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ABSTRACT

E-waste represents a considerable challenge in today's global economy. The ease of purchase and delivery via online methods, coupled with the rapid pace of technological advancement, has led to considerable e-waste. E-waste represents a different challenge for reverse logistics than just a product return. In the case of e-waste, the product has been used and is no longer wanted. Because an e-waste item is no longer wanted, the possibility of designing a product to eventually be remanufactured is an area of research that deserves investigation. The purpose of this article is to make the argument that U.S. corporations should be proactive in developing comprehensive programs to deal with e-waste. To accomplish this task, this article is divided into three sections: the growth of e-waste, relevant legislation as it pertains to e-waste, and reverse logistics and the electronic industry.

KEY WORDS E-waste; Legislation; Electronics; Reverse Logistics

E-waste represents a considerable challenge in today's global economy. The ease of purchase and delivery via online methods, coupled with the rapid pace of technological advancement, has led to considerable e-waste. Until recently, comprehensive data were not available about e-waste, nor was there any consistency in how e-waste was defined. For the purpose of this article, e-waste is defined as any electronic product and/or its components that have been discarded. The United Nations is working with governments, nongovernment agencies, and science organizations in a partnership known as Solving the E-waste Problem (StEP) Initiative to address the growing issues of e-waste. According to StEP, "By 2017, the global volume of discarded refrigerators, TVs, cellphones, computers, monitors and other electronic waste will weigh almost as much as 200 Empire State Buildings, a new report predicts" (SEI 2013). Because of the nature of

the product having a high demand and a short product life cycle before obsolescence, it can be assumed that countries and their governments will continue to legislate e-waste for the foreseeable future. The future legislation of e-waste is unknown, but it is certain that an increase in legislation will occur regarding the growing e-waste industry. E-waste is an area that will need to be addressed by all facets of society at some point. The focus of this article is on the demand side of this issue, but the supply side of this issue will warrant future research as well. The purpose of this article is to make the argument that U.S. corporations should be proactive in developing comprehensive programs to deal with e-waste. To accomplish this task, this article is divided into three sections: the growth of e-waste, relevant legislation as it pertains to e-waste, and reverse logistics and the electronic industry.

GROWTH OF E-WASTE

E-waste is growing at a rapid pace and will likely continue to grow. Although e-waste is a small portion of the total world waste, about .01 to 3 percent of the total (HOBI International n.d.) in many countries, e-waste is the fastest growing type of waste (Palladino 2013; "What's Driving" n.d.). SBI Energy found that e-waste is growing faster than any other form of waste by a multiple of three (HOBI International n.d.). The speed of e-waste growth has given rise to recycling and reuse services, which can also show the rapid growth of e-waste. A report entitled "E-Waste Recycling and Reuse Services Worldwide" found that the market for recycle and reuse services jumped from 6.2 to 6.8 billion from 2009 to 2010 and is expected to grow to more than triple by 2020 ("E-waste Recycling" n.d.). These data provide the argument that e-waste is growing at an unsustainable pace with no signs of slowing and is likely to cause many problems in the future.

The article "What's Driving the E-waste Crisis?" (n.d.) lists many major drivers to the e-waste environmental problem. High sales of electronics and rapid change in technology are major factors in the unprecedented volume of e-waste, and these products often are not even obsolete. For example, with a product life cycle of one to three years after initial purchase, many electronic devices will become unwanted at some point in their existence, which contributes to the 8 percent annual growth rate in the e-waste industry with no end in sight (Palladino 2013). In the United States, Americans dispose of 47.4 million computers, 27.2 million televisions, and 141 million mobile devices annually, according to the latest figures from the Environmental Protection Agency's report on Electronics Waste Management in the United States, and surprisingly, only a quarter of all those devices are collected for recycling (EPA 2011).

Some issues with the growth of e-waste must be highlighted. The article "What's Driving the E-waste Crisis?" (n.d.) mentions that on the corporate citizenship side, a major issue is that the design of most electronic products makes them difficult to disassemble, and companies therefore do not have a financial incentive to effectively and efficiently deal with e-waste unless required to do so via legislation. Another, more concerning, issue is an abuse by companies labeling scrap as a product that could be used

again, even when the companies are fully aware that the product will not be used again. This is a corporate culture issue but creates global environmental issues as well as geopolitical issues affecting trade policy concerning this waste. Another environmental issue of e-waste as listed in "What's Driving the E-waste Crisis?" (n.d.) are the toxins used in electronic and electrical products. E-waste is a growing issue, not just a theory, but there is a quantitative argument to be made as well.

