Int J Adv Manuf Technol (2014) 70:1403–1413
DOI 10.1007/s00170-013-5373-3

ORIGINAL ARTICLE

Development of decision support system for fastener selection in product recovery oriented design

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Received: 4 October 2011 / Accepted: 27 September 2013 / Published online: 22 October 2013

Abstract Among the important strategies in sustainable product development is by maintaining product recovery and prolonging product life which are highly dependent on the ease of disassembly. When considering the design for disassembly, there are many fastener-associated factors to be considered such as structural, disassembly process and the pre-disassembly process. There are very few designs for disassembly methods that support the selection of fasteners for design for disassembly (DfD) concepts. Most of the tools developed are more applicable during later stages of the design process when more product information is available. The process of selecting a fastener for its functional characteristics itself is often vague. Additionally, the requirements for disassemblability further complicate the process. This paper proposes the development of a multi-criteria decision making model to assist designers in selecting fasteners for DfD. PROMETHEE was used to build a decision-making model to help the designers in selecting the fasteners that could perform their intended functions with ease of disassembly. A design case study is described to reflect the usefulness of the fasteners selection model.

Keywords Design for disassembly · Product recovery · Fasteners selection · Decision-making model · PROMETHEE

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1 Introduction

Sustainable product development has been a key issue in recent years especially with the stronger awareness in the depletion of natural resources and environmental degradation. In the EU, the heighten awareness of sustainable development is intensified with the introduction of various regulatory measures to ensure sustainable development such as end of life on vehicle directives, energy using products directives and waste of electrical electronic equipment that comply the necessary requirements of product recovery and waste management issues before a product is introduce into its market. Other countries have also responded with various regulatory requirements, such as Japan. In order to remain competitive in this situation, manufacturers must actively ensure product compliance. The production of waste has over burden effect to the landfill cost, which leads to municipalities in some countries to introduce waste tax to producers and consumers. Waste generation is now not only an environmental issue but an economic issue as well whereby the cost of disposing wastes can no longer be discounted as trivial. Product recovery not only reduces the ecological impact, but could also have a positive economic impact to industries through the sale of reused parts and materials. Product recovery is defined as the activities that lead to the salvaging of material and energy of products at its end of life [1].

Another form of strategy in ensuring waste generation to its minimum is by prolonging the life of products through proper maintenance. It further reduces the emission that is caused by product wear and inefficiency. Product recovery and maintenance depend largely on its ability to be disassembled. The introduction of product service supply as a product recovery strategy also have led to the need for better components salvaging whereby disassembly is a critical activity in its success [2]. Disassembly is also important in recycling as the separation of materials will improve recycling efficiency.