts of China. This list is a very large market that can potentially buy industrial products from Thailand. Therefore, it would be a great opportunity to unlock this potential by developing Thai industries and link to the western border or to the Andaman Sea. The link could contribute significantly to increased competitiveness of Thailand's industrial sector.

Selecting target industries in the project study area

The project study area covered 12 Thai provinces: Tak, Kanchanaburi, Ratchaburi, Phetchaburi, Prachuap Khiri Khan, Chumphon, Ranong, Phangnga, Phuket, Krabi, Trang, and Satun. First of all, the criteria for selecting target industries were established based on analyses of the status and potential of the industries in the global economy. The short, medium, and long-term development trends were considered together to assess production and marketing competitiveness. Types of industry in the project study area and their economic, social and geographical linkages with neighbouring Myanmar were evaluated through collection of field survey data using questionnaires, in-depth interviews, and focus groups. The field survey was undertaken to gain participation from stakeholders within the study area so that the target industries are properly selected. The comparative advantage model is used to prioritize the importance and determine the type of industries with high potential and suitable to be promoted in the project study area.

Figure 1: The study framework for Andaman Coastal Area Link
Source: Thai Industrial Development Strategies in the Andaman Coastal Area to Link Neighbouring Countries Project

Defining criteria for selecting target industries

Seven key criteria were selected to provide a framework for analyzing the data and establishing the strategies/plans/projects for development strategies in the Andaman Coastal area to link neighbouring countries. The criteria are listed as follows:

1) Production factors and cluster: This focuses on analyzing factors of production and cluster of a target industry. The analysis will be conducted separately for factors of production and cluster.

2) Marketing cluster: This emphasizes markets for the products of a target industry, including both domestic and foreign markets. Major and minor markets for exports will also be analyzed to identify potential growth trends.

3) Supportive policies and measures: This criterion evaluates coherence with national, organizational, and local industrial development strategies. Commerce and investment benefits will also be taken into account, together with international agreements and internal supportive policies and measures such as strategy formulation under the current government and the National Economic and Social Development Plan.

4) Social factors (way of life/local wisdom): Social factors are considered to ensure agreement with the way of life of local people living in the study area.

5) Environmental factors: Environmental factors are included to estimate the impact of industrial development, both positive and negative, within the study area and its vicinity.

6) Global change contexts: This criterion evaluates trends in association of economic groups and global currency movements: technologies, changing social and environmental contexts, and shifting trends in consumer behaviour.

7) Agreement with local community: This evaluates stakeholder understanding, opinion and acceptance.

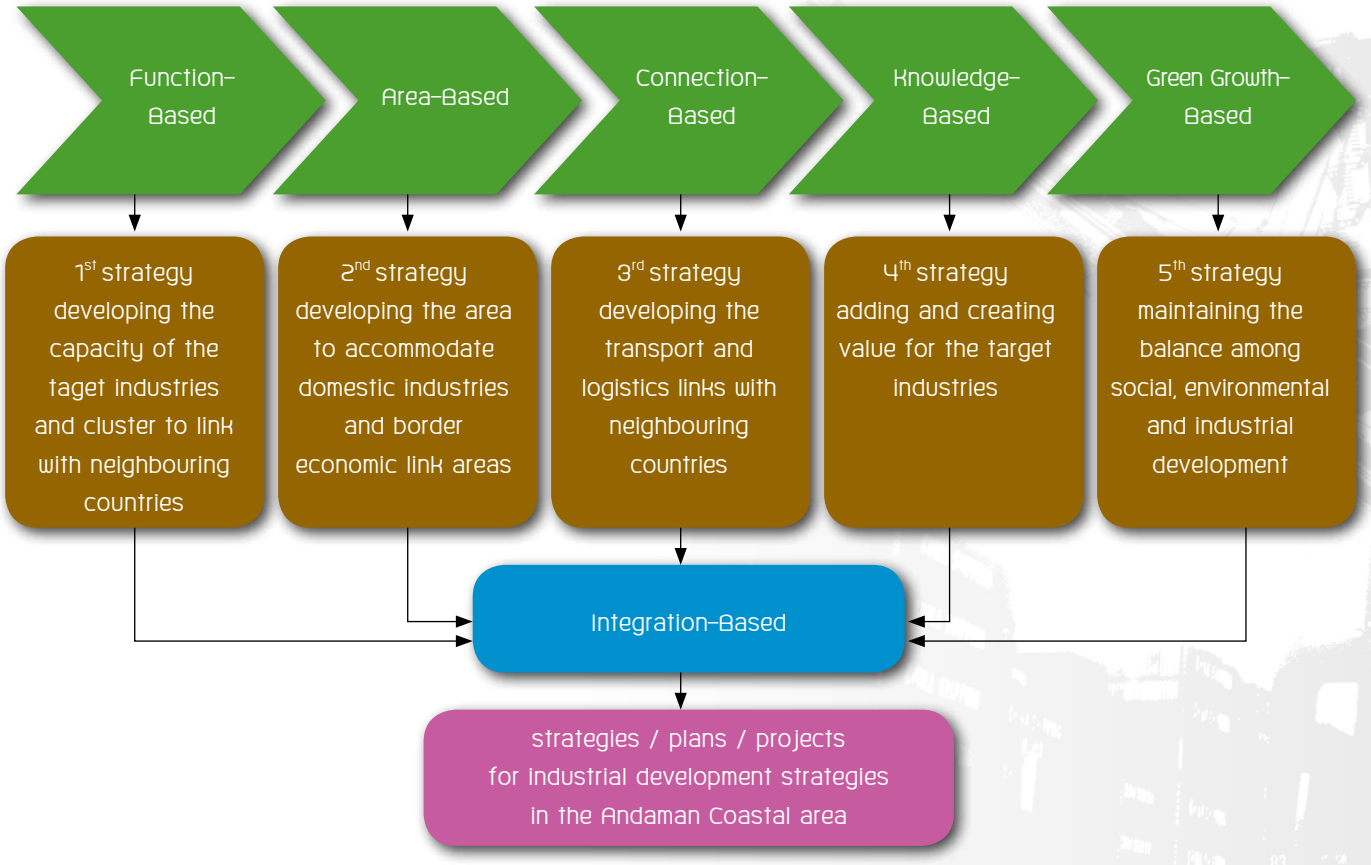

Figure 2: Thai industrial development strategies in the Andaman Coastal area to link with neighbouring countries
Source: Thai Industrial Development Strategies in the Andaman Coastal Area to Link Neighbouring Countries Project

Study results

The study has recommended development strategies for Thai industry operating in the Andaman Coastal area to link neighbouring countries. Five mutually supportive strategies are presented to increase strength and competitiveness of the target industries in the region, and especially the potential of the industries to establish commercial linkages with neighbouring countries. The strategies are as follows:

1) Function-based strategy to develop the capacity of target industries and clusters to link with neighbouring countries

2) Area-based strategy by developing the area to accommodate and serve domestic industries and border economic link areas

3) Connection-based strategy to develop transport and logistics links with neighbouring countries

4) Knowledge-based strategy to create and add value for target industries

5) Green growth strategy to maintain a balance among social, environmental, and industrial development goals.

In implementing the strategies, two major enabling factors must be integrated: 1) administrative mechanisms; and 2) implementation guidelines for the development strategies, which will also serve to build trust and attract investors. These are described in more detail below:

Administrative mechanisms

Administration mechanisms can be divided into 2 levels: 1) policy-level administrative mechanisms from the central government, and 2) operation-level administrative mechanisms in the target area. Administrative authority will be decentralized as much as possible to operation-level organizations to facilitate a one-stop service and timely and efficient problem solving.

Guideline for implementation of the industrial development strategies in the Andaman Coastal area to link neighbouring countries

Development strategies in the Andaman Coastal area must involve many agencies at both national and local levels. Coherence and coordination among all such agencies will be essential. Examples of such support may include the following:

1) Proposals to the Cabinet to approve strategies

During this process, it is recommended that the Government acknowledges industrial development in the Andaman coastal area to link neighbouring countries as an urgent policy priority, as part of preparations for ASEAN Economic integration under the ASEAN Economic Community (AEC) in 2015.

