Green Organization Model from Life Cycle Assessment of Hard Disk Drive

Jitti Nimnuch, Vorapoch Angkasith, Dhirananta Rithmanee

Abstract*—** *This research studies the guideline of applying the environmental impact analysis by using life cycle assessment (LCA). The guideline from life cycle assessment leads to Eco-design which is a tool to develop environmental friendly products. Eco-design was analyzed with Sustainable Development (SD) which the economy, social, and environment are considered equally important and the concepts come from corporate social responsibility standard, ISO 26000.**

The results from Green Organization Model may be a guideline for organizations to assess the impact of their business on three important fields; economy, social and environment. The sustainable development can provide guideline for business management as a green organization which leads to development of green strategy.

Keywords— **Life Cycle Assessment (LCA), Sustainable Development (SD), Green Organization**

1. INTRODUCTION

In order to reduce environmental impact and manage green organization, improvement or alternatives of production process are required to encourage balanced management between using resources and producing. The 10th Improvement of Economy and Social National Plan indicates that one of the main strategies is to develop biological diversities and to strengthen natural resources and environmental bases. Adjustment of production plan and behaviour to reduces effect on natural resources and environment bases is a sustainable consumption and leads to sustainable production.

This research uses Life Cycle Assessment (LCA) technique which is based on scientific and quantitative data. This characteristic makes it suitable to use as a reliable tool to compare or support decisions. LCA considers every step that enters the cycle from obtaining resources, designing, production, transportation, product usage, reuse to waste management after product expire (Cradle to grave). Energy, resources, and pollution from product is considered in order to improve the product and the production process to have the lowest impact to energy, environment and natural resources. LCA can be used as a guideline to design environmental friendly products (Eco-design). Eco-design is combined with sustainable development (SD) to balance economy, social and environment. These three main fields have minor factors that need to be considered such as increase of productivity, increase of production quality, waste reduction, and cost reduction by using Eco-design. The design aim is to reduce resources but increase the working process quality such as the production. Social quality is measured by Happy Workplace which contains factors of work, culture, leadership and other factors inside and outside of the organization. Most of the activity is for the surrounding society such as forest plantation, building dams and increase knowledge of the society. Environment factors are mainly based on LCA such as 1) Greenhouse effect 2) reduce of ozone layer 3) water and air pollution 4) acidity effect 5) energy usage 6) toxicity to nature. Eco-design will use these factors to gain the highest benefits from resources. These factors are also known as impact factors. These factors leads to quantity assessment and Green Organization Model resulting in increases of competitiveness of Hard Disc industry of Thailand.

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2. METHODOLOGY/EXPERIMENT DESIGN

1. Life cycle assessment (LCA) [1], [2], [5]

LCA is studied following the four steps from ISO14040; goal and scope definition, inventory analysis, impact assessment and interpretation (Figure 1).

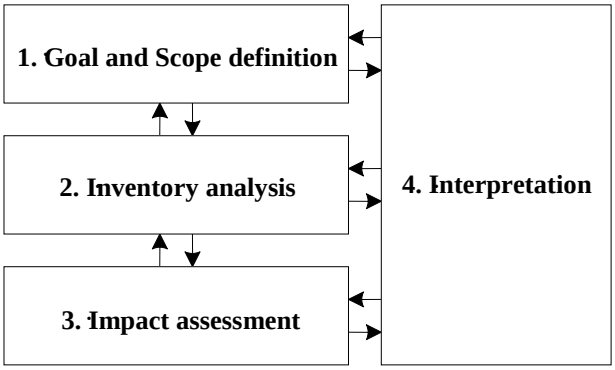


Figure 1: The four steps in LCA

1.1 Goal and Scope definition

1.1.1 Goal definition

- Assess environmental impact of Hard Disc Drive by LCA
- Greenhouse Gas and Carbon footprint are measured to find out which process release highest carbon footprint and design to reduce carbon footprint
- Analyse ideas in Green Organization Model in green organization management

