'Success in Six' Model to Increase Efficiency and Green Productivity

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ABSTRACT

The Asian Productivity Organisation developed Green Productivity (GP) as a strategy to leverage the power of productivity in order to improve the quality of our environment. GP can foster the creative exchange between people to (i) achieve a better quality of life for all, (ii) support social justice and fairness for citizenry, and (iii) enhance prosperity for their enterprises. This study aims to demonstrate the GP "Success in Six" model on a company that has been in the bottled water industry for over 52 years and manufactures its own 3- and 5-gallon bottled water. Through the model, we perform a 'walk through survey' method to generate and evaluate GP options with the assistance of an eco-map, i.e., a tool for mapping where the location of environmental problems and inefficiencies lie. Subsequently, we leverage on Material Flow Cost Accounting (MFCA) as a quantitative tool to provide recommendations that increase their resource productivity and reduce operational costs. From the analysis and through a material flow profit-and-loss statement, we observe that the proportion of positive products to negative products was 77% to 23%. The GP recommendation resulted in a 55% raw material cost reduction and 10% increase in recycling earnings.

Keywords: g*reen productivity; 'success in six' model; material flow cost accounting; manufacturing*

INTRODUCTION

Issues of sustainable development initiated by economic development activities have exploited resources, such as raw materials, energy and water through infrastructure, industry, building, electricity generation, transportation and others. This situation is a result of: i) supply and demand, where needs are increasing, but resources are insufficient; ii) irresponsible urban development that negatively impacts the environment (Neto, Agostino, Ameida, Garcia & Giannetti, 2018).

Xiang, Gao, Schlosser, Fant and Strzepek (2018) explains comprehensively the condition of water stress because of climate change. The inadequacy of water resources has continually become a critical challenge for a sustainable and growing society. By presenting their findings, Xiang et al. conclude that across southern and eastern Asia (SEA), water stress is worsening due to climate change and this situation is intensified by the large population size and economic projects. Across SEA, an estimated 200 million people are under the threat of water-stressed conditions from climate change and socioeconomic growth. Therefore, widespread adaptive measures are needed to meet these risks in water shortfalls. One of the measurements can be undertaken by adopting Green Productivity.

This paper provides a case study explaining how the green productivity concept was applied to a corporation involving in manufacturing and providing bottled water in order to reduce material costs.

BACKGROUND

Productivity is an important factor that contributes to a country's competitiveness, economic growth, and quality of life (Teniwut, Marimin & Indrasti, 2017). The concept of Green Productivity (GP) is drawn from the integration of two important developmental strategies, i.e., productivity improvement and environmental protection (Ahmed, 2012).

The Asian Productivity Organization (2006) defines Green Productivity (GP) as the logical connection between environment and economic improvement. GP is an umbrella concept covering a hierarchy of improvement opportunities for a business to meet or exceed the needs and expectations of the marketplace. Thesechanging expectations are now embracing good environmental management as a customer demand alongside quality, supply, delivery, technology, health and safety, and cost. GP attempts to answerthe society's needs for a better quality of life by increasing productivity through environmentally sound manufacturing practices and management activities.

According to Tuttle and Heap (2008), GP reflects the fact that the Asian view of productivity has always had a dual focus. There is the narrow firm level view as well as the broad, macro societal view, both of which are reflected in this definition. The APO view is that green productivity involves a concern with using a customer's focus to achieve the appropriate balance between profitability and environmental performance. Logamuthu and Zailani (2010) stated that there is a triple focus of GP - environment, quality, and profitability. Based on Gandhi, Selladurai and Santhi (2006), the central element of GP is the examination and re-evaluation of production processes to highlight ways to improve productivity, while reducing their environmental impact.

There are some external and internal drivers for GP. External forces typically include pressure from regulations, be they local, regional, national or international. Demands from various stakeholders such as consumers and suppliers may drive the organization's GP efforts. Regulations may be in the form of increasingly stricter and more complex regulations and standards, or fiscal instruments such as taxes and penalties or judicial directives. Many national regulations are a reflection of the international regulatory developments in environmental and natural resource protection. Internal forces that affect Green Productivity are integral to the enterprise, such as workers' health and safety, and internal efficiency. The establishment of standards such as SA8000 - adoption of the International Labour Organization's standards for social welfare, and social codes of conduct adopted by corporations and retail chains - are driving businesses to recognize workers' health and safety as a crucial issue in business today. The advantages of ensuring workers' health and

safety include reduced health and insurance costs, reduced absenteeism, lower liabilities and an increase in the morale of the workers.

