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Benefits, challenges and critical factors of success for Zero Waste: A systematic literature review

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ABSTRACT

Considering the growing concern with solid wastes problems and the pressing need for a holistic approach to their management, this study developed a literature review about the subject “Zero Waste”. To that end, a systematic literature review was executed, through which 102 published articles were analyzed with the aim to, initially, comprehend the concept of Zero Waste, and, then, map its benefits, challenges, and critical success factors. The results show that scholars have not reached a consensus regarding the concept of ZW. While some studies fully address this philosophy, other studies are based on just one or on some of its topics. The benefits were grouped and organized into four dimensions: benefits to the community, financial-economic benefits, benefits to the environment and benefits to the industry and stakeholders. As to the challenges, barriers were identified both in the macro environment (mainly political and cultural) and in the meso and micro environments (stakeholders, industries, and municipalities). The analysis of the articles enabled listing critical success factors, supported by a set of activities that must be carried out. Regarding future studies, it is worth noting that more empirical studies about ZW implementation are necessary, particularly with regard to educational practices designed to promote changes in user behavior.

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1. Introduction

Solid wastes have always been perceived as inevitable and undesirable, with heavy costs for final disposal. Historically solid waste management was shaped to serve a linear economy in which the production cycle covers the following stages: raw material extraction, manufacturing goods, sales, consumption, and disposal

(Curran and Williams, 2012; Zaman, 2014a). In this scenario, more than 1.47 billion tons of solid wastes are annually generated worldwide (Zaman, 2016), which are mostly managed inefficiently (Wilson, 2006; Zaman, 2015), accounting for a premature ending of the useful life of many materials that would have some additional value for sale and/or recycling.

Statistically, while 84% of the solid wastes generated globally are collected, only 15% are recycled, and the major part is taken to landfills (Zaman, 2016). Punctually, according to data from Zaman and Swapan (2016), a person generates 435 kg of residues

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a year, on average. Such data points to a significant problem, since inadequately stored solid waste promotes the emission of greenhouse gases, compromises water bodies, soils, vegetation, and public health (Sjöström and Östblom, 2010). In light of these facts, it is necessary to shift from the concept of a production process focused on a linear economy to the concept of a production process focused on a circular economy (Lehmann, 2011; Curran and Williams, 2012; Zaman, 2015). Circular economy aims to increase the efficiency of natural resource usage, especially on urban and industrial wastes (Ghisellini et al., 2016).

Recently, with the aim to guarantee sustainable growth, the European Union introduced a new directive concentrating efforts on this approach (EU 416/2015). Specifically, in order to facilitate the transition to a more circular economy, the document describes a set of policies with revised legislative proposals regarding wastes and a broad plan of action with a clear and ambitious long term orientation to increase recycling and reduce landfill disposal.

This means that planning the life cycle of the products should not be restricted to the point of disposal, but it should actually consider the reinsertion of solid wastes into new production processes (Rennings, 2000; Montalvo, 2003; Zaman and Lehmann, 2011), or the reuse in other possibilities (Strazza et al., 2015; Smol et al., 2016). Nevertheless, as described by Ghisellini et al. (2016), circular economy implementation still seems to be in its initial stages, majorly focused on recycling instead of reusing.

Waste management is highly inspired in the “solid waste hierarchy”, a philosophy that prioritizes practices from waste prevention to the landfill. Nevertheless, the solid waste hierarchy does not provide a sufficient background for waste and resource policy regarding the absolute reduction in material production, that is, zero waste (Gharfalkar et al., 2015; Ewijk and Stegemann, 2016). As a matter of fact, current environmental, social and economic demands focus on the identification of more efficient materials to be used in the transformation industry (Barrett and Scott, 2012; Shahbazi et al., 2016) and, besides that, it focuses on the adoption of a concept based on the waste’s value, which should be converted into resources without, necessarily, reprocessing (Fudala-Ksiazek et al., 2016).

