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Identifying design guidelines to meet the circular economy principles: a case study on electric and electronic equipment

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Abstract

This study presents a methodology that allows the analysis of how an existing product design meets the design guidelines required from the circular economy perspective, and which are the design guidelines that would need to be incorporated into its design to become a better circular design product. For that, as a starting point, the design guidelines required for the circular product design have been identified from an extensive literature review. Then, criteria have been defined to measure the margin of improvement of a product design based on the level of compliance of each circular design guideline, and the relevance of each circular design guideline for the specific product category to which it belongs. Finally, the methodology has been applied to a representative sample of 127 appliances belonging to different categories of small household electrical and electronic equipment. The circular design guidelines related to extending life span and to product/components reuse have been identified as those that more urgently need to be incorporated, while the urgency of those related to connectors or product structure is moderate.

Keywords: circular economy; design guidelines; electrical and electronic equipment; methodology

Abreviatures

EEE: electrical and electronic equipment	VAC: vacuum cleaners
sEEE: small electrical and electronic equipment	BLE: hand blenders
EL: Extension of life span	HEA: heaters
DC: Disassembly/Connectors	KET: kettles
DS: Disassembly/Product structure	IRO: irons
PR: Product reuse	HAI: hair dryers
RPP: Components reuse	TOA: toasters
MR: Material recycling	COF: coffee makers
MI: Margin of improvement	JUI: juicers
R: Relevance	SAN: sandwich makers

1. Introduction

In the last few years a trend growing towards the concept and development of circular economy (CE) models has appeared, which focuses on several of the resource and system challenges of industrial economies. According to The Ellen MacArthur Foundation (2012) model, one of its principles focuses on optimising resource yields by circulating products, components and materials for the best utility at all times. This means designing for repairing, remanufacturing, refurbishing or recycling, among others, to keep products, components or materials circulating in and contributing to the economy.

In this context, the European Commission approved a Circular Economy Action Plan (COM 614, 2015) in 2015 in order to increase the value of products by promoting their use for longer durations so as to minimise the amount of waste generated, and to boost the efficient use of resources. In 2017 a set of measures that focus on the implementation of that action plan (COM 33, 2017) was presented, where ecodesign is highlighted as a required tool to contribute to the circular economy. However, it is also necessary to stress the need to more systematically explore the possibility of establishing relevant product guidelines for the circular economy related to durability, reparability, upgradeability, disassembly, reuse and recycling.

The consideration of the circular economy principles is especially relevant in product development (Fernandez, 2015), in which design guidelines that aim to reuse, recycle, remanufacture or renovate and modernise the product must be integrated from early design stages. To date, these design guidelines have been included within the Design for X (DfX) framework. A good review of a wide range of DfX approaches can be found in Go et al. (2015) and in Moreno et al. (2016).

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