ASEIC

Eco-Innovation Consulting Project in Philippines

Final Report

2016

ASEM SMEs Eco-Innovation Center

Small and Medium Business Administration

ASEM SMEs Eco-Innovation Center

Executive Summary

Overview

In line with a global paradigm shift in the industrial environment, climate issues and the survival of business are currently becoming more crucial than ever. Maintaining and managing competitive production costs are becoming important for business due to rising natural resource and energy prices. Against this backdrop, SMEs in the Philippines are quite vulnerable in terms of tighter regulation and rising production cost and Eco-Innovation can be considered as an opportunity. This project sets consulting goals on System, Process, Product and Business based on categorization by purpose, and carry out Eco-Innovation for SMEs in the Philippines to build bases for participating companies to adapt to environmental challenges. Through this project, ASEIC hopes to lay the foundation for SMEs' strengthened capacity for Eco-Innovation in the Philippines as well as other ASEM Member States.

Final Results

The ASEIC Consulting Team encouraged the participating companies to enforce green management system through Eco-Innovation Consulting. In particular, the ASEIC Consulting Team was able to help them strengthen their green competitiveness as part of effort to respond to tighter environmental regulations in various areas; reduction of energy consumption, raw material waste management in each production process, environmentally-friendly product design, and green marketing.

• Quantitative Results

In total, 69 solutions were proposed through the 2016 Eco-Innovation Consulting Project. The potential economic benefits of these solutions are estimated to be KRW 201,370,000 (PHP 8,631,399) per year. In addition, the solutions' environmental benefit was calculated to be 283.77 tCO_2/year, which has same effect as planting 42,995 thirty-year-old pine trees.

• Qualitative Results

The ASEIC Consulting Team conducted assessments on the participating companies' environmental management as well as their process and energy efficiency. The ASEIC

Consulting Team reinforced the companies' internal capacities through education on environmental management in order to improve their Eco-Innovation related perspectives. The ASEIC Consulting Team also developed separate consulting manuals to give the participating companies chances to continue green management. Furthermore, the participating companies were able to complete Eco-Innovation in the process and energy management area through discovered solutions applicable to their work sites.

Partnerships

The Philippine Department of Trade and Industry (DTI) performs various policies for the local SMEs to make invigorate them. The Philippine Department of Environment and Natural Resources (DENR) is a governmental agency in charge of all national environmental initiatives. 2016 Eco-Innovation Consulting Project was conducted based on the organic cooperation between DTI, DENR and ASEIC.

The partners agreed on follow-up measures to continuously manage the problems and solutions for each participating company identified by the ASEIC Consulting Team. It provided information necessary for solution implementations, and a foundation to seek for mutual benefits between Korean and Philippine companies. Furthermore, the ASEIC Consulting Team encouraged participation of the other companies in the same field with the success stories of participating companies in order to increase the ripple effect of the results of Eco-Innovation Consulting Project.

Finally, the ASEIC Consulting Team sought to encourage the Philippine government to be interested in the project, so it can acknowledge the necessity for Eco-Innovation Consulting Project, apply and perform Eco-Innovation voluntarily.

Other Remarks

According to the survey with the participating companies, the satisfaction rate about the project was 92%, and the satisfaction rate about the solutions was 92%. Through participating in the project, the awareness rate about the Eco-Innovation was shown to have improved by the average of 22.8%. Among the individual categories, the awareness on technology showed the highest improvement rate of 41.2%. This shows that the Philippines has a high demand for technologies of Eco-Innovation. The Philippine SMEs requested the ASEIC Consulting Team to extend the consulting period for 1 or 2 more years. This will continue the monitoring of the companies to encourage them to carry out the solutions, therefore contribute to improve the awareness on Eco-Innovation as well.

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01 Project Background

1.1 Definition of Eco-Innovation

1.1.1 Background of Eco-Innovation

Sustainable Development General Goals (SDGs) are the common goals for all nations from 2016 to 2030. Following Millennium Development Goals (MDGs), they set antipoverty MDGs aimed for as the top priority, but they also aim to alleviate global common threats for all nations, such as polarization of economy and society, intensification of various social inequalities, and environmental destruction, that can threaten continuous developments.

Open Working Group suggested 17 SDGs. These are differentiated from the existing MDGs, as they are in consideration of overall economy, society and environment areas, such as economic growth and climate change.

Major advanced countries, such as EU, the U.S. and Japan are reinforcing environmental regulations every day aiming for cleaner production and building economic system with resource recycling. They are also taking actions to improve environmental characteristics of their products. This applies not only to large enterprises, but also to SMEs, thus they are expected to be gradually exposed to increased costs and regulatory risks from environmental regulations as time goes on.

The large enterprises are responding to the green paradigm, which emphasizes on sustainability of industries by adapting green management system, cleaner production and green technology. However, the SMEs relatively lack human resources, information and etc. compared to large enterprises, thus they cannot actively respond to the green paradigm, such as by adapting environmental management systems.

In order to solve such problems of the SMEs, a green capability reinforcement project, such as ASEM Eco-Innovation Consulting Project for the SMEs, was introduced. Eco-Innovation Consulting Project builds system and processes to reinforce green competitiveness of SMEs, and furthermore, it supports green products and development of green businesses. In particular, the SMEs in developing countries lack information, finance, human resources and etc. needed to build green management system and cleaner production compared to the SMEs in advanced countries, therefore it seems that they are in dire need for the support from Eco-Innovation Consulting Project.

1.1.2 Basic Concept and Development of Eco-Innovation

According to the European Commission (EC), the definition of Eco-Innovation is "all types of innovations that seek for provable developments, aiming for sustainable developments though alleviation of environmental pollution and utilization of resources with responsibilities, which also includes environmental technology, process, system, service and Eco-Innovation that provides environmental effects though it did not mean to."

The Eco-Innovation Observatory (EIO), operated by a three-year plan of EC, also defines Eco-Innovation as "all types of innovations that use natural resources and reduce emissions of harmful materials in daily lives." The definition by EIO is ahead of the existing idea that it is a kind of innovation aimed to reduce negative environmental impacts. Furthermore, such definition includes the means and methods that minimize the use of natural resources during the processes of designing, producing, using, reusing and recycling products and materials.

Meanwhile, according to the definition of the Organization for Economic Cooperation and Development (OECD), Eco-Innovation is differentiated from all of the other innovations for the following reasons: "It results in alleviation of environmental impacts regardless of intention. It also has a wide range that can surpass the traditional structural limits of innovative organizations, therefore accompanies wider range of social agreements that accelerate social-cultural and structural changes."

Eco-Innovation technology reduces or prevents pollutant formation directly from the source; it is any technology that minimizes environmental degradation occurring over the entire product life cycle, from the extraction of raw materials through the manufacturing and consumption of products to their disposal, either by recycling or returning them to nature.

It not only includes production technologies that reduce or prevent pollutant formation directly from the source, but also those that provide further management. This can include recycling or conserving materials and energy used in the production process, substituting raw materials with eco-friendly ones, designing processes and improving operation to minimize pollutant formation during production, and better utilizing raw materials to reduce losses.

The concept of Eco-Innovation can be applied to any industry or product. Cleaner production removes or reduces all emissions and wastes in the production process by conserving raw material, water, and energy and eliminating toxic or hazardous materials. While there are many ways to mitigate impact on the environment, safety, and health throughout the entire process, there are three critical factors in realizing Eco-Innovation: change in mindset, utilization of expertise, and advancement of technology.

* Change in Attitude: seeking for new ways to approach between industry and environment.
* Expertise: expertise on improving efficiency, changing internal management practices, modifying policies, procedures, and systems, etc.

1.2 Promotion of Eco-Innovation

| Figure 1 | Promotion of Eco-Innovation

One of the main roles of ASEIC, which was established to promote eco-friendliness and low-carbon green growth among ASEM members in Europe and Asia, will be to leverage ROK's strong Eco-Innovation capabilities to promote Eco-Innovative practices in other Asian ASEM member states. Since many developing countries are not aware of Eco-Innovation, have not yet recognized the need for it, or lack the technology for it, they are still experiencing the vicious cycle of serious environmental problems and weakening global competitiveness.

Eco-Innovation should be a tool, not for competition, but for sharing technology and experience among companies and countries in an effort to solve global environmental issues together. It is therefore essential to promote best practices (success stories) of Eco-Innovation and cleaner production technologies with countries that have limited access to them through close cooperation with their governments.

Accordingly, the 2016 Eco-Innovation Consulting Project worked with the government and other relevant organizations of the Philippines to lay the foundation for promoting the idea of Eco-Innovation and building local competencies.

02 Consulting Methodology

2.1 Project Objectives in the Philippines

2.1.1 Objectives of Eco-Innovation Consulting Project in the Philippines

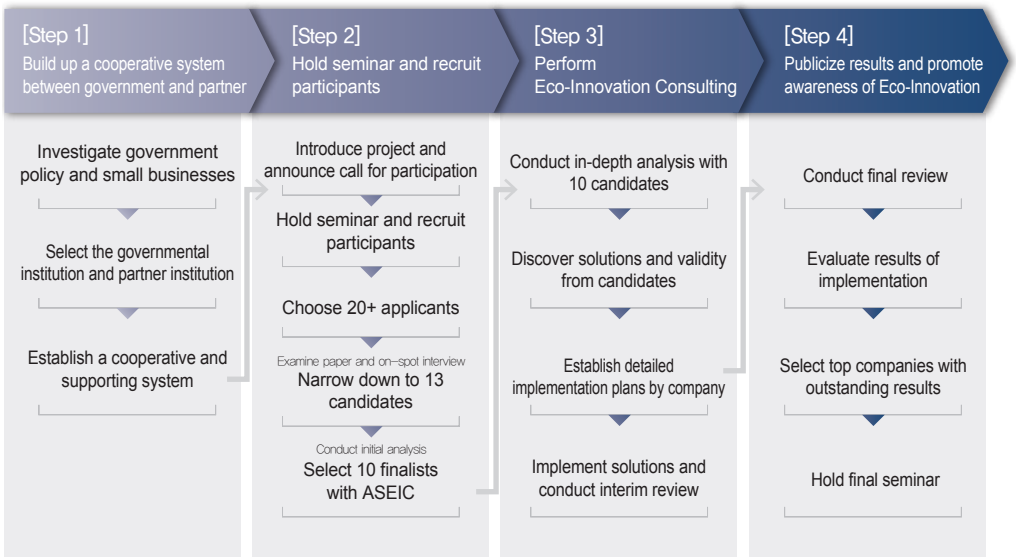
| Table 1 | Objectives of Consulting Project

	Expected Result	Target	Actual	Target-Actual Comparison
Environmental Management Service Improvement	Train professionals	10	10	100%
	Increase participants' awareness of Eco-Innovation	10	10	100%
	Build self-sustaining Eco-Innovation system	1	1	100%
Process Improvement	Efficient use of raw materials	5+ cases	8	160%
	Reduce energy use and greenhouse gas emissions	15+ cases	31	213%
	Reduce environmental emissions	5+ cases	5	100%
	Increase process management efficiency	20+ cases	25	130%
Improvement in Eco-friendly Products	Develop Eco-friendly product items	-	-	
Green Technology Business Opportunity Identification	Develop funding business model	-	1	100%
	Enter new markets	1+ cases	1	100%
Publicity and Promotion	Publicize results	1+ cases	1	100%
	Hold results seminars	1+ cases	1	100%

2.2 Detailed Plans and Methods

2.2.1 Project Delivery Framework

The delivery framework of this 8-month project consisted of four phases: establish partnerships, hold seminars and select companies to participate in the project, perform Eco-Innovation consulting, and promote project results. The first phase was to establish partnerships, and the second phase was to hold seminars and select companies to participate in the project. And the third phase was to carry out Eco-Innovation Consulting, leading the final phase of promoting and distributing success stories.



| Figure 2 | Eco-Innovation Implementation System

STEP 1. Hold Seminar and Recruit Participants

For the Eco-Innovation Consulting Project in the Philippines, a local partnership was established with the Department of Trade and Industry (DTI) and the Department of Environment and Natural Resources (DENR). DTI is in charge of modifying and performing all governmental activities related to trade, industry and investment. It operates various programs at 16 local DTI offices across the nation, including environmental improvement to support SMEs, training for improving productivity, and supporting joint-production facilities ASEIC Consulting Team decided to carry out the Eco-Innovation Consulting Project at DTI IV-A Office, which is in charge of Calabarzon region and the most economically active DTI office.

DENR is in charge of establishing and performing plans on conserving natural environment and preventing environmental pollution. Environmental Management Bureau (EMB) under DENR

operates supporting programs such as on-site monitoring to improve environment of SMEs that cannot follow environmental regulations. Therefore, the ASEIC Consulting Team decided to carry out the Eco-Innovation Project at DENR-EMB as well.

DTI and DENR sent out a call for Philippine SMEs to participate in the Eco-Innovation Consulting Project.

On June 21st, 2016, a workshop was held for Philippine SMEs that showed interest in Eco-Innovation Consulting Project. The workshop covered a range of topics including a project overview, action plan, and success stories.

Greetings from Government Agencies

Introduction on ASEIC

Overview of Consulting Project and Success Stories

Group Photo of Participants

| Figure 3 | Project Workshop

STEP 2. Select Project Participants

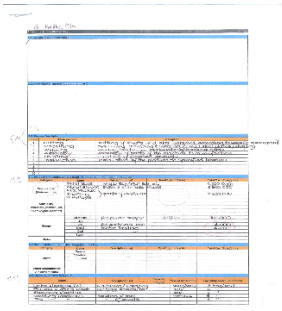
After the workshop, the ASEIC Consulting Team, DTI, and DENR examined the questionnaires that had been handed out to the 18 applicants chosen from an initial screening and agreed on 16 candidates to go on to the next stage.

Then the ASEIC Consulting Team conducted on-site analysis of the 16 candidates to select the final participants. This on-site analysis involved interviews of the candidates based on their questionnaire responses and identified their needs, potential solutions, and possibilities for generating economic and environmental benefits.

The questionnaire was necessary to identify each company's consulting needs in the following 4 areas of Eco-Innovation: eco-friendly management, process, product, and service. The company profile section of the questionnaire asked respondents to describe their company overview, main products, production process, purpose of participation, and prior activities related to Eco-Innovation. The production process section asked respondents to provide information on plant layout, production process flow charts, the use of raw materials and energy, and the amount of waste, wastewater, and air pollutants produced.

| Table 2 | Project Workshop

Worksheet 1	Company profile (e.g. address, industry, sales, number of employees)
Worksheet 1-2	Main products/services
Worksheet 2-1	Plant layout
Worksheet 2-2	Product process flow chart
Worksheet 2-3	Process description
Worksheet 2-4	Input data (e.g. raw materials, energy)
Worksheet 2-5	Output data (e.g. wastewater, waste, air pollutant emissions)
Worksheet 2-6	Main plant facilities and equipment



<Sample Questionnaire Response>

Based on the questionnaires answered by the participating companies, the ASEIC Consulting Team created five selection criteria; willingness to participate, understanding of Eco-Innovation Consulting Project, clarity of company demands, possibility of improvement and potentials, and chose the final 10 companies.

Initial Analysis

| Table 3 | Process of Initial Analysis

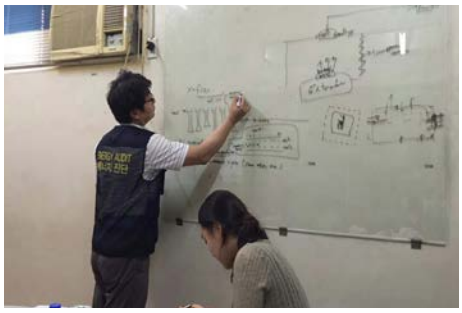
No	Action	Description	Duration
1	Introduce project	Provide overview of Eco-Innovation Project and action plan	10 min
2	Interview staff in charge	Use checklist to identify priority areas of improvement	30 min
3	Visit production plant	Visit production plant and identify solutions	80 min
4	Discuss solutions	Discuss solutions and reach agreement on details	30 min
5	Discuss next steps	Discuss next steps and timeline (specific to each company)	5 min

The purpose of the initial analysis was to determine solutions that comply with the objectives of Eco-Innovation Consulting Project by visiting the production plants and find issues in production process or operating the business. The initial analysis included a project introduction, interviews, site-visits, and discussions on solutions and next steps. When initial analysis took place, the ASEIC Consulting Team visited the participating companies with the energy experts and the production process experts to analyze the energy use and overall status of production process. After the visit, the ASEIC Consulting Team compiled feedback from professional consultants and provided an initial analysis report to participating companies.