Green Productivity is a proven concept, not just an idea. GP offers tried and tested methodologies to enhance profitability that can assist their organization achieve their competitive advantage. It also demonstrates practical ways to reduce the impact on the environment, which can lead to cost savings and risk reduction. For example, Marimin, Darmawan, Widhiarti and Yuliana (2018) address the result of a case study applying green productivity and sustainability assessment to the motorcycle tire production process. The main objective of the study was to obtain a potential productivity improvement scenario and, at the same time, perform a sustainability assessment of motorcycle tire production; Li and Wu (2018) measure and decompose the green productivity growth of 18 cities in Xinjiang over 2000–2015; Wang, Sun, Wang, Zhang and Zou (2018) discuss in detail how technological progress can effectively promote peripheral green total factor productivity growth under the influence of environmental regulations.

Green Productivity is a broad strategy for enhancing productivity and environmental performance. Used effectively, it can lead to positive change in socio-economic development. GP's greatest attribute is its potential for integrating environmental protection into the operations of a business as a means of improving productivity that can result in increased profitability, or simply better cash flow. There are three key terms or phrases that are used in the formal definition of GP: (i) strategy, (ii) productivity, which includes economic and environmental performance, and (iii) socio-economic development.

From the strategy aspect, the change has a large effect on the organization. As consumers have more disposable income, they aspire for products with better environmental performance. The organization can cause environmental damage and if the organizations do not take appropriate action, it can cause dissatisfaction among consumers. As a result, consumers may abstain from purchasing the products and/or legislate action. An attractive feature of Green Productivity is that it is a strategythat leads to gains in profitability through improvements in productivity and environmental performance. From the productivity aspect, productivity is a description of the current state of affairs and it

incorporates past efforts. To improve the productivity, the organization needs to establish its objectives and targets to meet its GP goals. From the socio-economic development aspect, GP is a proven methodology to evolve the traditional ideas about growth into sustained growth, which enhances community prosperity.

Green Productivity brings together three elements seen as part of the triple focuses: (i) the environment, represented by sustainable development, (ii) profitability, defined by factor inputs, and (iii) quality, voiced by the customer. GP uses the benefits of quality by promoting the use of (perhaps) newer and safer materials, increasing processing and production efficiency and improving working conditions. The practice of GP results in using material resources and energy more efficiently and sustainably. Productivity is improved by "doing better with less".

THE BOTTLED WATER CORPORATION (TBWC)

TBWC was founded in 1959, has multiple Good Manufacturing Practices (GMP) certified facilities in Taiwan and is a leading supplier of 3- and 5-gallon water bottles (see Figure 2) used in water dispensers. They first started with glass bottles, then polycarbonate (PC) bottles, and finally PET (polyethylene terephthalate) bottles. PC bottles were abandoned as they could possibly raise the risk of cancer. TBWC makes its PET bottles through a two-step cold preform moulding process. This process uses two separate machines:

1. an injection moulding machine for making the preforms, and
2. a reheat blow moulding machine to reheat the pre-forms and blow the bottles.

A sample preform and the preform manufacturing process is shown in Figure 1 and **Error! Reference source not found.**respectively.

With rising demand for bottled water, TBWC automated the manufacturing of PET bottles in 1986 and is continuously looking for ways to improve its productivity and environmental performance. Despite its high annual rainfall, Taiwan is only able to use 20% of it as a water resource**,** making it in the 18th place under the United Nations global

ranking in terms of being a water resource poor region (Taipei Times, 2014).

