Analysis of Material and Information Flows and Formulation of an ICT Waste Management Model

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ABSTRACT

The generation and accumulation of waste of electrical and electronic equipment (WEEE) is growing fast, becoming one of the most complex waste streams the modern world faces. The effective and efficient management of this waste stream raises the interest of the global scientific and business community. The purpose of this paper is to analyze the flow in an e-waste management system, present the main processes included and detect the information procedures that affect the operation of the system. For its research, first a detailed literature review is presented and second the critical information flows are analyzed. The findings indicate five critical informational procedures of managerial concern: (a) defining the infrastructure, technological systems, and investments that are needed to optimize an e-waste management network, (b) minimizing the total cost of the e-waste management system, (c) estimating ICT waste quantities as precisely as possible, (d) selecting the appropriate strategy for ICT waste treatment, and (e) redesigning the IT and telecommunication products in order to improve their recycling characteristics. The study concludes with the formulation and presentation of a material and information flow diagram of ICT waste management system.

Keywords: E-Waste Management System, ICT, Information Flow, Material Flow, WEEE

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1. INTRODUCTION

Obsolete electrical and electronic equipment, which is commonly known as WEEE or e-waste, constitutes one of the fastest growing waste streams. Over the last decades, electronics have become popular and necessary, changing rapidly the way our world works and introducing revolutionary and digital advancements in our everyday and business lives. Technology advances, declining trend in prices, and modern way of life have led to an increasing use of electronic devices, fast replacement and shorter life cycles of the products. Electronic equipment after the end of its useful life is discarded and if it is not handled properly can cause serious environmental and financial problems constituting alongside risk for human health.

The problem of e-waste lies on the exponentially increasing quantities and its complexity since it has to be collected and treated carefully and separately. Furthermore, electronic equipment contains toxic substances, valuable and raw materials that is considered economically effective and environmentally friendly to be extracted. Consequently proper e-waste management constitutes a major concern of waste professionals and scientists and is also top priority in many developed and developing countries. However, until now proper and efficient WEEE management systems have not been established in most countries since it requires in depth research and is difficult for them to replicate systems adopted by other countries, mostly due to differences in geo-location, cultural and consumer characteristics.

Under this perspective many worldwide and local efforts, initiatives and directives are developed in order to address issues of e-waste, one of these efforts is STEP (solving the e-waste problem). STEP promotes communication and exchange of knowledge on WEEE systems between countries and also enhances efforts on reverse supply chain (Widmer et al., 2005). Another example is the Basel Convention, an attempt to control and prevent transboundary movements of waste, including WEEE, from developed to developing countries (Sander & Schilling, 2010).

Moreover, in Europe the established legislation evolved in two directions in order to prevent e-waste generation and limit their consequences. The first one is the WEEE Directive, which promotes measures for proper e-waste treatment, efficient collection and recovery. And the second one is the Restriction of Hazardous Substances (RoHS), which imposes the replacement of harmful substances in products with other environmentally friendly materials. The EU WEEE directive proposed a classification of the obsolete electronic equipment in 10 categories: large home appliances, small home appliances, information technology and communications equipment, consumer equipment, lighting equipment, information technology and communications equipment, consumer equipment, tools, toys, leisure and sports equipment, medical devices, monitoring and control instruments, and automatic dispensers (EU Directive, 2002).

Over the years, it became clear that only when the entire e-waste system is taken into account, viable and effective solutions can be developed that can lead to reduction of e-waste impacts and take advantage of e-waste opportunities (energy and raw materials extraction). Under this perception, researchers and policymakers have focused not only on the identification of processes in the e-waste management system and the improvement of their characteristics but also on the fundamental information that is necessary for proper collection, sorting, treatment strategies, recovery operations and recycling.

In the present paper we examine the main processes after the end of life of electronic equipment, the operations and flows that are involved in an e-waste management system and how they interact. Moreover, we research and detect necessary information that affect the processes and play major role in the design of an efficient reverse management system. Since electronic waste is complex and includes a big range of products we focus our research on waste from Information and Communication Technology (ICT) equipment. Our upper goal is to provide both academics and policymakers a useful model and information in order to formulate a successful reverse management network. The rest of our paper is organized in
Classification of Landscape Sensitivity in the Territory of Cremona: Finalization of Indicators and Thematic Maps in GIS Environment