Before analyzing the legislation of e-waste, it is necessary to highlight the flow of e-waste. Only a small percentage of e-waste is recycled, even when it is taken to a recycling center (Basel Action Network 2013). It is estimated that from 11 to 14 percent of e-waste in the United States is actually recycled, meaning that the remaining is destroyed, which, when destroyed improperly, can contaminate water, air, and soil (Basel Action Network 2013).

In the United States, recyclers sent 70 to 80 percent of e-waste to developing countries in Africa and Asia (Basel Action Network 2013). Developing countries are likely facing the ramifications of the lack of proper recycling due to the flow of e-waste to them from more developed countries such as the United States. They are also suffering from the lack of technology for discarding e-waste properly, a lack of legislation, and lack of proper enforcement of legislation that does exist. For example, an estimated 70 to 80 percent of the e-waste that's given to recyclers is exported to countries with developing economies, in effect externalizing the real costs of managing hazardous waste and products (Basel Action Network 2013). Once e-waste is in these countries, primitive technologies such as open-air burning and riverside acid baths are used to extract a few materials. The rest of the toxic materials are usually dumped (Basel Action Network 2013). Simply put, developing countries often lack infrastructure and resources to operate and monitor responsible e-waste recycling operations.

Electronic waste is not normal waste; it contains material "such as mercury, lead, cadmium, arsenic, beryllium and brominated flame retardants," and when burned, they create more toxins, "such as halogenated dioxins and furans—some of the most toxic substances known to humankind" (GAO 2012). These substances are harmful and have been shown to cause cancer, among other detrimental physical problems, and because many of these chemicals do not break down over time, they find their way into sources of both food and water (Basel Action Network 2013). E-waste, when disposed of improperly, is not only a physical danger to society but also a possible personal privacy danger to individuals in the society. Confidentiality concerns also present a danger to individuals in the consuming countries.

Electronic devices contain more than harmful substances; they also contain valuable and/or personal information. Unless a computer or smartphone has had its memory removed or thoroughly deleted, a great deal of information can be gathered from it. According to the Ponemon Institute, "everything from bank records to classified missile test results were found on a random sample of hard drives on eBay." Moreover, the Ponemon Institute estimates that "70% of data breaches come from offline computers, usually after they have been disposed of by the equipment owner" (About Symantec n.d.). E-waste therefore represents two dangers; one is physical, and the other is personal information.

Taking into account the large demand for electronics, electronics' inevitable obsolescence, the ineffective processing of e-waste, and the dangers of e-waste, e-waste is a problem that deserves attention. E-waste's rapid growth is an issue that will continue to plague developing countries until companies are proactive with corporate policies that address the issue, or until they are forced to become reactive because of government regulations.

E-WASTE LEGISLATION AROUND THE WORLD

Europe was the first to begin addressing the issue of e-waste legislation. For example, Germany led the charge of dealing with waste in 1991 when it passed ordinances leading to materials moving backward throughout the supply chain, which was followed by the United Kingdom in 1996 when shippers and manufacturers were legislated to be responsible for the collection and recycling of their packaging materials (Walden 2005). The European Union members must follow the Waste Electrical and Electronic Equipment (WEEE) Directive, also known as the take-back legislation, which puts the responsibility on the electronics manufacturer for end-of-life issues.

The enormity of the problem of e-waste around the world has led other countries to follow Europe's lead from a policy and legislative standpoint to promote the effective handling of e-waste. The United Nations Environmental Program (2007) outlines various legislations with regard to e-waste around the world. The *E-waste Manual* outlines various ways to look at the possible legislation of e-waste and where many countries fall on the spectrum from having the basis of a legal framework to having a law that is fully enforced, including plans for the inventory, for how the e-waste will be collected, as well as for the technology that will be used to recycle and reuse the material. This spectrum ranges from low (not much in place as it pertains to e-waste) to high (programs in place and enforced) (United Nations Environmental Program 2007).

