E-Waste Management & Clean Technologies

Leon Thaqi[1]

[1]MSc in Management, City College (Sheffield University), Thessaloniki, Greece, e-mail: lethaqi@city.academic.gr

Abstract. Management of e-waste is becoming a challengeable issue in today's world. The increase of waste and the need for saving the environment are two global debates in the world. These managerial problems come as a result of technological advancements and globalization as global forces toward complexity. These global forces made e-waste management become a world's priority issue followed by cleaning technologies. Nowadays, industries are investing in e-waste management and cleaning technologies in order to save the planet, be healthier and reduce the pollution. However, it is very difficult to control the e-waste management because technological advancements will not stop and the electronic waste will become bigger problem for the world. Digitalization of the world brought benefits for people's life by facilitating the lifestyle; however, digitalization of the world increased the percentages of e-waste management all around the world.

Keywords: Management, e-waste, technology, globalization.

1 Introduction

World's population is increasing rapidly and there are emerging contemporary problems which are caused by humans. One of the most important problems that the world is facing nowadays is the electronic waste or the so-called e-waste. E-waste consists of valuable and toxic substances which have a great potential in harming human's health and environment. In addition to that, depending on the exposure level, health and physiological impacts of these substances are very high (Pavan & Dasgupta, 2010). There is a European Community which was developed for Waste Electrical and Electronic Equipment (WEEE) for the countries to follow the directives for reducing the e-waste overall. By looking at the most advanced technological countries it can be derived that U.S. and China are the most producers of electronic devices. However, only 12% of these electronic devices are recycled. The other countries just recycle a small part of their waste (Premalatha, 2014). Human health and environment should be protected especially in today's world where e-waste have become a problematic and complex for countries with a high density of population. Knowing the fact that waste is considered everything that surrounds us, brought up a global debate of reducing or recycling the waste. In order to protect the environment, people should come up with ideas such as recycling

Proceedings of the 7th International Conference on Information and Communication Technologies in Agriculture, Food and Environment (HAICTA 2015), Kavala, Greece, 17-20 September, 2015.

campaigns in order to fill the gap of environmental protection. Also, in solving the global electronic waste problem a numerous of attempts have been made to increase the efficiency in recycling e-waste management activities (Jinhui et al., 2015).

Having in mind that toxicity is very dangerous for human health, especially for organism that can cause damages, analysts, researchers and experts have started thinking of new technological methods of saving the planet (Zeng, 2015). Humans are meant to be the savers and the destroyers of this planet but it depends on the idea and the culture of a specific country whether they want to deal with problematic issues such as e-waste. Countries do produce waste everyday but the question is: Are they socially responsible or not? Many countries started paying a lot of attention to the e-waste management in the last decade because of the awareness of electronic waste. The awareness of electronic waste emerged because of its hazardous substances that it contains (Yeh, 2012). Secondary data and empirical observation have been analyzed to come up with any possible solution for Kosovo. In this case, there is a need for e-waste management because of the density of population. Since Kosovo is the newest country in the world, I believe that being part of these contemporary projects will help the country have better environment and better health in terms of population. Most of the less developed countries have these kinds of barriers in implementing these projects because of corruption, unemployment and economic development as the main tools for sustainable country. According to the research, Kosovo is reducing and preventing the increase of waste quantity (Baftiu, 2015).

2 E-Waste – A Growing Concern in Today's Environment

Electronic waste becomes a very important issue when the potential damages of them have been considerate. This concern emerged rapidly at every nook of the world because of the statistics saying that the worldwide sales of computers, in units, reached 270 millions in 2007. Furthermore, mobile phones do also play an important role regarding this issue as electronic devices. The electronic waste that has been created is very hard to be prevented because of technological advancements, globalization and increase of world population. These three characteristics are highly related to one another that could create an enormous amount of waste. However, the origin of e-waste has been raised from the updated hardware and software technologies that attracted the market and facilitated the lifestyle of humans. So, this lifestyle is mainly characterized by access to information, technological advancements and managerial issues which are combined in electronic devices such as computers or smart phones (Renckens, 2008). Countries have started to transport the waste to other countries just to recycle them and reuse them also. As an example, Canada's government wanted to implicate the policies and regulations for e-waste. Canada's government had two approaches toward e-waste which were toxic reduction in electronic devices and minimum release of toxic substances at the end of lifetime (Deathe, 2008).