Once they have been prioritized, the strategies together with the administration mechanisms mentioned above should then be proposed to the Cabinet for approval, following these steps:

(1) Approve the strategies to proceed

(2) Approve proposed administrative mechanisms

(3) Order concerned governmental agencies to cooperate and take actions according to their mandate and role identified under the strategies.

2) Provide information and training to personnel

Provide information and training to related personnel through meetings to establish mechanisms for effective collaboration among responsible Ministries, State agencies, and other stakeholders, focusing on the following areas:

(1) Function-based strategies: arrange a meeting with agencies related to production factors (including the Ministry of Agriculture and Cooperatives, Ministry of Industry Ministry of Natural Resources and Environment, Ministry of Labour and Social Welfare, Ministry of Commerce, Ministry of Science and Technology, Board of Investment, Federation of Thai Industries, Thai Chamber of Commerce and Board of Trade of Thailand).

(2) Area-based strategies: arrange a meeting among agencies related to development of industrial markets, both domestic and along the link with neighbouring countries. The strategies will also include review of regulations to eliminate bureaucratic obstacles and streamline border links. The concerned agencies would include the Industrial Estate Authority of Thailand, Ministry of Interior, Ministry of Industry, Ministry of Natural Resources and Environment, Ministry of Agriculture and Cooperatives, Ministry of Foreign Affairs, Ministry of Commerce, Customs Department, Board of Investment, Board of Provincial Chambers of Commerce, and the Federation of Provincial Industries within the target area.

(3) Connection-based strategies: arrange a meeting with agencies related to transport and logistics development and links to neighbouring countries such as the Ministry of Transport, Ministry of Industry, Ministry of Interior, Customs Department, Ministry of Foreign Affairs, Ministry of Labour, Board of Investment.

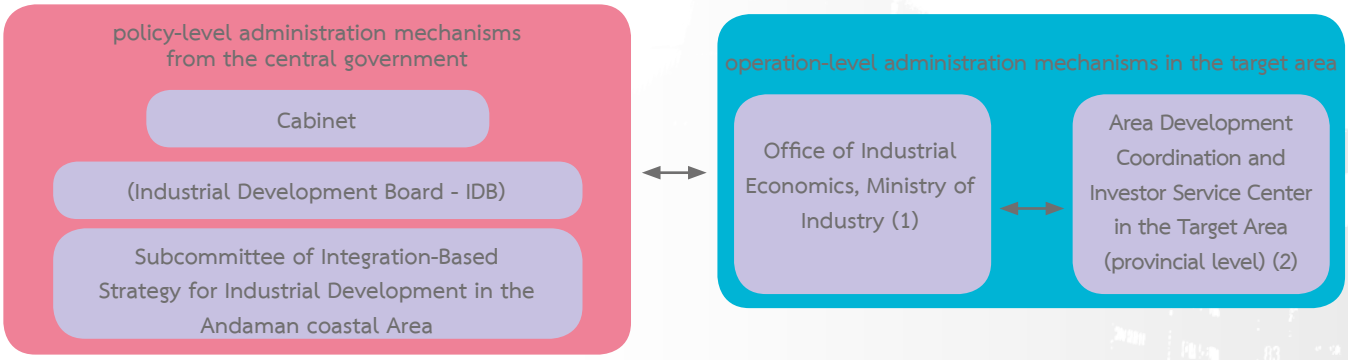

Figure 3: Implementation mechanism

Source: Thai Industrial Development Strategies in the Andaman Coastal Area to Link Neighbouring Countries Project

(4) Knowledge-based strategies: arrange a meeting with agencies related to research and development for adding and creating value for the target industries and increase industrial competitiveness for entrepreneurs. The related agencies may include the Ministry of Industry, Ministry of Science and Technology, Ministry of Agriculture and Cooperatives, Ministry of Natural Resources and Environment, Ministry of Commerce, as well as educational institutions.

(5) Green growth-based strategies: arrange a meeting with local communities, civil society groups and environmental organizations to establish mechanisms to maintain an equitable balance between development and social and environmental goals. The meeting should identify a pathway to develop the industrial potential in an eco-friendly way. Related agencies would include local government organizations, Ministry of Culture, Ministry of Industry, Ministry of Social Development and Human Security, Ministry of Labour, Ministry of Education, Ministry of Natural Resources and Environment, Ministry of Science and Technology.

3) Result monitoring process

(1) Create a result monitoring system to evaluate ongoing progress and achievements. A set of achievement criteria should be specifically defined to ensure accurate attribution of results to the defined strategies and activities of the assigned agencies.

(2) Encourage participation in the monitoring process by arranging a meeting among related agencies to establish an achievement assessment framework for implementing the strategies, as well as specific result frameworks for each strategy.

(3) Monitor accomplishments of agencies within the agreed framework and submit a copy of the report to the Office of Industrial Economics as the lead agency in charge of coordinating implementation. The report will be used for assessment at least on an annual basis and to make an annual report to the Cabinet.

(4) Establish a coordination centre to construct a central database for monitoring operational results according to the development strategies in the Andaman coastal area to link neighbouring countries.

Acknowledgements

This article is part of the research project ***"Thai Industrial Development Strategies in the Andaman Coastal Area to Link Neighbouring Countries Project"*** funded by the Office of Industrial Economics.

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ARTICLE

A Study on Management of Effluent from the Textile Bleaching and Dyeing Industry

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Introduction

The textile and garment industry is crucial to the Thai economy, accounting for exports valued at 250 billion baht in 2011. According to the Department of Industrial Works, most textile bleaching and dyeing factories are of medium and small size, and are located mostly in the central region, especially in Samut Prakan Province. The industry's vast water consumption results in numerous environmental problems such as contamination of effluent flows with dyes and other chemicals. Even though dye-contaminated wastewater is not excessively toxic, the effluent stream can be contaminated with unpleasant colors. Therefore, it is necessary to remove the color from the effluent before release into watercourses. However, many factories do not employ an appropriate technology of wastewater management.

The Department of Industrial Work's aim for this study was to survey the wastewater color and to improve the database of effluent drainage from dyeing, screening, textile decorating and bleaching factories, and to suggest guidelines for handling the effluent from the target group factories so that the industry can be developed sustainably, in harmonious coexistence with the surrounding communities.

Results of survey and analysis of effluent from the representative factories

A total of 98 factories participated in this study, including factories of type 22 (textile, thread, or non-asbestos fiber), type 24 (knitting, lacework, fabric garment, and bleaching), and type 98 (washing and ironing, dry-cleaning, laundering, dyeing of garment, carpet, or fur). There were 196 wastewater samples. The results show that the average total dye-contaminated raw wastewater and effluent were 648 and 173 ADMI (American Dye Manufacturers Institute) respectively. The data can be summarized as follows:

1) The total dye values of raw wastewater from production before entering the wastewater treatment system ranged from 2 to 5,465 ADMI; the average was 648.39 ADMI with standard deviation 1,106.6. (Figure 1)

2) The total dye values of factory effluent drained through the environment ranged from 6 to 1,120 ADMI; the average was 173 ADMI with standard deviation 189.43. (Figure 2)

3) 46.9 percent of the participating factories showed the dye value less than 100 ADMI, 77.5 percent less than 200 ADMI, and only 15.3 percent more than 300 ADMI (Figure 1)

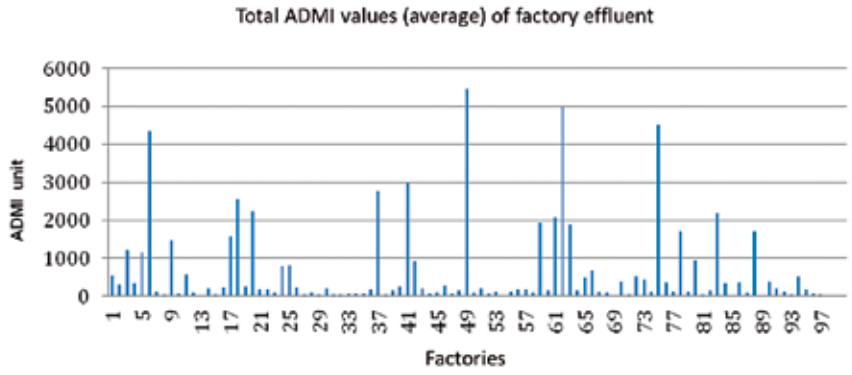


Figure 1: ADMI values of raw wastewater before entering wastewater treatment plant of the 98 sample factories
Source: A Study on Wastewater Quality from Selected Industries for Wastewater Quality Improvement (2013), Department of Industrial Works