Actual Size Measurement of Equipment

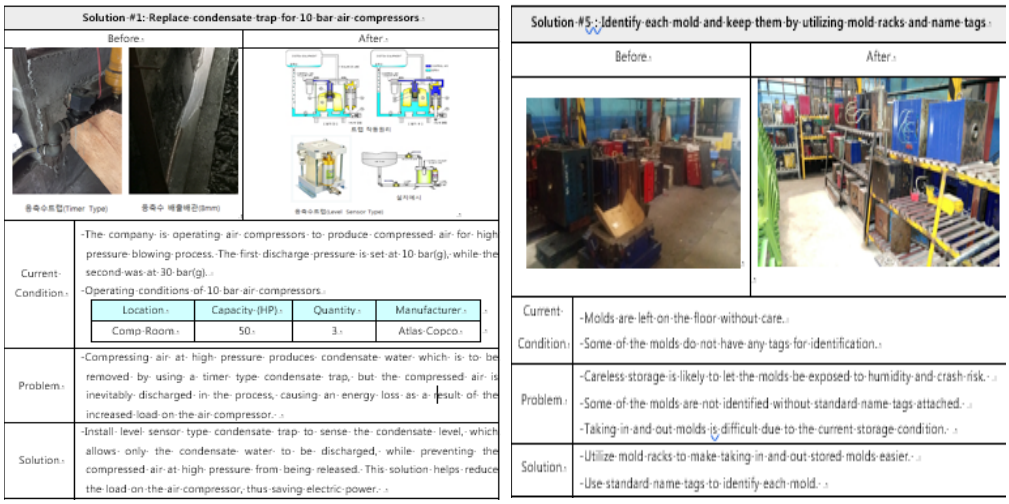
Actual Temperature Measurement of Equipment

Inspection of Production Process



Explanation of Solutions

| Figure 4 | Initial Analysis



| Figure 5 | Sample Initial Analysis Report

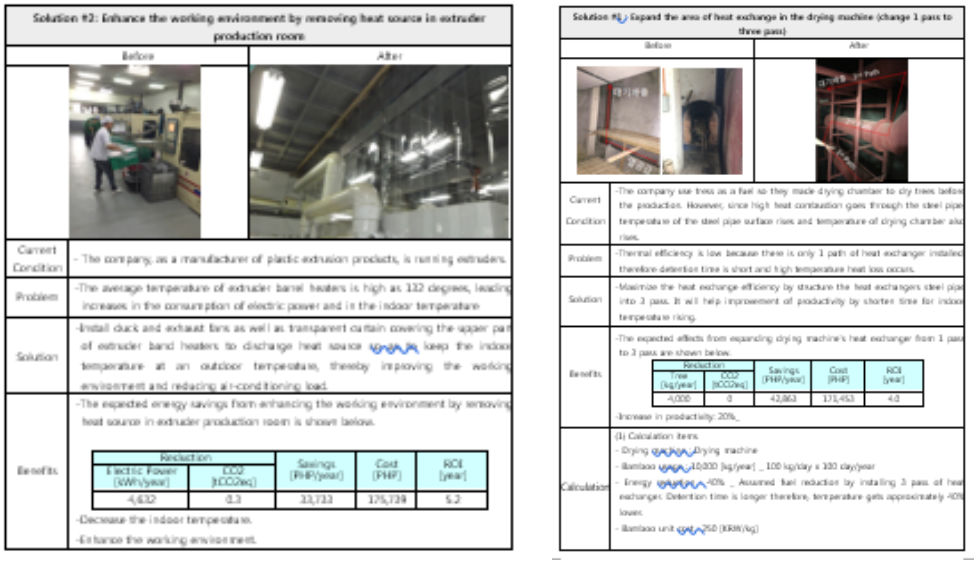
STEP 3. Promoting Eco-Innovation Consulting

In-depth Analysis

| Table 4 | Process of In-depth Analysis

No	Action	Description	Duration
1	Discuss schedule	Discuss schedule for in-depth analysis	5 min
2	Share results of initial analysis	- Share results of initial analysis - Explain main consulting solutions and collect related data	60 min
3	Conduct in-depth analysis	- Conduct on-site analysis and interview staff in charge to help develop solutions - Examine data for in-depth analysis - Discuss feasibility on implementing solutions - Perform environmental management evaluation	200 min
5	Discuss next steps	Set timeline for solution implementation	5 min

The purpose of the in-depth analysis is to make concrete the issues found in initial analysis and develop the solutions, and to finalize the ASEIC Consulting Team's recommendations. To aid the implementation of solutions, the ASEIC Consulting Team analyzed the technical and economic feasibility of solutions, established the necessary detailed plans accordingly, and shared technology deployment case studies and other relevant information.



| Figure 6 | Sample In-depth Analysis Results

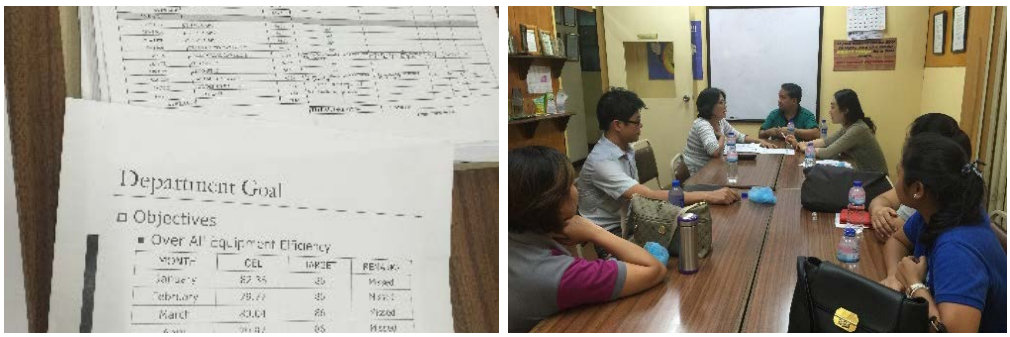
Intermediate Analysis

Intermediate analysis was conducted to check the implementation status of the participating companies and encourage them to carry out the unimplemented solutions. The ASEIC Consulting Team held workshops for each company to check on the reasons why the solutions were not implemented and identify the barriers, as well as discussed on how to make the suggestions applicable.

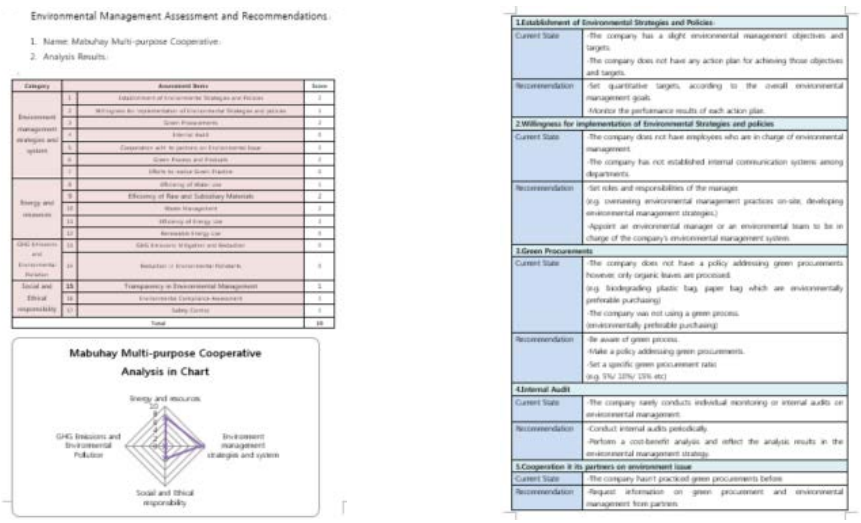
During the intermediate analysis, the ASEIC Consulting Team conducted Eco-Innovation training and environmental management evaluation. According to the industry each participating company belonged to, the ASEIC Consulting Team provided customized Eco-Innovation training on evaluation of the entire process, saving energy, waste treatment, environmental regulations, or green certification.

Based on the participating companies' main products and industry, environmental management evaluations were conducted in the form of interviewing the person in charge and analyzing the companies' current status data. The ASEIC Consulting Team evaluated the participating companies on four categories of Environmental Management Strategies, Environmental Management System, Energy & Resources, greenhouse gas emissions and environmental pollution, and corporate social responsibility (CSR), and provided environmental management evaluation report to each company.

| Figure 7 | Workshop per Company



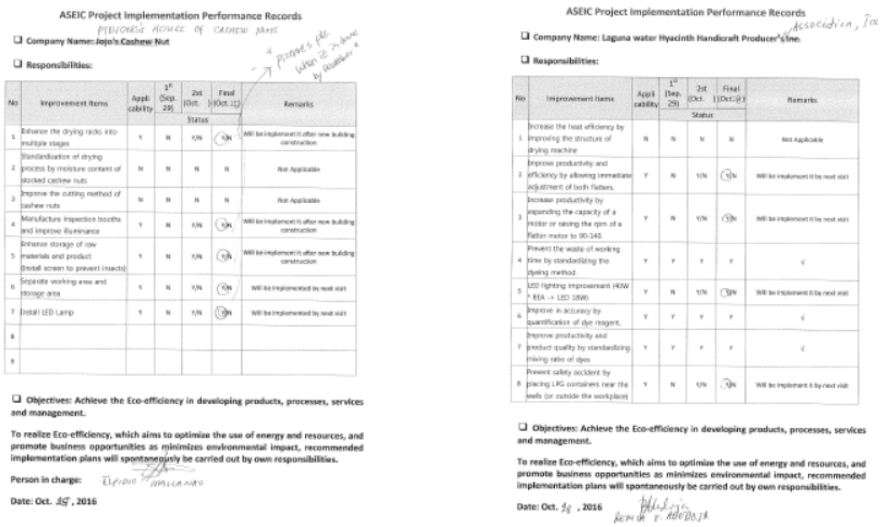
| Figure 8 | Training on Environmental Management Systems



| Figure 9 | Sample Environmental Management Report

Feasibility Study and Detailed Implementation Plan

The ASEIC Consulting Team assessed the economic and technical feasibility of the final solutions. The ASEIC Consulting Team took into consideration the difficulty of implementing the solutions, investment costs, payback period, and expected benefits in order to help each company make the right investment decision. In addition, the ASEIC Consulting Team established detailed implementation plans, as shown in <Figure 10>, considering the applicability and priority of each solution.



ASEIC Project Implementation Performance Records

❑ Company Name: Jojo's Cashew Nut

❑ Responsibilities:

No	Improvement Items	Applicability	1st (Sep. 29)	2nd (Oct.)	Final ( )(Oct.)	Remarks
			Status			
1	Enhance the drying racks into multiple stages	Y	N	Y/N	(Y)/N	Will be implement it after new building construction
2	Standardization of drying process by moisture content of stocked cashew nuts	N	N	N	N	Not Applicable
3	Improve the cutting method of cashew nuts	N	N	N	N	Not Applicable
4	Manufacture inspection booths and improve illuminance	Y	N	Y/N	(Y)/N	Will be implement it after new building construction
5	Enhance storage of raw materials and product Install screen to prevent insects	Y	N	Y/N	(Y)/N	Will be implement it after new building construction
6	Separate working area and storage area	Y	N	Y/N	(Y)/N	Will be implemented by next visit
7	Install LED Lamp	Y	N	Y/N	(Y)/N	Will be implemented by next visit
8						
9						

❑ Objectives: Achieve the Eco-efficiency in developing products, processes, services and management.

To realize Eco-efficiency, which aims to optimize the use of energy and resources, and promote business opportunities as minimizes environmental impact, recommended implementation plans will spontaneously be carried out by own responsibilities.

Person in charge:

Date: Oct. 29, 2016

ASEIC Project Implementation Performance Records

❑ Company Name: Laguna water Hyacinth Handicraft Producer's Ine.

❑ Responsibilities:

No	Improvement Items	Applicability	1st (Sep. 29)	2nd (Oct.	Final ( )(Oct.-2)	Remarks
			Status			
1	Increase the heat efficiency by improving the structure of drying machine	N	N	N	N	Not Applicable
2	Improve productivity and efficiency by allowing immediate adjustment of both flatters.	Y	N	Y/N	(Y)/N	Will be implement it by next visit
3	Increase productivity by expanding the capacity of a motor or raising the rpm of a flatter motor to 80-140.	Y	N	Y/N	(Y)/N	Will be implement it by next visit
4	Prevent the waste of working time by standardizing the drying method.	Y	Y	Y	Y	√
5	LED lighting improvement (45W → 18A → LED 18W)	Y	N	Y/N	(Y)/N	Will be implement it by next visit
6	Improve in accuracy by quantification of dye reagent.	Y	Y	Y	Y	√
7	Improve productivity and product quality by standardizing mixing ratio of dyes	Y	Y	Y	Y	√
8	Prevent safety accident by placing LPG containers near the walls (or outside the workplace)	Y	N	Y/N	(Y)/N	Will be implement it by next visit

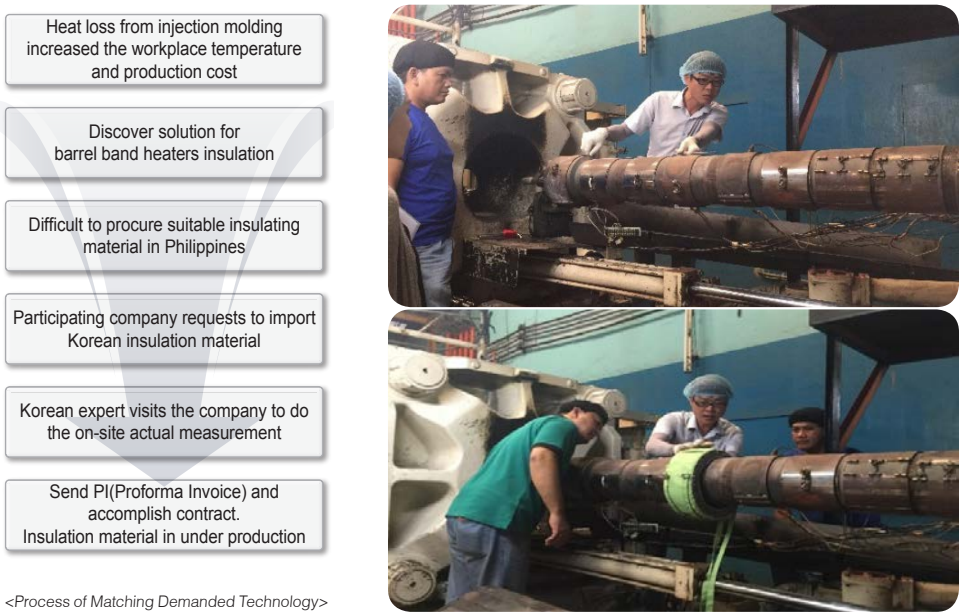
❑ Objectives: Achieve the Eco-efficiency in developing products, processes, services and management.

To realize Eco-efficiency, which aims to optimize the use of energy and resources, and promote business opportunities as minimizes environmental impact, recommended implementation plans will spontaneously be carried out by own responsibilities.

Date: Oct. 29, 2016

| Figure 10 | Detailed Implementation Plans

Matching the Demanded Technology



<Process of Matching Demanded Technology>

| Figure 11 | Process of Matching Demanded Technology

Through Eco-Innovation Consulting Project, the ASEIC Consulting Team could discover the demanded technologies that are difficult to procure in the Philippines. Plastimer Industrial Corporation, one of the participating companies, chose a solution suggested by the ASEIC Consulting Team that lowers the temperature inside the production plant through thermal insulation on the heat emitted from the injection molding machine to the outside.

The participating company had difficulties finding an appropriate insulating material that can endure the strong heat in the Philippines, so it wished to import an insulating material for injection molding machine from Korea. So the ASEIC Consulting Team discovered a Korean company that produces insulation material for injection molding machine, based on the specifications and performance information of the injection molding machine in the production plant, and had a discussion on estimation and on-site actual measurement. A Korean SME that produces high temperature insulating materials for barrels that wishes to export its products to the Philippines visited the production plant of the participating company and conducted actual measurement, constructed sample insulating materials, and made agreements with product payment and transportation conditions with the person in charge.

At the end of November 2016, the participating company paid for the products, so the Korean SME is producing the insulating material. It is scheduled to be transported to the Philippines at the end of 2016, and after it is installed, the internal temperature in the production plant will be reduced, therefore the working environment will improve.

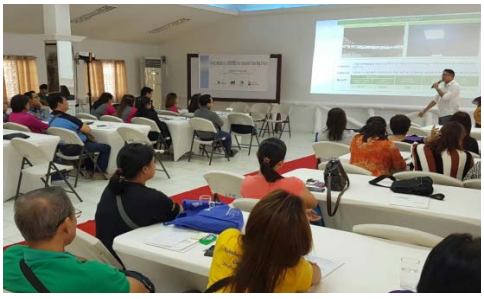
STEP 4. Project Publicity and Eco-Innovation Promotion

Post-Project Workshop (Final Results Briefing)

A post-project workshop was conducted to report and publicize the results of the 2016 Eco-Innovation Consulting Project. The workshop covered: a report on the final results of the consulting for the 10 participating companies, and success stories of 6 companies that generated particularly notable results. In addition, all participating companies were awarded Eco-Innovation Project Completion Certificates by ASEIC.

Greetings from Government Agencies

Final Results Briefing



Presentation on Consulting Success Stories

ASEIC Certificate Award Ceremony

| Figure 12 | Post-Project Workshop (Final Results Briefing)

Online Promotion

In order to promote success of 2016 Eco-Innovation Consulting Projects, the seminar and visits to the participating companies were promoted through the social network pages of DTI Rizal and DENR PEPP.

| Figure 13 | Promoting Eco-Innovation Consulting Project through the Social Network Pages of the Governmental Agencies

03 The Philippines' Business and Environment

The Philippines is a MVIP1) state, one of the most well-known new markets. It recorded the economic growth rate of 6.9% for the first half of 2016, demonstrating the highest growth in Asia. Major international economic organizations such as The International Monetary Fund (IMF), World Bank, and the Asian Development Bank (ADB) are anticipating the GDP growth of 6.3% per year until 2020. However, sharp increase in waste, air pollution, contaminant, and wastewater created by reckless development, population growth, urbanization, and industrialization have become main sources of environmental pollution.

Public transportations such as buses, jeepneys, and tricycles are pointed out as the main causes of air pollution. Industrialization and massification also contribute to intensifying air pollution.

Water pollution in rivers and lakes were particularly serious. Especially major rivers in Manila were contaminated by factory wastewater, sewage, and non-point pollution source, etc. Most of the wastewater is discharged either untreated or undertreated due to lack of wastewater treatment facilities.

Wastes are being dumped in landfills, but as there are more open-air storage yards than sanitary landfills, there is shortage in infrastructure for appropriate waste treatment. In addition, unauthorized waste dumping is frequent due to immature civic consciousness. Due to the issues with plastic solid waste disposal, starting with the Muntinlupa City since 2011, at least 27 cities have banned the use of plastic bags.

Manufacturing in the Philippines account for 20.3% of its GDP (USD 292 billion in 2015), and the manufacturing in 2015 recorded 4.2% growth compared to the previous year. The Philippines is the second largest producer of handicrafts, and more than one million people are working in the handicrafts. The amount of exports in handicrafts reached up to USD 130 million (2013). Handicraft industry is the major source of foreign currency in the Philippines.

1) MVIP: Four emerging Southeast Asian countries - Myanmar, Vietnam, Indonesia, and the Philippines.

Current Energy Conditions in the Philippines

- Demands for power increased by 4.8% (about 600 MW) per year due to fast economic growth
- According to Philippine Energy Plan (PEP) 2012-2030, the power capacity that has been installed until 2016 is 16,250 MW. The power capacity is anticipated to increase up to 25,800 MW by 2030, but the expected demands for power capacity is 29,330 MW, so the supply is expected to fall short
- The Philippine Government runs Energy Efficiency & Conservation (EE&C) Program to overcome power shortage
- It begins to take actions related to energy policy by running Open Access, Interim Mindanao Electricity Market; IMEM, National Electrification Administration; NEA Reform Act, Renewable Energy Program (FIT Confirmed), Energy Efficiency and Management Programs, etc.

04 Success Stories of Eco-Innovation in the Philippines

4.1 Enhancing Efficiency in Processing Raw Materials through the Introduction of High-efficiency Drying Facility

4.1.1 Summary

This manual handicraft company produces furniture, such as chairs and shelves, by processing bamboo. It uses a large drying oven to process the cut bamboos. The drying oven in the production plant, which was produced in November 2013, had low efficiency in heat transfer causing a large amount of energy loss.

In order to improve energy efficiency of the drying oven, the ASEIC Consulting Team suggested the solution that converted a 1-pass heat exchanger into 3-pass exchanger than can maximize the duration of heat retention.

When the solution is implemented, it is expected to improve the fuel efficiency and reduce about 40% of energy. It is also expected to reduce about 4,000 kg of fuel per year, and also expected to shorten the preheating time of the drying oven, thus greatly improve energy efficiency.