Figure 2: Sample 5-gallon Water Bottles

Figure 1: Sample PET Preforms

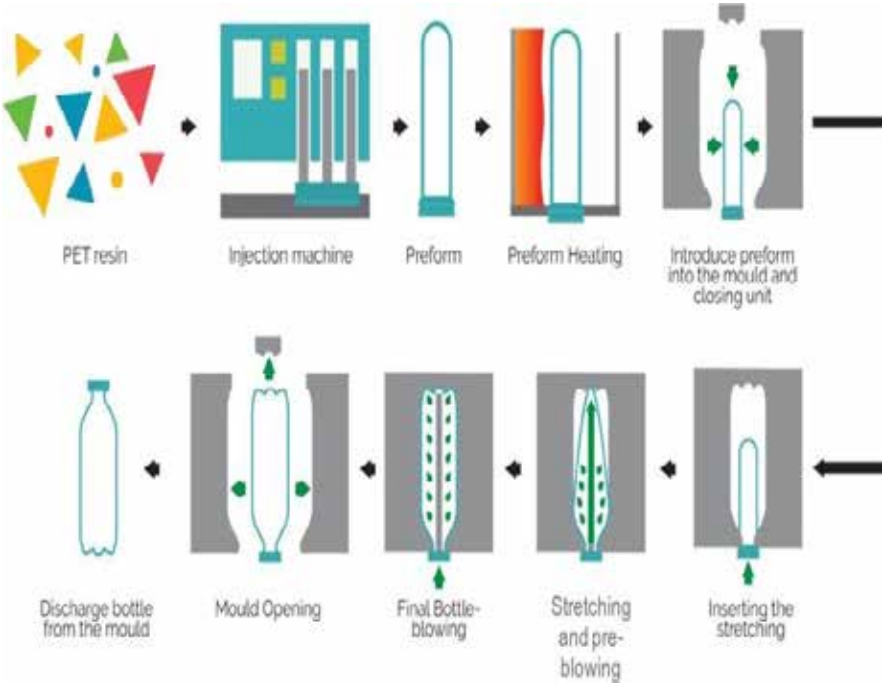

Figure 3: Preform Manufacturing Process

THE GP METHODOLOGY

The GP methodology consists of six major steps (success in six). Each step can be completed by following specified tasks, of which there are 13 (see Table 1). This study further leveraged on Material Flow Cost Accounting (MFCA) to quantify material loss in relation to the production process.

Table 1: Green Productivity Methodology (Asian Productivity Organisation, 2006)

Step 1: Getting started	Task 1: Team formation Task 2: Walk-through survey and information Collection
Step 2: Planning	Task 3: Identification of problems Task 4: Setting of objectives and targets
Step 3: Generation, evaluation, and prioritization of GP options	Task 5: Generation of GP options Task 6: Screening, evaluation, and prioritization of GP options
Step 4: Implementation of GP options	Task 7: Formulation of GP implementation and plan Task 8: Implementation of selected options Task 9: Training, awareness building, and developing competence
Step 5: Monitoring and review	Task 10: Monitoring and evaluation of results Task 11: Management review
Step 6: Sustaining GP	Task 12: Incorporating changes into an organizational system of management Task 13: Identifying new/additional problem areas for continuous Improvement

Example of applications of MFCA can be found in Doorasamy (2016) in which the author uses MFCA to assess the level at which cleaner production (CP) can improve both environmental and economic performance of an organization. This work resulted in a percentage reduction of unburned coal from 25% to 2%, improved boiler efficiency from 70% to 98% and decreased coal usage. Siew, Wan and Andiappan (2018) adopt an MFCA-based approach to reduce waste generation for a sago wastewater treatment process and to ensure that pollutants in discharged water comply with discharge regulations.

SUCCESS IN SIX

Step 1: Getting started

To conduct the study, two cross-functional teams comprising four members each were formed. This team was formed based on needs analysis with the assistance of an external consultant. Team 1 was tasked to observe water bottling and water treatmentoperations including the recycling of bottle washing water. Team 2 studied the bottled water value chain. Walk-through surveysand interviews were performed in order to quickly identify problem areas.

During the walk-through survey, the followings were observed:
1. Water leakages when washing the recycled bottles.
2. Drenched flooring which is a major contributor to slips and falls where serious injuries are the result.
3. 20% of water used for cleaning is wasted during the production process.
4. Lack of glove usage during production. Statistically, wearing gloves reduces the relative risk of hand injury by 60 percent (Sorock et al., 2004).
5. Insufficient use of floor marking for walking paths.
6. Manual recording used to track bottle usagefrequency.
7. Manual quality checks used to ensure bottle reusability.