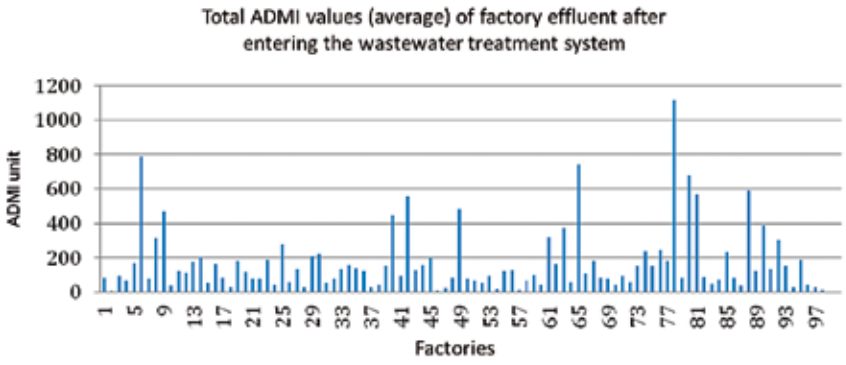


Figure 2: ADMI values of factory effluent from the wastewater treatment system of the 98 sample factories
Source: A Study on Wastewater Quality from Selected Industries for Wastewater Quality Improvement (2013), Department of Industrial Works

Table 1: List of factories with different dye values

Dye values of wastewater in ADMI unit	Number of factories	%	Accumulated %
0-100	46	46.93	46.94
101-200	30	30.61	77.55
201-300	7	7.14	84.69
301-400	5	5.10	89.80
400-1200	10	10.20	100

Source: A Study on Wastewater Quality from Selected Industries for Wastewater Quality Improvement (2013), Department of Industrial Works

Relationship between groups of dyes used in factories and dye-effluent from target factories

Using questionnaires, representatives from 91 factories were interviewed on the use of dyes in their business. Usage of dyes by group is shown in Figure 3. It was found that most factories used reactive dye (62.2%), disperse dye (48.4%), direct dye (22.0%), and acid dye (16.5%). Other dye groups included cationic sulfur vat and azoic (33.0%). From the data, it was likely that the factories using reactive and disperse dyes would have higher average dye values than those using direct and acid dyes. Other types of dyes used in factories included indigo pigment and alginate compounds.

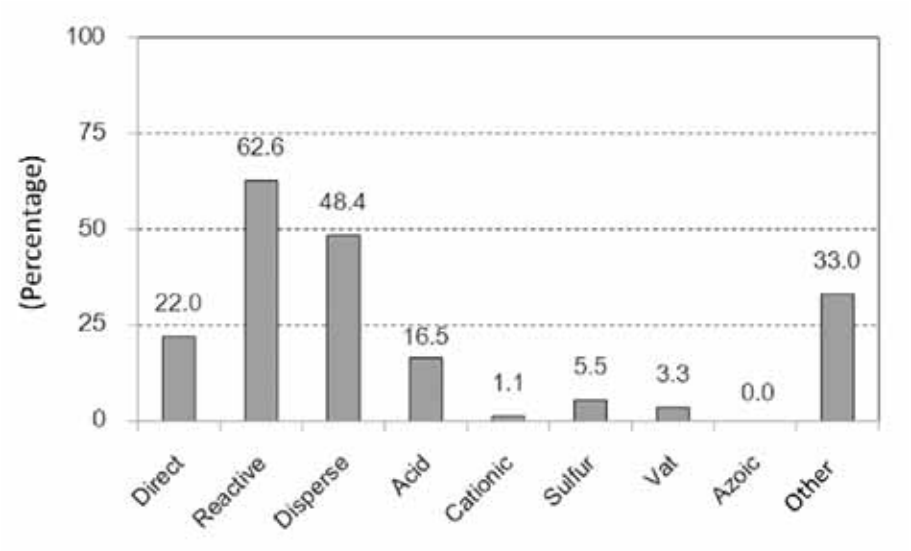


Figure 3: Types of dyes used in the 91 target factories
Source: A Study on Wastewater Quality from Selected Industries for Wastewater Quality Improvement (2013), Department of Industrial Works

Guidelines for handling effluent from factories/an appropriate wastewater management system

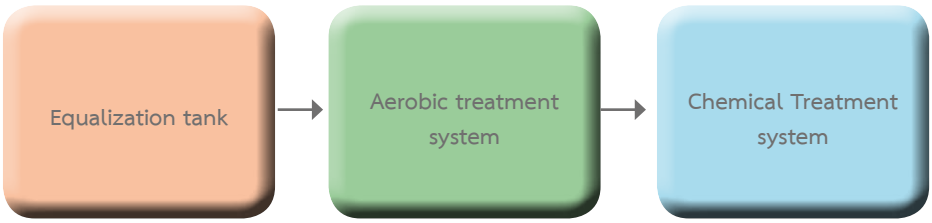
By investigating the wastewater management systems of the representative factories, the study showed that efficient treatment systems for dye effluent from textile bleaching factories have the following characteristics:

1) Chemical sedimentation followed by biological treatment

A chemical sedimentation system followed by a biological treatment system is most suitable for factories that use insoluble dyes such as disperse, vat, and sulfur dyes. Such a system removes dyes and suspended matter by chemical sedimentation. Thereafter, a biological treatment system using aerobic system is used to remove organic compounds. The study showed that the system could remove dyes as effectively as 70%.

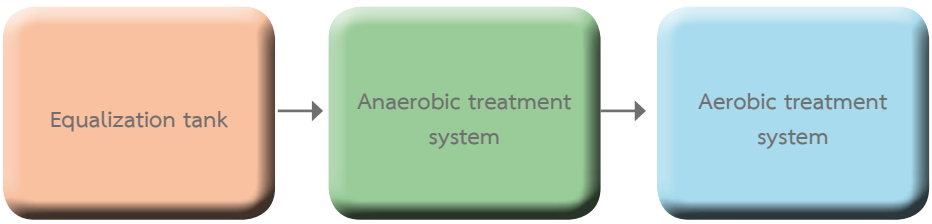
2) Biological treatment followed by chemical sedimentation

A biological treatment system can remove dyes since microorganisms absorb the dyes in their cell walls. The remaining dyes will be removed by chemical sedimentation. This system is appropriate for factories using soluble dyes such as direct, acid, and basic dyes, as well as mixtures of soluble and insoluble dyes. The study showed that the system could remove dyes as effectively as 80-90%.



3) Biological wastewater treatment system (non-oxygen followed by oxygen system)

This system is suitable for factories using reactive dyes because anaerobic treatment alone is insufficient to remove reactive dye molecules. However, anaerobic wastewater treatment system requires a large area of land and is difficult to construct. Therefore, it is only suitable for factories with ample space. According to previous studies, anaerobic wastewater treatment system follow by aerobic treatment (activated sludge) could remove dyes as effectively as 89.5%.



4) Biological wastewater treatment followed by chemical oxidization

Biological wastewater treatment followed by chemical oxidization requires use of chemicals such as ozone and chlorine. It increases the operational cost and demands extra operation during the handling of toxic oxidizing agents. Such systems are suitable for factories with space limitations and with qualified personnel to control the operation.

5) Wastewater treatment (types 1–4 combined) followed by sand filter tank

In case a factory is facing the problem of suspended matter exceeding the legally prescribed standard, installation of a sand filter tank is an alternative that helps reduce suspended matter for factories using insoluble dyes. The sand filter tank should be installed at the last treatment process. Studies show effectiveness in dye removal ranging from 30-70%.

Acknowledgements

This article forms part of the findings of a study: *"A Study on Wastewater Quality from Selected Industries for Wastewater Quality Improvement"* by the Department of Industrial Works.

