CHAPTER

9

PRODUCT END-OF-LIFE MULTI-CRITERIA DECISION ANALYSIS FOR GENERAL PAPER PRODUCTS

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9.1 INTRODUCTION

Recently, the product manufacturing industry has expanded faster than anticipated. As the world population increases, the production of goods also increases. Most manufacturing companies focus on improving product design, manufacturing, and marketing to produce better products (Toffel, 2003). Nevertheless, the rapid development of the production of goods has led to environmental effects due to the manufacturing process. Over many decades, unsustainable consumption and production patterns have resulted in increased waste generation (Lee et al., 2001). The impact of this high-volume manufacturing process can cause environmental effects due to the product's life cycle (Gehin et al., 2008).

In this new era, the quantity of waste products continues to increase. To date, suitable methods that can be used to determine the end of life (EOL) of a product option remain limited. The only regulation for expired products is the landfilling process (Rose et al., 2000). In addition,

most previously developed methodologies do not consider the materials' ecological, economic, and social parameters prior to determining the product EOL. Therefore, this chapter proposes a methodology for determining EOL options using multi criteria decision analysis (MCDA) and the analytic hierarchy process (AHP). Besides, this chapter explains the graphical user interface (GUI) for general paper products because it is currently in demand.

9.2   END OF LIFE

End of life (EOL) is defined as the final stages of a product's existence where it no longer fulfils the demands of the purchaser or the first user. It is also defined as when the product can no longer work as the original function due to failure or wear out (Rose et al., 2000). Regarding its EOL, it can either be reused, remanufactured, recycled, dumped in a landfill or incinerated (Lee et al., 2001), which are some options in planning a suitable process for the products.

The option for determining product EOL depends on the objective of whether to maximise surplus or minimise environmental impact. The impacts of product disposal can be minimised through ideas and designs that consider these impacts before products are produced.

Rose et al., (2000) developed the software called EOL design advisor (ELDA) to guide all manufacturers in determining the suitable EOL option based on the product characteristics. It is a web-based tool for improving and evaluating product EOL options. The ability of ELDA to classify EOL options enables manufacturers to redesign products with low environmental impact.

Using the proposed software, the option can be accurately determined using AHP in comparing the criteria to evaluate the product's environmental impacts. Lee et al. (2001) presented a comprehensive framework for assessing whether or not an EOL option is feasible by using the material composition of the component as the foundation for the guideline. The decision to remanufacture or reuse involves advanced component knowledge, manufacturing process and

EOL status, as manual intervention can only make the decision. Many researchers have suggested a method for calculating the EOL value of the product for every choice taken.

9.3 GRAPHICAL USER INTERFACE

Graphical user interface (GUI) interfaces with electronic devices such as computers and laptops. It is a user interface that visually represents the necessary commands and operating system or software device functions. Users are not required to know or understand how those commands work, as GUI is user-friendly. The simplicity of use of GUIs has allowed the public to access a wide range of systems for everyday usage regardless of expertise or knowledge. In this chapter, GUI was developed by using visual basic for applications (VBA) in Microsoft Excel based on the process of the AHP method. VBA is a Microsoft Visual Basic adaptation of the event-driven programming language. It has an integrated development environment (IDE) that allows you to create user-defined functions (UDFs). Using the Visual Basic Editor (VBE), which offers a window for creating and debugging code and the module organisation process, VBA programming may make spreadsheet manipulation possible.

A comprehensive review of the challenges and the state of the art of real-time communication in sensor networks can be found in. A routing protocol based on link quality is proposed in the ETX metric developed as the metric's function is to select the forwarding node.

9.4 PROPOSED METHODOLOGY

Analytic hierarchy process (AHP) is a useful tool for addressing complicated decision-making problems, and it may assist decision-makers in prioritising and making the best option possible (Beynon, 2011). It solves decision-making challenges using criteria and alternative hierarchical structures.