These observations form the basis of improvements at latter steps.

Step 2: Planning

An eco-map (see Figure 4) from the data and information gathered from Step 1 was used to identify root causes and set performance targets.

Observations were categorised into three areas:
1. Health, Safety and the environment (HSE) for water leakages during bottle refilling, drenched floors, lack of safety equipment and poor markings for walking paths.
2. Recycling operations for wastewater andthe bottle reuse process.
3. Technology to assist with recording and quality checks.

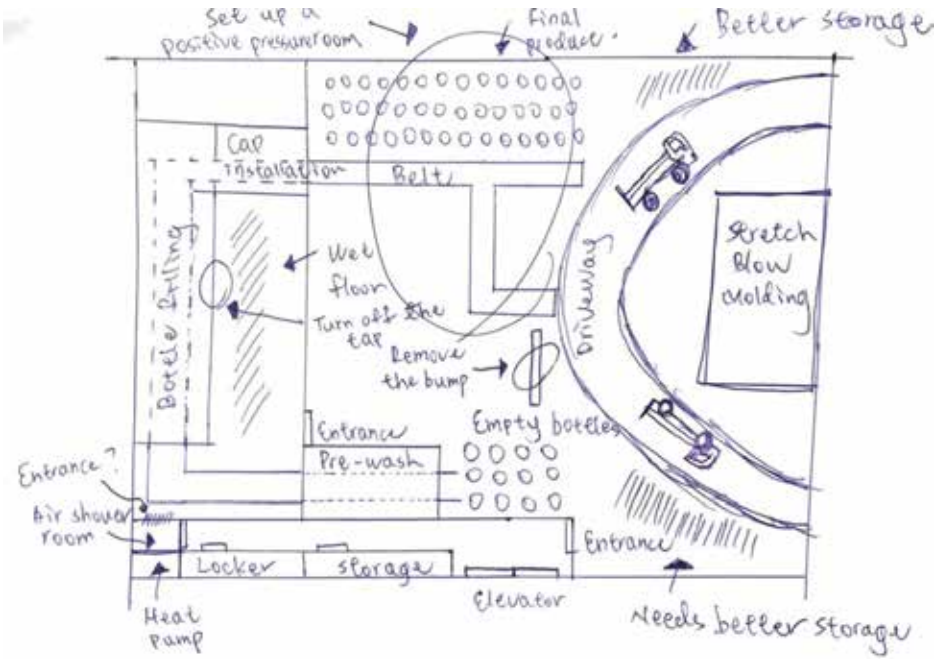

Figure 4: Eco-map of the facility with initial GP options based on the walk-through survey

To address these areas, the following targets were proposed:
1. Health, Safety and the environment (HSE): Zero failures
2. Recycling operations: Best effort
3. Technology: Best effort

Step 3: Generation, evaluation, and prioritization of GP options

The following GP options were proposed:

1. Health, Safety and the environment (HSE)
   (a) For water leakages, measure the volume of water wasted and identify the source of the leakage. Water waste should be near-zero during production with minimum leakage.
   (b) For drenched flooring, set up a standard operational procedure (SOP) to reduce water spillage or floor structures that allow for surface water drainage.

(c) For the lack of safety equipment, set up a business excellence team to ensure that SOPs are practiced.
(d) For poor markings at walking areas, identify the right type of floor markings for each area.

2. Recycling operations
   (a) Fully reclaim waste water leakage.
   (b) Perform recycling based on the material composition indicated by the recycling code commonly found for plastic products.

3. Technology
   (a) Leverage on barcodes or passive RFID tags to assist with obtaining bottle usage frequency and quality checks

Step 4: Implementation of GP options

A plan was developed to (i) act as a guideline to implement your selected Green Productivity options, (ii) build awareness and assist with training and (iii) serve as a means to review the progress and report to top management.

Step 5: Monitoring and review

The monitoring and reviewing of GP options is vital to ensure that the plan and targets are achieved. Findings are reported for review by management on a periodical basis.