4.1.2 Consulting Background

The Philippines is the second largest producer of handicrafts, and more than one million people were working in the handicrafts in 2015. The amount of exports in handicrafts reached up to USD 130 million (2013). Handicraft industry is the major source of foreign currency in the Philippines. The major raw materials for handicraft products are bamboo, coconut, abaca (manila hemp) and etc. These are the plants that can be obtained easily in the Philippines and they require drying and processing.

The company uses a large drying oven to process the cut bamboos. In case of hot air dryer, the efficiency of the heat exchanger is an important criterion for determining the energy efficiency. So it is important to design a high efficiency heat exchanger. However, the heat exchanger in the drying oven was designed in an inefficient structure, which resulted in low efficiency in heat

transfer and waste of fuel. The ASEIC Consulting Team suggested the solution to re-design the 1-pass heat exchanger in the drying oven into 3-pass structure, which has a longer pipe, to enhance the efficiency in heat exchange.

| Figure 14 | Inside of the drying oven (left) and the employee of the local company explaining how to operate the drying oven (right)

4.1.3. Financial Barriers

In order to install the 3-pass heat exchanger suggested by the ASEIC Consulting Team, a new steel pipe with the identical diameter (Φ250mm x 10m x 5t, steel tubes) as the existing heat exchanger pipe must be produced. This requires initial investment costs of KRW 4,000,000 (USD 3,620). The participating company was determined for improvement, but the installation cost was a burden, so it needed a connection to external financial support. Therefore, the ASEIC Consulting Team and the company requested the Shared Service Facility (SSF)[2] to local government unit in Rizal for energy efficiency improvement, and on July 2016, KRW 9,635,000 (PHP 413,000) was approved. In order to implement the solution, the list of needed equipment was written and submitted to the local government, and the purchased equipment is being delivered to the site. The solution is expected to be completed within 2016.

4.1.4 Selection of Solution

The company uses a room-type drying oven to make the moisture content of the raw materials, such as bamboo, used in furniture manufacturing to meet the quality standard. The drying oven was consisted of two parts: the furnace and the drying room. When they light fire in the furnace with bamboo sawdust charcoal[3] and firewood to create heat, the high-temperature heat of combustion goes through the pipe in the drying room. In this process, the temperature of the surface of the pipe rises, and the heat is transmitted to the air, increasing the temperature of the drying room and drying the bamboos. The heat, cooled after drying the bamboo, is emitted through the chimney connected to the end of the pipe.

2) The company installed the drying oven with the financial support from The Philippine Department of Industry and Trade (DTI), under the condition that the people working in the similar industry would share it.

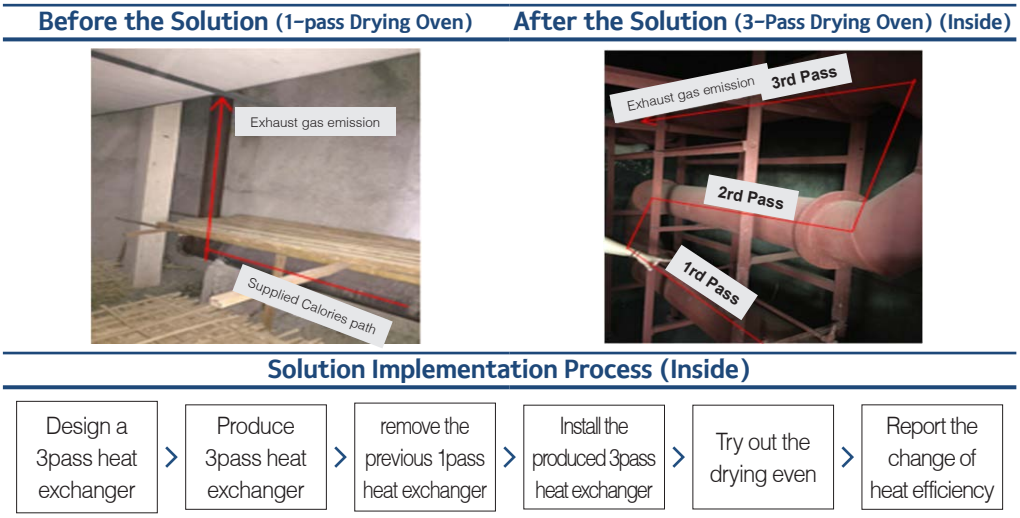
3) The charcoal used for drying is an upcycling (the act of creating new value out of waste materials by methods such as adding a design. The concept goes beyond the existing concept of simple recycling and results in a new product) fuel, utilizing and re-processing the sawdust from processing the bamboos in the production plant.

Currently, the heat that goes through the 1-pass pipe and emitted to the outside has short retention time inside the drying room, so it is still hot. In order to prevent energy loss from emitting high heat, the solution that changes the 1-pass pipe to 3-pass pipe, which increases the retention time of the high heat in the drying room. The principle of this solution is to improve the heat transfer efficiency inside the drying oven to lower the temperature of the heat emitted to the outside.

| Figure 15 | Inside of the Furnace and the Current Drying Room of the Drying Oven

4.1.5 Solution Implementation

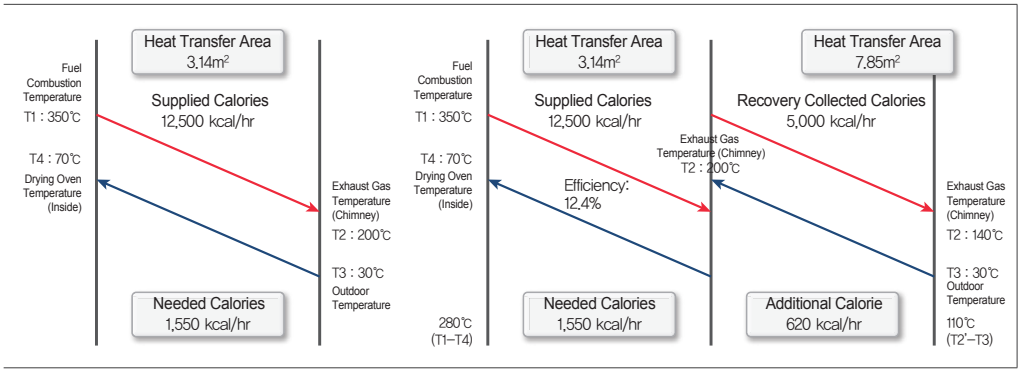
As shown in <Figure 16>, the ASEIC Consulting Team suggested the company to change the 1-pass heat exchanger into 3-pass structure, in consideration of the size of the drying room in the production plant. When a 3-pass heat exchanger is ordered and produced, the existing 1-pass heat exchanger will be torn down and 3-pass heat exchanger will be installed for a trial run. The ASEIC Consulting Team also suggested to make the curves of the 3-pass heat exchangers to be allowed for opening and closing, so the internal cleaning and maintenance of the heat exchanger will be easy in the future.



| Figure 16 | Inside the Drying Oven before and after the Solution (Inside)

4.1.6 Project Achievements

Changing the steel pipe inside the drying room into 3-pass structure improves heat exchanging efficiency for about 4.9%. When the heat generated in the furnace of the drying oven goes through the 1-pass heat exchanger and emitted through the chimney, the average temperature of the exhaust gas is 200 ˚C, but when the structure is changed to 3-pass structure, the temperature is expected to be reduced up to 140 ˚C. This is expected to save about 40% of energy, reducing 10,000kg of firewood per year to 6,000kg per year, used as fuel for drying raw bamboo materials.



| Figure 17 | The Schema of Heat Exchanges Before Implementing the Solution (Left) and After Implementing the Solution (Right)

As shown in <Figure 17>, when the heat transfer area of the heat exchanger increases from 1 pass to 3 pass, when the heat exchanging area of the heat exchanger is increased from 1-pass to 3-pass, the temperature of the heat emitted to the outside is reduced from 200 ℃ to 140 ℃, which can collect additional heat of 5,000[kcal/hr]. If the 12.4% of heat exchanging efficiency is applied to the collected calories, the additional active calories that can be provided to the drying oven is 620kcal/hr. This is expected to improve the heat exchanging efficiency and save the fuel. It also shortens the preheating time to reach the temperature that enables the drying of the bamboo, so the productivity is also expected to improve.

| Table 5 | Calculation of Economic Benefits

(1) Calculation Criteria
- Firewood Consumption: 10,000[kg/year]; 100 kg/day× 100 days/year
- Price of Firewood: 250 [KRW/kg]
- The Efficiency of the Existing Heat Exchanger=Calories Needed in the Drying Oven / Supplied Calories × 100% = 12.4%
  = 1,550(kcal/hr) / 12,500(kcal/hr) × 100%
  ※ Supplied Calories: Amount of Consumed Firewood (kg/hr) ×Calories of Firewood (kcal/kg) = 4.16(kg/hr) × 3,000(kcal/kg)
  = 12,500[kcal/hr]
  ※ Calories Needed in the Drying Oven : Volume of the Drying Oven (m3) ×Specific Heat of Air (kcal/h·m^3·℃) ×Temperature Difference(℃)
  = 100(m^3) × 0.31(kcal/m^3·℃) × 50(℃) = 1,550[kcal/h]

- Energy Savings = (Additional Collected Calories / Calories Needed in the Drying Oven) × 100 = 40%
  = 620(kcal/hr) / 1,550(kcal/h]) × 100%
  ※ Amount of Hot Air : Supplied Calories (kcal/hr) × (The Temperature at the Opening of the Combustor -The Temperature of Exhaust Gas)[℃]
  = 12,500(kcal/hr) × (350 - 200)[℃] = 83.33(kcal/℃.h)
  ※ The Additional Collected Calories through Improving the Heat Transfer Area (kcal/hr) : 620[kcal/hr]
  = Amount of Hot Air (kcal/℃·h)×Temperature Difference (℃) ×Heat Exchanging Efficiency (%)
  = 83.33(kcal/℃.·h) × 60(℃) × 0.124 = 620[kcal/hr]

(2) Fuel Savings= 4,000[kg/year]
  = Amount of Consumed Firewood[kg/year] × Saving Rate[%]
  = 10,000[kg/year] × 0.4

(3) Savings on Fuel Price Per Year= 1,000[KRW/year]
  = Savings on Firewood[kg/year] × Firewood Price[KRW/kg]
  = 4,000[kg/year] × 250[KRW/kg]

(4) Investment: 4,000,000 [KRW]
- Steel Pipe(Φ250mm ×10m×5t): 4,000,000 [KRW]
- Costs for Cutting, Processing, and Installation Not Included (The Company Self-Supplied the Process)

(5) Investment Payback Period= 4.0[years]
  = Investment [KRW] / Savings Per Year [KRW/year]
  = 4,000,000 [KRW] / 1,000,000 [KRW/year]

(6) Reductions on Greenhouse Gas Emissions
: Thanks to the use of biofuel (bamboo sawdust charcoal and bamboo debris), no greenhouse gas emission took place.

4.2 Enhancing Productivity and Reducing Greenhouse Gas Emissions through Improving and Standardizing of Processes

4.2.1 Summary

This handicraft company produces crafts such as bags, carpets and wallets by processing the stems of hyacinth, a plant that lives in the water. The company harvests hyacinth stems, and

processes them into raw materials for handicraft by drying and pressing, and produces products by hand-weaving them. Due to the characteristics of handicraft, the products are made based on the workers' experience rather than standardized production process. So, the major issues are relatively longer production time and energy loss.

Thus, the ASEIC Consulting Team suggested to increase the efficiencies in stem pressing process and dyeing process, which can improve productivity. In other words, the ASEIC Consulting Team suggested the solutions that can improve productivity by 6 times by improving the pressing equipment, and that can save about 158kg of annual fuel usage and 630kg of greenhouse gas emissions per year by standardizing the dyeing process and reducing the production time.

4.2.2 Consulting Background

According to a study by University of Manila, the Philippines, Laguna de Bay was seriously polluted, so it required purification. The investigation team pointed out that water hyacinth was one of the causes of water pollution. Especially, water hyacinth has strong fertility, so it grows into an adult plant in about two weeks, and the thin, hairy roots tangle and form a thick layer on the surface of the water. One noticeable point is that the thick layer of roots cover the surface and interferes with the photosynthesis of other aquatic plants, and reduces the dissolved oxygen, thus causing water pollution. In addition, this layer of roots interferes with the current, and made it impossible for the people to do aquatic activities, such as boat riding and fishing.

Water Hyacinth : A plant originated from South America, which grows in tropical and subtropical regions. It floats on the water, and has thin, hairy roots. It can grow up to 1m in deep waters. The stem grows up to maximum 60cm, and the seed can survive up to maximum 20 years.

| Figure 18 | Photo of Water Hyacinth (Left) and Removing Water Hyacinth (Right)

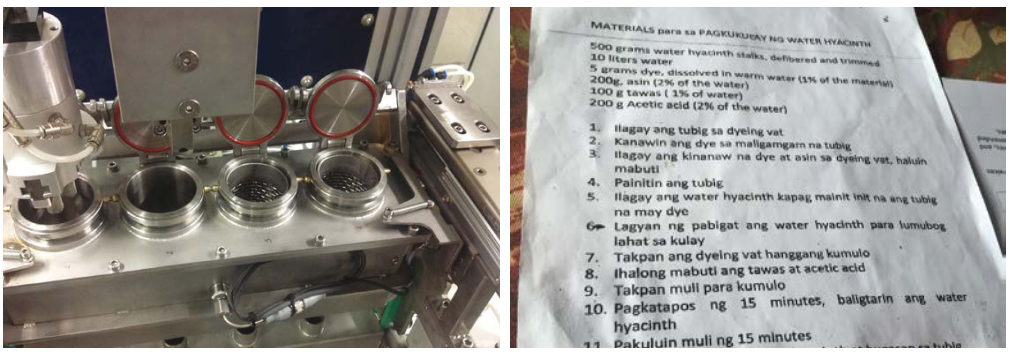
Water hyacinth causes bad influence on the aquatic environment, but it's also an essential economic means that allows the local residents to make a living. The Philippine Department of Trade and Industry (DTI) teach the local residents how to harvest water hyacinth stems. The local residents who completed this education harvest stems from the lake and sell them to the

participating company and other hyacinth stem processing companies for 10 cents per stem. The purchased fresh hyacinth stems are dried, pressed and dyed at the participating company, and sold for 30 cents per stem.

4.2.3 Financial Barriers

The ASEIC Consulting Team considered the introduction of automatic dye injection equipment (About USD 400 to 1,200) in order to standardize the dyeing process, which was taking place without measuring. Automatic dye injection equipment automatically injects the dye according to pre-set mixing ratio. It is easy to operate, but it requires high initial installation cost, so it was difficult to implement due to the conditions.

Instead of this solution, the ASEIC Consulting Team suggested the standardization of the dyeing process by reflecting the dyeing process instructions of Philippine Department of Science and Technology (DOST), which can use digital scales, thermometers and timers. This solution came with the process of training the workers to measure the dye with a digital scale, to check the temperature of the installed dye tank while dyeing the hyacinth, and to obey the dyeing time by using a timer.



| Figure 19 | Automatic Dye Injection Equipment (Left) and Instructions for Standardizing the Dyeing Process (Right)

4.2.4. Environmental Barriers

According to International Union for Conservation of Nature (IUCN), water hyacinth is classified as one of the 100 living organisms that cause negative influence on the ecosystem and contribute to its destruction. Some African countries designated water hyacinth as harmful plant to the marine ecosystem. Therefore, water hyacinth threatens the biodiversity and indigenous living organisms.[4] If the damage is calculated into the sums, it's USD 120 billion per year in the

4) Rands et al. 2010, Vila et al. 2011, Hejda et al. 2009

U.S.[5], and it amounts to USD 100 billion in Africa.[6]

As the global warming is accelerated, the habitat of water hyacinth, a tropical and subtropical plant, grows and expands, and a destruction of ecosystem is inevitable. As the water hyacinth has more negative influence on the ecosystem as a destructor, rather than positive influence as a carbon dioxide sink, so it needs to be controlled in number through harvesting. Improving the efficiency of the stem processing through the solution suggested to the participating company will contribute to the controlling the number of water hyacinth.

4.2.5. Selection of Solution

The participating company processes hyacinth stems by drying, pressing and dyeing, and weaves then by hand to produce handicraft such as bags and carpets.

The gap in the flattening machine that presses hyacinth stems are uneven, so only one part of the flattening machine was being used. The ASEIC Consulting Team readjusted the gap of the flattening machine so it can process 4 stems at a time. This contributed to quadrupling the producing speed of the participating company. At the same time, the ASEIC Consulting Team changed the motor of the flattening machine from the old 100rpm model (the unit of motor movements) to a 150rpm model. This improved the pressing speed by 1.5 times, and was able to save 144kWh of electric energy per year.