Valuable and toxic substances have been seen in electronic waste. There are different substances that may release toxic substances such as phosphor, copper, lead, plastics etc. These substances are mostly present in electronic devices which cover 70% of US landfills with heavy metals. What makes this problem complex is that the replacement of computers have been applied almost every five years while the replacement of smart phones is maybe less than a year. This explains the complexity why it is so hard to manage the electronic waste while people still do store them (Pavan, 2010).

Table 1. The categories of products with details of a recycling company in Australia.

E-waste product category	Description
E_1 Computer	PC, notebook computer, CRT monitor, LCD monitor, PC keyboard, mouse, cables associated with PC system, modem, etc.
E_2 Communication equipment	Server, rack mount cabinet, hub, switch, router, modem/print server, assorted network gear, PABX controller unit, telephone handsets, uninterruptable power supply, etc.
E_3 Battery	Lead acid battery, lithium ion, lithium battery, NiCad battery (sealed/vented), NiMH battery, Alkaline battery, etc.
E_4 Mobile phone	Mobile phone handsets, batteries, chargers, accessories, etc.
E_5 Office electrical equipment	Desktop printer, enterprise printer, photocopier, fax machine, desktop scanner, desktop multifunction printer/scanner, etc.
E_6 Consumer electrical equipment	CRT television, plasma television, LCD television, VCR/DVD/set top box, Hi-Fi stereo, speakers, domestic vacuum cleaner, microwave oven, cordless phone, video camera, digital still camera, etc.

Note. Cathode Ray Tube (CRT), Liquid Crystal Display (LCD), Personal Computer (PC), Private Automatic Branch Exchange (PABX), Nickel Cadmium (NiCad), Nickel Metal Hydride (NiMH), Video Cassette Recorder (VCR), Digital Versatile Disc (DVD), High Fidelity (Hi-Fi).

With a very qualitative management department, this company can destroy, recycle and reuse the electronic waste with the most innovative techniques. The biggest clients of this company are the governments and the main producers of well-known global brands such as HP, Dell, IBM, Toshiba etc. This company provided this table by grouping the e-waste products in six categories shown above. What differences this recycling company is the sustainability within a company and the sustainability in terms of social, economic and environment aspects (Hsing, 2012). European Union has tried to be engaged to e-waste technologies and management in order to develop a plan of recycling the unwanted technological devices or the outdated ones. Based on the research, Europe produced 11.6 Mt of total e-waste in 2014. However, in 2012 only 3.2 Mt was collected by 28 member states. Findings show that western Balkan region did not implement an effective e-waste system like EU member states. Including Kosovo here, this means that Kosovo still does not have a national legislation dealing with e-waste (Baldé et al, 2014).

Knowing the fact that e-waste is increasing extremely fast and the difficulties to handle the e-waste management is pushing countries forward to develop a solution and create a market and offer solution for e-waste management (Neyland, 2012).

Even though waste management is very hard to be controlled, countries do collect their created waste. According to World Bank, countries with high incomes do collect the waste (around 96% collection of waste) in comparison with low income countries that collect the waste much less (around 40% collection of waste) (World Bank, 2012).

3 The Global Impact of E-Waste

E-waste has achieved a critical point globally in terms of the massive technological and electronic production. This critical point is growing very fast and the main priority of industrial management is to find a proper way of saving the environment and people's health. Having in mind that the population is still growing and the production will not stop; there is something that should be done in terms of e-waste. As mentioned above, the main producers of e-waste are U.S, Western Europe, Japan and China with a total of almost 50 million tons of it.

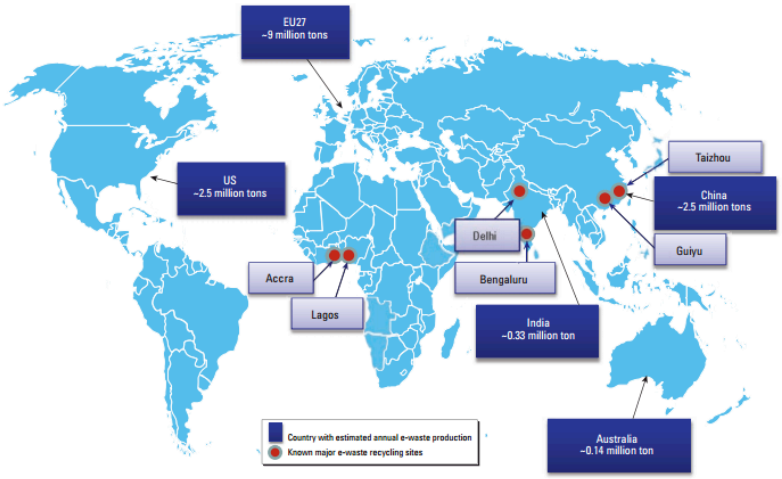

Fig. 1.

