The Role of University in E-Waste Recycling: Case of Universiti Kebangsaan Malaysia

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Abstract: A total of 500 questionnaires were sent to 10 selected faculties and institutes to 300 staffs and 200 students within the university community. The survey response indicates relatively low level of WEEE recycling participation among the surveyed staffs and students at 35 and 19%, respectively. Although, the recycling practice is low, the study indicates that 85% of the staffs and 80% of students surveyed within the university community found it necessary for WEEE to be properly collected and recycled. Majority of them show good repair attitude at 55% for staffs and 53% for students but with poor disposal practices. However, the study reveals the need for increasing awareness of WEEE recycling, not only in the university but also at municipal levels. The study recommends that various offices, university hostels, departments, faculties, institutes and research centers should establish better WEEE recycling and disposal practices to reduce the impact on the ecosystem.

Key words: Role, university, campus, community, e-Waste, recycling, employees, students

INTRODUCTION

The idea of zero-waste going on in most university campuses and management of waste in an environmentally friendly manner is a step towards sustainable development. The use of Electrical and Electronic Equipment (EEE) has become an important part of university campus communities. With increase in the use of EEE also comes the challenge of their proper management and disposal. A good example of such management is the action of Indiana University Bloomington and Indiana University-Purdue University Indianapolis (IUPUI) Electronic Waste Collection Days at which a grand total of 832,000 pounds or 416 tons of electronic waste WEEE was amassed (Knudsen, 2009). Reports show that IUPUI had also organized and hosted an annual Tox Away Day event to collect hazardous waste in collaboration with groups of individuals, purchasing e-Waste specialists from IUPUI, IU Bloomington and Apple Inc. as well as generous support from University Information Technology Services (UITS). The Indiana University sustainability task force has enabled the project to emerge as an excellent example for other universities and communities who may desire to conduct similar e-Waste collection events in future (Knudsen, 2009).

Universiti Kebangsaan Malaysia (UKM) in the effort to achieve a zero waste campus, launched a research project in 2009 to examine the status of e-Waste management within the campus community and to come up with a sustainable e-Waste framework for the university. The research aims to create awareness on recycling and determine proper e-Waste management practices. This output will not only benefit the campus but also the municipalities.

Davis and Wolski (2009) stated that there is no particular method that would effectively or totally eradicate the e-Waste generated within an organization. There are some factors that surround the timely disposal of equipment which may lead to the storage of the equipment for so long before disposal after they might have been written-off. This storage period can be a threat to the economic value of the equipment and pose health and safety problems. Per capita waste generation estimates can vary widely and depend a great deal on demographics and the state of the economy (Countryman, 2009).

In this regard, the action of reducing, re-using and recycling within the waste management hierarchy assumes particular importance (Oskamp, 1995; Hamburg et al., 1997) especially when it comes to the e-Waste management system. Kelly et al. (2006) indicated that successful recycling programmes depend not only on technology but also on the involvement of people the development and maintenance of environmentally responsible behaviour is of considerable importance.

Considering the volume of Waste Electrical and Electronic (WEEE) university campus communities

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generate, it is necessary to develop and adopt a waste management strategy that is designed to maximize participation.

This study reviews the need and the role of universities to participate in e-Waste recycling before focusing on UKM's employee and student level of participation and perception and factors that could affect their participation in e-Waste recycling in UKM.

The resource potential of WEEE and risk impact: Considering the amount of Electrical and Electronic Equipment (EEE) used in various universities, hazards associated with improper management and resource availability in EEE, it is then important for universities to actively participate in recycling of EEE. Hageluken and Meskers (2008) indicated that e-waste is usually regarded as a waste problem which can cause environmental damage if not dealt with in an appropriate way although, there exists enormous resource impact of Electrical and Electronic Equipment (EEE) which is widely overlooked. EEE is a major driver for the development of demand and prices for a number of metals (Hageluken and Meskers, 2008). Studies in China have proven that electronic waste recycling centers and locations have become hot spots for Persistent Organic Pollutants (POPs) and heavy metals (Leung *et al.*, 2006). It is expected that some of these chemicals will find their way into the ecosystem. High levels of blood lead detected in children and PBDEs in the serum of e-Waste workers and dioxins in the human milk of local mothers indicated serious threat to the health of local people due to uncontrolled e-Waste recycling activities (Bi *et al.*, 2007; Chan *et al.*, 2007; Huo *et al.*, 2007).