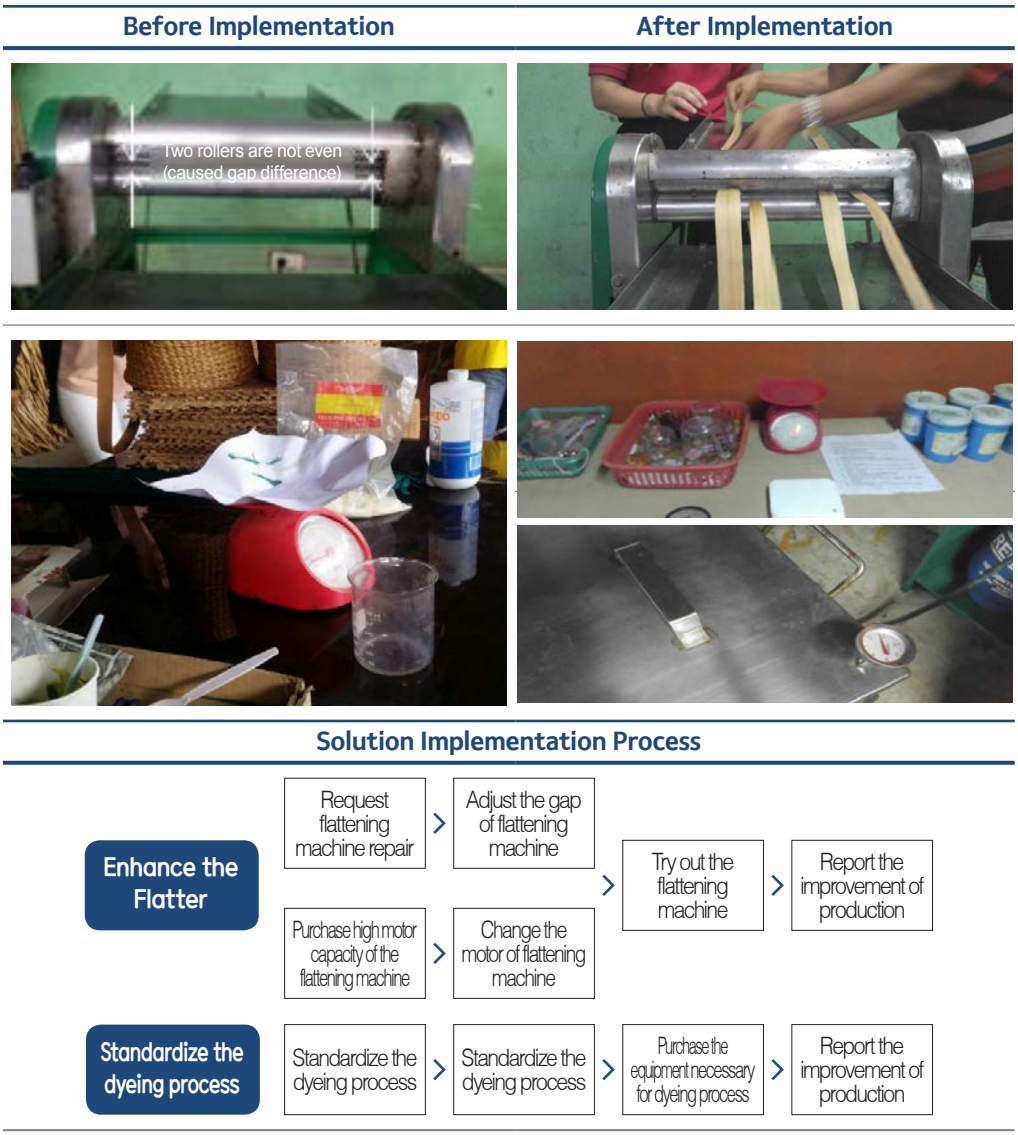
While the dye tank heats up to dye the hyacinth stems, the worker was injecting the dye with a rough guess based on the personal experience. The old method heats the dye tank until it reaches the desired color. Therefore, the LPG fuel was being wasted when the dye was being added. By standardizing the dyeing process through managing the appropriate temperature by using a thermometer and pre-measuring the dye before injecting it, the duration time for the dyeing process was reduced by 33%, from 60 minutes to 40 minutes. This saved 158kg of LPG fuel per year.

| Figure 20 | Dried Hyacinth (Left) and the Dyeing Process (Right)

5) Pimentel et al. 2005, Kettunen et al. 2009

6) Mwangi, Theuri, (2013),"Water hyacinth-Can its aggressive invasion be controlled?".[pdf]: UNEP. Available at http://www.unep.org/geas/[Accessed 18 Oct. 2016]

4.2.6. Implementation of Solution



| Figure 21 | Before and After Improving the Pressing Process and the Dyeing Process

As shown in <Figure 21>, the gap between the two rollers in the flattening machine was big, so the hyacinth stems were not being pressed properly. This also damaged the quality of the products. To solve this issue, the company requested a flattening machine engineer for a correction, thus the engineer adjusted the gap to be narrower.

The participating company was using uncalibrated manual scales, contaminated paper cups and beakers, and unsealed dyes to carry out the dyeing process. In order to make improvements, the ASEIC Consulting Team suggested the company to use measuring cups, measuring spoons and digital scales, so it can correctly measure the dye to inject. The ASEIC Consulting Team instructed the company to equip the dye tank with a thermometer to check the temperature and a timer to obey the dyeing time, and to store the dyes in special containers. In order to make sure the standardization of the dyeing process can be implemented properly in the production plant, the ASEIC Consulting Team asked the person in charge at the participating company to educate the employees about the dyeing process.

4.2.7. Project Achievements

Adjusting the gap inside the flattening machine enabled it to press 4 stems at once, so it improved the productivity by 4 times. In addition, the ASEIC Consulting Team improved the number of revolutions of the motor to 150rpm, thus increased the compressing speed for about 1.5 times, which improved the efficiency of the process by 6 times. Through these solutions, the ASEIC Consulting Team and the company can expect to save 360kWh of power per year.

The standardization of the dyeing process reduced the overall duration time of dyeing by 20 minutes, thus expected to save 158kg of LPG per year. Improving the compressing process and the dyeing process can reduce power usage and fuel usage, reducing the greenhouse gas emissions of 630kg per year.

Along with saving power, fuel and reducing environmental impacts, the company is expected to improve overall productivity by redistributing its human resources, which were committed to compressing and dyeing processes for a long time, to other processes.

| Table 6 | Calculation of Economic Benefits

(1) Calculation Criteria
- Cost of Electric Power : KRW 170[KRW/kWh]
- Power Consumption : 0.25[kW]
- LPG Consumption : 480[kg/year]
- Improvement Rate : 75%(Adjustment of the gap), 50%(Improvement of rpm), 33%(Reducing the duration of the dyeing process by 20 minutes)
- Time of Operation : 2,304[hr/year]_8[hr/d]*6[d/w]*4[w/m]*12[m/y]
- Operation Rate : 50%_Apply the operation rate when conducting on-site investigation

Adjust the gap of the flattening machine	Adjust the revolution per minute (rpm) of the flattening machine	Standardize the dyeing process
(2) Power Savings = Power consumption [kW] × improvement rate [%] × operation time [hr/year] × operation rate[%] = 0.25[kW] × 0.75 × 2,304[hr/year] × 0.5 = 216[kWh/year]	(2) Power Savings = Power consumption[kWh] × improvement rate[%] ×operation time[hr/year] × operation rate[%] = 0.25[kW] × 0.5 × 2,304[hr/year] × 0.5 = 144[kWh/year]	(2) Fuel Savings = LPG Consumption [kg/year] × reduction rate[%] = 480[kg/year] × 0.33[%] = 158[kg/year]
(3) Annual reduction in power consumption =Power reduction [kWh/year] × cost of electric power[KRW/kWh] = 216[kWh/year] × 170[KRW/kWh] = 36,700 [KRW/year]	(3) Annual reduction in power consumption =Power reduction[kWh/year] × cost of electric power[KRW/kWh] = 144[kWh/year] × 170[KRW/kWh = 24,500 [KRW/year]	(3) Annual reduction in fuel consumption = Fuel reduction[kg/year] × Cost of fuel [KRW/kg] = 158[kg/year] × 3,750[KRW/kg] = 592,000 [KRW/year]
(4) Investment: None	(4) When motor replacement is necessary: 130,000 [KRW]	(4) Investment: 92,000 [KRW] - Scale: 45.000 [KRW] - Measuring cup: 10,000[KRW] _per 2 cups - Timer: 25,000 [KRW] - Measuring spoon: 12,000 [KRW]
(5) Investment Payback Period = 0 [year]	(5) Investment Payback Period = Investment [KRW] / Savings Per Year [KRW/year] = 130,000 [KRW] / 24,500 [KRW/year] = 5.3[year]	(5) Investment Payback Period = Investment [KRW] / Savings Per Year [KRW/year] = 92,000 [KRW] / 592,000 [KRW/year] = 0.2[year]
(6) Reductions on Greenhouse Gas Emissions = Power savings[MWh/year] × GHG emission factor [tGHG/MWh] = 0.21 × 0.46625[tCO_2eq/MWh] = 0.1[tCO2eq/year]	(6) Reductions on Greenhouse Gas Emissions = Power savings[MWh/year] ×GHG emission factor[tGHG/MWh] = 0.14 × 0.46625[tCO2eq/MWh] = 0.07[tCO2eq/year]	(6) Reductions on Greenhouse Gas Emissions = Fuel savings[kg/year] × Net calorific value[MJ/kg] × GHG emission factor[tCO2eq/TJ] = 158[kg/year] × 46.3[MJ/kg] × 63.236[tCO2eq/TJ] × 10-6 = 0.46[tCO2eq/year]

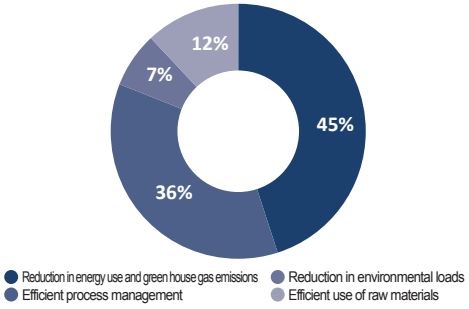
05 Expected Benefits of 2016 Eco-Innovation Consulting Project in the Philippines

5.1 Expected Benefits at a Glance

In total, 69 solutions were proposed through the 2016 Eco-Innovation Consulting Project in the Philippines. The potential economic benefits of these solutions are estimated to be PHP 8,631,399 per year (KRW: 201,370,000 per year, Exchange rate: PHP 23.33 per KRW 1,000 , dated October 5th, 2016). In addition, the solutions' environmental benefit was calculated to be 283.77 tCO2 per year, which has same effect as planting 42,995 thirty-year-old pine trees. 53 out of 69 solutions were implemented, thus the current implementation rate is 76.8%. The ASEIC Consulting Team hopes that the unimplemented solutions can be continued to be implemented in the future.

| Table 7 | Expected Benefits of 2016 Eco-Innovation Consulting Project in the Philippines

Consulting Area	Number of Solutions	Expected Economic Benefit (Unit: KRW 1,000)
Energy	31	132,887
Process management	25	30,640
Reduction in environmental emissions	5	28,160
Raw materials	8	9,683
Total	69	201,370[7]



| Figure 22 | Results of 2016 Eco-Innovation Consulting Project in the Philippines

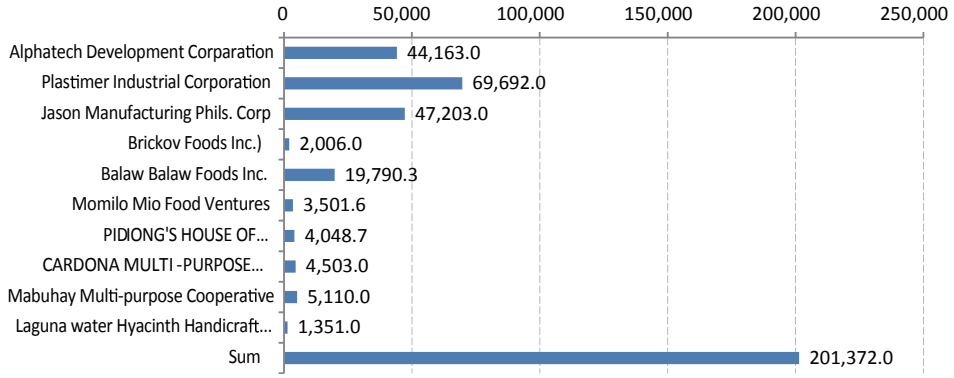
The participating companies of the Eco-Innovation Consulting Project were in 10 different industries: 5 in the food industry, 3 in the plastic manufacturing industry, and 2 in the handicraft industry. The 10 participating companies were highly interested in one common factor: energy saving solution, which can solve issues with high production cost. The demands for the solutions that can improve poor production environments due to the hot climate of the Philippines were also high. As shown in <Figure 22>, the final results of the consulting can be broken down into the

7) Written under the assumption of 100% implementation rate.

following areas in descending order of proportion: reduction in energy use (45%), efficient process management (36%), efficient use of raw materials (12%), and reduction in environmental emissions (7%).

5.2 Expected Economic Benefits

Among the participating companies, Plastimer Industrial Corporation was expected to gain the highest economic benefit as a result of the consulting with KRW 69,692,000 per year, followed by Jason Manufacturing Phils. Corp. and Alphatech Development Corporation, with KRW 47,203.0 per year and KRW 44,163,000 per year respectively. There were significant differences between the estimated economic benefits of 10 participating companies depending on company size and characteristics of the production processes.



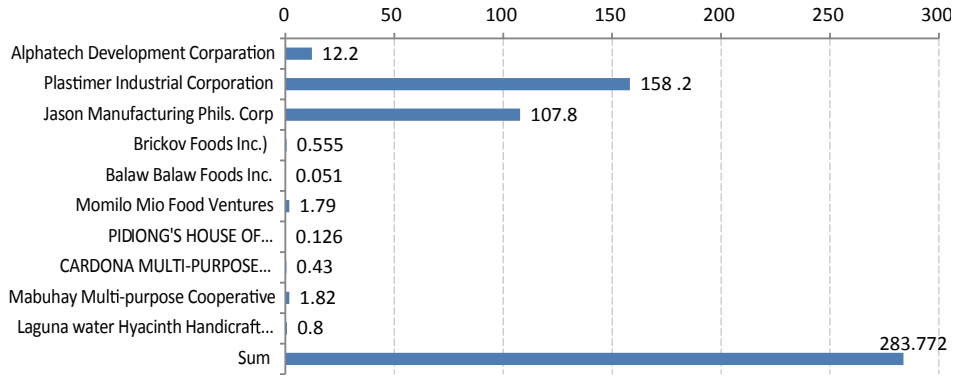
| Figure23 | Estimated Economic Benefits by Company

Alphatech Development Corporation, Plastimer Industrial Corporation, and Jason Manufacturing Phils. Corp. are all plastic manufacturing companies, and they all use electrical energy to operate most of the processing equipment. In order to greatly reduce the production cost for plastic products, the solutions that can innovatively reduce the power consumption were discovered, and they could create large economic effects.

In case of Plastimer Industrial Corporation, it could save innovative amount of energy by thermal insulation of the injection molding machine, which consumes a large amount of power. Jason Manufacturing Phils. Corp. applied thermal insulation on the band heater of the extruder, the main electrical equipment of the company, and Alphatech Development Corporation improved the inverter of the air compressor, which has high power consumption, so it can automatically control itself. Both companies experienced great economic effects by these solutions.

In case of the 5 companies with the lowest results (Laguna water Hyacinth Handicraft Producers' Association, Inc., CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING, Momilo Mio Food Ventures, Mabuhay Multi-purpose Cooperative, Brickov Foods Inc.), it was determined that they experienced small energy saving effects as they produced their products manually without manufacturing equipment that use very little energy. In case of Mabuhay Multi-purpose Cooperative, it expected low economic results even though it had high participation rate in Eco-Innovation Consulting Project. It seemed to have limitations in having economic results as it was a small company and had small absolute output.

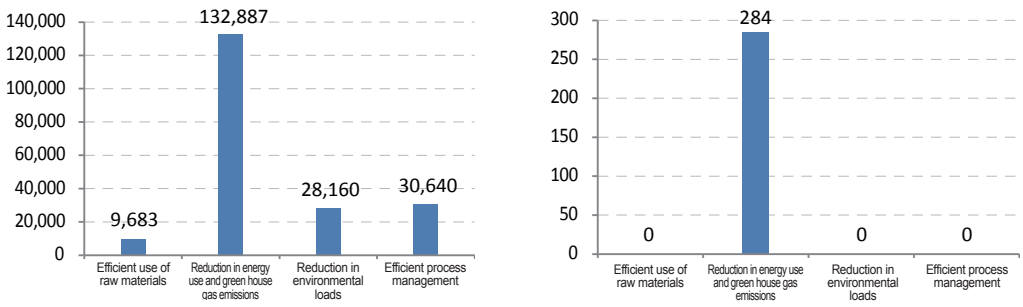
5.3 Expected Environmental Benefits



| Figure 24 | Environmental Results by Companies

The environmental benefits expected to be gained by participating companies, as shown in <Figure 24>, were calculated by using the carbon emission factor specified in Intergovernmental Panel on Climate Change (IPCC) guidelines and converting the amount of energy reduction into tCO2.

Comparing environmental effects of participating companies, Plastimer Industrial Corporation and Jason Manufacturing Phils. Corp. are clearly expected to have higher environmental effects with the results of 158.2 tCO2 per year and 107.8 tCO2 per year respectively. The estimates are particularly high for these companies due to their greater capacity for energy reduction. The 5 companies with relatively lower environmental effects (Balaw Balaw Foods Inc., PIDIONG'S HOUSE OF CASHEW NUTS, CARDONA MULTI-PURPOSE COOPERATIVE BAMBOO PROCESSING, Brickov Foods Inc., Laguna Water Hyacinth Handicraft Producer's Association, Inc.) had small absolute amount of greenhouse gas emission as most of their processes were done manually. In case of Balaw Balaw Foods Inc., it was expected to have low environmental effects as it is a small company and has small absolute output.



| Figure25 | Analysis result of Eco-Innovation Consulting improvement effectiveness

5.4 Overall Expected Benefits

If the potential economic benefits of this project are categorized into the four areas of Eco-Innovation Consulting (reduction in energy use and greenhouse gas emissions, efficient process management, efficient use of raw materials, and reduction in environmental loads), reduction in energy use and greenhouse gas emissions is expected to generate the greatest economic benefit (KRW 132,887,000 per year). It is anticipated to be highly effective because it improves energy efficiency of the equipment with high energy consumption in the production plants of the Philippines. High energy supply costs in the Philippines is considered to be one of the reasons why the economics effects created by the reduction of energy and greenhouse gas emissions were high. Reducing electricity use, the main energy source in most of the production plants, can reduce energy and greenhouse gas emissions, and is expected to create environmental benefit of 283.77 tCO2 per year.

Furthermore, improving production process can increase efficiency in the use of raw materials, which amounts to the economic benefit of KRW 9,683,000 per year.

The 5 participating companies under the management of DENR took exclusive caution in reducing environmental emissions (loads), as environmental awareness in the Philippines was growing and the monitoring of governmental environmental regulation was reinforced. Therefore, the ASEIC Consulting Team and the companies are expected to achieve economic benefit that amounts to KRW 28,160,000 per year, and it is assumed that efficiency of reducing environmental loads will be quite high, considering effectiveness of factors that do not add up to tCO2 value, such as reduction in water usage.

5.5 Expected Benefits by Company

5.5.1 Alphatech Development Corporation

Company Profile

Alphatech Development Corporation is a company founded in 1999, and it produces plastic containers and delivers them to multinational living supply manufacturing companies. It manufactures plastic containers for cosmetics and detergents by using recyclable polyethylene, polypropylene, and PET materials. It manufactures the containers through the processes of extrusion blow molding, stretch injection blow molding, injection blow molding and etc.

| Figure 26 | Production Process of Alphatech Development Corporation

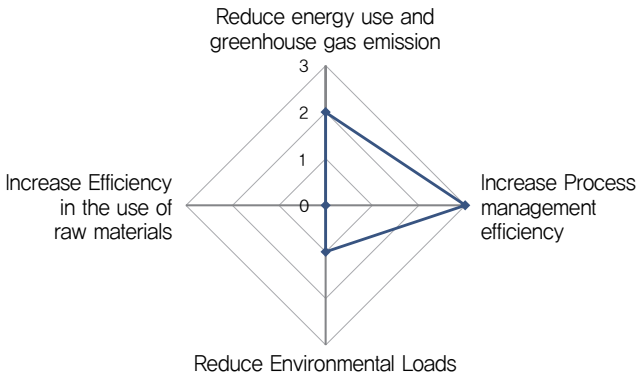
As presented in <Figure 26>, the company molds its products by injecting the raw plastic materials into an extrusion molding machine or an injection molding machine. Molded products go through inspections, have their labels on the exterior, and then are packed and shipped. The participating company consumes large amount of electric energy up to 800,000 kWh per year, so the key point is to reduce the consumption of electric energy. Using the extruder, injector, and air compressor for the molding process consumes a large amount of electric energy. For this reason, the company needed a solution to cut energy use, which reduces production costs.

