



## Full length article

# Relation of Brazilian institutional users and technical assistances with electronics and their waste: What has changed?



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## ABSTRACT

Little is known about the perceptions and practices of institutional users (IUs) and technical assistances (TAs) of electronic equipment, which participate in the WEEE stream as much as the individuals. That is why this study aims to analyze the relationships between these two sectors, the electronic equipment (EEs) and their waste, in Blumenau, Brazil in the years of 2010 and 2015. The seven most frequently used pieces of equipment were selected as follows: the central processing unit, computer monitor, keyboard, mouse, printer, cellular phone, and landline telephone. Questionnaires were used to register the perceptions of IUs and TAs on the useful life, reason to disposal of the EEs, and on their knowledge about the waste and related legislation. The results showed a downward trend for the useful life perception of the equipment. In both years, the most cited reason for the exchange/disposal was related to end-of-use of EEs and one of the highlighted aspects was the difficulty in elimination. For this reason, some IUs and TAs chose to stock their waste in the workplace or dispose them in the municipal solid waste collection. Moreover, the study identifies informal recycling companies of electronic waste (e-waste) as a market that has increased in Brazil. It was also observed that over time there has not been a major change in knowledge about laws of e-waste; therefore it is necessary to consolidate the country's e-waste management with the implementation of a reverse logistics which includes electronic institutional users and technical assistances.

## 1. Introduction

It has been estimated that in Brazil the mean generation of waste electrical and electronic equipment (WEEE) was equal to 1.4 million tons per year (Araujo et al., 2015), with a noticeable increase in the sales of electronic products (ABINEE, 2015). It is therefore necessary to reflect on the environmental implications of this increase on consumption (Al Razi, 2016), which appears to be widespread throughout the world (Echegaray and Hansstein, 2017; Paiano et al., 2013). In 2012, for example, 62 million cellular phones were sold only in Brazil, with a total of 256 million active lines (IDC, 2012; ANATEL, 2012), and most devices had less than two years of use (CPQD, 2012). A survey by Brazilian Ministry of Environmental found out that in 2012, 18% of Brazilians discard their used cellular phones in the trash and 9% of the other electronic equipments classified as Green Line equipments (MMA, 2012).

Green Line is one of the four classifications of electrical and electronic equipment. There is only an ordination geared towards the commercial and industrial aspects of the equipment, grouping them

into four types: Green Line – central processing units (CPUs), desktops, notebooks, printers, computer monitors, cellular phones, and landline telephone; Brown Line – TV tube/monitor, plasma TV/LCD, DVD/VHS, and audio products; White Line – refrigerators, freezers, stoves, washing machines, and air-conditioning; and Blue Line – mixers, blenders, flutirons, and drills (Ministry of Development, Industry and Trade Foreign, 2013).

The federal law number 12305 (Brazil, 2010) establishing the “National Policy on Solid Waste (NPSW).” introducing the principle of “shared responsibility” involving manufactures, importer, distributors, traders, retailers, government, and final consumers in e-waste (electronic waste) management. Moreover, the law is based on ‘polluter pays’ principle determining the compulsory implementation of reverse logistics that in the case of WEEE is occurring through the constitution of ‘sectoral agreements’. For the purposes of federal law 12305 a sectoral agreement is an “act of a contractual nature entered into between the public authority and manufacturers, importers, distributors or traders, in view of the implementation of shared responsibility for the product life cycle” (Brazil, 2010).

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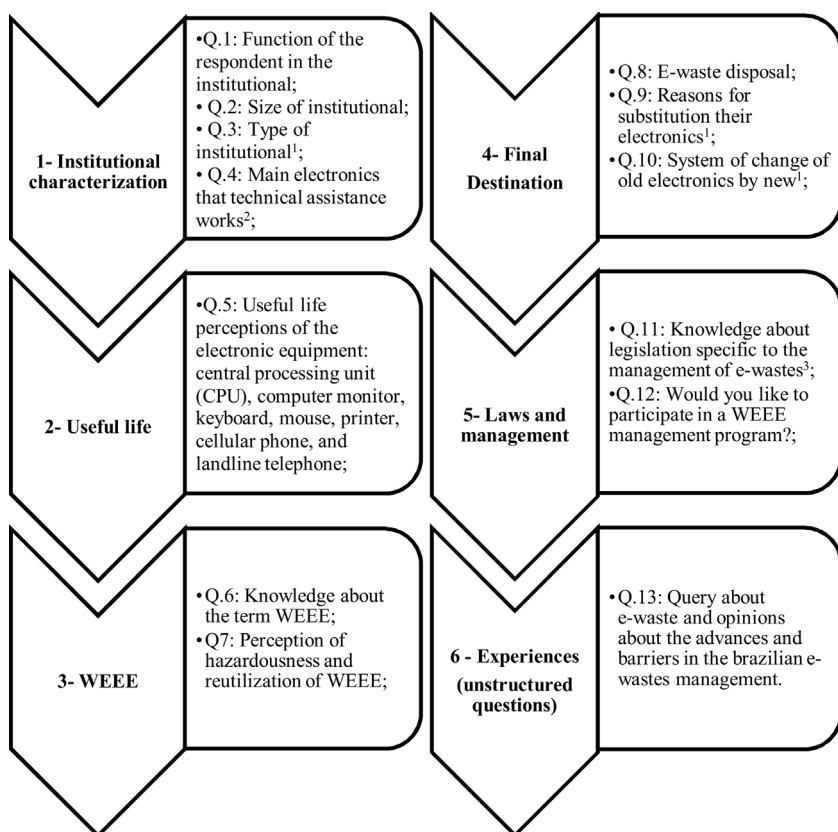