The role of the university in e-waste recycling: The ways by which the university could play active roles in the recycling of e-waste have been indicated. One of these ways includes creating awareness on campus which is important to increasing employee and student participation in recycling. Attitudes towards recycling must be positively altered to achieve successful recycling practice (Greulich and Akers, 2009). It is important for universities to establish a sustainability department that would foster and also make the goal achievable. There is need for university employees and students to be proactive in participating in recycling programmes. This could be achieved by creating a recycling center on campus that will allow staff and students to participate more because of its convenient location and operation.

Greulich and Akers (2009) stated that increasing awareness of the life cycle of trash and its deleterious effects on the environment can facilitate more student participation in recycling and how important it is to educate students on how recycling could help to reduce negative environmental effects.

The Council of Australian University Directors of Information Technology, commissioned a report in 2005 to determine the scope and issues regarding e-Waste within universities (CAUDIT, 2006). The report included the results of a questionnaire sent to representatives in ten universities (including Griffith) to determine actions on purchasing, end of life and policy issues concerning waste electronic equipment (Davis and Wolski, 2009). The Griffith steps include the formulation of an e-Waste policy which tends to address the key factors including definitions, legal requirements (including guidelines for the disposal of assets and consumerables) data and software security, protection of the environment and social responsibility. The policy was supported by an accompanying report entitled Processing and Treatment of Electronic Waste Generated from Computers within Griffith University which was remarkable and stood as a standard for e-Waste management within Australia and globally (Davis and Wolski, 2009).

The University of Sydney has also been proactive in the management of e-Waste. Its report shows that in 2006, the University trailed an e-Waste collection at their two main campuses in Camperdown and Darlington and succeeded in collecting about 20 tonnes of materials. In 2007, the program was extended to other University of Sydney campuses. Since, then around 120 tonnes of e-Waste has been collected and stripped down to its various material components and recovered and recycled for reuse.

The University of Richmond in her effort to manage the environment, in 2008, signed the American College and University Presidents Climate Commitment. This commits the university to creating a comprehensive action plan to move toward climate neutrality. Even before sustainability became one of the university's overall goals, Information Services (IS) had already established a sustainability program through reusing (redeploying) and recycling computers (Wendy, 2009).

The Macquarie University's effort towards proper e-Waste management went beyond its campus; by organizing e-Waste disposal days which are held at least 4 times yearly. The event is carried out in partnership with a contracted company, MRI to collect and recycle e-Waste to a standard of ISO 14001 and EPA thus achieving 98% diversion from landfill (Macquarie University, 2008).

Other universities with good examples of e-Waste management include University of California, Duke University, Colorado University, University of Guelph and

Chicago University. Thus, researchers can see how much these universities are striving towards achieving a sustainable development.

MATERIALS AND METHODS

Universiti Kebangsaan Malaysia is a public university located in Bangi, Selangor which is about 35 km South of Kuala Lumpur, the Malaysian capital. Its campus of 1,096 ha is located in a green, attractive valley.