Current Issues and Consulting Needs

One of the common needs of the Philippine participating companies is to lower the temperature of the production plants. Especially, the temperature in the workplace was too high during the hot dry season. This could worsen the working condition for the employees. The barrel, the major heat source of the extruder was not insulated, so the heat from the barrel was increasing the temperature of the production plant of the company. At the same time, the production plant lacked a ventilation system, so the heat could not escape to the outside. In order to solve this problem, the participating company installed invisible curtains in the extruder area so the heat from the barrel can escape to the outside immediately, thus it could lower the temperature inside the production plant.

The major clients of the participating company, the multinational companies of the United States, Japan and etc., are demanding for the company's ISO 14001 certification, so the company is being prepared to acquire the certification. Thus, the company was also highly interested in the

results of environmental management evaluation conducted by the Eco-Innovation Consulting Team.



| Figure 27 | Consulting Needs of Alphatech Development Corporation

Analysis

| Table 8 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Improve condensate trap of the air compressor	Install Level Sensor Type Trap to remove emission of high-pressure compressed, thus removed the load of the air compressor	Y
2	Remove heat source of the extruder to reduce cooling load	Install duct and exhaust fan to discharge the heat source of the extruder	Y
3	Automatically inject raw materials into the injection molding machine	Automatically inject raw materials by using the Ring Blower	Y
4	Manage illumination of the exterior inspection tables	Manage the illumination of the exterior inspection tables to improve the level of quality management	Y
5	Identify and manage the aisle and the products	Paint the lines on the floor for distinguishing and identify products on the storage shelves	Y
6	Equalize the thickness of plastic chunks melted in the process of extruding molding	Measure the temperature periodically and set the maintenance period for process management	N

As shown in <Table 8>, the initial analysis on Alphatech Development Corporation discovered total of 6 solutions.

The ASEIC Consulting Team instructed the company to discharge the condensed water by sensing the level of water and opening the trap, instead of the previous method of setting the timer to remove the water in constant time gap.

In order to lower the internal temperature, the ASEIC Consulting Team divided the extruder, the major heat source of the production plant, with plastic curtains. This was to collect the heat from where the heat source is converged to and discharge it to the outside immediately.

In order to improve the process of climbing up to the top of the injection molding machine and injecting the plastic resin manually, the ASEIC Consulting Team suggested the company to introduce the automatic material injector in order to improve productivity and solve the issues about workers' safety.

The ASEIC Consulting Team also ordered the company to increase the illumination of the exterior inspection tables by using LED light bulbs, in order to improve work efficiency and quality management.

Final Results

| Table 9 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Improve condensate trap of the air compressor	25,563 kWh/year	KRW 4,345,000/ year	Y
2	Remove heat source of the extruder to reduce cooling load	4,632 kWh/year	KRW 787,000/year	N
3	Automatically inject raw materials into the injection molding machine	817.6 MD/year	KRW 8,176,000/year	Y
4	Manage illumination of the exterior inspection tables	121 MD/year	KRW 1,210,000/year	Y
5	Identify and manage the aisle and the products	170 MD/year	KRW 1,700,000/year	N
6	Equalize the thickness of plastic chunks melted in the process of extruding molding	-	KRW 27,945,000/year	N
Total	6	Energy : 30,195 kWh/year Manpower : 1,108.6 MD/year	KRW 44,163,000/year	

As shown in <Table 9>, Alphatech Development Corporation implemented 3 out of 6 solutions.

The company made an improvement in discharging the condensed water by sensing the level of water and opening the trap, instead of the previous method of setting the timer to remove the water in constant time gap. It could save a large amount of the electric energy it was wasting.

Dividing the extruder, the major heat source of the production plant, with plastic curtains could collect the heat from where the heat source is converged to and discharge it to the outside immediately and lower the internal temperature. This solution also improved the hot work environment, a chronic problem of the production plants in the Philippines, so it improved work efficiency as well.

The company installed an automatic material injector, so it improved the productivity of the manual job of workers climbing to the top of the injection molding machine to improve productivity and solve the issue about workers' safety.

In order to increase the illuminance of the exterior inspection tables, the ASEIC Consulting Team suggested using LED. The participating company could enhance the illumination and save a lot of electric energy by replacing all of the light bulbs into LED lights, not only on the exterior inspection tables, but also in all of the production plant.

When the warehouse under construction at the back of the factory is completed by the end of November 2016, the company will rearrange the space inside the warehouse and manage the products by referring to the solution on identifying and managing the aisle and the products, suggested by the ASEIC Consulting Team. This will fundamentally solve the issue on poor identification of the aisle and the storage area due to the lack of space inside the production plant.

As shown in <Table 9>, if Alphatech Development Corporation implements all the solutions presented in the Consulting Project, it is expected to save 30,195 kWh of energy and 1,108.6 MD of manpower per year. These achievements translate into KRW 44,163,000 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

The participating company was determined to implement the solutions by using the Gantt Chart to subdivide the implementation schedule in weekly terms and monitoring itself. The management team and the plant manager reviewed the suggested solutions to implement them in a way they accord with the condition of the production plant. They also calculated the Return on Investment (ROI) that reflects the local conditions to decide the investments needed for the implementation of the solutions. The company was active in implementing of solutions.

The company could save electric energy in the production process and reduce greenhouse gas emissions, and could secure the safety of the workers by implementing the solutions suggested by the ASEIC Consulting Team. This enabled them to meet the demands of the multinational customers furthermore. When choosing a business partner, the multinational companies decide the evaluation factors considering product quality, workers' safety and

environmental influence in business operation and many more, and demand their potential partners to meet the certain levels.

5.5.2. Plastimer Industrial Corporation

Company Profile

Founded in 2004, Plastimer Industrial Corporation manufactures injected and molded plastic products. It has high level of environmental awareness, even obtaining ISO 14001 certification. It injects and molds recyclable resins such as HDPE, CPP, LDPE to produce plastic packaging containers and plastic parts for household appliances, and ships them to multinational customers.

| Figure 28 | Production Process of Plastimer Industrial Corporation

As presented in <Figure 28>, the company molds its products by injecting the plastic materials mixed in certain ratio into an injection molding machine. When the plastic is molded, the products are packaged and shipped. Manufacturing plastic uses a lot more electric energy compared to other energy sources. The participating company also uses electric energy up to 3,681,384 kWh per year. The injection molding machine and the condenser used in the molding process consume a lot of electric energy, so the company needed a solution that can reduce energy use in the process and lower the production cost.

Current Issues and Consulting Needs

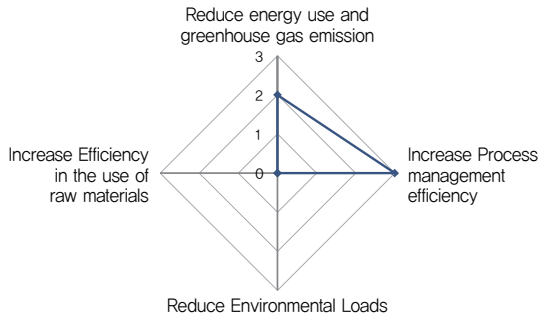
Electricity rate in the Philippines is PHP 7 (about KRW 170)[8] per 1 kWh, significantly higher than Korea's electricity rate, the average of KRW 67.06.[9] The injection molding machine used in the molding process consume a lot of electric energy, so the company needed a solution that can reduce energy use of the injection molding machine significantly and lower the production cost. At the same time, the temperature of the production plant rose due to the large amount of heat released from the barrel of the injection molding machine. In order to solve these two issues, the company suggested the solution that uses an insulating material to block the heat from

8) Based on electricity bills issued to Plastimer Industrial Corporation. Electricity for industrial use in the Philippines apply different rates based on which electricity supplying service the companies registered for.

9) Source: Korea Electric Power Corporation's Electric Power Statistics News, Issue 442, Electric Power Trading Record Table, Page 69, July 2016

the barrel of the injection molding machine. In order to implement the solutions, the ASEIC Consulting Team decided to import insulation material for injection molding machines from Korea. A Korean insulating material manufacturer visited the participating company and measured the injection molding machine in site. The insulating material is being produced in a factory in Korea for export.

The company already acquired ISO 9001 and ISO 14001 qualifications, and it's paying exceptional attention on quality and environmental management in order to maintain eligibility for the certifications.



| Figure 29 | Consulting Needs of Plastimer Industrial Corporation

Analysis

| Table 10 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Streamline the coolant pump	Install the inverter to automatically detect and control the pressure variation inside the pipe	Y
2	Insulate band heaters of the barrel of the injection molding machine	Install thermal insulation cover to improve insulation of the band heater	Y
3	Analyze the effects of implementing high-efficiency motor	Replaced the motor with high-efficiency motor	N
4	Equip tool post for replacing molds and repairing facilities	Equip tool post for replacing molds and repairing facilities	Y
5	Improve mold management by using mold racks and name tags	Identify and store molds by using mold racks and name tags	Y
6	Manage illumination of the exterior inspection tables	Manage the illumination of the exterior examination tables to improve the level of quality management	Y
7	Manage index for equipment availability	Post the monthly equipment availability and unavailability by using statistical methods	Y

As shown in <Table 10>, the initial analysis on Plastimer Industrial Corporation discovered

total of 7 solutions.

In order to save energy, the ASEIC Consulting Team suggested a solution to replace the inverter inside the coolant pump into an automatic inverter, as the old inverter is operated manually and has little energy saving effect. The ASEIC Consulting Team suggested the company to insulate the band heater of the injection molding machine, the heat source in the production plant, in order to lower the temperature inside the production plant.

To manage the molds efficiently, the ASEIC Consulting Team instructed the company to attach name tags on the molds and store them in a mold rack.

The ASEIC Consulting Team suggested improving the illumination of the external examination tables so the company can improve working efficiency. The ASEIC Consulting Team also instructed the company to replace the molds and produce a tool post for repairing facilities.

Final Results

| Table 11 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Streamline the coolant pump	68,558 kWh/year	KRW 11,654,000/year	Y
2	Insulate band heaters of the barrel of the injection molding machine	270,947 kWh/year	KRW 46,060,000/year	Y
3	Analyze the effects of implementing high-efficiency motor	Can save 4 to 5% of power when the high-efficiency motor is in operation		N
4	Equip tool post for replacing molds and repairing facilities	894.3 MD/year	KRW 8,943,000/year	Y
5	Improve mold management by using mold racks and name tags	182.5 MD/year	KRW 1,825,000/year	Y
6	Manage illumination of the exterior inspection tables	121 MD/year	KRW 1,210,000/year	Y
7	Manage index for equipment availability	-	-	Y
Total	7	Energy : 339,505 kWh/year Manpower : 1,197.8 MD/year	KRW 69,692,000/year	

As shown in <Table 11>, Plastimer Industrial Corporation implemented 6 out of 7 solutions. The company installed an automatic inverter so it can automatically detect and control the

pressure variation inside the coolant pipe in order to save electric energy.
The ASEIC Consulting Team covered the band heater of the injection molding machine, the heat source in the production plant, with an insulating material to block the heat from being released to the outside. This lowered the internal temperature of the production plant and improved the working efficiency of the workers.
The company will also replace dark lightbulbs to improve the illumination, and will use an illuminometer to check the illumination periodically in order to maintain proper illumination.
The names and the purposes of the molds were written on them with a paint, and the molds were stored in a mold rack for systematic management. The ASEIC Consulting Team also produced a wheeled tool post for replacing molds and repairing tools, so the maintenance can take place by using the tool post in case of emergency.
As shown in <Table 11>, if Plastimer Industrial Corporation implements all the solutions presented in the Consulting Project, it is expected to save 339,505 kWh of energy and 1,197.8 MD of manpower per year. These achievements translate into KRW 69,692,000 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

The participating company has a personnel in charge of environmental management, so it is continuously monitoring the environmental management. Its main customers are multinational companies, such as in Japan. It has a high level of environmental management demand, high enough for the overseas customers to visit the company and review the management. As the company implemented the solution suggested by the ASEIC Consulting Team, such as managing coolant pump inverter and insulating the band heater, it is expected to easily achieve the reduction of electric power and greenhouse gas emissions, some of its objectives of the environmental management goals.
Since it was difficult to find an insulating material for band heaters with appropriate functions in the Philippines, the company requested the ASEIC Consulting Team to import insulating material for injection molding machine made in Korea. A Korean expert in insulating materials was sent to the company to conduct actual measurement of the injection molding machine in the production plant On November 2016, the insulating material was being produced in a factory in Korea and it was successfully delivered to the Philippines at the end of December. The participating company was determined to invest in the project and implemented most of the suggested solutions, serving as an example for other participating companies.

5.5.3. Jason Manufacturing Phils. Corp.

Company Profile

Founded in 1985, Jason Manufacturing Phils. Corp. produces plastic bags. It mainly uses high density materials such as polyethylene and polypropylene to produce industrial plastic bags according to the customer demands, such as for food storage, trash storage or product storage.

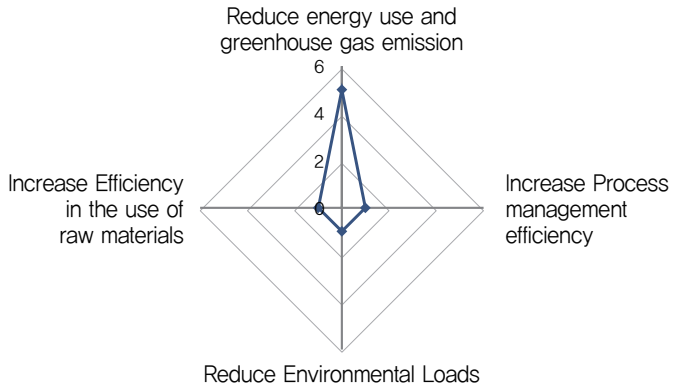
| Figure 30 | Production Process of Jason Manufacturing Phils. Corp.

As presented in <Figure 30>, the company molds its products by injecting the raw plastic materials into an extruder. The extruded products are cut into certain sizes, go through inspections, labeled and shipped. The participating company consumes large amount of electric energy up to 200,000 kWh per year, so the key point is to reduce the consumption of electric energy. Using the extruder for the molding process consumes a large amount of electric energy. For this reason, the company needed a solution to cut energy use, which reduces production costs.

Current Issues and Consulting Needs

Jason Manufacturing Phils. Corp. uses equipment with high power consumption, such as extruder or printer in most of its processes to produce the products, so it was in dire need for a solution that can reduce the use of electricity. The company reduced the use of electric energy by standardizing the duration of process and insulating the extruder. It also replaced the light bulbs inside the factory into LED lights, focusing on the additional reduction of electricity consumption, and the implementation of solutions could innovatively reduce energy consumption.

It also reinforced the process management, such as standardizing of raw material mixing process and managing raw material inventory, which must be managed in plastic producing companies. It was to meet the demands of multinational companies, the main target customers.



| Figure 31 | Consulting Needs of Jason Manufacturing Phils.Corp.

Analysis

| Table 12 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Replace fluorescent mercury lamps with LED lightbulbs	Replace lights with high-efficiency LED lightbulbs	Y
2	Improve the operation of 1 line of printer	Produce additional printing mold and operate 2 lines at the same time	Y
3	Minimize power loss by standardizing the raw material mixing process	Attach the manuals about mixing ratio and time per product, raw material and color on the mixers	Y
4	Improve insulation on the band heater of the extruder	Install thermal insulation cover to improve insulation of the band heater	Y
5	Control extruder blower inverter	Control the inverter to reduce fraction defective of the products and reduce the consumption of electricity	N
6	Specify criteria for handling hazardous chemicals	Manage safety and health by specifying criteria for handling hazardous chemicals	Y
7	Install alarm on the raw material mixers	Improve work efficiency by installing timers on the raw material mixers	Y
8	Manage inventory by using first-in, first-out shelf	Install shelves for products and mark IN-OUT line on the floors	N

As shown in <Table 12>, the initial analysis on Jason Manufacturing Phils. Corp. discovered total of 8 solutions.

The raw material storage lacked shelves for loading the materials, thus the raw materials were not being managed appropriately. The ASEIC Consulting Team instructed company to install shelves that enables first-in, first-out management.

In order to reduce the use of electricity, which takes a large part of production cost, the ASEIC Consulting Team suggested replacing the existing fluorescent mercury lamps into LED lightbulbs.

The ASEIC Consulting Team also suggested improving the printing mold, which is used for printing on the plastic bags after they are produced, into two lines in order to reduce the operating cost of the printer by 50%. In addition, the hazardous chemicals, such as ink, were neglected without proper management. Thus, the ASEIC Consulting Team instructed the company to prepare criteria for handling the chemicals.

The ASEIC Consulting Team suggested installing timers with alarms on the raw material mixers in order to control the operation time of the mixers and prevent power loss. Furthermore, the ASEIC Consulting Team instructed the company to standardize the mixing process for quality management.

In order to lower the internal temperature, the ASEIC Consulting Team suggested covering the barrel of the extruder, the heat source of the production plant, with an insulating material so the heat will not escape to the outside. The extruder blower was being controlled manually, and it was causing power loss. In order to improve this issue, the ASEIC Consulting Team suggested a solution of controlling the blower with an inverter.

Final Results

| Table 13 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Replace fluorescent mercury lamps with LED lightbulbs	32,400 kWh/year	KRW 9,008,000/year	Y
2	Improve the operation of 1 line of printer	6,246 kWh/year	KRW 1,061,000/year	Y
3	Minimize power loss by standardizing the raw material mixing process	1,425 kWh/year	KRW 242,000/year	Y
4	Improve insulation on the band heater of the extruder	87,488 kWh/year	KRW 14,872,000/year	N
5	Control extruder blower inverter	103,606 kWh/year	KRW 17,613,000/year	N
6	Specify criteria for handling hazardous chemicals	-	-	Y
7	Install alarm on the raw material mixers	60.8 MD/year	KRW 608,000/year	Y
8	Manage inventory by using first-in, first-out shelf	380.2 MD/year	KRW 3,802,000/year	N
Total	8	Manpower : 441 MD/year Energy : 231,165 kWh/year	KRW 47,206,000/year	

As shown in <Table 13>, Jason Manufacturing Phils. Corp. implemented 5 out of 8 solutions. The company replaced the fluorescent mercury lamps in the production plant and the office with LED light bulbs, and attached timers with alarms on the raw material mixers to control the operating time of the mixers and reduce power consumption.

The company standardized the mixing process and equipped the standardized manuals on each mixer so the workers can perform the operation according to the manuals.

