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Planning for Environmental Sustainability Improvements – A Concept based on Eco-Efficiency Improvement

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Abstract

One of the major issues companies face in driving environmental sustainability is the lack of focus. To overcome this issue, we propose a methodology based on the concept of eco-efficiency improvement (EEI) to help companies plan for environmental sustainability improvements. Through this methodology, the current state of a company in terms of environmental performance is assessed and hotspots for improvement are identified. Subsequently, proposed initiatives to address the hotspots are evaluated and prioritised to help the company focus their sustainability efforts to achieve greatest impacts. To demonstrate the application of the methodology, a case study of a fruit juice manufacturing company is presented.

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1. Introduction

One of the major issues companies face in driving sustainability is the lack of focus. In a survey by McKinsey & Company, they found that companies often have more ongoing initiatives than they can effectively manage. Two-thirds of the 500 companies surveyed have more than 10 to 30 different sustainability initiatives at one time [1]. That in turn causes a common situation whereby top management fail to prioritise ongoing initiatives, resulting in fragmented, decentralised business units that are not well-aligned with one another or overall top-level goals. In contrast, a McKinsey Global Survey, consisting of 3,344 participating company executives in February 2014, found that companies with a unified strategy, coupled with no more than just five strategic initiatives were almost three times as likely to be among the top performers, in terms of both financial and sustainability performance [2]. These findings highlight the importance and need for prioritising sustainability initiatives.

In prioritising sustainability initiatives, companies need to focus on the quality, rather than the quantity of initiatives.

They must know which initiatives are worthwhile to pursue, and which are not, given that resources are often limited. One way to do this is to use eco-efficiency as an indicator to evaluate the cost-benefits of sustainability initiatives.

Eco-efficiency is defined as the ratio of a company's financial performance to its environmental performance [3]. Various methods based on this indicator have been proposed to assess and improve the sustainability of companies [4,5], products, services and systems [6–8]. In the paper by Li et al., an eco-efficiency approach was used to evaluate the energy and resource efficiency of manufacturing processes [9]. Life cycle costing and carbon footprint analysis methods were combined by Low et al. to model and benchmark the eco-efficiency of closed-loop product life cycles [10]. In another paper, the authors used a similar concept to guide decisions in design for environment (DFE) [11]. In the work by Ng et al., the use of the carbon-value efficiency metric was proposed to integrate and implement lean and green approaches to improve the eco-efficiency of companies' operations [12]. Visualisation techniques have also been introduced to improve the intuitiveness of eco-efficiency analysis for

decision support [13–15]. Eco-efficiency best practices have been established in the aspects of company strategy [16], product and process improvement [17,18], leveraging technology [19] and customer integration [20]. However, existing methods for eco-efficiency improvement deal with limited number of initiatives [4,5], lack support for early-stage initiative prioritisation [4] and have not considered the impact of time horizon in the analysis [4–7]. Without an effective mechanism for initiative prioritisation, application of best practices in the companies' context may not bring about the desired impact [1].

Complementing the existing body of works, we propose a methodology to help companies plan for environmental sustainability improvements based on the concept of eco-efficiency improvement (EEI). In this paper, we will explain the methodology in terms of how the current state of a company's environmental performance can be assessed to establish a baseline, how hotspots for improvement can be identified, and how proposed initiatives to address the hotspots can be evaluated and prioritised.

For the purpose of demonstrating the application of our proposed methodology, a running example using a case study of a fruit juice manufacturing company is presented. This company is a well-established Singapore fruit juice manufacturer with a regional manufacturing and distribution network. The company produces large amounts of fruit juices with its primary product being apple juice, which is produced

daily and exported to Southeast Asia and Australasia. The company aims to bring quality apple juice to its customers, with as low overall carbon emissions as possible throughout the product's entire life cycle. Using this case study, we will demonstrate how through our proposed methodology, companies are able to consolidate their environmental sustainability efforts and focus on the things that have the greatest impacts.

2. Methodology

Our proposed methodology based on the concept of eco-efficiency improvement (EEI) is shown in Fig. 1. It follows the structure of a framework consisting of four phases. Based on this structure, the steps in the methodology are described in the following sections.

2.1. Current state assessment

In this phase, the objective is to assess the environmental performance of a system and establish a baseline for improvement. The business-as-usual scenario was set as the baseline as a reference for comparison. In the case study of the fruit juice manufacturing company, the system targeted for improvement is the life cycle of a one-litre (1L) carton apple juice. The life cycle processes are mapped out in Fig. 2.

To assess the environmental aspect of the system's eco-efficiency, we built a carbon footprint (CFP) model covering the full life cycle of the product (i.e. raw material acquisition, manufacturing, distribution, usage and end-of-life) following the guidelines set out in ISO/TS 14067 [21]. Within each life cycle stage, detailed processes are modelled with the individual inputs and outputs associated to the life cycle activities documented. This forms the life cycle inventory data with which CFP is computed by taking into account all the greenhouse gases and multiplying it by their respective global warming potential (GWP) values published by the IPCC [22].

With the life cycle CFP of the 1L carton apple juice computed, we have established a baseline for improvement. However, in order to evaluate the costs of implementing sustainability initiatives in the later phase, a financial baseline also needs to be established. This is necessary because some initiatives may incur additional capital expenditure (CAPEX)

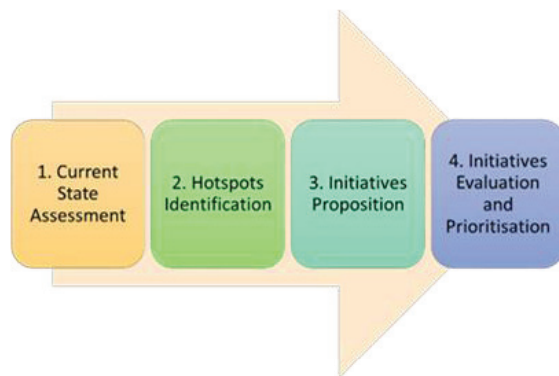


Fig. 1. Framework to plan for sustainability improvements.

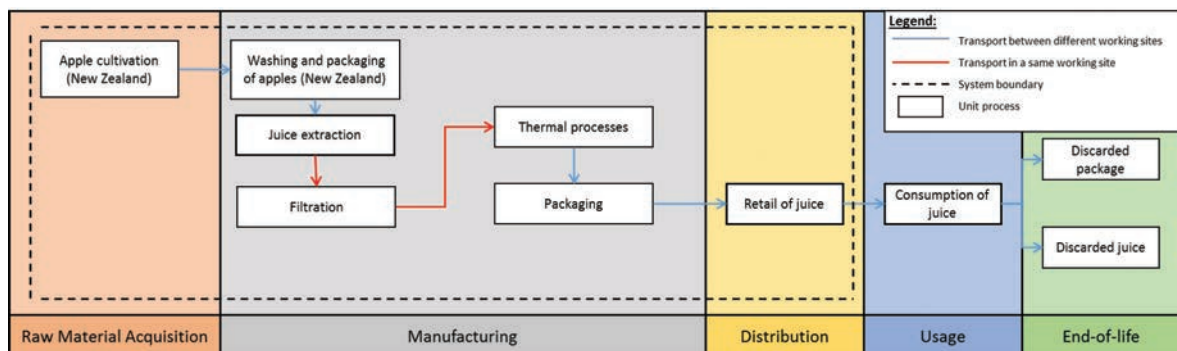


Fig. 2. Life cycle process map for case study of fruit juice manufacturing company.

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