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Chemical Treatment system

Biological treatment system

Non-oxygen biological wastewater treatment system (activated sludge)

Sand filter system

Figure 4: efficient treatment systems for dye effluent from textile bleaching factories

Source: A Study on Wastewater Quality from Selected Industries for Wastewater Quality Improvement (2013)

Study of Potential

Utilization of Oil Shale of Mae Sot Basin

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Introduction

Oil shale is a sedimentary rock containing organic matter "kerogen" as its main component. Kerogen is a mixture of organic compounds, which have not been decomposed by bacteria, mixed with sand and sediments deposited in the area like lake, lagoon, swamp, and delta. This mineral resource is a potential energy source and raw material for some industries. The mineral is used by being retorted into shale oil or directly burnt as fuel to produce electricity. Moreover, waste material and ash from shale oil can be used as a raw material for cement manufacture. Oil shale is found in several area of Thailand and the largest reserve is in Mae Sot Basin, Tak Province, which has the greatest potential source for further development.

The project: "Technological Development for Mae Sot Oil Shale" was initiated to develop knowledge and management for utilization of Mae Sot oil shale, which could be an important potential energy reserve and industrial raw materials for Thailand.

Estonia Case Study

Oil shale deposits have been found in more than 40 countries around the world. The top 10 countries of with oil shale reserves can be shown in Table 1.

Table 1: Top 10 countries of global oil shale reserves

Rank	Country	Reserves (million MT oil equivalent)
1	USA	303.56
2	Russia	39.00
3	Congo	14.31
4	Brazil	12.00
5	Jordan	5.20
6	Morocco	5.02
7	Australia	4.54
8	China	2.74
9	Estonia	2.49
10	Italy	1.43

Mark A. Wilson

Commercial production and use of shale oil are limited to 6 main countries: Estonia, China, Brazil, Russia, Germany and Australia. Among these countries, Estonia possesses the largest production volume, with 1,060 metric tons of oil shale produced (recorded data up to 2008).

This study examines the case of Estonia, which provides a model for successful commercial production and use of oil shale. The country has continuously developed oil shale technologies, and more than 80% of its electrical power used in the country today is produced from oil shale.

Furthermore, Estonia also promotes research and development of oil shale technologies. Tartu University was the center for oil shale development when the University's oil shale laboratory was established in 1925 and later moved to Tallinn Technical University in 1936. Estonia's Institute of Chemistry conducts studies of chemical quality and technology relevant to oil shale. The Estonian Academy of Sciences Research Institute was founded to study oil shale mining and management. The Oil Shale Research Institute, Kothla-Järve was founded in 1958 to be Estonia's center for oil shale research for industries. Later in 1998, the institute joined with Tallin University of Technology, and in 2005 was again reorganized as the Department of Oil Shale Technology at the Faculty of Chemical and Materials Technology. As a result

of decades of focusing on technology and R&D on oil shale, Estonia is a very resourceful and skillful oil shale resource developer.

Oil shale mining in Estonia can be traced back a hundred years. The first production was in 1918, which was the world's biggest oil shale mining site. Today, the site contains four open pit mines (surface mining method) and three underground mines (with "room and pillar" and "long wall" mining methods). Eighty-five percent of the oil shale from the mines is used to produce electricity, twelve for oil extraction, and the rest (three percent) as a raw material in the cement industry.

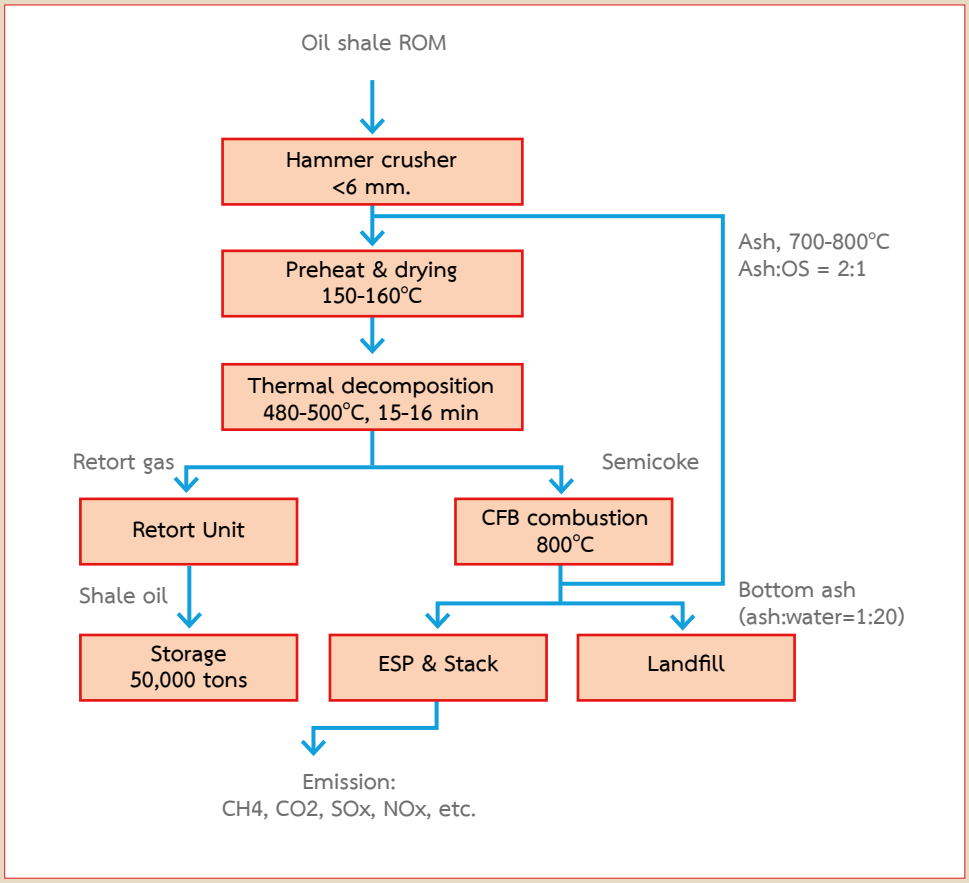

Figure 1: Chart of Simple Oil Shale Producing Process

Estonia's two major power plants are Eesti and Balti power plants, both produce a combination of 95% of the country's electrical power consumption. Eesti has a capacity of 2,595 MW from seven Pulverized Coal (PC) boilers and one Circulating Fluidized Bed (CFB) boiler, whereas Balti plant has a capacity of 1,270 MW from three PC boilers and one CFB boiler.

The oil producing process from oil shale starts from transporting of oil shale from the mines, both surface and underground. The oil shale is then fed into a crusher to be broken into small pieces, dehydrated, then retorted to recover oil or directly burnt in steam boiler. If extracted for oil by retorting, the waste obtained is spent oil shale while direct burning yields mainly burnt oil shale and fly ash. These wastes are counted as byproducts which may be used in the construction industry and a good substitute for minerals used in the industry (Figure 1).

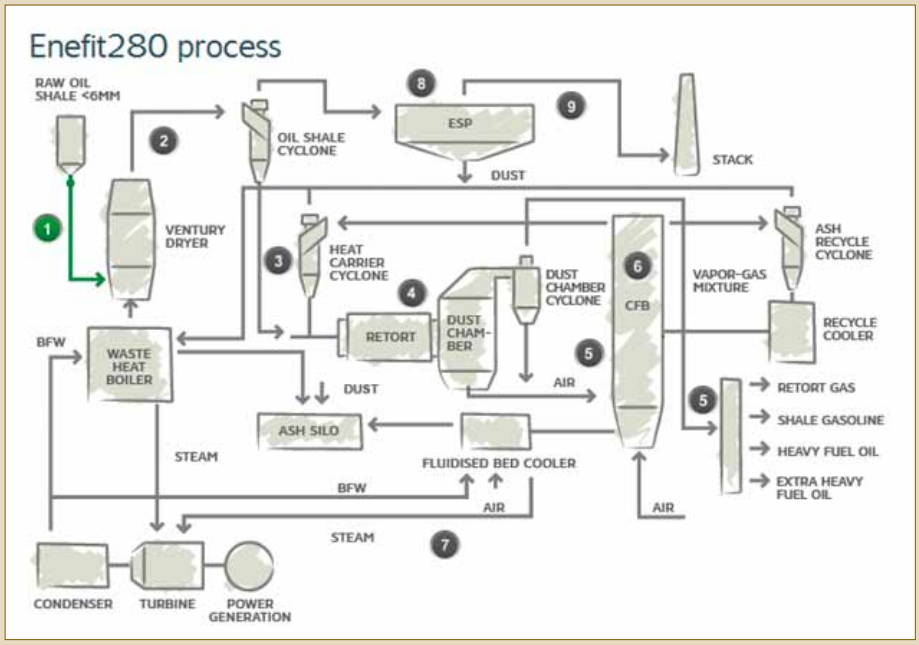

Figure 2: Enefit Outotec Technology of Shale Oil Decomposing Procedure
Source: Enefit, 2013

Enefit Outotec's technology of oil extraction is commercially called Enefit280. It is a process of surface oil shale extraction which was developed from Enefit140, the original technology which is a cross-process of Galotor process and Circulating fluidized bed combustion. Enefit280's oil shale extraction process includes mining, crushing and oil extraction with additional approach of environmental management, which are waste disposal and ex-mined land restoration (Figure 2).