The company also improved the printing mold into two lines to double the printing efficiency and also marked the hazardous chemicals at the printing section and stored them on a chemical shelf.

In case of insulating the extruder barrel, the company decided to purchase an insulating material that can endure the temperature of the barrel from a local merchandiser.

In case of the solution controlling the blower with an inverter, since it could be operated via manual air control based on personal experience, so it will be considered for future implementation.

First-in, first-out shelves will be reconsidered when the production is relatively less than usual, as the production delivery date is currently overdue.

As shown in <Table 13>, if Jason Manufacturing Phils. Corp. implements all the solutions presented in the Consulting Project, it is expected to save 231,165 kWh of energy and 441 MD of manpower per year. These achievements translate into KRW 47,206,000 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

In the beginning of the consulting project, the CEO of the participating company was not strongly committed to the Eco-Innovation Consulting solutions. The probable reason was because the existing production process was being operated without particular issues, thus the CEO did not feel the necessity for the solutions on the process. However when the multinational customers visited the company for an on-site inspection and pointed out the production environment, the participating company became aware of the need for improving the production environment.

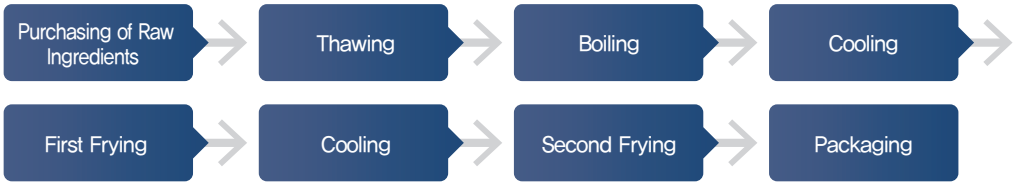
Many of the solutions could not be implemented due to the tight production schedule during the project, which made it unable to stop the operation of the production plant. However, the company will implement the solutions suggested by the ASEIC Consulting Team in the future, reflecting the demands by the customers for improving the production environment.

As the large production plant with dozens of extruders use electricity as its power source, the company can expect high economic and environmental benefits through improving energy efficiency of the production process.

5.5.4. Brickov Foods Inc.

Company Profile

Brickov Foods Inc. processes fried pork rind and organs and delivers them to local retailers. The company is strongly aware of Eco-Innovation. It uses large amount of water while processing the raw ingredients, so in order to reduce production costs, it voluntarily installed a rain water harvesting tank to use the collected rain water for cleaning purposes.



| Figure 32 | Production Process of Brickov Foods Inc.

As shown in <Figure 32>, the company produces its products by thawing and boiling pork rind and organs, the raw ingredients, and deep-frying them twice. Due to the animal fat and deep-

frying oil discharged while boiling pork rind and organs, the wastewater is being contaminated. So, the company built and runs a small wastewater treatment facility equipped with oil skimmer inside the production plant.

Current Issues and Consulting Needs

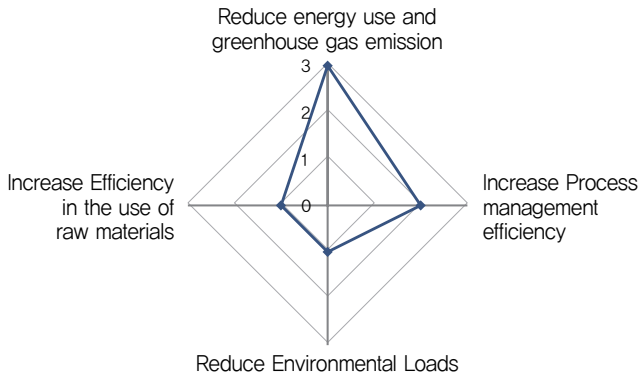
Brickov Food Corp. wanted to improve unpleasant work environment caused by oil mist from various sections in the production plant. It also wished to improve product quality management in order to reduce fraction defective of the products.

In order to improve the production equipment that cannot block oil mist, the company installed a lid for opening and closing on the frying pot to prevent the oil mist from being discharged to outside in order to solve the issue about work environment.

It also produced basket cradle that can store finished products, the fried foods, and it adjusted the temperature and humidity of the storage for finished products to conduct product quality management.

The company was actively involved in the project. It implemented not only the solutions suggested by the ASEIC Consulting Team, but also the voluntary ideas that can improve the work environment, and had a discussion with the ASEIC Consulting Team to actualize the solutions and ideas.

For example, the company had a discussion with the ASEIC Consulting Team about the waste oil collecting equipment it designed on its own to actualize it. Currently, it is being prepared for construction inside the production plant.



| Figure 33 | Consulting Needs of Brickov Foods Corp Inc.

Analysis

| Table 14 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Install lid on the frying pot	Improve fuel efficiency and work environment	Y
2	Standardize frying temperature and working hours	Reduce energy use and conduct quality management through standardizing frying temperature and working hours	Y
3	Produce cradles for baskets holding fried food	Improve product hygiene and work environment by producing cradles for baskets holding fried food	Y
4	Manage temperature and humidity of the product storage	Improve storing of products by managing temperature and humidity of the product storage	Y
5	Use natural lighting to save energy	Install a window in the production plant for natural lighting	Y
6	Replace fluorescent mercury lamps with LED lightbulbs	Replace lights with high-efficiency LED lightbulbs	Y
7	Replace oil skimmer belt	Manage water quality by replacing the belt	N

As shown in <Table 14>, the initial analysis on Brickov Food Inc. discovered total of 7 solutions.
The ASEIC Consulting Team suggested the company to install a lid on the frying pot in order to reduce heat energy loss caused by the lack of lid and improve fuel efficiency. This solution was expected to solve the safety issue inside the production plant as well, as it will prevent oil mist from being discharged to the outside.
The ASEIC Consulting Team instructed the company to standardize the frying temperature and time to reduce fuel consumption and manage the product quality.
The ASEIC Consulting Team suggested replacing the fluorescent mercury lamps with high efficiency LED light bulbs and install a window in the production plant for natural lighting in order to reduce consumption of electric energy.
In order to manage product hygiene, the ASEIC Consulting Team suggested the company to replace wooden baskets for storing fried food into stainless steel baskets, and instructed the company to install a thermometer and a hygrometer in the product storage to manage temperature and humidity, thus to manage product quality.

Final Results

| Table 15 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Install lid on the frying pot	15,541 kg/year	KRW 1,165,000/year	Y
2	Standardize frying temperature and working hours	54.8 MD/year	KRW 548,000/year	Y
3	Produce cradles for baskets holding fried food	13.7 MD/year	KRW 137,000/year	Y
4	Manage temperature and humidity of the product storage	-	-	Y
5	Use natural lighting to save energy	92.16 kWh/year	KRW 15,700/year	Y
6	Replace fluorescent mercury lamps with LED lightbulbs	276.3 kWh/year	KRW 47,000/year	Y
7	Replace oil skimmer belt	-	KRW 93,000/year	N
Total	7	Manpower : 68.5 MD/year Energy :368.46 kWh/year 15,541 kg/year	KRW 2,005,700/year	

As shown in <Table 15>, Brickov Foods Inc. implemented 6 out of 7 solutions.

When installing a lid on the frying pot, the company considered worker's safety and improved it by installing a pulley on the lid, so the workers can open and close the lid from a distance. The company installed a thermometer and used a timer to standardize the working hours, thus it could improve product quality and save energy.

The company also replaced all of the lamps with high-efficiency LED lightbulbs and installed a window in the production plant for natural lighting, thus it could save electric energy.

The company started to manage temperature and humidity of the product storage by installing a thermometer and a hygrometer. However, the product storage is high in humidity and affects the product quality, so the company will install a dehumidifier.

The participating company fabricated stainless steel baskets autonomously to minimize the cost of solution implementation.

As shown in <Table 15>, if Brickov Foods Inc. implements all the solutions presented in the Consulting Project, it is expected to save 368.46 kWh of energy, 15,541 kg of fuel, and 68.5 MD of manpower per year. These achievements translate into KRW 2,005,700 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

The participating company responded that it already understands the idea of Eco-Innovation perfectly on the survey conducted at the beginning of the consulting project. The company also obtained the highest score among the food processing companies on the environmental management evaluation conducted by the ASEIC Consulting Team. Although it is a small company, the CEO and the employees had high level of environmental awareness, and based on such awareness, it showed an advanced attitude by installing and operating rain water harvesting and recycling tank and wastewater treatment facility voluntarily.

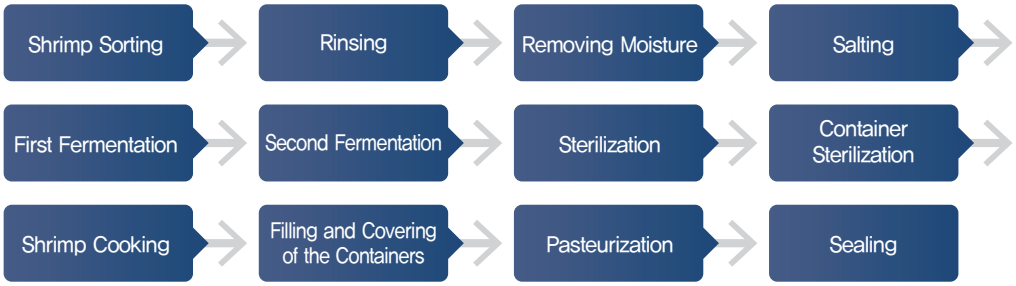
The CEO and the employees carefully studied the list of solutions provided by the ASEIC Consulting Team, and applied the conditions of the site and recreated the solutions into the most appropriate solutions to the actual working site. In order to install a lid on the frying pot, the participating company utilized a pulley to install the lid on the frying pot for the convenience of the workers who will use the improved equipment. This improvement is expected to not only improve work environment, but also enhance working efficiency of the workers as well.

If the waste oil collecting facility and vacuum packaging machine for the products, which the company is preparing autonomously to improve production environment, can be operated, the production efficiency is expected to improve furthermore. The ASEIC Consulting Team hopes that the company's Eco-Innovation achievements can be promoted to the companies of the same field, thus more companies can improve their environments at their production plants.

5.5.5. Balaw Balaw Foods Inc.

Company Profile

Balaw Balaw Foods Inc. was established in 2007. It processes and sells salted shrimps and shrimp powder for cooking. It opened a restaurant in 1982 that used the salted shrimps made on its own. Then, many customers requested to purchase the salted shrimps, so it started to manufacture and sell the salted shrimps.



| Figure 34 | Production Process of Balaw Balaw Foods Inc.

As presented in <Figure 34>, the company sorts and rinses shrimp, the raw ingredient, in order to prepare for processing. It salts the shrimps and ferments them for two times. Then it puts the fermented shrimps into the sterilized containers and seals them to finish the products. The covered cans are pasteurized with hot steam to sterilize the microorganisms in the food and prevent spoiling. Various steps of the processes were taking place in a limited working space, so the production plant needed environmental improvements, such as appropriate ventilation and illumination management.

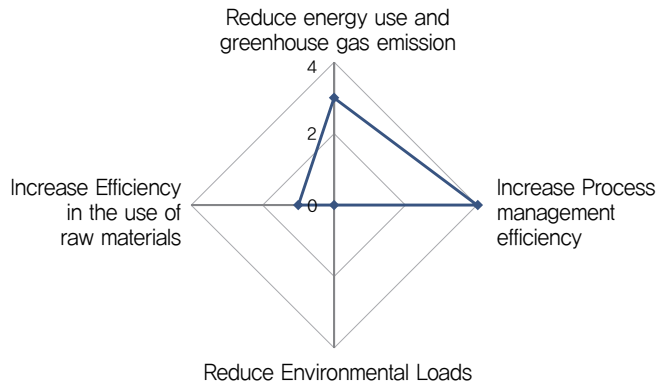
Current Issues and Consulting Needs

In order to use the limited working space efficiently, Balaw Balaw Foods Inc. was using shelves and tool hangers to utilize the space on the walls as much as it could.

The existing exhaust gas hood is small, so it could not appropriately discharge the heat created by the LPG heater for cooking to the outside. This made the production plant quite hot inside. In order to improve this issue, the ASEIC Consulting Team and the company installed a new exhaust gas hood with an appropriate capacity to ventilate the inside of the production plant.

The participating company was wasting production time and human resources due to the inefficient production process. In order to improve this issue, the ASEIC Consulting Team and the company installed a timer on the cooking mixer to manage the cooking time, and improved the illumination of the shrimp sorting table in order to streamline the production process.

The ASEIC Consulting Team and the company also simplified the processes by managing the production facilities. And as the company also runs a large restaurant, the ASEIC Consulting Team carefully reviewed the solutions that can solve hygiene issues inside the production plant.



| Figure 35 | Consulting Needs of Balaw Balaw Foods Inc.

Analysis

| Table 16 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Improve capacity of the exhaust gas hood	Improve capacity of the exhaust gas hood to reduce cooling load	Y
2	Improve illumination for sorting salted shrimps	Improve illumination for sorting salted shrimps to improve work environment and sorting quality	Y
3	Make workers wear gloves when working	Make workers wear gloves when working to improve food hygiene	Y
4	Install timer on the cooking mixer	Install timer on cooking mixer to improve working efficiency	Y
5	Mark graduations on the thermometer of the cooking mixer	Mark graduations on the thermometer of the cooking mixer to manage temperature	Y
6	Install first-in, first-out shelves for the products and raw ingredients	Install first-in, first-out shelves for the products and raw ingredients to manage the inventory	Y
7	Improve flame checking window of the cooking mixer	Install a mirror in order to check the flames through the lower part of the cooking mixer	Y
8	Replace fluorescent mercury lamps with LED light bulbs	Replace lights with high-efficiency LED light bulbs	Y

As shown in <Table 16>, the initial analysis on Balaw Balaw Foods Inc. discovered total of 8 solutions. In order to improve the work environment, the ASEIC Consulting Team suggested the company to expand the capacity of the exhaust gas hood to induce appropriate ventilation inside the production plant and lower the internal temperature.

The workers were not wearing gloves when sorting the shrimps, so there was an issue about product hygiene. Thus, the ASEIC Consulting Team instructed the workers to wear gloves for the sorting process. In addition, the ASEIC Consulting Team suggested the company to install lighting on the shrimp sorting tables to improve insufficient illumination, in order to improve working efficiency and product quality.

The ASEIC Consulting Team suggested installing a timer on the cooking mixer to standardize the process and prevent the loss of electric energy. In order to improve operation efficiency of the cooking mixer, the main production facility, the ASEIC Consulting Team instructed the company to mark the appropriate temperature range on the thermometer of the cooking mixer, so the workers can check the internal temperature on a regular basis. The ASEIC Consulting Team also suggested the company to install a mirror at the bottom of the cooking mixer so the workers can check for the flames.

The ASEIC Consulting Team proposed the use of LED light bulbs to save energy. It also suggested introducing swing-type first-in, first-out inventory shelf for smoother inventory management.

Final Results

| Table 17 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Improve capacity of the exhaust gas hood	96 kWh/year	KRW 16,300/year	Y
2	Improve illumination for sorting salted shrimps	24.3 MD/year	KRW 243,000/year	Y
3	Make workers wear gloves when working	-	-	Y
4	Install timer on the cooking mixer	6.1 MD/year	KRW 61,000/year	Y
5	Mark graduations on the thermometer of the cooking mixer	3 MD/year	KRW 30,000/year	Y
6	Install first-in, first-out shelves for the products and raw ingredients	60.8 MD/year	KRW 608,000/year	N
7	Improve flame checking window of the cooking mixer	3 MD/year	KRW 30,000/year	Y
8	Replace fluorescent mercury lamps with LED light bulbs	110.6 kWh/year	KRW 18,802,000/year	Y
Total	8	Manpower : 97.2 MD/year Energy : 206.6 kWh/year	KRW 19,790,300/year	

As shown in <Table 17>, Balaw Balaw Foods Inc. implemented 7 out of 8 solutions.

The company installed the exhaust gas hood with the area of 1,200mm by 600mm to increase ventilation capacity. This could maintain the production plant in a pleasant condition and prevent the internal temperature from rising.

The company installed light bulbs on the shrimp sorting table to relieve eye fatigue of the workers and improve quality management and enhance working efficiency. The company also standardized the temperature and operating time of the production facility to greatly improve the production efficiency. It also installed high-efficiency LED light bulbs to save energy as well.

In order to improve working efficiency, the company installed a mirror on the flame checking window, and marked an appropriate temperature range on the thermometer to check on the cooking mixer if it works properly whenever necessary. The swing-type first-in, first-out inventory shelf is scheduled to be implemented by early 2017, in consideration of the participating company's budget.

As shown in <Table 17>, if Balaw Balaw Foods Inc. implements all the solutions presented in the Consulting Project, it is expected to save 206.6 kWh of energy and 97.2 MD of manpower per year. These achievements translate into KRW 19,790,300 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

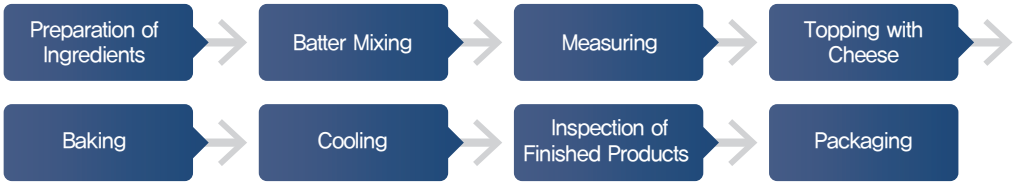
The participating company tried hard to implement the solutions as much as possible. It is being prepared for HACCP certification in order to export its products overseas, such as the United States. In order to meet the certification criteria, the company needed to improve the environment of its production plant.

The solutions suggested by the ASEIC Consulting Team, such as the illumination and hygiene management of the sorting table, standardization of the cooking process, and improving of the work environment, fit into the improvements the company intended to make. Therefore, the CEO of the company took charge and implemented the solutions voluntarily. Implementation of these solutions not only improved the environment inside the production plant, but also enhanced working efficiency of the workers.

5.5.6. Momilo Mio Food Ventures

Company Profile

Established in 2010, Momilo Mio Food Ventures is a baking company cooperating with Sarap, Inc., a local food processing association in Rizal, to supply cheese pies and cookies to local shops. It produces retro style cheese pies of 1980s and 1990s to differentiate itself from other baking companies.



| Figure 36 | Production Process of Momilo Mio Food Ventures

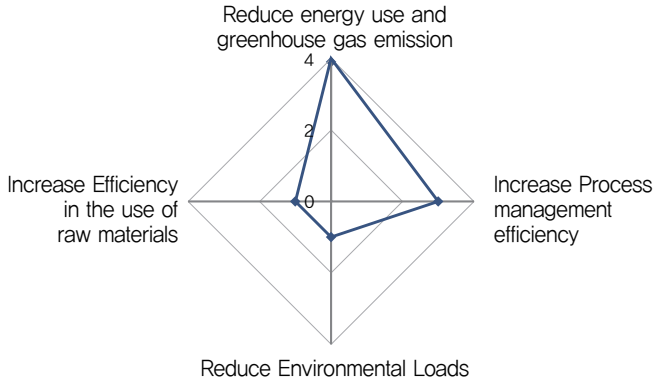
The participating company bakes cheese pies by measuring and mixing the raw ingredients, pouring the batter into the molds, topping them with cheese and baking them in the oven. Among the entire process, the oven baking process uses LPG fuel and consumes 60% of the total energy consumption. The old oven was causing heat loss and wasting energy, so it was urgent to solve this issue.