The figure above explains the importance of e-waste and how countries have thought of it by reducing their waste. The key success factor of helping the environment is to reduce as much as possible the e-waste substances by producers and recyclers. This picture shows that many countries have shown progress and commitment regarding this issue (Chen, 2011).

There are still opportunities for e-waste management in a large scale, especially with metals. Metals can be re-produced by recycling process. Most of the today's production that contains metal has been modified to low carbon technologies as a new way of production. This low carbon technology is a key metal resource which can be found in electric cars, light bulbs, wind turbines and many other green technologies. For example, a Belgium company Umicore that recycles more than

35,000 t/each year of e-waste, mostly mobile phones. This company believes that motel recycling companies gain a lot of profits, especially the last five years where people see a great potential of it (Burke, 2010).

In terms of environment and ecological way of thinking, there is still a global debate for almost a decade. Most researchers and experts believe that environmental problems are highly related to digital economy. The digitalization of economy has great impact on social, environmental and economical aspects of the whole world. Everyone out there gets touched by these changes or chronic problem. The technological advancements in terms of electronics have expanded so much by using them. These electronic devices made life much easier either the daily routines or office work (Ciocoiu, 2010). Environment and e-waste management differ a lot from each other based on the product waste and the substances that it releases. Environment with a full of e-waste may harm even the underground resources of a country. Natural resources such as gold and silver may be influences from the e-waste by finding them more quickly than using the traditional way of mining. Hence, world is thinking of creating a market for e-waste by reproducing them or recycling them in order to reduce the waste generation (Deathe, 2008). In the case of Kosovo, based on the research, Kosovo lacks of using any effective way of stopping the waste production but it is getting into the law enforcement regarding e-waste management. Many campaigns have been organized by increasing the awareness of environment. The table below shows the amount of waste produced by three European Countries and Kosovo's treatment of the waste.

Table 1: The amount of waste in three EU countries and Republic of Kosovo

	Austria	**Denmark**	**Slovenia**	**Croatia**	**Kosovo**
Number of inhabitants (m)	8.1	5.4	2	4.45	2.3
Total amount of waste (million tonnes/ day)	48.6	13.0	8.4	12.6	2.504
Amount of municipal waste (million tonnes) per year	3.1	3.1	0.8	1.2	~ 0,4
Annual amount of municipal waste per capita (kg)	383	574	400	270	192

Table 2: Treatment and disposal of waste in three EU countries and Kosovo

	Austria	Denmark	Slovenia	Croatia	Kosovo
Waste collected for recycling	34.3%	14%	10%	10%	9%
Waste collected for biological treatment	21.7%	-	12%	1%	1%
Waste collected for incineration	14.7%	81%	-	-	-
Waste collected for land filling	28.5%	5%	73%	89%	90%

Source: the data in Tables 1 and 2 for Kosovo are calculated and based on a report on the state of waste in Kosovo in 2008.

4 Clean Technology Revolution

The use of solar energy and renewable energy has been a debate on a global scale recently. The use of renewable energy have emerged the market that seek for profit. This new way of promotion green environment with renewable energy is having a great success in terms of investments on it. Being monopolistic in today's world is having an advantage of producing goods or services by using clean technology which saves the environment and reduces the pollution. These types of advantages are highly required in today's industries. The advantages of this technology are because of the low cost and the reduction of pollution which will promote a new way of living and new way of manufacturing goods. New cleaning technologies use renewable energies that will create the above mentioned advantages of a specific company (Youssef, 2015). An example supporting this fact is the Colorado state which has involved 700 companies in clean technology market by employing more than 20,000 local employees. This positive initiative of Colorado has been as a role model for other states in the U.S to develop climate and energy policy. The biggest investor in the world in cleaning technologies is China which exceeds the investments of Colorado with a margin of 50 to 1 (Spaanstra, 2010).

Revolution of clean technologies has some barriers regarding the implementation of it. This implementation is highly related to property rights, import/export taxation which may reduce the investments because of the high risk. There should be a free market in terms of promotion these kinds of technologies even in the poorer countries that do not have access to them. Globalization has a great impact on cleaning technologies in terms of development and deployment of renewable energy (Vennemo, 2015).

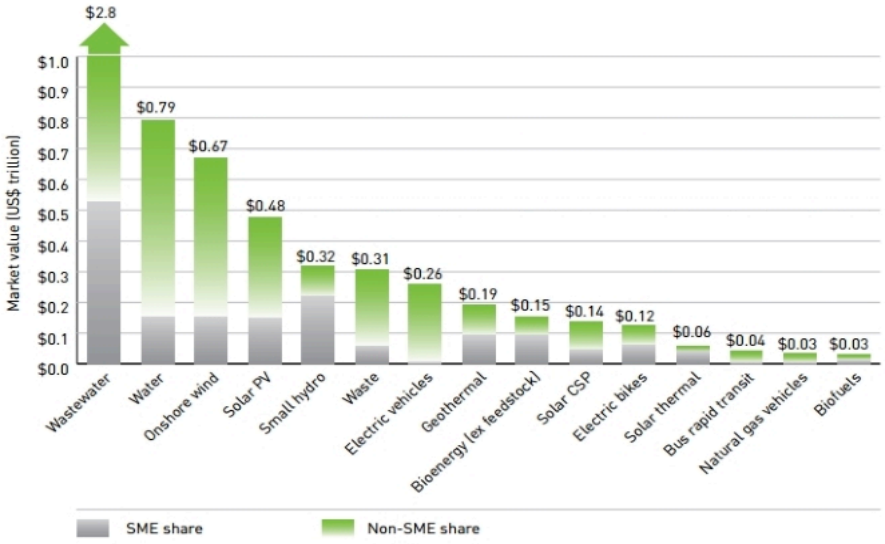

Fig. 2.

The graph above explains how U.S's market value is distributed between SME's and non-SME's shares in terms of cleaning technology. It is obvious that these countries of U.S have thought of clean technology in terms of economical and environmental way.

In the case of Kosovo, Ministry of Environment and Spatial Planning have developed a plan on waste management from 2012 to 2016. This plan explains the main objectives of such as strengthening waste management, areas which needs investments in terms of waste and infrastructure and raising the awareness of waste. This article suggest that by implementing this plan Kosovo will have an opportunity to attract investments on cleaning technologies as a critical point for the future (PRKWM, 2012).

5 Conclusion and Recommendations

In today's world enormous amount of e-waste is generated from developed countries which have caused serious pollution all around the world. Most of the producers, as mentioned above are U.S and China that have strong industries in terms of technology and produce great amount of electronic waste (Jujun et al., 2014). According to research, globalization process and technological advancement have conquered the world, regulations, policies and recycling technologies have been implemented by some producers, in order to protect and save the environment. Risk assessment for humans has increased due to e-waste (Jianjie, et al., 2013). However, by implementing laws and regulatory programs, positive effects have been seen in controlling and releasing heavy metals to the environment. The main critical point of technology advancement and increase of electronic waste is that features and capabilities of technological devices are rapidly changing. As a result of these changes, new ways of e-waste management have to be considered (Kang & Schoenung, 2005). Based on the empirical observation, recommendations will be addressed to government of Kosovo in order to collect and reduce the e-waste. Some activities that government of Kosovo should perform are implementing standards for treating and processing e-waste, implement an action plan for collecting e-waste from households, encourage improvement of e-waste through inspecting by any national agency.

References

1. Burke, M. (2010). Wanted: e-waste. Chemistry & Industry, (13), p. 24-26.
2. Chen, A., Dietrich, K. N., Xia, H., & Shuk-mei, H. (2011). Developmental Neurotoxicants in E-Waste: An Emerging Health Concern. Environmental Health Perspectives, 119(4), p. 431-438.
3. Chung Hsing, Y., & Yan, X. (2012). Evaluating Recycling Sustainability Performance of E-waste Products. 6(1), p. 207-223.