Thus, considering the pressing need for a holistic view for solid waste management, some researchers have provided scientific studies that encompass “Zero Waste (ZW),” a broader approach when compared to that described in the “solid waste hierarchy”. According to Curran and Williams (2012), ZW refers to a unifying concept that embraces a series of measures that aim to eliminate waste and to challenge traditional thoughts. Mainly, ZW recognizes waste as a resource (Zaman, 2016), that is, it adopts a concept based on the value of the waste (Ewijk and Stegemann, 2016; Islam, 2017). Zaman (2015) highlights that, the concept of ZW is in constant development and being implemented in distinct sectors, such as waste treatment and management, mining, manufacturing, and urban development.

Nevertheless, academia does not provide a clear view on the ZW theme (Greyson, 2007; Curran and Williams, 2012; Zaman, 2016). Additionally, in the study of Zaman and Lehmann (2011), the authors highlight the challenge of operationalizing ZW-related actions. Still, there are theoretical overlaps regarding “life cycle management”, “solid waste hierarchy” and “ZW” (Gharfalkar et al., 2015; Ewijk and Stegemann, 2016). In view of that, it is of latent need to proceed to a deeper analysis on the theme, especially regarding the implications of such policy (Silva et al., 2016). Thus, the present study, by means of a bibliographic review of the literature, aims to clarify the concept of ZW, identify benefits and challenges, as well as verify critical success factors related to the operationalization and the performance of ZW actions.

This article is organized in six sections. After this introduction, Section 2 presents the method used to develop this literature

review. Section 3 describes the concept of ZW through distinct contributions mapped in the articles selected for the present study. Section 4 presents the benefits and challenges related to ZW, and lists the critical success factors identified in the researched literature. Section 5 lists critical success factors in the literature analyzed. Section 6 discusses the results and proposes future research in the area.

2. Method

To reach the objectives proposed in the introduction of this article, a literature review was executed, through a systematic analysis. This method was chosen for it mitigates the possibility of errors and it enables replicability (Mulrow, 1994). Following the instructions of Tranfield et al. (2003) and Moher et al. (2009), the development of the review involved five steps: (i) research objective definition; (ii) database selection; (iii) keyword identification; (iv) selection of compatible articles and (v) data extraction.

Regarding the (i) objective, this study aimed to comprehend the distinct concepts that are currently being used in academic papers for the ZW theme, their similarities, and contradictions, as well as the benefits, challenges, and critical success factors. As to (ii) database selection, the authors decided to search within the “Science Direct” and “Web of Science” databases. The (iii) keywords were searched through two steps: initially, only the term “zero waste” was searched for, which should be present in the titles, keywords and/or abstracts; afterwards with the aim to validate the robustness of the search, we conducted a new search on the “Science Direct” database through the Boolean operation (a: “landfill avoidance” OR “reduction” OR “mitigation”; AND b: “zero waste”), searching in “all fields”. The type of document included in the search was “articles”, and time limits were not defined.

The choice for an exclusive search on the “Science Direct” database is justified once that all the journals that contained the most selected articles in the first search are encompassed in this database (Waste Management, Journal of Cleaner Production and Resources, Conservation and Recycling, respectively). Quantitatively, the first search resulted in three hundred and nine articles (110 from the “Science Direct” database and 199 articles from the “Web of Science” database). Of the total, 83 articles were chosen, 26 of which were common among the platforms. Thus, 57 articles were initially selected. The second search generated a total of 511 articles. From this quantity, 149 articles were selected.

After the exclusion of the duplicates in both searches, (iv) the process of article selection started with the reading of the abstracts of the remaining articles, which was independently executed by more than one researcher, who were oriented to only select the articles that had research questions and results directly related to the objectives of this study. The entire sample was divided between the three researchers. At the end of this step, the set of publications to be used in the systematic review was reduced to 102 articles that effectively covered the issue (see Table 1 and Appendix A).

Afterwards, (v) the data extraction was carried out. To that end, the set of publications underwent a critical evaluation of the researchers. The verification focused on the identification of the concepts, benefits, challenges, and critical success factors of ZW. Finally, an aggregating approach was used to summarize the conclusions of the articles under review. Such an aggregative approach largely depends on the subjective interpretation of the researcher about the papers reviewed. This occurs because, as stated by Tranfield et al. (2003), a certain degree of subjective latitude must be given to the researcher so distinct studies can be compared and considered in order to extract shared meanings and abstract

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