Survey design: This study is conducted through a questionnaire survey whereby questionnaires were distributed within the University. The survey was conducted from July to December, 2009 in UKM. A total of 500 questionnaires were sent to 10 selected Faculties and Institutes amongst 300 employees (Academic and Administrative) and 200 students (undergraduates and postgraduates) within the university community. Of the 500 questionnaires a total of 470 were returned 270 from employees and 200 from students. In each faculty and institute, a total of 50 questionnaires were distributed; 30 among the employees and 20 among the students. The sample was split into students and employees in order to enable data from each group to be analysed separately as it was expected that employee members would constitute a significantly different demographic group from students and thus there was reason to expect some differences in attitudes and behaviours. As a measure to facilitating the return of the questionnaires by employees within stipulated time, two methods which involved dropping the questionnaire in the letter box of selected employees and a door to door personal conversation with the respondents were used while a random distribution of questionnaires was conducted among the students. The data of the survey were analysed using the SPSS production mode facility. A descriptive statistical analysis such as on percentage and correlation was used with regards to the data from the survey. The primary and main objective of the survey was to evaluate the level of participation and interest of employees and students in e-waste recycling within the university campus community.

RESULTS AND DISCUSSION

Campus e-Waste recycling participation: Recycling is the process of taking a product at the end of its useful life and using the whole or part of it to make another product. In this study, participation in recycling simply means the handing in of end of life Electronic and Electrical Equipment (EEE) to collectors or recyclers. The data of the

survey were analysed to determine the rate of e-Waste recycling practice among the employees and students in UKM. Table 1 shows that 35% of the 270 interviewed employees have participated in recycling of their e-Waste while 65% have not participated in recycling of their e-Waste. On the other hand, 19% of the 200 students interviewed have participated in recycling of their e-Waste and 81% have never participated in recycling. Table 1 also shows the students' poor participation in e-Waste recycling while the employees have better participation. Comparing the response of both parties, it could be concluded that the employees have a better participation in e-Waste recycling compared to the students.

Campus perception of e-Waste recycling: This study tends to examine the opinion of UKM employees and students in relation to recycling of e-Waste within the campus. In a question designed as in your opinion: is it necessary for e-Waste to be collected and recycled?, the respondents were enthusiastic as 85.6% of employees accepted the move for recycling within the campus and 14.4% turned it down. In addition, 80% of the students accepted that e-Waste should be collected and recycled within the campus while only 20% said no to recycling of e-Waste within the campus. Although, individual participation in the recycling of e-Waste is low as shown in Table 1, the results of this study indicate a great support from the employees and students in ensuring that e-waste recycling be carried out within the university campus community (Table 2).

Why campus e-Waste recycling is important?: Recycling of e-Waste (like computers, TVs, monitors, electronics equipment) helps to recover important natural resources, like copper, silver and gold for reuse while reducing the need for surface mining. Recycling of e-Waste is said to be a better option and environmental friendly solution rather than extracting new raw materials. At the same time, recycling reduces pollution and energy use. Davis and

Table 1: Level of participation in e-Waste recycling

Category of response	Employees		Students	
	No.	Percentage	No.	Percentage
Yes	95	35.2	38	19
No	175	64.8	162	81
Total	270	100.0	200	100

Table 2: Employee and student perception of e-Waste recycling

Category of response	Employees		Students	
	No.	Percentage	No.	Percentage
Yes	231	85.6	160	80
No	39	14.4	40	20
Total	270	100.0	200	100

Wolski (2009) stated as one of the reasons for Griffith University to search for alternative measures to dispose computers is to achieve greater sustainability and increase the university community's realisation of social and environmental responsibilities linked with sustainability principles.

In view of the above reasons for e-Waste recycling, this study examined employees and students knowledge in relation to why e-Waste should be collected and recycled (Table 3). The results indicate that 18.1 and 15.5% of the employees and students believed that recycling could help in the recovery of materials from obsolete EEE's. The majority of both employees and students in an equal proportion of 67% also believed that recycling would help in the safeguarding the environmental health which proves that the respondents are environmentally conscious. The response regarding revenue generation from recycling of WEEE was low at 4.4 and 3.5% for employees and students, respectively. Few respondents; 10.4 and 13.5% of employees and students stated that resource conservation is one of the benefits that could be derived from recycling of WEEE.