According to the United Nations Environmental Program (2007), the United States does not have federal legislation, but some states have taken action and created their own legislation with regard to e-waste. Specifically, California's laws are among the most stringent of the state laws, requiring anyone buying a monitor in the state of California to pay a recycling fee that funds e-waste disposal (Kopytoff 2013). Based upon this information, a conclusion can be drawn that at the federal level, the United States, though the top producer of e-waste, has not legislatively been as proactive as other countries with regard to e-waste.

Even though the United States is the largest producer of e-waste (McAllister n.d.; Palladino 2013), the United States has not, to date, ratified the Basel Convention (McAllister n.d.). From a global perspective, the Basel Convention is attempting to push awareness of e-waste throughout the world: "The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal bans the exchange of hazardous waste, including e-waste, between developed and developing countries" (McAllister n.d.). Though the United States has not yet ratified the Basel Convention,

that does not mean that legislation is not on the way. If American companies continue to be reactive, they can wait for more state and federal legislation, which is impending. For many reasons, such a strategy is not smart for any company.

Because of the rising volume of e-waste within the United States and elsewhere, the detriment to the environment by the toxins included in e-waste, and the impact that e-waste will continue to have on developing nations, it could be argued that the U.S. federal government will not have a choice but to legislate e-waste. Legislation has become a driving force, and organizations would be well served by developing comprehensive systems to effectively and efficiently deal with e-waste. Electronic companies in the European Union provide a good example of such comprehensive strategies that occur from cradle to cradle. In addition to the European electronic companies following the WEEE Directive, they are known throughout the world as being "greener," thus having better customer loyalty. Furthermore, becoming a "greener," or more environmentally friendly, organization can enhance a corporation's image, leading to a more profitable business. U.S. electronic companies would be well served to proactively pursue effective and efficient programs to deal with e-waste. They need to start being proactive in considering e-waste to remain competitive with their European counterparts, as well as to be seen as environmentally friendly, or "green," thus increasing brand loyalty. Developing, implementing, and promoting an efficient and effective system to deal with e-waste can be an effective marketing tool. Environmental and green policies can be an effective way to enhance an organization's corporate image. As Chan, Chan, and Jain (2012) cited, "Fleischmann et al. (2001) mentioned that people are [amenable] to green branding" (p. 1320). Companies could benefit from increased customer loyalty if they were to gain reputations for recycling e-waste. Companies that recycle e-waste appropriately and communicate their progress to customers in corporate social responsibility reports demonstrate their commitment to protecting human and environmental health, which could result in an increase in business within the United States and around the world.

In addition to being known as green companies, electronic manufactures could make profits from focusing on the end of life of their products. One strategic approach is for the electronic industry to do a better job of engineering products with the end of life of the product in mind. This is not a novel concept and is utilized in other industries, specifically the automotive industry, but it is an ideal option for the electronic industry to refurbish or reuse parts rather than toss them in landfills. If the reengineering of a product considered the refurbishing need later, there could be a potential for profits in the form of cheaper raw material, as well as the potential for a company to be seen as a green company. The cradle-to-cradle mindset is a win-win; however, it is a change in the strategic mindset of many American electronic companies because the government has not required these companies to consider the end-of-life impact on e-waste. Because there is a lack of federal legislation in the United States, the responsibility falls on the companies to develop and promote strategies that consider the end of life of electronic products. Companies that combine factors such as reducing, reusing, and recycling when

considering their supply chain will be able to manage costs by being more efficient while helping the environment and their bottom lines.

REVERSE LOGISTICS AND THE ELECTRONIC INDUSTRY

E-waste represents a different challenge to reverse logistics than just a product return. In the case of e-waste, the product has been used and is no longer wanted. Because an e-waste item is no longer wanted, the possibility of designing a product to eventually be remanufactured is an area of research that deserves investigation. Remanufacturing products has long been a staple of the U.S. automotive industry. If the electronics industry began to design products with a plan that those products would eventually be remanufactured, there may be a profit at the end of an e-waste strategy.

