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A Design Tool to Diagnose Product Recyclability During Product Design Phase

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Abstract: Product development with a high potential for materials recycling is a way to contribute to the conservation of natural resources. Therefore, issues such as product reuse, remanufacturing and reprocessing must be considered during the product design stage. This paper proposes a diagnostic tool to evaluate product recyclability to be applied during the product design phase, acting as a supporting tool for designer decision-making. The potential for recyclability is connected to two factors: materials recycling and disassembly process. For disassembly process, the number, type and accessibility of fasteners were considered. For material recycling process, recycling infrastructure, material compatibility, presence of hazardous materials and existence of contaminants were considered. The proposed indexes are to be used with the product's Bill of Materials (BOM), during the conceptual and embodiment phases of product design. The tool was designed to provide the product's grade of recyclability a graphical diagnosis, aiding the designer in making better design choices. Thus, the designer can diagnose the most critical parts and change the product while still in the design phase, improving the product's recyclability at its end-of-life. A Design for the Environment (DFE) suggestion bank is also provided, to aid the designer in carrying out the improvement decisions. The proposed tool was used in a portable cassette and CD player, simulating its redesign, aiming to improve its end-of-life (EoL) performance. The results demonstrated the ease-of-use of the proposed tool, as well as the importance of having the DFE suggestion bank to give support for improvements.

Keywords: recyclability; index; end-of-life; product design; design tool.

1 Introduction

Concern about improper use of natural resources, free space reduction in landfills, and hazardous waste disposal has led legislators to delegate responsibility for product recycling to producers. Examples of this include actions from international agreements such as the Kyoto Protocol, regulatory standards such as the ISO 14000 series and laws such as the Waste Electrical and Electronic Equipment (WEEE) and the End of Life Vehicles (ELV) Directives, both from the European community.

In their review, Goodall et al. (2014) discussed the employed tools and methods to evaluate remanufacturing and their decision levels: strategic, tactical or operational. Strategic level

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