Table 4 shows the Pearson correlation between the participation in e-Waste recycling and the level of education, income level and age among the UKM employees. Analysis of the surveyed data shows a positive relationship between participation in e-Waste recycling and level of education (0.112) and negative relationship between participation in e-waste recycling and level of income (-0.088) and age (-0.065), respectively. But the values of Pearson correlation are found to be statistically significant at the 0.01 level. The results of the study show that education level plays an important role in respondents' participation in e-Waste recycling while level of income and age do not play important roles in respondents' participation in e-Waste recycling.

Table 5 indicates that 55 and 53% of the respondents show a positive attitude towards repair/refurbishment of WEEE while 45 and 47% of the respondents show a negative attitude or are not familiar with repairing/refurbishing of WEEE. Although, the majority of the respondents repair/refurbish their WEEE, more is needed to be done in creating awareness since repair is an element of reuse which is one of the best forms of practice to managing e-Waste.

Table 6 shows the pearson correlation between the attitudes towards repair/refurbishing and the level of education, income level and age among the UKM employees. Analysis of the data shows a negative relationship between participation in e-Waste recycling and level of education (-0.28) and a positive relationship between employees' attitudes towards repair/refurbishing

Table 3: Employee and student concern over why e-Waste should be collected and recycled

Category of response	Employees		Students	
	No.	Percentage	No.	Percentage
Material recovery	49	18.1	31	15.5
Environmental health	181	67.0	134	67.0
Revenue generation	12	4.4	7	3.5
Resource conservation	28	10.4	27	13.5
Others	0	0.0	1	0.5
Total	270	100.0	200	100.0

Table 4: Factors expected to affect the participation of UKM employees in e-Waste recycling

	Participation in e-Waste recycling		
Factors	Pearson correlation (r)	Significance (p)	Frequency (n)
Level of education	0.112	0.067	270
Income level	-0.088	0.150	270
Age	-0.065	0.287	270

Table 5: Attitude towards repair/refurbishment of WEEE in UKM

Category of response	Employees		Students	
	No.	Percentage	No.	Percentage
Yes	148	54.8	106	53
No	122	45.2	94	47
Total	270	100.0	200	100

Table 6: Factors expected to affect the attitude of UKM employees towards repair/refurbishment of WEEE attitude towards repair/refurbishment of WEEE

Factors	Pearson correlation (r)	Significance (p)	Frequency (n)
Level of education	-0.028	0.648	270
Income level	0.066	0.279	270
Age	0.063	0.300	270

and their level of income (0.066) and age (0.279) respectively. But the values of pearson correlation are found to be statistically insignificant as the results are greater than the significant level $\alpha = 0.01$.

Results obtained from the factors expected to affect recycling of e-Waste in this present study are similar to those of several other studies. Vining and Ebreo (1990), Oskamp *et al.* (1991), Gamba and Oskamp (1994) and Meneses and Palacio (2005) reported that education has no significant effect on recycling behavior. Some studies find a positive relationship between income level and recycling involvement (Vining and Ebreo, 1990; Oskamp *et al.*, 1991; Gamba and Oskamp, 1994). However, a study by Scott (1999) finds no statistically significant relationship between income level and recycling involvement, and this is similar to the present study whereby the level of income and age of the respondents show a positive relationship but were found to be statistically insignificant.

CONCLUSION

Considering the amount of EEE used in the campuses and at municipalities and a likely big amount of WEEE to

be generated over time, it is essential for the resources to be recovered and for the maintenance of good environmental footprint. This study hereby, concludes that individuals of UKM campus have a low performance in recycling of their end of life EEE. Although, individual performance is low, researchers could see a great support for e-Waste collection and recycling. The results also indicate that e-Waste collection and recycling would be a good cause rather than be harmful to the environment, thereby fostering a sustainable society. The attitude towards repair and refurbishment of WEEE by the UKM campus respondents is a clear indication that the individuals are thinking positively towards environmental well being, whether carried out consciously or unconsciously.