Ash from oil shale can be recycled to be used as a cementing material or additive in the construction industries; for example, as a cement additive in road construction, or as a soil conditioner for agriculture. Moreover, fly ash collected from the process can be used for other products. Larger particles of fly ash can be used to make autoclaved cellular concrete blocks, soil conditioning material, and additive to produce granular fertilizer and a subbase for road construction.

There are some supportive determinants for oil shale resource development in Estonia. The major factor is that oil shale is the major source of energy of the country. With the strong support from the Estonian government, the available oil shale is considered to be an important strategic resource of the country. Therefore, the Estonian government promotes domestic us of oil shale through technological development, together with financial and policy support.

Opportunity for Development of Mae Sot Oil Shale

According to a 2007 study of the oil shale resources in Mae Sot Basin, Thailand (Suwannathong, 2007), oil shale deposits are scattered in 11 provinces, mostly in the north of the country in provinces such as Chiang Mai, Mae Hong Son, Chiang Rai, Khamphaengpetch, Uttaradit and Tak. The others are scattered in Surat Thani, Petchabun and Petchaburi. However, the largest reserves are found in the Mae Sot, Tak, which

accounts for most of the country's reserved volume of 18,668 million tons of oil shale. This resource can produce 810 million tons of shale oil. The quality of Thai oil shale holds different levels of calorific values and ash portion (Table 2).

Table 2: Quality of Oil Shale from Mae Sot Basin

Calorific value	700-4,000	Ash Analysis) (wt %)	
Ash (%)	56-70	SiO_2	38
Organic matter (%)	10-24	Al_2O_3	13
Moisture (wt %)	3.3-69.7	Fe_2O_3	5
Sulphur (wt %)	0.6-1.3	CaO	23
Spent shale (%)	66-94	MgO	7
Carbon to hydrogen ratio	7.5	others	14

Source: Apiradee Suwannathong (2007)

Mae Sot basin offers considerable potential for development of shale oil, which can serve contribute to import substitution and reduce dependence on imported energy. The government's promotion of local mineral use will stimulate local and national development. However, oil shale presents several disadvantages including a lower heat value than other fuels, and thus is of lower economic value compared with other kind of resources. Secondly, the process generates large quantities of waste, especially fly ash from burning the oil shale. Despite the lower quality of Thai oil shale compared with the case of Estonia, the government has yet to promote and support the industry's development. Private enterprises working alone could not hope to recoup their research costs in developing oil shale resources. In Thailand, oil shale sources are smaller and have lower development potential than in Estonia. In addition, obstacles include proximity between mineral sources and communities, and the long distances from the sources of raw material to users in industrial areas.

The oil shale utility development of Mae Sot Basin needs further study, considering Estonia as a model.

Acknowledgements

This article is a part of the project *"Technology and Utility Development of Mae Sot Basin Oil Shale Source"*, funded by the Department of Fundamental and Mining Enterprise, Ministry of Industry.

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Supichai Tangjaitrong, Ph.D.

CU Industrial Linkage

Partners in progress

Supichai Tangjaitrong, Ph.D., (director of Industry Collaboration Office, Chula Unisearch, Chulalongkorn University) is a former member of Thailand Energy Regulatory Commission, with extensive experience in natural resources, environment and system management. His current role is to coordinate academic collaboration between the university and the private sector.

We first asked Dr. Supichai to explain the project's origins.

"...we found that Chulalongkorn University has the body of knowledge relating to production and industrial business in every aspect..."

"I looked around at all the marvelous works being done at Chulalongkorn University. They came in from all kinds of fields, especially in engineering, production processes and management. The university has a broad spectrum of specialized knowledge and innovative measures that can help the industrial sector either in a form of consultation or specific research to improve the quality of existing products and services, or even to create new ones."

"But I realized that although we have invested a great deal in research facilities that can produce a large number of graduates, we had, so far, not fully utilized or focused these assets to benefit the industrial sector. That is because we have never prioritized cooperative research with industry."

"It's quite understandable that industries want a quick return on investment, so it is more preferable to buy either know-how, software, processes, or even a whole production line from overseas. Thai industries must rely on specialized technical expertise from aboard, and many also are vulnerable to the demands of markets regulated by foreign countries. However, the dramatically increasing of energy and production costs in Thailand as well as the emerging of industrial capacities in our neighbor countries over the last decade push our industries to realize that being depending on off-the-shelf manufacturing and processes will definitely make them lose their competitiveness and prone to fall behind. Emphasis on R&D will be crucial to the industries if they want to expand in the market that demand more knowledge-intensive products. Only those who can adapt and re-tool quickly to new market realities can survive in the current market atmosphere. This is where Chulalongkorn University can help industry."

The importance of channeling research to the industrial sector

"...to create the collaboration between Chulalongkorn University and the industrial sector and use the know-how from research for commercial purposes..."

"R&D is vital to industry in so many ways. It is our principle to ensure that in selecting and designing research projects, we listen to what industry wants and ensure it really does satisfy industry needs, whether it is an improving of existing products or services, creating new production processes or products. R&D for the industries can create from a science and technology aspect, a management or marketing concepts, or the combination of many knowledge disciplines. This is the essence of our collaboration."

"Much of this applied research necessarily requires fairly short time horizons, as industry always wants answers fast. We must however not neglect pure research, or longer-term studies where commercial applications are not just around the corner. This kind of research is important in acquiring a deeper technological understanding that may become commercially relevant in a future that brings new and unpredictable challenges. We need knowledge to get prepared to deal with market changes. Moreover, the industries must prepare to handle several environmental issues such as climate change, natural disasters, population growth, and a smaller adaptation space. That is why knowledge expansion research is so important."

"Therefore, in today's fast-changing world, industry needs know-how from our research more than ever before. The collaboration is therefore an excellent opportunity for Chulalongkorn to harness its collective knowledge to benefit the industrial sector and develop the country. In addition, the collaboration will also give us opportunities to learn a great deal from the pragmatism of industry, and this will crucially help our students stay grounded and practically oriented to solve real-world problems."

What are the benefits to both parties?

"...new body of knowledge is found and extended with which the private sector can make use of in their business..."

"As industries in Thailand realize the importance of R&D, more and more research units are established in the companies. However, depending solely in-house research

unit is not the best solution. Unless a company has unlimited budget to invest on R&D and can recruit enough accomplished scientists and engineers; collaborating with others will always more efficient and cost effective. Good ideas in science and technology are rarely emerge from a single lab, in particular if the labs are forced to produce some products. On the other hand, proficient professors and their energetic graduate students in university labs have a lot more chance to create bright ideas that could lead to a better solutions for the industry. That is why all the major global innovative companies make a close research connection with universities"

"The collaboration, of course, brings a feeling of mutual ownership and shared goals. We invest the time and expertise of our researchers, our know-how and resources, while the private sector invests their manpower, tools, facilities, and research funding. The collaboration is therefore highly synergistic and a platform for collaborate parties to learn and to share experiences.."

"While industry benefits commercially from the highly targeted research we conduct on their behalf, the University benefits from industry's investment in research resources, tools, and equipment"

What are your plans for the future?

"...For the first two years, we plan to work with large industry sectors which are key engines of national industrial development..."

"Right now we are exploring existing industries such as chemicals, textiles, automotive, electronics, medical, sports, agriculture, and environmental management. This seems to be a board spectrum of industries, however, they reflect research resources and knowledge domain of the unveristy, However, we will focus on our research competency that will help industry developing new products and processes. As well as undertaking research and project planning on behalf of our industry partners, the university will improve our own internal research management processes to increase efficiency; we'll also revise our rules covering research support system in order to be more flexible and create smoother linkages to share knowledge. For example, integrating of internal research databases will provide real-time management information on utilization of university resources in order to ensure we are really optimizing their potentials."