Step 6: Sustaining GP

The final step requires sustaining GP action plans to correct where necessary or to build on existing successes. Having a feedback loop is essential to keep track of the progress and to respond to the changing circumstances imposed by internal and external drivers, including customer expectations, the environment and other innovations that may accelerate the greening of productivity.

KEY MFCA FINDINGS AND RECOMMENDATIONS

MFCA is one of the major tools for environmental management accounting and promotes increased transparency of material use practices through the development of a material flow model. It traces and quantifies the flows and stocks of materials within an organization in physical and monetary units. This is a method of environmental management accounting that simultaneously achieves 'reduced environmental impacts' and 'improved business efficiency'. Concisely, MFCA is an instrument used by manufacturing companies to improve their material efficiency. For the period of February to July 2017, the followings were identified for the production process:

1. 62.9% of raw material costs are from PET resins (see Figure 5)
2. The cost of positive products (what we want to produce) constitutes77% of total output (see Figure 6)
3. The cost of negative products (waste) constitutes 23% of total output (see Figure 6)

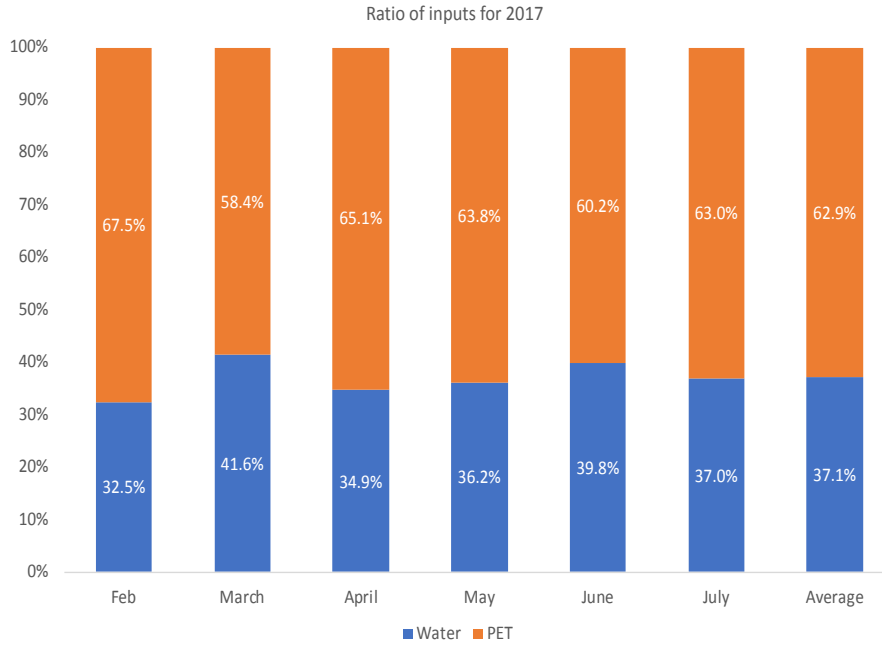

Figure 5: Water and PET usage from February to July 2017

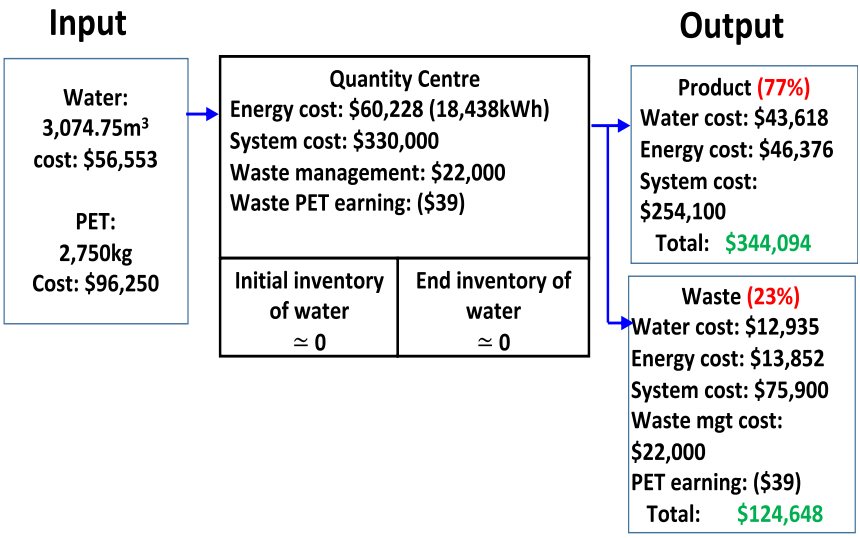

Figure 6: Material Balance

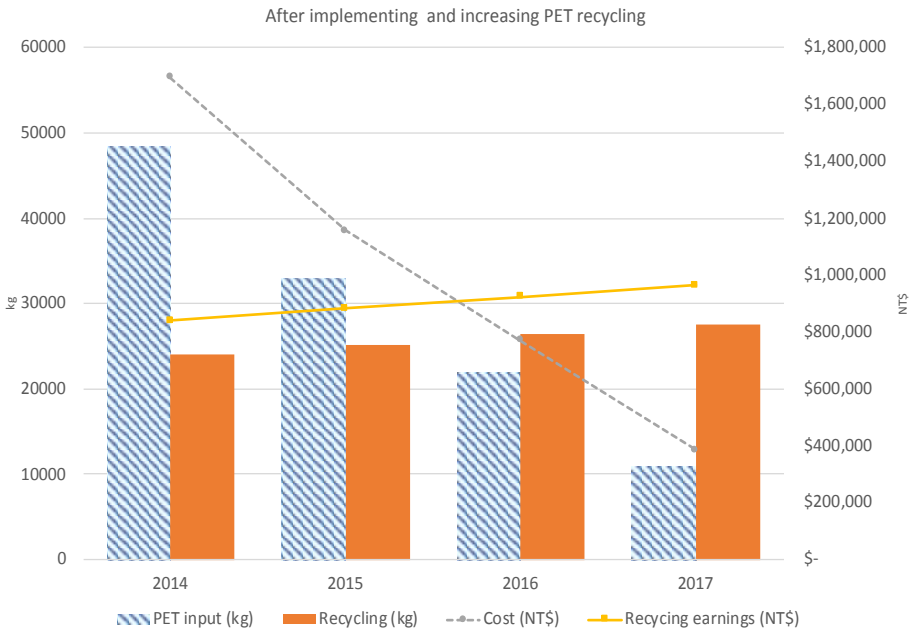

Figure 7: Savings resulting from PET recycling activities

To reduce material costs, the GP recommendation was to increase PET recycling activities. From 2014 to 2016, recycling activities resulted in a 55% raw material cost reduction and 10% increase in earnings. As a result of our further recommendations, a further reduction of material cost by 50% and an increase in earnings by 4.3% from 2016 to 2017 is expected (see Figure 7).

CONCLUSION