Current Issues and Consulting Needs

Both of the two production plants of Momilo Mio Food Ventures have ovens installed inside their production plants, and the workers were working on the production process in the same space. Heat was leaking from the aged oven and increased the temperature inside the production plants. The working environment was very poor, thus it was necessary to improve the environment of the production plants.

In order to solve this issue, the ASEIC Consulting Team and the company reviewed the solutions of reinforcing the oven with an insulating material and separating the oven section. In consideration of the small spaces in the production plants, the company and the ASEIC Consulting Team selected and implemented the solution of covering the exterior of the oven with an insulating material and removing the heat source. This could lower the temperature inside the production plants, thus the company could improve the work environment and reduce fuel consumption during the baking process.

The illumination inside the production plants was low, thus it was not efficient to inspect finished products.. So, the ASEIC Consulting Team and the company increased the number of light bulbs inside the production plants and replace fluorescent light bulbs into LED light bulbs to increase the illumination and improve the level of quality management.



| Figure 37 | Consulting Needs of Momilo Mio Food Ventures

Analysis

| Table 18 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Improve the size of transportation equipment for cakes	Improve the size of transportation equipment to shorten the cake transporting time and prevent heat loss inside the oven	Y
2	Improve insulation on the exterior of the ovens	Reinforce the surface of the ovens with flame resistant insulating material to minimize heat loss	Y
3	Standardize the oven operation schedule	Reduce heat loss by scheduling the product preparation time and reducing oven operating time	N
4	Replace mercury light bulbs with LED light bulbs	Replace lights with high-efficiency LED light bulbs (20W→ 8W)	Y
5	Install inspection tables and improve illumination	Install inspection tables and improve illumination to enhance the level of quality management	Y
6	Separate spaces for installing the ovens	Separate the space where the gas oven is installed from other working spaces to improve work environment	N
7	Improve measuring methods	Calibrate the scale and use squeeze bag to improve measuring methods	N
8	Secure ventilation space at the bottom of the LPG storage	Open the bottom part of the LPG storage to prevent accidents when gas leak takes place	Y
9	Segregate waste for recycling	Install recycling bins	Y

As shown in <Table 18>, the initial analysis on Momilo mio Food discovered total of 9 solutions. The ASEIC Consulting Team suggested the company to get bigger working tools in order to shorten the time spent for transporting cakes in the oven to reduce heat loss in the inside of the ovens.

In order to prevent heat loss on the surface of the steel LPG ovens and stop the temperature inside the production plants from rising, the ASEIC Consulting Team instructed the company to reinforce the surface of the ovens with insulating materials. The ASEIC Consulting Team also suggested a solution of separating the space for installing the ovens to remove the heat source inside the production plants, which can reduce the internal temperature.

The ASEIC Consulting Team instructed the company to open the bottom part of the LPG storage for ventilation, so it can prevent accidents at the production plants.

The ASEIC Consulting Team also suggested replacing mercury light bulbs with LED light bulbs

to save electric energy, and to install inspection table for finished products to enhance the level of quality management.

The workers were measuring the raw ingredients manually, so it took a long time to carry out the process. In order to solve this issue, the ASEIC Consulting Team suggested the company to use squeeze bags when measuring the raw ingredients and calibrate the measuring scale on a regular basis to improve the measuring accuracy.

Final Results

| Table 19 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Improve the size of transportation equipment for cakes	60.7 kg/year	KRW 227,000/year	Y
2	Improve insulation on the exterior of the ovens	428 kg/year	KRW 1,605,000/year	Y
3	Standardize the oven operation schedule	94.4 kg/year	KRW 354,000/year	N
4	Replace mercury lightbulbs with LED lightbulbs	221 kWh/year	KRW 37,500/year	Y
5	Install inspection tables and improve illumination	36.5 MD/year	KRW 365,000/year	Y
6	Separate spaces for installing the ovens	-	-	N
7	Improve measuring methods	91.3 MD/year	KRW 913,000/year	N
8	Secure ventilation space at the bottom of the LPG storage	-	-	Y
9	Separate waste for recycling	0.4 MD/year	KRW 144/year	Y
Total	9	Manpower : 128.2 MD/year Energy : 221 kWh/year 583.1 kg/year	KRW 3,501,644/year	

As shown in <Table 19>, Momilo Mio Food Ventures implemented 6 out of 9 solutions.

In order to prevent heat loss when taking cakes out of the oven, the company made the transportation tools bigger and testing them currently. After the worker in charge of the process confirms the working efficiency of the new transportation equipment, the company will make a final decision on the implementation of the solution.

The heat was being transported to the air from the surface of the steel LPG ovens, and the temperature inside the production plants was rising. In addition, the ovens were not insulated,

so the LPG fuel was being wasted. So the company reinforced the surface of the ovens with insulating materials. This lowered temperature inside the production plant and reduce LPG fuel consumption.

The lightings in the production plants were replaced with LED light bulbs, thus the company could save electric energy as well.

The company opened the bottom part of the LPG storage for ventilation, so it could make the work environment safe. The company also attached light bulbs on the inspection table to improve illumination and quality of finished products, thus enhanced working efficiency of the workers.

In case of the solution about separating the spaces for using the ovens, it is in consideration for implementation in the future after the production plants are expanded, as the production plants currently have limited spaces.

As shown in <Table 19>, if Momilo Mio Food Ventures implements all the solutions presented in the Consulting Project, it is expected to save 221 kWh of energy, 583.1 kg of fuel, and 128.2 MD of manpower per year. These achievements translate into KRW 3,501,644 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

The participating company posted the quotes that induce green actions, such as "save water," "turn off the power" or "keep the working tables clean," and installed recycling bins to encourage its employees to practice Eco-Innovation while working. It is because the company recognized that the employee participation is the most important factor in carrying out Eco-Innovation, which is directly connected to the enhanced productivity, after having an interview about environmental management with the ASEIC Consulting Team.

The company insulated the two ovens, the main heat sources, to not only reduce fuel consumption, but also improve the poor work environment with high temperature. The solution dramatically reduced the temperature of the surfaces of the ovens. So, the company could maintain the temperature inside the production plant similar to the outside, which used to be higher than the outside by 5 ℃ or more. The working efficiency of the workers was greatly improved as well. The solution about insulation, which has double benefits with low investment costs, will be shared with the members of Sarap, Inc., a food processing association in Rizal, as the company is its member.

5.5.7. PIDIONG'S HOUSE OF CASHEW NUTS

Company Profile

PIDIONG'S HOUSE OF CASHEW NUTS was established in 1900. It is a family business that processed cashew nuts. It harvests cashew nuts from the farm and processes them in order to provide them to bakeries that use cashew nuts as the raw ingredients and retailers.

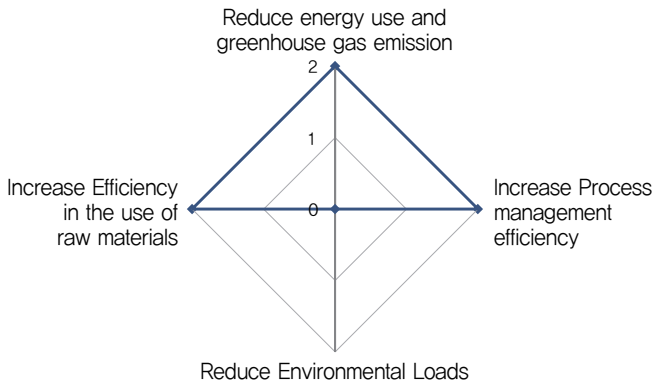
| Figure 38 | PIDIONG'S HOUSE OF CASHEW NUTS

The participating company processes cashew nuts by the following processes: first, it removes hard shells of the cashew fruit, dries the cashew nuts and trims the skin off the cashew nuts before shipping. In order to improve the fuel efficiency of the cashew nut drying oven, which uses charcoal as fuel, the ASEIC Consulting Team suggested a solution to design the drying oven into a multi-stage structured one.

Current Issues and Consulting Needs

PIDIONG'S HOUSE OF CASHEW NUTS' entire production process is done manually, thus the working tables which the workers do their works takes most spaces inside the production plant. As the working tables were placed in between the raw ingredient bags, and the working areas were not divided by the processes, the production plant lacked spaces to store raw ingredients and semi-finished products. In order to solve this issue, the participating company rearranged the production process to fit the production line. It also installed a shelf on the wall to store products, thus could categorize the spaces more efficiently. In addition, it constructed a new building and separated the production area and the product storage area, in order to solve the fundamental issue about securing the space.

The illumination inside the production plant was too low, so the product quality was not being properly managed. The issue could be solved by installing a working table for product quality management and replacing the dark existing fluorescent light bulbs with LED light bulbs, thus creating an environment that enables appropriate quality management.



| Figure 39 | Consulting Needs of PIDIONG'S HOUSE OF CASHEW NUTS

Analysis

| Table 20 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Improve drying racks in the drying oven into multi-stage structure	Perform multi-stage drying to dry a large amount of products at the same time	Y
2	Fabricate quality inspection tables and improve illumination	Install sorting containers and inspection tables with white bottoms and with LED light bulbs attached to them	Y
3	Measure moisture content	Measure moisture content to standardize the drying process	N
4	Improve storing methods for raw ingredients and products	Identify the storage areas and racks for raw materials and products by names or other methods	Y
5	Replace mercury light bulbs with LED light bulbs	Replace lights with high-efficiency LED light bulbs	Y
6	Separate work area and storage area	Secure storage/working spaces to increase efficiency	Y

As shown in <Table 20>, the initial analysis on PIDIONG'S HOUSE OF CASHEW NUTS discovered total of 6 solutions. The ASEIC Consulting Team instructed the company to design the 1-stage dryer into a multi-stage structure to dry a large amount of cashew nuts at the same time, so it could save fuel used for the drying process.

Cashew nuts were being sorted on the working tables with low illumination and dark color. So

the ASEIC Consulting Team suggested replacing the working tables with light color in order to check for foreign materials more easily, and to equip the tables with the sorting containers and lightings. In addition, the ASEIC Consulting Team instructed the company to install racks to store the raw materials piled up and disordered, and to write names and dates on the bags for more efficient inventory management.

The ASEIC Consulting Team also suggested replacing the lightings with high-efficiency LED light bulbs to save electric energy as well.

Final Results

| Table 21 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Improve drying racks in the drying oven into multi-stage structure	2,880 kg/year	KRW 720,000/year	Y
2	Fabricate quality inspection tables and improve illumination	73 MD/year	KRW 730,000/year	N
3	Measure moisture content	-	KRW 180,000/year	N
4	Improve storing methods for raw ingredients and products	152 MD/year	KRW 1,520,000/year	Y
5	Replace mercury lightbulbs with LED lightbulbs	276.3 kWh/year	KRW 47,000/year	N
6	Separate work area and storage area	85.17 MD/year	KRW 851,700/year	Y
Total	6	Manpower :310.17 MD/year Energy : 276.3kWh/year Fuel: 2,880 kg/year	KRW 4,048,700/year	

As shown in <Table 21>, PIDIONG'S HOUSE OF CASHEW NUTS implemented 3 out of 6 solutions. The production increased greatly compared to the time when the company first opened. So, in order to Secure product storage area, the company tore down one of the two building and constructed a two-story building to fix the fundamental issue about lack of space. The existing building will be reorganized by installing storage rack inside the production plant, separating work areas and etc., to utilize the space efficiently.

The solution about redesigning the drying oven into a multi-stage structured one to save energy got overlapped with the Philippine government's notice on the suspension of coal use, so the company decided to replace it with LPG oven in January 2017. Replacing coal fuel with LPG will

also contribute to the reduction of greenhouse gas emissions. The company will also replace all of the light bulbs in the new and existing production plants with LED light bulbs to save electric energy as well.

In order to perform strict quality management, the company will install quality inspection tables equipped with high-illumination LED light bulbs in the new building, which is currently under construction.

As shown in <Table 21>, if PIDIONG'S HOUSE OF CASHEW NUTS implements all the solutions presented in the Consulting Project, it is expected to save 276.3 kWh of energy, 2,880 kg of fuel, and 310.17 MD of manpower per year. These achievements translate into KRW 4,048,700 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

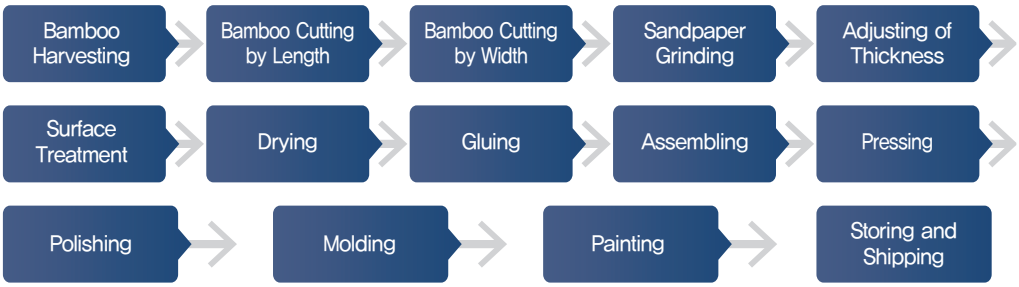
The ASEIC Consulting Team focused more on improving efficiency of working space rather than applying advanced technologies for the implementation of Eco-Innovation of this company. When the ASEIC Consulting Team visited PIDIONG'S HOUSE OF CASHEW NUTS for the first time to conduct initial analysis, the production plant was filled with piles of raw ingredients and semi-finished products, leaving almost nowhere to set anyone's foot on. As most of its processes were done manually, the semi-finished products were piled up near the workers, thus it was difficult to manage the space efficiently.

The participating company fundamentally solved the issue about spacing, which it had been suffering for decades, through a solution suggested by the ASEIC Consulting Team and dramatically improved its work environment. It tore down the one-story existing building and constructed a new two-story building to secure work area and product storage area. The company will also secure product storage area eligible for first-in, first-out management inside the new building, and will reorganize the existing building by processes to maximize the spacing efficiency. The company will also make a space for the workers to rest in a corner of the new building, so the working efficiency can be expected to improve as well.

5.5.8. CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING

Company Profile

Established in 1986, CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING is a handicraft company that processes bamboos to produce furniture, such as chairs. It dries the bamboos, the main raw material, trims them according to the purpose and assembles them to produce furniture.



| Figure 40 | Production Process of CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING

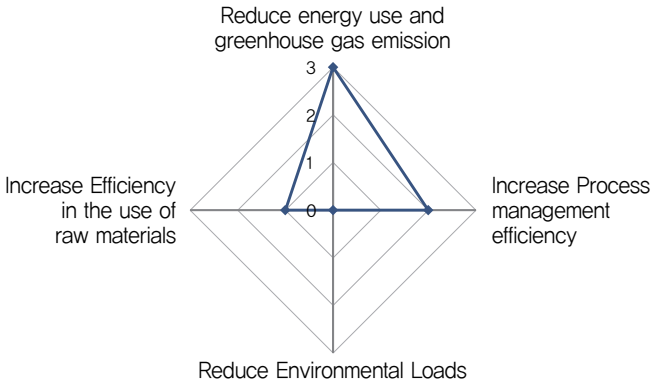
As shown in <Figure 40>, the company trims the bamboos into certain thicknesses to process them into the raw materials. Then it assembles the bamboos according to the furniture designs to produce furniture products. The company was supported by the Shared Service Facility (SSF) Project by the Philippine Department of Trade and Industry (DTI), which supports SME association.

Current Issues and Consulting Needs

Most of the production facilities at CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING use electricity, so the key point was to save energy and reduce production costs. The ASEIC Consulting Team and the company installed a graduated ruler on the cutter to minimize the time spent during the cutting process. In addition, the company could save the use of electricity by managing the operation schedules of the facilities.

The drying oven used for drying the raw bamboo materials was designed in 1-pass structure, so the drying heat was being wasted. In order to solve this issue, the ASEIC Consulting Team discovered a solution of extending the 1-pass drying oven into a 3-pass structure. The construction is currently taking place in the production plant.

The participating company uses equipment like saws, which requires concern for workers' safety, so it was particularly interested in on-site safety management. The ASEIC Consulting Team prepared covers for the double-edged saws, which were being used with bare hands, in consideration for workers' safety.



| Figure 41 | Consulting Needs of CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING

Analysis

| Table 22 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Increase the heat exchange area of the drying oven	Change the 1-pass structure to 3-pass structure to maximize efficiency and improve productivity	Y
2	Use covers for double-edged saws	Use covers for double-edged saws to improve safety and reduce working hours	Y
3	Produce and use jigs for the pressing process	Use jigs for band saws to improve productivity and reduce working hours	N
4	Attach graduated ruler on the cutter	Use jigs for band saws to improve productivity and reduce working hours	Y
5	Use management ledger for shipping and receiving of raw materials	Manage shipping and receiving of raw materials for more convenient inventory management	Y
6	Use management ledger for facility operation schedule	Manage facility operation time to save power	Y

As shown in <Table 22>, the initial analysis on CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING discovered total of 6 solutions. The ASEIC Consulting Team diagnosed that designing the steel pipe into 3-pass structure to maximize heat exchange efficiency will shorten the time for rising the internal temperature and will improve productivity as well.

In order to save power, the ASEIC Consulting Team instructed the company to use management

ledger for facility operation schedule, so it can manage operation time for production facilities.
The workers on site were using double-edged saws with bare hands. The ASEIC Consulting Team suggested them to use covers on the saws to prevent accidents and improve productivity.
The ASEIC Consulting Team suggested the company to use jigs when using band saws and attach graduated ruler on the cutter to enhance accuracy. In addition, the ASEIC Consulting Team instructed the company to use jigs during the pressing process to improve productivity and reduce production time.
The ASEIC Consulting Team also suggested using management ledger for shipping and receiving of raw materials for more efficient inventory management for the raw materials.