RECOMMENDATIONS

The study recommends that Universiti Kebangsaan Malaysia administrators and community should look into what it would cost the university management and stakeholders to come up with a WEEE collection and recycling center within the campus, either solely or in collaboration with companies or organsations that might be interested to partner with them. The study also recommends that sensitization of employees and students through teaching and seminars regarding e-Waste would go a long way to solving this global problem.

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REFERENCES

Bi, X., G.O. Thomas, K.C. Jones, W. Qu, G. Sheng, F.L. Martin and J. Fu, 2007. Exposure of electronics dismantling workers to polybrominated diphenyl ethers, polychlorinated biphenyls and organochlorine pesticides in South China. Environ. Sci. Technol., 41: 5647-5653.

CAUDIT, 2006. Electronic waste report. Griffith University on behalf of the Council of Australian University Directors for Information Technology.

Chan, J.K.Y., G.H. Xing, Y. Xu, Y. Liang and L.X. Chen *et al.*, 2007. Body loadings and health risk assessment of polychlorinated dibenzo-p-dioxins and dibenzofurans at an intensive electronic waste recycling site in China. Environ. Sci. Technol., 41: 7668-7674.

Countryman, A., 2009. Another load of I.U's Trash? An analysis of the waste composition of the residence halls of Indiana University. http://www.indiana.edu/~sustain/docs/ayinterns_08-09/Waste%20Audit_Countryman. pdf.

Davis, G. and M. Wolski, 2009. E-waste and the sustainable organisation: Griffith University's approach to e-waste. Int. J. Sustainability Higher Educ., 10: 21-32.

Gamba, R.J. and S. Oskamp, 1994. Factors influencing community residents participation in commingled curbside recycling programs. Environ. Behav., 26: 587-612.

Greulich, M. and S. Akers, 2009. Recycling center feasibility study. http://www.indiana.edu/~sustain/docs/ayinterns_08-09/Recycling%20Center%20Feasibility%20Study_Greulich.pdf.

Hageluken, C. and C.E.M. Meskers, 2008. Mining our Computers-Opportunities and Challenges to Recover Scarce and Valuable Metals from End-of-Life Electronic Devices. In: Electronics Goes Green 2008+, Reichl, H., N.F. Nissen, J. Muller and O. Deubzer (Eds.). Fraunhofer IRB Verlag, Stuttgart, Germany, pp: 623-628.

Hamburg, K.T., C.E. Haque and J.C. Everitt, 1997. Municipal waste recycling in Brandon, Manitoba: Determinants of participatory behaviour. Can. Geogr., 41: 149-165.

Huo, X., L. Peng, X. Xu, L. Zheng and B. Qiu *et al.*, 2007. Elevated blood lead levels of children in Guiyu, an electronic waste recycling town in China. Environ. Health Perspect., 115: 1113-1117.

Kelly, T.C., I.G. Mason, M.W. Leiss and S. Ganesh, 2006. University community responses to on-campus resource recycling. J. Resour., Conserv. Recycl., 47: 42-55.

Knudsen, L., 2009. The creation of a community electronic waste collection event. IUB and IUPUI Electronic Waste Collection Days, pp: 5-13. http://www.indiana.edu/~sustain/docs/ayinterns_08-09/E%20Waste_Knudsen.pdf.

Leung, A., Z.W. Cai and M.H. Wong, 2006. Environmental contamination from electronic waste recycling at Guiyu, Southeast China. J. Mater. Cycles Waste Manage., 8: 21-33.

Meneses, G.D. and A.B. Palacio, 2005. Recycling behavior: A multidimensional approach. Environ. Behav., 37: 837-860.

Oskamp, S., 1995. Resource conservation and recycling: Behavior and policy. J. Social Issues, 51: 157-177.

Oskamp, S., M.J. Harrington, T.C. Edwards, D.L. