Electronic waste: the leading information ethical concern of the information age

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Abstract

Electronic waste (e-waste) is becoming one of the leading global concerns in the information age. This article establishes e-waste as an informational ethical issue impacting the environment as well as the health and well-being of citizens. Furthermore it elaborates on the consequences of the e-waste problem nationally and globally. The current solutions to the e-waste problem as implemented in other countries are considered with specific reference to the feasibility of such solutions in South Africa with mind to the suitability of such solutions in the rest of the African continent. The authors gained insight into the awareness about the e-waste issue as well as the willingness and ability of future information professionals to contribute to the recycling of e-waste in the long term, through the implementation of a survey to undergraduate students within the School of Information Technology. The School of IT (SIT) at the University of Pretoria is a unique institution for tertiary education in the field of information technology and a big contributor to future leaders in the IT industry. Through the incorporation of primary and secondary research the authors hope to contribute to the field of information ethical research on e-waste as well as to present viable and effective methods to combat the problem of e-waste in the third world through collaboration with manufacturers and end-users.

Introduction

Electronic waste also known as e-waste or WEEE (Waste from Electronic or Electrical equipment) is a primary concern in the information age where the development and evolution of technology in terms of functionality, design and environmental soundness and performance is an ever-evolving industry. According to Lee *et al* (2007:381) it is this increase in this design and functionality of products that stimulate consumers' desire to buy equipment and decreases the sales of used electronic equipment. This phenomenon leads directly to an increase in e-waste generated by consumers. E-waste needs to be the consideration of third-world countries, such as South Africa, as they inadvertently become the dumping grounds for e-waste from the developed world. This is mainly due to the lack of developed policies regulating the handling, discarding and importation of hazardous waste in these developing countries (Veera *et al* 2009:11).

Nationally e-waste is increasing in South Africa and technology experts state that further advances in the technological industry may have a direct effect on the creation of e-waste in South Africa in the near future (von Maltitz 2012). This problem will further be exasperated by the South African carbon taxation initiative of 2013/14. Although this initiative will improve organisational effectiveness in terms of low-energy hardware usage, it will inevitably leave organisations with "replaceable" hardware that needs to be effectively recycled, placing greater demands on the recycling infrastructure of South Africa (James 2012). The growth of cloud computing will have a similar effect on the prevalence of e-waste. As more providers offer a stable cloud solution, more organisations will demand the cloud infrastructure (von Maltitz 2012) resulting in obsolete company hardware. Rapid technology changes such as these, while improving commerce, is listed as one of the primary drivers behind the generation of e-waste (Richards 2012).

Globally the problem of e-waste is increasing. India experienced a reported 50 thousand tons of illegally imported e-waste from the developed world in 2009 (Veera *et al* 2009:11) while Nigeria reported 500 thousand tons of the same in 2010 (Osuagwu and Ikerionwu 2010:142). With the total amount of e-waste in Europe is set to increase to 45% by 2020 (Banndyopadhyay 2010:793) the global generation of e-waste is predicted to increase between 16% and 28% every year (Nnorom *et al* 2009:1629). This consideration of imported e-waste is outside the e-waste generated by the country itself as a participant in the global information economy which requires users to communicate with cell

phones, computers and other ICT technologies that are discarded within their own countries. India produced a reported 3.3 lakh tons of e-waste in 2007 (Veera *et al* 2009:11). By 2010 China had established 81 e-waste treatment plants to deal with the e-waste produced by China itself (Song *et al* 2012:223). The continued increase in e-waste generated by the populace described earlier will however require the continued increase in e-waste recycling plants and the recycling capacity of a country (Lee *et al* 2007:394) This amount of e-waste has devastating effects on their environments and their people. Case studies conducted in China concluded that the dust generated by the recycling plantations effected schoolyards and food markets 8 and 30km's away. The dust absorbed by the average adult could amount to as much as 100mg (Leung *et al* 2008:2674). Exposure to the heavy metals contained in the dust generated from the e-waste recycling plants affects not only the physical health of those exposed to it (in terms of damage to the central nervous system decay and organ damage) but the lead contained in e-waste has been associated with a decline in the IQ of children (Leung *et al* 2008:2674). The dust that is not directly ingested by humans becomes absorbed in groundwater and surface soil and due to its non-biodegradable nature is absorbed by humans indirectly (Saphores *et al* 2011:50).

South Africa, as a leader among the regional developing countries (Schoeman 2000:47) has a responsibility to itself and the other countries experiencing the consequences of e-waste to develop sustainable solutions and set an example for action against e-waste. The first step in the development of an industry Waste Management Plan according to the Industry Waste Management Plan guidelines set by the Drug Enforcement Agency (DEA) in June 2010 is the setting of targets for re-use, recycling and recovery (Anderson 2012). This is however impossible without accurate figures about the current e-waste levels and generation. South Africa similar to many other developing countries has no accurate measurements of the e-waste imported, generated or recycled within their borders due to the fact that e-waste is not considered a priority waste. This results in the lack of legislation that enforces the submission of an e-Waste Management Plan. Without the proper enforcement of documentation regarding the generation and recycling of e-waste South Africa has no accurate measurement of the extent of e-waste pollution within its borders (Anderson 2012). This article will attempt to explore the approach to and possible solutions of the e-waste issue from an ethical point of view and with special consideration to the South African economical, technological and social environment.

E–waste as an information ethical issue

E-waste can be seen as an information ethical issue for two primary reasons: the origin of the problem and the effects of it, both of which will be discussed further. Firstly, it is primarily an information ethical issue due to the direct relation of ICT to the evolution of the information and knowledge society. According to Britz & Lor (2008) the progress of countries towards becoming an information and knowledge society has taken on the characteristics of a race. To win this race countries are investing heavily in ICTs as ICTs have proved to be the key to economic prosperity in many developed countries. Furthermore a sophisticated ICT infrastructure has been hailed as one of the main criteria of the information and knowledge society (Martin 1995, 2000; Webster 2000, Britz & Lor 2008, Holmner 2008) stimulating this investment in ICTs. This investment together with the rapid pace at which ICTs become obsolete has contributed to the increase in e-waste as mentioned earlier (Lee *et al* 2007:394). An estimated 17% of e-waste by weight in India in 2009 was attributed to computers, and a disturbing 0.5% by weight attributed to mobile phones, approximately 1.65 tons (Veera *et al* 2009:11). With mobile phones and computers being upgraded continually, it is estimated that this number will continue to grow. According to Lee *et al* (2007) in 2000-2002 about 80% of new cell phone sales volume in Korea was attributed to obsolescence indicating a frequent replacement rate and approximately 13.2 million discarded cell phones.

Secondly, the effects of the e-waste problem also render this a uniquely information ethical issue. The degeneration and informal recycling of e-waste has consequences that affect a large population of both those directly and indirectly involved with e-waste, which relates to the social responsibility of humans. Smith an Kelly (2003:321-322) examine the manner in which science and technological expertise has become intrinsically bound with policy making and development in a global environment with changing economic, political and social issues that affect various industries. The information scientists of South Africa will be required to be involved in the establishment and enforcement of ‘best practice’ guidelines as e-waste is not an issue that can be solved with political or cultural guidelines currently established. Smith and Kelly (2003:324) go on to state that in terms of the integration of science and technological expertise and policy making it is crucial to set guidelines created in an ethical, social and political context. South Africa has an illustrated lack of policies regarding e-waste as discussed above. This lack of grounding in the ethical considerations of the e-waste issue – specifically regarding the possible

harm to the environment and population of a country –must be incorporated into information technology education in order to ensure the development of socially conscious and ethically sound practices from future information scientists (Zazzau 2006:99-100). As previously mentioned, the current lack of policy and legislation leads to the majority of informal recycling of e-waste and e-waste dumping taking place outside of controlled and protected environments. The heavy metals affect not only those who are burning and destroying e-waste with their bare hands but also seep into the groundwater, soil and air and can lead to internal organ failure, glad malfunction and even affect sexual development of certain organisms (Saphores *et al* 2011:50). Some of the chemicals present that are not biodegradable (such as lead and mercury) have irreversible effects on the development of children, infants and contribute to toxic natural conditions that affect livestock and plant growth (Lee *et al* 2007:394).

Thus it can be seen that e-waste is an informational ethical issue as we are the direct cause of it as citizens of the global information society and ICT professionals. Furthermore it is our social ethical responsibility primarily due to the fact that it is irredeemably destroying our environments and populations despite the fact that it is preventable.

Methodology

The primary research paradigm followed for this article is a qualitative approach. As qualitative research is about "exploring issues, understanding phenomena and answering questions" (Ereaut 2007) the authors explored the issues pertaining to e-waste as an information ethical issue, the current status thereof as well as the environmental and health impact of e-waste. The literature study was furthermore supplemented with a pilot study that made use of a questionnaire as data collection instrument. The questionnaire containing closed-ended as well as open-ended questions was distributed to obtain data on the participants' awareness of the issue of e-waste, their willingness to participate in the initiatives available to them, and their perspectives on the parties who should be held responsible for the recycling of e-waste. The pilot study made use of a group of first year students at the University of Pretoria, studying IT within the School of IT. These students were study one of the following degrees: BIS Multimedia, BIS Information Science, BIS Publishing, B Information Technology, BCom Informatics, BSc Information Technology and BSc Computer Science. From the 420 students within the School of IT, 207 completed the questionnaire, resulting in a favourable 49.2% completion ratio.

The simple rules that govern a prolific and accurate research design include the selection of the population, a group, usually consisting of people with a common set of characteristics one wishes to study and draw conclusions about (Leedy 1997:203; Zikmund 2003; Babbie 2008:121). As discussed above, IT professionals and students play a big part in the e-waste problem and therefore have a common set of characteristics. Nevertheless, it is virtually impossible to study all the members of a population or target group of interest and therefore a sample is needed.

The sampling technique used in this research is a non-probability research technique called convenience sampling. This form of sampling was selected due to the convenience of access to the participants as well as their proximity to the researchers (Castillo 2009). The survey consisted of open ended and multiple choice answers in the form of dichotomous questions and cumulative questions which were analysed according to response weight and cross-referenced with identified filter questions in order to create a complete understanding of the sample frame.

Awareness of the e–waste issue

Of the sample 61% of respondents said that they were aware of what e-waste is, with only 39% saying that they have never heard the term before and do not know what it entails. The break-down of the awareness of e-waste per degree is however very informative– indicating that the very hardware orientated degrees, such as Computer Science and Information Technology have the highest awareness of the issue. This is opposed to the more content-orientated degrees such as Publishing, Multimedia and Information Science that show less awareness

Of the 39% of respondents who said that they were not aware of the e-waste issue, 89% state that they would still be interested in learning about it in their IT studies in the School of IT (SIT) and/or would participate in drives lead by the SIT. Overall 96.5% of all the respondents stated that they would include e-waste as a component in their studies primarily to increase awareness of the issue and to grow their own knowledge as e-waste is a growing issue with a large, detrimental effect on the environment and mankind. The 3.5% of respondents that did not want to include components of e-waste in their studies thought that it would not benefit them in their career choice or that it should have been included in secondary education, these respondents mainly belong to the BSc Information Technology degree (4 Year).

How were students educated about e–waste?

Of the 61% of respondents who knew what e-waste was, 52% were educated about the issues from a high-school teacher. However only 44% of these respondents stated that the issue of e-waste was addressed in the formal high-school curriculum (within IT, CAT, Geography, Life Orientation). This indicates that high-school teachers also informed students outside of these subject areas indicating awareness in the educational system of the growing importance of e-waste despite the fact that it is not really addressed by the current curriculum. The second largest group of respondents that knew about e-waste were informed about the e-waste issue by the media (35%) which corresponds to the amount of respondents who were made aware of the various e-waste drives through the media (33%) showing the effectiveness of media campaigns driven by vendors in educating the audience about e-waste. Only 2% of respondents heard about e-waste from their parents, showing a concerning pattern of older generation involvement with the e-waste issue. The same amount of students (2%) indicated that they learned about e-waste from other sources, such as their own research and online while 9% responded that they heard about e-waste from a university lecturer, probably from previous studies or awareness drives.

Overall 84.5% students were aware of e-waste drives lead by organisations, with the leading organisation being Incredible Connection (31%) followed by Spar (27%) Woolworths (23%) and other organisations (including Pick ‘n Pay and private computer stores) at 4%. The chain store Makro had only a15% awareness likely due to their specialised clientele (as an outlet store) not including students. In terms of drive awareness the largest group of respondents became aware of organisational drives through in-store advertising and promotion (37%), followed by the awareness spread by the media mentioned earlier (33%). The spread of awareness of the drives hosted by the retailers through word-of-mouth amounted to 20%, with a mere 10% doing their own research to discover locations for e-waste recycling.

Perspectives on responsibility

Traditionally the original equipment manufacturers (OEM) had very little responsibilities towards the manufactured products they produced, beyond shipping and involved service plans. However during the past 2 decades the global climate towards equipment manufacturers has changed. In 1999 Norway implemented a ‘take-back’ policy that holds manufacturers responsible for

environmentally sound recycling of their products (Veera *et al* 2009:11). This principle of extended producer responsibility (EPR) is effectively the principle of all of the 'take-back' policies, extending the responsibilities of the manufacturers to a post-consumer stage of product existence and has been implemented in most first-world countries (Bandyopadhyay 2010:794). The EU, South Korea, Japan and Taiwan are already demands that OEM be responsible for 75% of their manufactured products' recycling (Osuagwu and Ikerionwu 2010:143). In terms of the Basel Conventions' restrictions on the transportation of hazardous waste (which prohibits in many instances the transportation of e-waste to the OEM) non-manufacturing countries such as Norway holds the importer responsible in place of the OEM (Veera *et al* 2009:11). In Africa, the Nigerian solution to their growing e-waste issue is the Mobile Phone Partnership (MPP) which creates an agreement between the Basil Convention and OEMs such as Nokia and Motorolla to dispose of the involved cell phones in a responsible manner.

These examples all illustrate the responsibilities of the OEMs in the post-production process. Nevertheless the responsibilities of the OEMs actually already begin before the product hits the market in the pre-production process. During the pre-production and production process, the OEM carries the ethical responsibility of material selection in order to determine the least harmful substances that could be used and the design of sustainable products (thus eliminating the planned obsolesce of products) in order to effectively reduce the e-waste output from the products (Osuagwu and Ikerionwu 2010:147). Narayanan and Kumar (2010:217) also stress the importance of volume control to lower wastage and over-production of products as well as the responsibilities of OEMs of recovery and re-use of product elements. This re-use of product elements will furthermore ease the dismantling, re-use and recycling of product elements. A consideration that carries weight for both the OEM that dismantles it and the user who will likely be more capable of upgrading and re-using their own e-waste (Davis and Wolski 2009:27).

When the respondents were asked what the responsibilities of the OEMs were regarding e-waste, 13.4% of respondents stated that they would pay an additional deposit on purchase to have their equipment recycled by the original equipment manufacturers. This is similar to the recycling initiative in Norway and other first world countries. The responsibility of recycling according to 28% of respondents falls to the OEMs over the national and provincial governments' responsibility that will be discussed in the following paragraph.

What are the responsibilities of governments and industries?

Governments carry the responsibility of enforcing the 'take-back' policies, as well as the current structures in place for the responsible recycling of e-waste such as the Basel convention. The regulation of the taxes, laws and levies associated with the implementation of responsible e-waste solutions are also of primary concern for governments (Osuagwu and Ikerionwu 2010:148). Several industries have also taken it upon themselves to regulate the destruction and recycling of e-waste with the help of government institutions. Through the implementation and regulation of such initiatives an advanced recycling fee (ARF) is charged to the consumer that is calculated and intended to cover the cost of the recycling of the purchased product. Countries such as Switzerland use the ARF to fund the recycling of electronic products with the help of NGO's and industry leaders (Sinha-Khetriwal *et al* 2005:495). This serves as a highly effective method of management of e-waste without additional pressures on the governments involved and specifically penalises those consumers who replace products that are not at their end-of-life. The implementation of ARF in South Africa would also avoid placing a crippling tax on the poorest technology consumers who receive technological donations. In this way the illegal dumping of computers and other e-waste will not become a necessary alternative. This will be due to the recycling fees already being paid when the product is purchased, rendering the lowest-income users free to responsibly recycle (Veera *et al* 2009:11; Bandyopadhyay 2010:797).

According to Osuagwu and Ikerionwu (2010:148) governments should also take responsibility in terms of encouraging the research and implementation of solutions for e-waste, as well as encouraging support of NGO's and recycling initiatives.

In terms of responsibility of government for recycling e-waste in South Africa 24% of respondents felt that the National Government should be responsible for e-waste recycling, with 12% feeling that Provincial government should be responsible for recycling e-waste. Only 6% of respondents felt that non-governmental organisation should be responsible for e-waste recycling. In terms of ARF charged on the purchase of equipment 6.5% of respondents state that they would pay additional recycling taxes on purchase. Considering the limitations of the manufacturing industry the deposits paid on purchase to have equipment recycled by the OEM could also be considered as part of ARF funding. In terms of organisational responsibility to recycle e-waste 26% of

respondents considered organisations partially or completely run by the South African Government should hold responsibility for recycling e-waste on corporate level. Furthermore 32% of respondents stated that organisational heads and governing bodies of organisations should be responsible for e-waste management within their organisation.

What are the responsibilities of information scientists, academics and professionals?

As mentioned above information scientists and academics as professionals have the responsibility to research the effects, and most importantly the possible solutions to the e-waste problem. As the party that is most likely to be aware of the true and possible implications of the e-waste problem it is also the responsibility of the information scientists and academics to educate the average citizen (Zazzau 2006:99). Saphores *et al* (2011:50) conclude that this is the most important step in creating a sustainable e-waste solution in a community, as most of the citizens that are responsible for the majority of e-waste are not aware of the true effects and destruction it causes. Schultz *et al* (1995:107) echo this statement when they state that the generalised view on recycling improves and motivates people to recycle if that person is aware of the effects, materials and locations for recycling, and if recycled products and recycling services are well known to them. Education also extends to the promotion of awareness of recycling points and methods, Veers *et al* (2009:17) found that while 80% of surveyed vendors were aware of the possible effects of e-waste 50% of them buried their electronics that were unusable in the soil, while 13% burnt it, directly due to lack of knowledge about methods and points of recycling. Professionals also hold certain responsibilities outside of those of OEMs. According to Davis and Wolski (2009:27) the consumer as professional holds responsibilities in the areas of product purchasers as drivers of the manufacturing industry.

Consumers as professionals should insist on products that comply with environmental standards held by that country, such as IEEE 1680 in terms of the reduction of toxics in the content of products, the selection of biodegradable materials, end-of-life designs, life-cycle extensions and energy conservation (Davis and Wolski 2009:27). The aforementioned Carbon Tax initiative of 2013/14 attempts to address this issue in South Africa. In order to deliver the most adequate leadership in the field of recycling and re-use it is the primary task of professionals to institute a strict and strictly followed policy for the replacement of electronic equipment, as was done in the study by Davis and

Wolski (2009). According to Veera *et al* (2009:11) 94% of the polled IT professionals did not have a disposal policy on e-waste, this not only sets a bad example for the industry leaders and employees but also disregards the power that the industry leaders could exercise over product manufacturers as discussed earlier.

What are the responsibilities of the consumers themselves?

As future information scientists, academics and IT professionals the respondents as individuals have a responsibility concerning the correct disposal of e-waste. Osuagwu and Ikerionwu (2010:149) clearly create a framework for the behaviour of individuals who want to be part of the environmentally conscious disposal of e-waste. Among others they propose reuse as a primary method of environmentally conscious use of electronic products, as prevention of electronic waste is better than the recycling of it. In the same vein they also suggest that care be taken when donating items, as donated items often become e-waste through mismanagement of technology and technological disposal through less educated users.

It is the responsibility of each individual to consider what constitutes electronic waste and to understand that stockpiling e-waste does not offer a legitimate solution and diminishes the resale or possibly recycling value of these appliances (Davis and Wolski 2009:22). It is the responsibility of the individual to manage his/her own electronic waste and recycling, and to do so even though environmental concerns are not the primary motivator, and despite the perceived inconvenience that is the primary cause of lack of recycling among consumers (Saphores *et al* 2012:51). This is supported by the 31% of respondents of the questionnaire who believed that private citizens themselves should be responsible for recycling.

The respondents to the questionnaire were also asked if they would personally partake in a drive to reduce e-waste. 86% of students responded positively that they would. Primary motivators for partaking in an e-waste drive were to save the environment, to prevent waste and to make the world a better place – environmental concerns were the primary motivator for respondents, as is the idea of personal responsibility. Of the 14% of respondents who would not want to partake in such an e-waste drive, the major hindrance is the time it would take. The personal responsibility that the respondents would take towards their own e-waste would contribute greatly to the creation and implementation of

sustainable e-waste initiatives in South Africa. As future industry leaders the respondents would not only contribute their own e-waste to effective recycling but could also potentially implement policies and guidelines that could affect industry disposal of e-waste on a large scale. It thus carries great promise for the future of e-waste recycling in South Africa that only 8.5% of respondents stated they would only dispose of e-waste with their normal garbage as this implies that there is a measure of awareness of personal responsibility regarding e-waste in the remaining 91.5% of respondents.

Conclusion

The ARF model used by other non-manufacturing countries such as Switzerland where NGO's and government organisations are held responsible for the recycling of e-waste is currently being supported by the e-Waste Association of South Africa (eWASA) (Botes 2012). In this model a small fee is paid on purchase, only 6.5% of respondents would partake in this initiative. The 'take-back' policy instituted by Norway and the Eastern countries mentioned above would not work in South Africa as we do not have the infrastructure to transport the e-waste to manufacturing countries, nor do we have the manufacturing resources to facilitate the 75% recycling demands on OEM's that the 'take-back' countries demand. While the respondents preferred to have the OEM's involved many countries such as Norway the importers are held responsible for the recycling of the electronic products that they import. Considering the preferences of the respondents to drop off their e-waste at a recycling centre (60.7% prefer this), the views that the private citizens should be responsible for e-waste recycling (31%) this model might be a better option for South African e-waste recycling. National government should be held responsible according to 24% of respondents, while 12% consider it to be a provincial matter – as waste is disposed of in the USA, on state level (Fredriksson & Millimet 2002), the problem with this model is the equal distribution of resources in the nine provinces.

This article attempted to establish e-waste as an informational ethical issue impacting the environment as well as the information manufacturing and processing industry. The current solutions to the e-waste problem as implemented in other countries were considered with specific reference to the feasibility of such solutions in South Africa using a study conducted with the undergraduate students within the School of IT. Through the incorporation of primary and secondary research the authors hoped to contribute to the field of information ethical research on e-waste as well as to present viable and effective

methods to combat the problem of e-waste in the third world through collaboration with manufacturers and end-users.

The biggest concern in South Africa is the lack of awareness and knowledge about the e-waste issue and how it affects South African citizens (Botes 2012). Through this study the researchers established that in order to raise awareness there should be increased advertising on media channels and in store promotions, that National government should be more involved and that there needs to be increased awareness in the school system. The most popular recycling scheme was that of Incredible Connection, who offer a cash of purchase incentive on their e-waste donations and advertise heavily in store and through media. This model of recycling will serve highly effective in South Africa if we follow the model that importers are held responsible for their e-waste recycling. Advertising and promotions should include the terms 'e-waste' and 'hazardous waste' as these are the terms that respondents are most aware of at 36% and 28% respectively. These methods of advertising will raise awareness and educate the end user, vitally important in South Africa.

Further attempts to raise awareness in organisations should be attempted from the top down; respondents indicated that organisational heads and governing bodies should be responsible for establishing e-waste policies (32%), followed by governmental organisations (26%) and special divisions within an organisation (21%). It is vital that citizens and information specialists become aware of the e-waste issue, specifically its impact on South Africa, the environment and mankind.

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