Final Results

| Table 23 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Increase the heat exchange area of the drying oven	4,000 kg/year	KRW 1,000,000/year	Y
2	Use covers for double-edged saws	129 kWh/year	KRW 21,900/year	Y
3	Produce and use jigs for the pressing process	103 kWh/year 91.3 MD/year	KRW 930,600/year	N
4	Attach graduated ruler on the cutter	691 kWh/year 60.8 MD/year	KRW 725,000/year	Y
5	Use management ledger for shipping and receiving of raw materials	182.5 MD/year	KRW 1,825,000/year	Y
6	Use management ledger for facility operation schedule	-	-	Y
Total	6	Manpower : 334.6 MD/year Energy : 923 kWh/year Fuel : 4,000 kg/year	KRW 4,502,500/year	

As shown in <Table 23>, CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING implemented 5 out of 6 solutions.
The company could save power by using a management ledger for facility operation schedule and managing facility operation time. It also implemented the use of management ledger for shipping and receiving of raw materials to manage inventory for raw materials.
In order to prevent accidents for the workers and improve productivity, the company produced

and installed covers on the saws. The company also attached graduated ruler on the cutter to enhance accuracy of the cutting process.

On the other hand, when the ASEIC Consulting Team and the company tried to introduce a jig into the pressing process using the band saw, the use of jig elongated the production time and declined the productivity, so this solution was excluded from the list of solutions for implementation.

Improving the heat exchanger into 3-pass structure required high installation cost, so the company searched for introduction of external financial support. The company requested for financial support to the local government unit of Cardona region for the purpose of energy efficiency improvement of Shared Service Facility (SSF) and got approved. The budget was scheduled to be executed, so the solution would be implemented within 2016.

As shown in <Table 23>, if CARDONA MULTI-PURPOSE COOPERATIVE EBAMBOO PROCESSING implements all the solutions presented in the Consulting Project, it is expected to save 923 kWh of energy, 4,000 kg of fuel, and 334.6 MD of manpower per year. These achievements translate into KRW 4,502,500 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

The participating company was strongly determined about improving the work environment inside its production plant, based on the knowledge it obtained through the Eco-Innovation seminar held by the ASEIC Consulting Team and the education on green production technology by DTI.

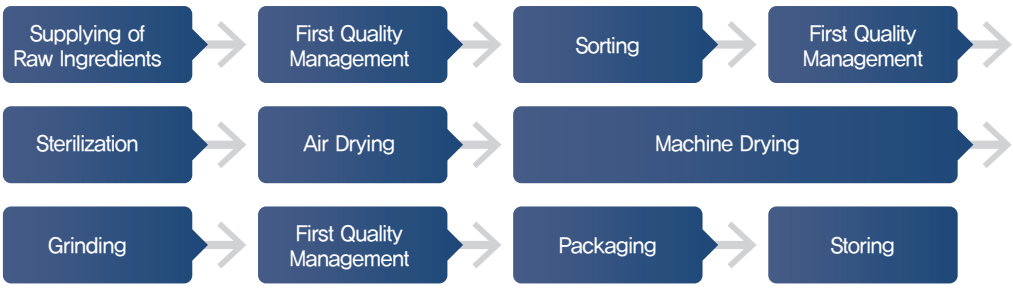
Because of the characteristics of bamboos, a large amount of dust was being created inside the production plant. And the chemicals used in the painting process can be harmful to the workers if not managed properly. In order to solve these issues fundamentally, the participating company discussed about introducing environmental management system to the production plant based on the results of environmental management evaluation conducted by the ASEIC Consulting Team.

Despite the financial barriers, the participating company was active in implementing the solutions and discovered external financial supports. This will be shared as an example of success story in the future that about implementing a solution by making a connection to the external financial support in the Eco-Innovation Consulting Project.

5.5.9. Mabuhay Multi-purpose Cooperative

Company Profile

Established in 2010, Mabuhay Multi-purpose Cooperative manufactures tea products. It processes crops such as guyabano, moringa and turmeric into teas for sale.



| Figure 42 | Production Process of Mabuhay Multi-purpose Cooperative

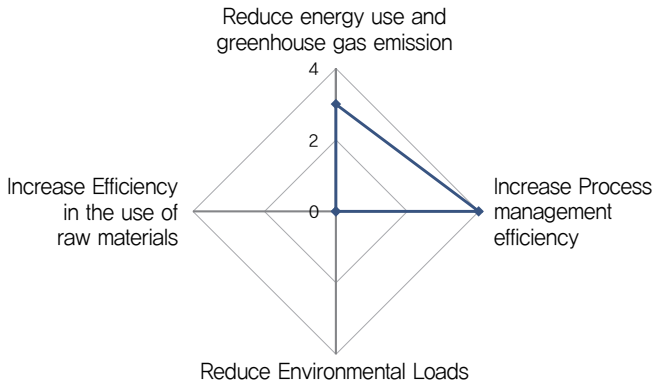
As shown in <Figure 42>, the company produces its products by washing, drying and grinding various crops, putting them in tea bags and packaging. The company owns facilities supported by Shared Service Facility (SFF) Project of the Philippine Department of Trade and Industry (DTI). The companies producing tea, seasonings and etc. share the participating company's facilities.

Current Issues and Consulting Needs

The dryer consumes the most energy among all of the facilities owned by the participating company. When the dryer is operated inside the production plant with the windows closed, the heat from the dryer quickly raises the temperature inside the production plant. There was no appropriate ventilation facility inside the production plant, so the air could not circulate and the heat from the dryer could not escape. Thus, the inside of the production plant was quite hot, so the work environment needed to be improved.

The ASEIC Consulting Team and the company installed a filter on the window to purify the air coming from the outside to the inside. Then, the ASEIC Consulting Team instructed the participating company to install an inflow fan to make the outside to flow into the production plant. These induced the air circulation and could lower the temperature inside the hot production plant.

The dryer was being operated in incomplete combustion, so the ASEIC Consulting Team instructed the company to operate it in complete combustion through periodic maintenance, in order to improve fuel efficiency and save fuel.



| Figure 43 | Consulting Needs of Mabuhay Multi-purpose Cooperative

Analysis

| Table 24 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Improve incomplete combustion of the burner in the dryer	Adjust air damper to provide air for combustion appropriately and improve combustion efficiency	Y
2	Install air intake fan inside the production plant	Install air intake fan inside the production plant to maintain positive pressure and improve cooling load	Y
3	Install air filter on the window frame	Install air filter on the window frame to block foreign materials when inflowing the air from the outside	Y
4	Wear non-slip gloves	Wear non-slip gloves to improve working efficiency when organizing tea bags	Y
5	Categorize display stand for organizing tea bags with dividers	Categorize display stand for organizing tea bags with dividers to prevent slipping	Y

As shown in <Table 24>, the initial analysis on Mabuhay Multi-purpose Cooperative discovered total of 5 solutions.

In order to prevent fuel loss caused by the incomplete combustion of the burner in the dryer, which consumes most energy, the ASEIC Consulting Team suggested a solution about adjusting the air damper to provide appropriate amount of air needed for the combustion.

To induce ventilation inside the production plant, the ASEIC Consulting Team suggested

installing an inflow fan to make the outside air flow in and maintain the air pressure inside of the production plant as a positive pressure, so the air can circulate.
The ASEIC Consulting Team installed a filter on the window frame to purify air when it inflows into the production. This blocks foreign materials from coming in, so this solution solved an issue about quality degrading of tea bags when the window is left open.
The ASEIC Consulting Team also prepared a display stand separated by dividers to organize tea bags. The ASEIC Consulting Team also instructed the workers to wear non-slip gloves to enhance efficiency when packaging tea bags.

Final Results

| Table 25 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Improve incomplete combustion of the burner in the dryer	432 kg/year	KRW 1,620,000/year	Y
2	Install air intake fan inside the production plant	1,209 kWh/year	KRW 205,000/year	Y
3	Install air filter on the window frame	-	-	Y
4	Wear non-slip gloves	109.5 MD/year	KRW 1,095,000/year	Y
5	Categorize display stand for organizing tea bags with dividers	219 MD/year	KRW 2,190,000/year	Y
Total	5	Manpower : 328.5 MD/year Energy : 1,209 kWh/year Fuel : 432 kg/year	KRW 5,110,000/year	

As shown in <Table 25>, Mabuhay Multi-purpose Cooperative implemented all of 5 solutions.
The company solved the issue about incomplete combustion by adjusting the air damper of the LPG dryer burner and providing appropriate amount of air.
The ASEIC Consulting Team instructed the company to operate the air outtake fan in the production plant in the opposite direction, so it can be used as an intake fan,, thus the air inside and outside the production plant can circulate. The company also installed a filter on the window frame to block foreign materials from entering when the outside air flows into the inside.
The workers wore non-slip gloves and used a display stand categorized with dividers for organizing tea bags to enhance working efficiency.
As shown in <Table 25>, if Mabuhay Multi-purpose Cooperative implements all the solutions presented in the Consulting Project, it is expected to save 1,209 kWh of energy, 432 kg of fuel,

and 328.5 MD of manpower per year. These achievements translate into KRW 5,110,000 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

When the ASEIC Consulting Team visited the production plant for the first time in June 2016, the participating company was drying tea leaves with a dryer. The steam created during the process was saturated inside the closed production plant. Therefore, the work environment was very hot and humid, causing low working efficiency of the workers. Because of the issue about the quality of the tea bags, the company could not open the windows. So, in order to lower the temperature, the company operated an air conditioner, and this was the cause of increasing production cost in the Philippines, where the electricity charge is expensive.

The solutions suggested by the ASEIC Consulting Team involving the changing of the use of the fan and installing non-woven fabric filter on the window are economical and efficient solutions that reflect the financial situation of the small participating company. The participating company was also exceptionally satisfied with the excellent effects compared to the investment.

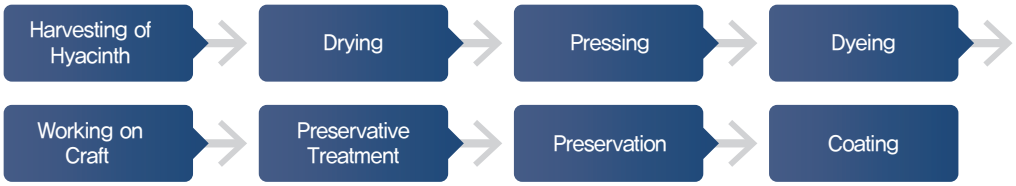
In the Philippines, it is important to maintain the internal temperature of the production plant low, due to the tropical climate. The ASEIC Consulting Team expects the solutions implemented by the company can be promoted to the companies in the same fields, so the SME workers can work in a pleasant work environment.

5.5.10. Laguna Water Hyacinth Handcraft Producers' Association, Inc.

Company Profile

Laguna Water Hyacinth Handcraft Producers' Association Inc. received support on production facilities through the Shared Service Facilities (SSF) Program by the Philippine Department of Industry and Trade (DTI), which is conducted to encourage the development of SMEs. Currently, 11 members of the handicraft association are sharing the company's facilities.

This company processes water hyacinth stems, the main raw materials, to produce bags, shoes, wallets and carpets via handicraft.

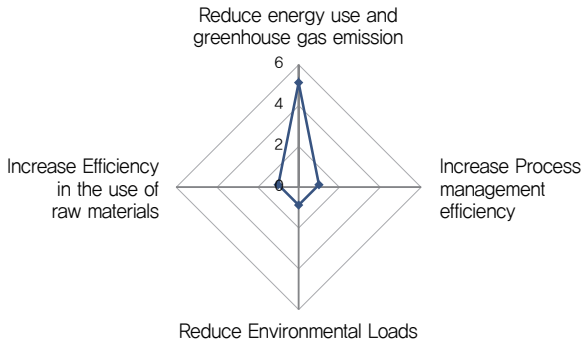


| Figure 44 | Production Process of Laguna Water Hyacinth Handcraft Producers' Association

As presented in <Figure 44>, the company harvests and dries the hyacinth, then presses and dyes them to process them into raw materials. Then it makes them into bags, shoes, wallets and carpets, etc., via handwork. It wished to standardize the dyeing process in order to improve product quality and working efficiency as well.

Current Issues and Consulting Needs

Most of the production process of Laguna Water Hyacinth Handcraft Producers' Association Inc. is done by hands. Due to the characteristics of handicraft, the products are produced based on the workers' experience rather than standardized production process. So the pending issue was to streamline the production process to solve relatively longer production time and energy loss.
The ASEIC Consulting Team and the company could perform quality management more efficiently by maintaining the flattening machine, which uses electricity, and adjusting the gap of the flattening machine. The company could reduce power consumption by speeding up the flattening machine and dramatically reducing the duration time for the pressing process. At the same time, it could reduce duration time spent on the dyeing process by standardizing it with scales and timers. It also minimizes the fuel consumption , which contributes to enhancing efficiency in the use of fuel. The participating company was also interested in efficient use of raw materials, as it wove the leftover pieces of hyacinth stems to recycle them as the materials for the products in order to practice "Zero-waste."



| Figure 45 | Consulting Needs of Laguna Water Hyacinth Handcraft Producers' Association Inc.

Analysis

| Table 26 | Initial Analysis Results

NO	Solution	Details	Adopted?
1	Improve the structure of the heat exchanger of the dryer	Improve the structure of the dryer to enhance thermal efficiency	N
2	Adjust both sides of gap of the flatterflattening machine	Adjust both sides of the gap of the flattening machine to enhance productivity and pressing efficiency	Y
3	Increase motor capacity of the flattening machine	Increase motor capacity of the flattening machine to enhance production speed	Y
4	Standardize the dyeing process	Standardize dye preparation and chemical ratios to improve product quality and enhance working efficiency	Y
5	Replace fluorescent mercury lamps with LED light bulbs	Replace lights with high-efficiency LED light bulbs	Y
6	Measure dyes with a scale	Measure dyes with a scale to enhance accuracy	Y
7	Fabricate container for LPG container and place it in a safe location	Make a container for LPG container and place it in a corner of the wall to prevent accidents	Y

As shown in <Table 26>, the initial analysis on Laguna Water Hyacinth Handicraft Producer's Inc. discovered total of 7 solutions.

The ASEIC Consulting Team suggested the solution of installing a baffle on the back of the dryer currently with low thermal efficiency to delay the emission of combustion gas and enhance thermal efficiency.

The ASEIC Consulting Teasuggested to replace the mercury light bulbs with high efficiency LED light bulbs and place LPG container near the walls to prevent accidents.

The gap in the flattening machine that presses hyacinth stems was uneven, so the ASEIC Consulting Team suggested readjusting the gap of the flattening machine to enhance production speed. The ASEIC Consulting Team also instructed the company to replace the motor of the flattening machine with high-speed motor to enhance energy efficiency.

The ASEIC Consulting Team also suggested standardizing the dyeing process in order to cut down the duration time of dyeing the raw materials and reducing LPG fuel consumption.

Final Results

| Table 27 | In-depth Analysis Results

NO	Solution	Expected Result		Adopted?
		Estimated Savings	Economic Benefit	
1	Improve the structure of the heat exchanger of the dryer	1,080 kg/year	KRW 270,000/year	N
2	Adjust both sides of the gap of the compressor flattening machine	216 kWh/year	KRW 36,700/year	Y
3	Increase motor capacity of the flattening machine	144 kWh/year	KRW 24,500/year	Y
4	Standardize the dyeing process	158 kWh/year 24.3MD/year	KRW 835,000/year	Y
5	Replace fluorescent mercury lamps with LED light bulbs	368 kWh/year	KRW 62,500/year	Y
6	Measure dyes with a scale	12.2 MD/year	KRW 122,000/year	Y
7	Fabricate container for LPG container and place it in a safe location	-	-	Y
Total	7	Manpower : 36.5 MD/year Energy : 886 kWh/year Fuel :1,080 kg/year	KRW 1,350,700/year	

As shown in <Table 27>, Laguna Water Hyacinth Handicraft Producers' Association, Inc. implemented 6 out of 7 solutions.

The company replaced the mercury light bulbs with high efficiency LED light bulbs and stored the LPG container near the walls to prevent accidents.

The company readjusted the gap of the flattening machine to enhance production speed. The company also replaced the motor of the flatter with high-speed motor to enhance energy efficiency.

The company standardized the dyeing process to cut down the duration time of dyeing the raw materials and reduce LPG fuel consumption.

The company had a discussion about repairing the dryer with the personnel from Department of Science and Technology (DOST) who designed the dryer. However, it was difficult to tear down the dryer sealed by welding, so it was impossible to implement the solution inside the production plant. But DOST decided to reflect the solution when it produces dryers in the future.

As shown in <Table 27>, if Laguna Water Hyacinth Handicraft Producers' Association, Inc. implements all the solutions presented in the Consulting Project, it is expected to save 886 kWh of energy, 1,080 kg of fuel, and 36.5 MD of manpower per year. These achievements translate into KRW 1,350,700 per year in economic terms.

Overall Assessment (Effectiveness of the Consulting, etc.)

Water hyacinth stems used by the participating company are harvested from the Laguna de Bay. Laguna de Bay is seriously polluted because the water hyacinths covered the surface of the lake. Therefore, in order to purify the water, the water hyacinths must be removed. By improving the pressing process and standardizing the dyeing process, the company could improve productivity, thus could process more hyacinth stems at the same time. This can not only enhance the productivity, but also contribute to reducing environmental pollution.

The participating company conducts eco-friendly image marketing with the idea of processing water hyacinth, which causes water pollution, and making products out of it. In the same context, the company was highly interested in green marketing when taking the education session on environmental management conducted by the ASEIC Consulting Team. It is reviewing the method of promoting eco-friendly practices of the company by using social network services.

06 Follow-ups

The common pending issues that participating companies faced during the Eco-Innovation Consulting Project is how to secure initial investment to carry on the solutions provided by the ASEIC Consulting Team.

Solutions like introducing energy saving facility have relatively short payback with energy saving costs, so they are relatively easier to get investments. Participating companies with financial powers can make investments by themselves, but, on the other hand, for some without financial, it is recommended to look for extra help by consulting with the related government department, such as the Philippine Department of Trade and Industry (DTI) and the Department of Energy (DOE). There are several low interest loan support programs available for investments on energy saving facility, which encourage the participating companies to invest in energy saving facilities.

Some of the participating companies need to introduce environmental pollution preventing facilities for water, air and waste, in order to comply with the reinforced environmental regulations. Considering the distinct characteristics of SMEs, it is important to suggest and educate the companies about the best available technologies that can respond to environmental regulations with the minimum costs. In addition, it is also necessary to consult the Philippine Department of Environment and Natural Resources (DENR) and local governments to work on assisting environmental improvement funds or low interest loan support, in order to encourage introduction of environmental pollution prevention facilities.

Connection with Shared Service Facilities (SSF) can also be considered as a support measure for the participating companies of the Eco-Innovation Consulting Project. When discovering appropriate projects, it is necessary to assign a share of budget on the SSF project that reflects the demands of the local participating companies. Also, extra points can be given to the candidate SSF projects if the ASEIC participating companies are included as a facility target of SSF at the evaluation and approval phase. At the allocating facilities and monitoring step, accessibility to gain additional supports should be considered through systematic cooperation between ASEIC and SSF, and this can create more synergy effect .

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