Environmental issues are surfacing. Businesses need to place emphasis on the green productivity (GP) process in order to increase their competitive advantage, to be more efficient and environmentally friendly. GP not only provides a structured methodology to identify problems and solve them, but also to support the sustainability development goals. Companies which are implementing GP can be recognised as a 'green company' and this label is attractive to investors thus easing the financial process from banks or institutions under the sustainable finance approach.

Given that the walk-through process was performed over a duration of one day, results from the TBWC case study show that opportunities for improvement can also be identified. We summarise by highlighting that MFCA was used to identify factors affecting the costs. This was followed by recommending a specific initiative, among others, to intensify recycling activities to achieve a reduction in material costs. Recommendations resulting from the methodology can be implemented in order to provide alternative solutions to solve problems. The model also provides a logical step-by-approach which can assist a company to implement GP. Such a tool can be implemented in all manufacturing companies and can be enhanced with other quantitative approaches. An extension of this work would be to investigate the efficiency of PET recycling processes.

FURTHER STUDY

This case study provides a platform to continue evaluating the implementation of the GP model in other industries. The use of

quantitative approaches for testing variables generally provide an avenue for deeper insights when considering practical implementations. As such, the use of MFCA as a part of an environmental toolkit can be combined with the GP methodology to improve efficiency in the production process. This will help productivity implementations in different industries to quantify any obstacles and any benefits that can be obtained.

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