"We have had a number of very constructive discussions with several companies. Most of them have already agreed to work together with us on this venture once resources, budgets, and organizational matters have been decided. It's a great start."

How can interested private sector companies get involved?

"...if you are interested and ready to link with new knowledge, Chulalongkorn University is willing to share the experience..."

"We are willing to talk with companies that are interested and ready to link with new knowledge. They only need to call us at the Industry Collaboration Office. Then we will arrange for one or a series of meeting between the company's delegates and the Chulalongkorn members, so that expected goals, needs, and collaborating possibilities are mutually understand. After that, a plan on how we might work together could be drafted. The collaborative level may vary from simply a problem oriented project to a strategic research unit depending on how to achieve the research goal."

"I am certain that the private sector will see great benefits from this collaboration opportunity, which will help contributing to the success in developing their long term business growth."

Supichai Tangjaitrong, Ph.D.,

earned a Bachelor of Science and Master of Science in Physics from Chulalongkorn University, a Master of Engineering Science in System Engineering degree from James Cook University, Australia, and a Ph.D. in Geographical Science from the Australian National University, Australia.

Achievement/work experience:

- Member of the Energy Regulatory Commission
- Deputy Director of Environmental Research Institute, Chulalongkorn University
- Assistant Professor at the Faculty of Science, Chulalongkorn University
- Member of Specialized Investigation Commission for the Petroleum Exploration and/or Production Project Environmental Impact Analysis Report (2006 – 2008)
- Committee member on Science and Technology and Committee member on Economic, Technology, and International Trade, Parliament (2001 – 2006)
- Head of Department of Marine Science, Faculty of Science, Chulalongkorn University (2000 – 2004)
- Deputy Dean (Information Technology Management) Faculty of Science, Chulalongkorn University (1997 – 2000)
- Previous researches and responsibilities include of Environmental Impact Analysis of the Nam Ngiep Dam Development in Lao PDR (project director); Environmental Impact Analysis of the Hat Gyi Dam Development in Myanmar (change of downstream riverine aspect); Marine Environmental Risk Assessment of the Mabta Phut coastal sea in Rayong Province (project director).

"Around us"

Assoc. Prof. Thavivongse Sriburi, Ph.D.

Industrial Development and Environmental Management

Thailand's industrial sector has undergone rapid development as successive governments have prioritized it under each national development plan with a vision view to transform the country into a key industrial hub in Asia. However, such a rapid pace of development has come at a price, with environmental impacts as a major and growing concern. Unfortunately, with weak regulation and enforcement, the negative industrial impacts on environment and local communities have been hard to control. Today, studies show increasing incidence of chronic health problems among communities living in the vicinity of industrial operations.

For decades, as the government promotes industrial development, efforts have been made to establish industrial zones or parks to avoid proximity to residential areas and increase competitiveness through clustering. However, industrial parks owned by both public and private sectors have been criticized for inefficient management and ineffective emergency responses. Industrial parks have brought a variety of problems including congested traffic, polluted air and waterways, illegal dumping of hazardous wastes and odours. The government's efforts to address such challenges continue to be hampered by limited human and financial resources together with ineffective regulations and poor enforcement. Factories are able to exploit legal loopholes with impunity, avoiding their statutory and social responsibilities and exacerbating the burden on local communities and the environment.

Industrial development in Thailand began with labour-intensive enterprises such as food processing and other agro-industries, and textiles. Technological advances have since taken Thailand's industrial sector along an increasingly high-tech trajectory, using technologies that are largely imported and producing products such as computer devices and automotive parts, destined mostly for lucrative export markets. Exports have generated a great deal of foreign exchange earnings for the country and are a major pillar of national GDP. In the meantime, efforts continue to promote medium and small scale industries to reduce dependence of the sector on developed countries. Use of domestically-sourced raw materials is also promoted to minimize the risks of foreign reliance and maintain self-sufficiency.

But with industries of all types and sizes proliferating across the country, it is hardly possible for state officials to exercise effective control. There are numerous cases where factories have caused chronic health problems to local residents and irreversibly damaged land and water ecosystems, regardless of all applicable regulatory controls. The 'Polluter Pays' principle would hardly seem to apply to Thailand, and society pays the full price of negative externalities (e.g.

the health costs of pollution) generated by industrial operations.

An example is offered in the area of environmental impact control and prevention. According to the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992) sections 46-51, planned industrial operations of specified types and size are required to conduct an environmental impact assessment (EIA). For each industrial type and size, governmental agencies have endeavored to compile guidelines for EIA reporting under this law, but have encountered conflicts from the outset. First, the

EIA is information-intensive; environmental assessment requires intensive efforts and technical expertise in multiple fields. This requirement stands in the way of business operators who see the EIA process as an obstacle and want the EIA report to be completed as soon as possible. Second, EIA reports must include proposed measures for environmental impact mitigation and monitoring both during construction and operational phases following commission. However, even after approval of an EIA, many businesses do not follow the mitigation procedures and measures promised, resulting in accidents and deaths, nuisance and health impacts to workers and residents, pollution and improper handling and disposal of hazardous wastes. Such potential impacts have been often identified as risks in EIA reports, and become a reality through negligence or greed. Residents living close to industrial zones are frequently affected and live in a climate of fear. The result is an erosion of public confidence in EIA reports, which potentially should serve as an important tool to ensure responsible, safe and sustainable operation of industrial activities.

With the erosion of public acceptance of EIA reports conducted under the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992), other measures are being sought to address the issue. For example, relevant agencies have listed the types of business that could cause severe health impacts, and developed a new guideline- the Health Impact Assessment (HIA). The HIA was devised as a comprehensive analysis of potential health impacts of proposed industrial operations. Large industries in the future, including those under development today, are required to follow the methods and measures stipulated under HIA. However (and as with EIA), efforts to comply with this new guideline inevitably delays project completion and increases the cost to the business operator.

The government also plans to implement a second assessment tool referred to as the Strategic Environmental Assessment (SEA), to assist in approval decisions for large-scale industrial projects. For example, a project covering a large area such as a water resource development project will require assessment under the criteria of SEA, to quantify potential impacts on the entire watershed or river basin. Similarly, a railway project that passes through many provinces would also require assessment. The SEA is designed as an in-depth evaluation of all relevant factors including economic, social, health, and environmental aspects. The guideline requires large project to be first assessed according to SEA in order to point out which activities should be further evaluated

via EIA and/or HIA reports. The law stipulates that SEA shall be conducted with the full participation of, and consultation with, local residents and other stakeholders. (Stakeholder and community participation is typically cited by communities as an area that is ignored or given only nominal attention in conducting EIAs).

SEA will have a direct role in and impact on many types and sizes of industries. Ensuring public participation from the outset enables affected communities to understand the implications and impacts of proposed projects, and empower them to make informed and balanced decisions on whether to accept or reject the development, what mitigating measures would be needed, as well as reasons for relocating the project. The requirement for SEA of large projects provides government with important and impartial evidence and projected future scenarios. The SEA report may then provide the government with grounds to require an EIA for individual sub-projects; more importantly, such EIAs will be conducted once public acceptance for the project has been gained.

When SEA is successful and gains public confidence, the project owner or business operator is required to abide by the conditions specified in the SEA report, and must also begin work on EIA for the project as agreed upon. The EIA report must specify in details proposed measures for preventing and mitigating potential environmental impacts identified during the EIA, as well as the means for ongoing impact monitoring during construction and operational phases. In order to complete an EIA report, the project owner or business operator is required to strictly follow the recommendations or advice provided by related agencies, and public participation in this process is a legal requirement.

It can be concluded that in the past EIA was implemented for specific projects. When many projects were launched in the same area, the potential cumulative impacts were never assessed. SEA addresses this by covering the activity at a larger and more comprehensive scale, including impacts on physical resources, ecosystems, public health as well as economic, social, and environmental impacts. Public participation is a key pillar of SEA. On completion of the SEA, the conditions accepted by the public are specified. For example, individual projects or activities in the locality may be required to undergo an EIA. In particular, the project owner and business operator are required under the SEA to complete a comprehensive checklist in order to fulfill the environmental management system.