4. Ciocoiu, N., Burcea, S., & Tartiu, V. (2010). Environmental Impact of ICT and Implications for E-Waste Management in Romania. Economia: Seria Management, 13(2), p. 348-360.
5. Deathe, A. L., MacDonald, E., & Amos, W. (2008). E-waste Management Programmes and the Promotion of Design for the Environment: Assessing Canada's Contributions. Review Of European Community & International Environmental Law, 17(3), p. 321-336.
6. Deathe, A. L., MacDonald, E., & Amos, W. (2008). E-waste Management Programmes and the Promotion of Design for the Environment: Assessing Canada's Contributions. Review Of European Community & International Environmental Law, 17(3), p. 321-336.
7. Jianjie, F., Aiqian, Z., Thanh, W., Guangbo, Q., Junjuan, S., Bo, Y., & ... Guibin, J. (2013). Influence of E-Waste Dismantling and Its Regulations: Temporal Trend, Spatial Distribution of Heavy Metals in Rice Grains, and Its Potential Health Risk. Environmental Science & Technology, 47(13), p. 7437-7445.
8. Jujun, R., Yiming, Q., & Zhenming, X. (2014). Environment-friendly technology for recovering nonferrous metals from e-waste: Eddy current separation. Resources, Conservation & Recycling, p. 87109-116.
9. Kang, H., & Schoenung, J. M. (2005). Electronic waste recycling: A review of U.S. infrastructure and technology options. Resources, Conservation & Recycling, 45(4), p. 368-400.
10. Neyland, D., & Simakova, E. (2012). Managing electronic waste: a study of market failure. New Technology, Work & Employment, 27(1), p. 36-51.
11. Pavan, P. R., & Dasgupta, M. S. (2010). E-waste Management -- A Study in Perspective of Pilani. CURIE Journal, 2(4), p. 11-20.
12. Premalatha, M. A. (2014). The Generation, Impact, and Management of E-Waste: State of the Art. Critical Reviews In Environmental Science & Technology, 44(14), p. 1577-1678.
13. Renckens, S. (2008). Yes, We Will! Voluntarism in US E-Waste Governance. Review Of European Community & International Environmental Law, 17(3), p. 286-299.
14. Spaanstra, J., & O'Neal, R. (2010). A Colorado cleans technology revolution or new energy economy fantasy? Coloradobiz, 37(4), p. 10.
15. Vennemo, H. (2015). The Globalization of Clean Energy Technology--Lessons from China. 4(1), p. 170-172.
16. World Bank. (2012). Waste Collection. In: Daniel Hoornweg and Perinaz Bhada-Tata What a waste: A global review of solid waste management. Washington: Urban Development & Local Government Unit. p.13-15.
17. Yeh, C., & Xu, Y. (2012). Evaluating Recycling Sustainability Performance of E-Waste Products. Journal Of CENTRUM Cathedra, 5(2), p. 207-223.
18. Youssef, S. B. (2015). Timing of Adoption of Clean Technologies by Regulated Monopolies. 62(1), p. 77-92.

19. Zeng, X., Song, Q., Li, J., Yuan, W., Duan, H., & Liu, L. (2015). Solving e-waste problem using an integrated mobile recycling plant. Journal Of Cleaner Production, p. 9055-59.
20. Pavan, P. R., & Dasgupta, M. S. (2010). E-waste Management -- A Study in Perspective of Pilani. CURIE Journal, 2(4), p. 11-20.
21. Jinhui, L., Xianlai, Z., Mengjun, C., Ogunseitan, O. A., & Stevels, A. (2015). "Control-Alt-Delete": Rebooting Solutions for the E-Waste Problem. Environmental Science & Technology, 49(12), p. 7095-7108.
22. Baldé, C.P., Wang, F., Kuehr, R., Huisman, J.. (2014). The Global E-waste Monitor 2014. Available: http://i.unu.edu/media/unu.edu/news/52624/UNU-1stGlobal-E-Waste-Monitor-2014-small.pdf. Last accessed 15 Jul 2015.
23. Naim Baftiu . (2015). Electrical Equipment and Electronic and their Impact of Waste in the Republic of Kosovo. Academic Journal of Interdisciplinary Studies MCSER Publishing. 4 (1), p. 96-100.
24. Ministry of Environment and Spatial Planning. (2012). Plan of the republic of Kosovo on waste management (PRKWM). Available: http://mmph.rks-gov.net/repository/docs/+PRKMM_Ang_701821.pdf. Last accessed 10 Jul 2015.