The size of the remanufacturing industry cannot be ignored. Chan et al. (2012) note, "In Europe and the US, as high as 70% of returned cell phones could be reused economically (Franke et al. 2006)" (p. 1320). If firms designed products not only to be finished goods but also to be future raw material, it might lead to a focus on the further development of a cradle-to-cradle mentality or closed-loop supply chain. This is not a new concept; the idea of a closed-loop supply chain or a cradle-to-cradle mentality has been proposed (McDonough and Braungart 2002). The key to both of these ideas is focusing not only on the forward flow of products but also on the reverse flow of products.

Though reverse logistics is not a new concept, it is increasingly becoming an area of concern for organizations. Reverse logistics is the practice of physically moving a product backward through the supply chain. This could happen for a variety of reasons. Chan et al. (2012, p. 1320) outline five areas of returns: Unavoidable Returns, Environmental and Green Returns, Enforced Legislation, Economics, and Corporate Citizenship. To date, many studies in the area of reverse logistics have dealt with unavoidable returns, which can include defective and unwanted products. These studies provide insight into the costs of reverse logistics for organizations.

The cost of returning products is substantial. According to Blanchard (2007), returned products represent a significant cost to manufacturers and retailers. Returns represent $100 billion in lost sales and reverse logistics costs (or about 3.8 percent for the average retailer or manufacturer) annually (Blanchard 2007). Consumer electronic (e-waste) returns are rising rapidly, growing to $17 billion, or 21 percent, from 2007 to 2011 (Douthit et al. 2012). Though these numbers deal with different reasons for returning products, the act of physically moving products backward through the supply chain is a cost. Understanding that this is a current cost to organizations under a lightly regulated environment in the United States means that when the legislation does occur, it will warrant an innovative strategy for organizations to effectively and efficiently reverse a product through the supply chain.

E-waste is an enormous business, with electronics companies often opting to collaborate with 3PL companies to assist in the complex reverse-logistics strategies.

According to the Global Electronic Recycling Market Report, by 2019, it will be a $41.36 billion industry, and in terms of volume, the market is forecasted to reach 141.05 million tons by 2019; thus, electronics industries have to consider the options of reducing waste, refurbishing, reusing, and recycling. When considering recycling, electronic companies should consider two major steps: treatment and recycling. In the treatment stage, the wastes are sorted, disassembled, depolluted, and prepared for the subsequent processes ("Electronic Recycling Market" 2013). One would select a supplier and consider performance, risk, financial cost, activity, and speed. In the recycling stage, materials from the treatment stage are made into reclaimed materials. The most recycled products in the electronics industry are copper, steel, and plastic resins, which are a big business ("Electronic Recycling Market" 2013). Globally, steel is the most recycled material and tends to be the focus of many electronic companies because steel is heavily used in electronic devices and recycling steel is much cheaper than is mining steel.

CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

American companies have been shielded from many of the legislative practices of other nations as they pertain to e-waste, but these companies will have to adapt and change. Considering the inevitability of this change, this article has shown that a company may be much better served by being proactive in developing an efficient and effective e-waste program. Though this task will be complex, the company can gain the advantage of enhancing its corporate image while preparing for upcoming legislation.

Many streams of future research should be investigated. E-waste represents a logistical issue. Reverse logistics is an area of research that is growing, and how e-waste and reverse logistics coincide warrants future research. However, research needs to be conducted to determine the feasibility of designing an electronic for future remanufacturing, as well as the possibility of profit in remanufacturing a product that is already obsolete. Moreover, this topic needs to be viewed through the lens of the supply side; specifically, consumer incentives for proper e-waste disposal need to be researched further. Additionally, the corporate image and marketing of green aspects need to be studied as they relate to the e-waste industry.

Determining if there is a difference in generational views on green practices and corporate image is an area that warrants further research, as well. If younger generations place more importance on greener philosophies, then utilizing green practices to enhance a corporate image may make a green strategy even more urgent.

Taken as a whole, e-waste represents an issue for the environment and for emerging economies. E-waste is a crisis that will continue indefinitely. Whether proactively or legislatively, American companies at some point will have to develop a system to effectively and efficiently deal with their e-waste. The hope is that if companies plan far enough in advance, they will be able to develop a system on their own timeframe that is both effective and profitable while capitalizing on a positive corporate image. It is not a matter of whether there will be a necessity to create a system to deal

with e-waste for American companies, but a matter of *when*, and of whether it is profitable.

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