Figure 2: Hard Disc Drive parts

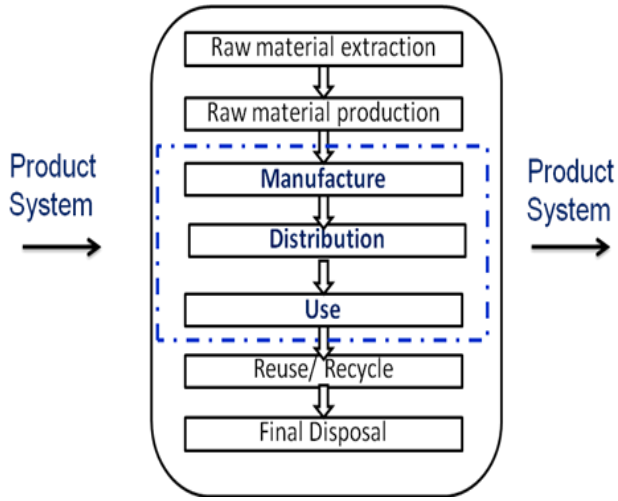


Figure 3: The LCA scopes of Hard Disc Drive

1.1.2 Units of the study

Units of the study were set to use as a basis to set data collection of input and output of the interested system. The functional unit (FU) in this study is a 2.5 inches Hard Disc Drive with 4 years life span that is used in portable computer (Figure 2).

1.1.3 Scope definition of LCA

- The scope of study is the Hard Disc Drive impact on the environment from greenhouse gas and carbon footprint. The assessment begins from the production, transportation and using of the product (Figure 3). The life cycle is divided into 3 steps 1) product assembly. 2) transportation 3) use Hard Disc Drive as a main component in portable computer. Each steps will be explained in analysis list
- The environmental impacts that were chosen to study are 1) Green house effect 2) reduction of ozone layer 3) water and air pollution 4) acidity effect 5) energy usage 6) toxicity to nature. These are the environmental impacts that cause most problems in Thailand.
- Carbon footprint will be applied into two approaches; science and green organization business management which the details are as followed.
  -Approach1 (Science) Find the way to reduce carbon footprint at the point that produce most carbon footprint.
  -Approach2 (Green organization business management)Ideas of designing Green Organization Model)

1.1.4 Hypothesis and limitations

LCA requires large database. However, Thailand did not collect much database. Also resources for making Hard Disc Drive are imported from abroad. Abroad database are acquired such as Eco-invent 2.0 from SimaPro 7.1 which is an instant program used for environmental impact assessment. Therefore, in this research some data that are not collected in Thailand will be from abroad such as research data and journal. [3]

3. RESULTS AND DISCUSSION

This research will aid in finding the environment impact, Green house gas and Carbon footprint. Also, it can leads to a guideline in reducing energy usage and environmental impact of Hard Disc Drive which can be applied to organizations as followed.

-Increase competitiveness from Life cycle assessment. The environmental impacts and Carbon footprint from Life cycle assessment leads to improvement in production process or alternatives. This includes business management as green organization, for instance, Green marketing and able to compete in Non-Tariff Barrier (NTB).

- Life Cycle Inventory Database of inputs and outputs will be obtained which provides information for applying LCA to Hard Disc industry, such as Eco-design, Carbon Footprint, Eco-Label, and Sustainable Product.

-The company can adapt the concept and results from Life Cycle Assessment, Greenhouse Gas and, Carbon Footprint in advertisement. By building environmental friendly stores, green society, and Eco-efficiency attitude, consumers will realize the values of the product to the environment in the long run. [6] ,[7]

As for the concept of Green Organization Model, the process of obtaining begins with three related fields; economy, social and environment. The impact fields are shown in Figure 5.

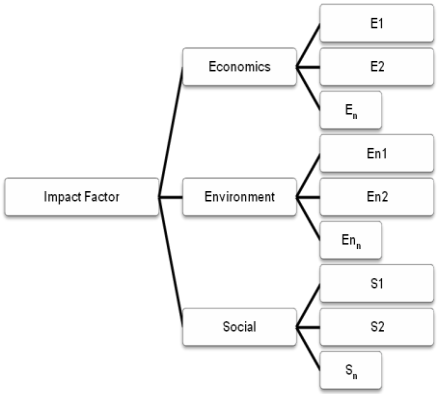


Figure 5: Examples of impact factors from three fields; economy, social and environment. (E1, E2, E_n, En1, En2, En_n, S1, S2, S_n) are impact assessments