Although SEA has yet to be enacted as a law, when EIA is still questioned by the public, in the meantime, government agencies have to perform a preliminary SEA in order that the public can accept the project in principle, and later follow up with an EIA for specific projects or activities.

Project

Using Biochar for Soil Ameli
for Food Security and Sustain

Unisearch has been granted a research fund under the technology transfer theme for a project: *"Using Biochar for Soil Amelioration and Increasing Crop Yield for Food Security and Sustainable Agriculture"*, as part of a broader Knowledge Management and Technology Transfer Programme - Research and Innovation 2014.

Thailand is a predominantly agricultural country, with over 40% of the population dependent on agriculture. Rural incomes are very low and many survive in conditions close to poverty. The government's poverty alleviation efforts have largely failed to improve living conditions and livelihoods for the poor and vulnerable. Since technology can offer farmers new choices and opportunities to improve productivity and incomes, it is necessary to introduce and promote these technologies in a way that is adapted to local conditions, and that also makes use of traditional local wisdom. This project aims to provide such avenues to transfer appropriate technologies and ensure acceptance and adoption by local communities. It is crucial that such technologies should be easy to understand and adapt for practical use.

In rural areas, key factors contributing to poverty are high production costs, low quality of produce, poor soil fertility and lack of reliable water sources. Heavy use of fertilizers and pesticides have increased production costs and led to indebtedness and environmental problems, including chemical residues in soils, as well as impacts on health, biodiversity and quality of life.

Therefore, HM King Bhumibol has advocated a new theory on land and water management in order to mitigate this problem. The theory aims to improve living standards for rural people by encouraging them to be more self-reliant and use fewer agrochemicals on the farm. It also aims to maintain productivity while sustainably conserving natural resources and food sources for humans as a form of natural capital for sustainable development in the long term.

Since 2011, the Huay Sai Royal Development Study Center and the Pa Deng Biochar Research Center (PdBRC) in Petchaburi, Thailand have conducted research into the use of biochar for soil amelioration and

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nable Agriculture Proposes

Assoc. Prof. Thavivongse Sriburi, Ph.D. and Saowanee Wijitkosum, Ph.D.

increased crop yields. The results so far indicate that biochar could significantly improve soil quality and increase crop yields for field crops, horticultural crops, vegetables and rice. In our most recent research, we have developed a biochar retort known as the Controlled Temperature Biochar Retort for Slow Pyrolysis Process (Patent). The retort is cost-efficient, can be built easily using locally available materials and produces biochar of the required quality and characteristics. The research has generated a database that will contribute to dissemination of knowledge to local communities, and encourages the use of research-based strategies for national development.


Saowanee Wijitkosum, Ph.D.

The project *"Using Biochar for Soil Amelioration and Increasing Crop Yield for Food Security and Sustainable Agriculture Proposes"* operates by transferring knowledge and technology through community-level workshops for farmers, staff and officers of public agencies, local administration officers and community leaders. The workshops aim to transfer technology that is appropriate to the locality. The Controlled Temperature Biochar Retort for Slow Pyrolysis Process is easy to replicate and convenient for local use. The participants are to be trained both in theory and practice of biochar production and use. The training includes producing biochar from crop residues and incorporating the biochar into the soil, in order to improve soil quality and crop yields. The workshops adopt the concepts of knowledge management and capacity building to build on existing knowledge and develop models to transfer the knowledge and technology to local communities. This research aims to contribute towards the goals of sustainable agriculture and food security, beginning in a small area, with the ultimate goal to replicate and expand the programme in other areas throughout the country.

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Activities News

Brainstorming: Establishing Chula's Research Clusters Framework




Unisearch recently held a brainstorming conference to establish a framework for the Chula Research Clusters for 2015. Held under the theme of ***"Research towards Prosperity and Sustainability of the Nation"***, the event took place on 16-17 May 2014 at Baan Amphawa Resort and Spa, Amphawa, Samut Songkram. The event was attended by Prof. Vichai Boonsaeng, Ph.D., Director of the National Research Universities (NRU), Office of Higher Education Commission; Prof. Vichai shared with participants the guidelines for NRU budget management for 2015. Senior Chulalongkorn University executives attending the conference included Prof. Mongkol Techakumphu, DVM, Ph.D., Chulalongkorn University Vice President Research and Innovation and President of Chula's Research Clusters; Prof. Kua Wongboonsin, Ph.D., Project Adviser; Assoc. Prof. Amorn Petsom, Ph.D., Chairman of Chula's Research Clusters; Assoc. Prof. Buncha Pulpoka, Ph.D., Assistant to the President's Office, Chulalongkorn University and Assoc. Prof. Kris Angkanaporn, DVM, Ph.D., Assistant to the President's Office.

The presidents of all 8 Chula Research Clusters also participated, namely: Prof. Anan Srikiatkhachorn, M.D., President of the Health Cluster; Prof. Somsak Panha, Ph.D., President of the Food and Water cluster; Assoc. Prof. Polkit Sangvanich, Ph.D., President of the Advanced Materials cluster; Prof. Tharapong Vitidsant, Ph.D., President of the Energy Cluster; Asst. Prof. Chakkaphan Sutthirat, Ph.D., President of the Climate Change and Disaster Management Cluster; Assoc. Prof. Ratana Somrongthong, Ph.D., represented the Aging Society cluster; Assoc. Prof. Vithaya Kulsomboon, Ph.D., President of the Human Security cluster and Assoc. Prof. Sunait Chutintaranond, Ph.D., President of the ASEAN Studies Cluster. Managing executives from Chula Unisearch also participated in the conference; including, Assoc. Prof. Thavivongse Sriburi, Ph.D., Managing Director; Assoc. Prof. Voranop Viyakarn, Ph.D., Deputy Director and Saowanee Wijitkosum, Ph.D., Deputy Director. The conference was successfully concluded according to its objectives, resulting in agreement on goals and a framework of Chula Research Clusters, which will contribute towards the continuing wealth and sustainability of the nation.

Chula – PTTGC: Guidelines for University-Industry Research Collaboration towards Predetermined Goals

Chulalongkorn University and PTT Global Chemical Public Company Limited (PTTGC) held a joint workshop on ***"Guidelines for University-Industry Research Collaboration towards Predetermined Goals"*** to enhance research collaboration in key fields. The workshop was held on 2-3 June 2014 at the Trio Hotel, Pattaya. Participants from PTTGC included Mr. Athavudhi Hirunburana, Chief Operating Officer, Down Stream Petrochemical Business; Sukhgij Ysothonsreekul, Ph.D., Vice President of the Scientific Research Division and Jittiporn Kruenate, Ph.D., Manager of the Product and Process Development Division. Representatives from Chulalongkorn University included Prof. Mongkol Techakumphu, DVM, Ph.D., Chulalongkorn University Vice President Research and Innovation; Assoc. Prof. Pintip Pongpetch, Ph.D., Chairman of the University-Industry Collaboration Project; Assoc. Prof. Amorn Petsom, Ph.D., Chairman of Chula's Research Clusters and Assoc. Prof. Bancha Pulpoka, Ph.D., Assistant to the President's Office, Chulalongkorn University. Professors and lecturers from various faculties and institutions within Chulalongkorn University also participated as follows: Asst. Prof. Pomthong Malakul Na Ayudhaya, Ph.D., Dean of the Petroleum and Petrochemical College; Prof. Suttichai Assabumrungrat, Ph.D., Deputy Dean, Faculty of Engineering; Asst. Prof. Duanghathai Pentrakoon, Ph.D., Acting Director, Chulalongkorn University Intellectual Property Institute; Assoc. Prof. Thavivongse Sriburi, Ph.D., Managing Director, Chula Unisearch and Supichai Tangjaitrong, Ph.D., Director of Industry Collaboration Office, Chula Unisearch.

This workshop gave an opportunity to lecturers and leading researchers of CU to meet and converse with experts and leading researchers from PTTGC in order to illustrate CU's research potential, results and advancement. Delegates also visited the PTT Global Chemical Science and Innovation Center.