Fig. 1. Structure theme questionnaires.

<sup>1</sup>Specific question from the IU; <sup>2</sup>Specific question from the TA; <sup>3</sup>Question added in 2015.

On February 13, 2013 the Brazilian Ministry of the Environment published a sectoral agreement in order to improve the reverse logistics system for the electronics products and their components, however, in this agreement the electronic technical assistances did not participate. Ten proposals were submitted, and four were selected to be evaluated with public consultation (SINIR, 2017). Once the sectoral agreement has been legalized, the goal of the Brazilian government is to recycle 17% of all the amount of electronics sold in five years (Brazil, 2013).

The implementation of a management system of WEEE should be an integrative proposal from various sectors of society (Morris and Metternicht, 2016; Manomaivibool and Hong, 2014). The consumer awareness of the proper disposal of electronics, and the social and environmental benefits of this practice should be recognized (Kilic et al., 2015), as well as the behavior of the users with regard to their wish for properly disposing of waste (Echegaray and Hansstein, 2017; Jang and Kim, 2010; Lin et al., 2010).

In this context, researchers have dedicated on investigating the intentions and behaviors of individuals (Echegaray and Hansstein, 2017; Sun et al., 2015; Ylä-Mella et al., 2015; Yin et al., 2014; Cox et al., 2013; Miafodyeva et al., 2013) and the opinion of legislators and waste management experts (Morris and Metternicht, 2016; Thavalingam and Karunasena, 2016; Guarnieri et al., 2016). Little is known about the perceptions and practices of institutional users (IUs) – defined as public or private institutions that use electronic equipment to carry out their commercial activity; and technical assistances (TAs) of electronic equipment – private institutions that provide intellectual, technological and material service to users in need to solve technical problems related to their electronics (BD, 2012), which participate in the WEEE stream as much as the individuals. Even less is known on how this relationship will develop over time.

In this scenario, this study aimed to understand the perception and behavior of institution users and technical assistances in relation to their equipment and electronic waste (e-waste) in Blumenau, Brazil. This city is one of the most important computer technology centers in

Brazil, which along with Joinville and Florianópolis; promote the state of Santa Catarina as being a benchmark of excellence in the software development area (Blusoft, 2016). However, the informal and improper discard of WEEE still persists in the municipality (Lischeski, 2011; Moura, 2016) and this can cause deleterious effects on society and the environment (Dwivedy et al., 2012).

The study was carried out at two time points in order to make a comparison in some aspects of the management of WEEE whose results could contribute to a reverse logistics system. Local questions are directly addressed by this study; however, these reflections are closely related to practices and systems at the regional and national levels, as it is the case when discussing reverse logistics.

## 2. Methodology

The survey was conducted in the municipality of Blumenau, state of Santa Catarina, southern Brazil (Lon 49.06° W Lat 26.91° S), having an area of 520 km<sup>2</sup> and an estimated population of 338,876 in 2015 (IBGE, 2017). The study addressed electronic equipments (EEs) and their waste, including the Green Line category, which is the third of ten classes proposed by Directive 2002/96/EC (2003). The seven most frequently used pieces of equipment were selected, including: CPU, computer monitor, keyboard, mouse, printers, cellular phone, and landline telephone.

The evaluation of the perception and behavior of the institutional users and technical assistances of electronic equipments was made through the semi-structured questionnaire. Sixty (60) institutions answered the questionnaire in 2010 and sixty (60) in 2015, and the composition of the sample by type of institution in 2015 reproduced exactly that of 2010.

The study was approved by the ethics committee of the Regional University Foundation of Blumenau (FURB), protocol number 132/10 and 47336115.6.0000.5370/2015, for 2010 and 2015. The IUs and TAs responded to a questionnaire that was delivered in person or online,

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