The function of each impact factors

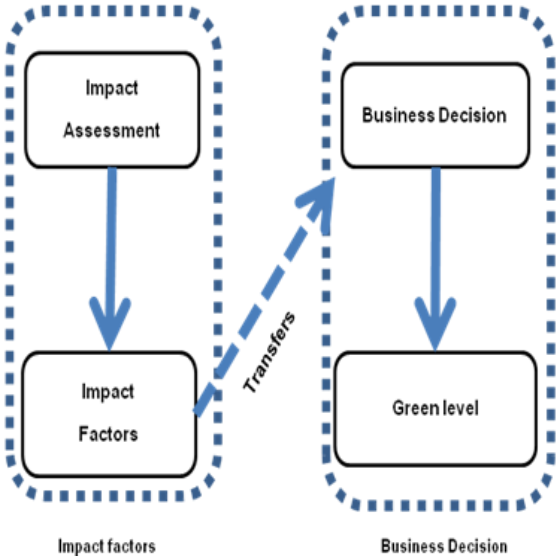
F (Impact factors) = Impact factors(Economic) $\boldsymbol{\theta}$ Impact factors(Environment) $\boldsymbol{\theta}$ Impact factors(Social)

Impact factors' functions from factors from economy social and environment. $\boldsymbol{\theta}$ is Operator function

Figure 6: Green level analysis

When the impact factors functions enters the Business decision, it will leads to Green Organization Model (Figure 7). In this step, we are studying the best tool to use in this research.

F (Green level) = F (Impact factors) $\boldsymbol{\theta}$ F (Business Decision)



Green level analysis is combined with Sustainable Development Model that considers three green factors; economy, environment, and social. The concepts comes from corporate social responsibility standard, ISO 26000 and results in Green Organization Model

1.2 Inventory Analysis

This step includes collection of data that is involved with the environment from each step in goals and scope definition and calculation of inputs and outputs of the product system. The details are as followed.

1.2.1 Manufacturing of Hard Disc Drive parts

This step begins from combining the Hard Disc Drive and packaging. The data was kindly provided from the large Hard Disc Drive manufacturing company of Thailand. The resources, energy and waste are from one Hard Disc Drive (Figure 4).

1.2.2 Usage

The objectives of Hard Disc Drive is to collect permanent data such as the performance system, software system, programs and data in the computer. In this research, usage means the steps using Hard Disc Drive compartment in portable computer in offices base on the length of product warranty.

1.2.3 Transportation

In this research, transportation is the distribution of Hard Disc Drive. The data was kindly provided from the large Hard Disc Drive manufacturing company of Thailand, by SimaPro 7.1 program and truck transportation database of Thailand. Data are calculated by vehicle type, distance and transport weight.

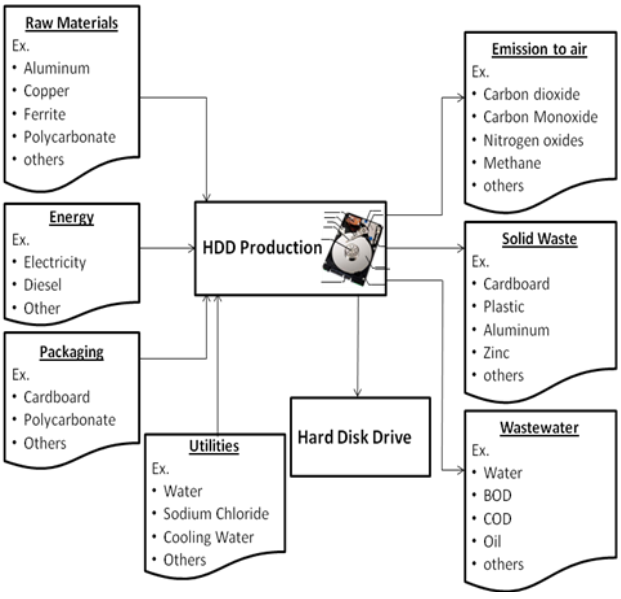


Figure 4: Example of inputs and outputs of Hard Disc Drive manufacturing

1.3 Assessment of Impact

The assessment of environmental impact of product from resources and inputs-outputs from Inventory Analysis step are very important. Classification of groups and comparing impacts are done to prepare information to interpret environment impacts from production step.