During the workshop, representatives from CU and PTTGC exchanged ideas to establish guidelines for a sustainable research collaboration as well as ideas for PTTGC researchers' product development. The University-Industry Research Collaboration is part of CU's proactive research strategy which aims to link research to benefit industry, and fast-track commercial development.

Opening Ceremony for the 3rd "Bhumipalang Phandin" for Chief Executives






Prof. Pirom Kamolratanakul, M.D., President of Chulalongkorn University, presided over the opening ceremony of ***the 3rd "Bhumipalang Phandin" Chulalongkorn University Executive Program (BPP)*** on Tuesday 17 June 2014 at Maha Chulalongkorn building, Chulalongkorn University. Prof. Pirom was also a special lecturer on the subject of ***"Chulalongkorn University and Bhumipalang Phandin"***. In this occasion, former participants of BPP; including Mr. Chuan Leekpai, Khunying Sudarat Keyuraphan, Mr. Sittichai Khowsurat and Khunying Natthika Wattanavekin Angubolkul, were also presented at the ceremony and gave a warm welcome to the current generation.

Unisearch was assigned by Chulalongkorn University to organize the ***"Bhumipalang Phandin" Chulalongkorn University Executive Program (BPP)*** from the 1st generation to this 3rd generation. The aims of this program are to create a space to enhance collaboration among experts from various fields and strengthen their expertise to benefit the Kingdom, lay a foundation and raise awareness of the importance to maintain major institutions of the Kingdom. The core of the program is to emphasize His Majesty's royal wish and royal duty and his tireless effort for the wellbeing of the Kingdom and the people. The program aims to support His Majesty's success towards the country's continuous development, prosperity and security. The King's royal duty should be set as a best practice and an example for those who are able to make a change. The program also aims to create a strong network among chief executives, which will lead to collaboration for the advancement of the country.

A discussion-based approach will be implemented as the main teaching method. Lectures, discussions, seminars, debates and brainstorming will be integrated into the curriculum for all subjects. The program also includes study trips within the country and writing an independent study (IS). The IS will allow participants to study, analyze, synthesize and develop a proposed policy and strategy for various sectors related to the advancement of the country. The program comprises a total study time of 100 hours. BPP is held each Tuesday from 17 June 2014 to 16 December 2014 from 13.30-18.00 hours at the Maha Chulalongkorn Building, Chulalongkorn University.

Opening Ceremony for the Workshop: "Using Biochar to Increase Yield and Improve Soil Quality"

Unisearch has been granted a research fund from the National Research Council of Thailand under the technology transfer theme for a project: ***"Using Biochar for Soil Amelioration and Increasing Crop Yield for Food Security and Sustainable Agriculture"***. The first ***"Using Biochar to Increase Yield and Improve Soil Quality"*** workshop was held at the Huay Sai Royal Development Study Center, Petchaburi on 8 July 2014. Participants were staff of the Huay Sai Royal Development Study Center, staff from other local sectors, and local farmers. Pol. Lt. Gen Chamroen Kanthahong, Deputy Director of the Huay Sai Royal Development Study Center, presided over the opening ceremony.

The workshop aimed to transfer research-based knowledge to local communities, to improve their quality of life, and to encourage adoption of sustainable agriculture techniques. Participants were trained on how to use biochar as a soil amendment and boost crop yields. The workshop also provided an avenue to transfer appropriate technology for producing biochar to participants from Kaeng Krachan and Cha-Am districts, Petchaburi. Participants gained first-hand experience in producing biochar, and applying the material to agricultural land.

The workshop is an eight-month program from June 2014 to February 2015, targeting a total of 70 participants. Recently, **Unisearch** organized three workshops for government officers from local government offices, officers from Local Administration in the areas, and farmers. Currently, Unisearch researchers are visiting local farmers interested in applying biochar on their farms.

The 3rd Thailand National Research Universities Summit (NRU SUMMIT III)

The Higher Education Research Promotion (HERP) and National Research Universities (NRU), under the management of Office of the Higher Education Commission (OHEC) held the **3rd Thailand National Research Universities Summit (NRU SUMMIT III): Prelude to World Class University** on 31 July – 1 August, 2014 at the Bangkok Convention Centre, 22nd Floor, Centara Grand Central World Hotel, Bangkok, Thailand. Assoc. Prof. Kamjorn Tatiyakavee, M.D., Secretary-General of OHEC presided over the summit. Participants were directors of NRU universities.

The Higher Education Research Promotion (HERP) and National Research Universities (NRU), under the management of Office of the Higher Education Commission (OHEC) has held the Thailand National Research Universities Summit (NRU SUMMIT) for three consecutive years and **Unisearch** has been appointed to organize the summit ever since. The summit aimed to showcase the potential and development of research and innovation through collaboration, reflecting the preparedness of Thailand's research community and institutions for ASEAN integration and global competition.

The NRU III summit gathered and showcased researches from top researchers from 9 leading universities in Thailand: Chulalongkorn, Mahidol, Kasetsart, Thammasat, Chiang Mai, Khon Khaen, Prince of Songkla, King Mongkut's University of Technology Thonburi, and Suranaree University of Technology. The research areas focused on topics that could be utilized by both industry and the social sector to improve the country's regional and global competitiveness.

The summit comprised several activities including a research symposium, a critical inquiry on *"National Universities to Global Universities"* and special seminars on the topics of *"Thailand's Word Class Research and Global Benefit"*, *"9 NRUs: Good Practices for Success"* and *"Research for Excellence Guidelines: Paving ways to World Class University"*. Academic exhibitions and research presentation posters were also exhibited. The summit attracted more than 1,500 visitors per day.

MOU Signing Ceremony of joint research and development between Chulalongkorn University and Betagro Group

On 4 August, 2014, at the lobby on the 2nd floor of Chamchuri Building 2, Prof. Pirom Kamolratanakul, M.D., President of Chulalongkorn University and Mr. Vanus Taepaisitphongse, Chief Executive Officer of Betagro Public Company Limited signed a Memorandum of Understanding (MOU) on joint research and development. The signing ceremony was witnessed by Prof. Mongkol Techakumphu, DVM, Ph.D., Chulalongkorn University Vice President Research and Innovation; Assoc. Prof. Thavivongse Sriburi, Ph.D., Managing Director of Chula Unisearch, Supichai Tangjaitrong, Ph.D., Director of Industry Collaboration Office, and Mr. Vasit Taepaisitphongse, President committee of Betagro Group. The two parties discussed in detail about their joint research and development projects such as development of Entogenous Vaccine for *E. coli* and anaesthetic for fish, a project of Faculty of Veterinary Science, Chulalongkorn University and Betagro Group.

Chulalongkorn University and Betagro group will work together in joint research and development projects for 5 years, starting of the day of the signing ceremony. The purpose of this agreement is for co-operation in research and development and exchange of information, personnel, and researchers. The agreement also aim to contribute the society in form of researches, internship, multidisciplinary study, projects in undergraduate and postgraduate levels, and excellence in academic matters, technology, innovation for enterprises. The agreement included CSR concerning social and environmental issues.

Unisearch is an information center service within Chulalongkorn University. It will serve as a center of the joint research and development projects.

Bureau of Academic Support and Service, KMITL Visited Unisearch

On 2 May 2014, Assoc. Prof. Voranop Viyakarn, Ph.D., Deputy Director of Chula Unisearch welcomed Mr. Teerayudh Buranabhithaksantee, Director of Bureau of Academic Support and Service (BASS), King Mongkut's Institute of Technology Ladkrabang along with the staff of BASS. The BASS's director and staff paid a visit to observe and learn about how **Unisearch** offers academic services and assists with research projects for its clients. BASS would adapt the knowledge to strengthen its services in the future.

Training on "Power Up Your Positive Mind"

Unisearch held a training on ***"Power Up Your Positive Mind"*** for 50 Unisearch Staff on Friday 2 May 2014 at Meeting Room 201, Chulalongkorn University Research Building. Asst. Prof. Nipa Keosringam, Ph.D., was the honorable lecturer. The training aimed to enhance knowledge and understanding of the benefits of positive thinking through various case studies and examples that could be adapted for practical use. The training also helped enhance positive thinking skills through group activities and inspirational discussions. Such activities were specially designed to inspire and influence participants to shift their mindset to be more *"positive"* towards themselves and others. The positive mindset could bring more happiness to the participants for work and everyday life.

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