Data from the resources and energy list throughout the usage of a Hard Disc Drive in its lifespan is used to calculate for environmental impact by SimaPro 7.1. IPCC 2007 contains classification of environmental impacts and characterization of each group. [4]

1.4 Interpretation

Interpretation makes us understand the guideline in reducing the impact to the environment of a product. We can identify which process cause the highest impact on environment and should have adjustment to create a better environment.

1.4.1 Life Cycle Assessment (LCA) is a technique based in science and quantitative data and is used as a tool to compare or support reliable decisions which will consider inputs to the system such as energy and natural resource.

The guideline leads to development of the manufacturing process to have higher quality or to increase alternatives to reduces impact to the environment. Green organization management in the marketing direction by using LCA results in Eco-design.

Eco-design main idea is to design environmental friendly product and are divided into

1) Design to save resources

2) Design for saving energy

3) Design for packaging

4) Design for recycle

5) Design for disassembly

1.4.2 Sustainable Development (SD)

The definition of Sustainable Development (SD) by World Business Council Sustainable Development (WBCSD) is the development that response to present people and must not affects the need of future people. New organizations need sustainable development because climate change and the resources will be depleted in the next generation. Also factory expansion will leads to reduction of half of the forest, especially in China. Sustainable Development (SD) composes of balanced economy, social and environment. These three parts have minor factors to be considered. Economy will be interested in results from Eco-designing to reduce cost and increase the sales. The socials will consider Happy Workplace Theory which composes of work culture and other factors. Lastly environment cares about LCA in terms of 1) Green house effect 2) reduction of ozone 3) water and air pollution 4) acidity effect 5) energy usage 6) toxicity to nature. These lead to Eco-design that focuses on using resources to have the highest benefit. These impact factors finally lead to Green Organization Model which increases competitiveness of Thailand Hard Disc Drive producers. These will results in having environmental friendly products

1.4.3 Mathematics tools for business decision

The mathematics tools that were used to analyze impact factor are available such as Decision tree model, AHP. , Fuzzy. These tools are studied to select the most suitable tool for analysis.

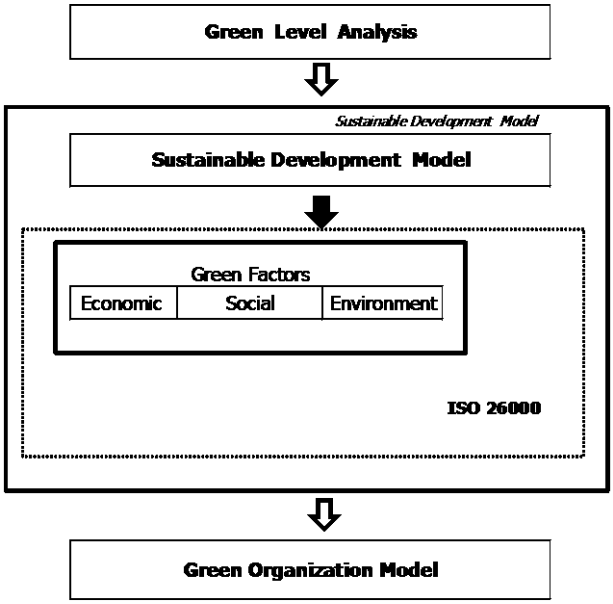


Figure 7: Green Organization Model

Green Organization Model will be a guideline for organization in assessing the impact of business to social, economy and environment under sustainable development. The guideline will improve green production processes or green production alternatives and business management as a green organization. The global market is more concerned does not only considers the quality and the costs of product but the environment is also a factor that is used to restrict market.

4. CONCLUSION

Organizations with business management as a green organizations leads to balances in creating and using resources in a sustainable development way and increases in competitiveness. Presently the world does not only pay attention to the quality process and its costs, but also to the impacts on the environment. The factors have been assessed for their impact on each part of the business; social, economy and environment by using Green Organization Model. This is done by using the guideline obtained from Life Cycle Assessment (LCA) in cooperated with Sustainable Development (SD)

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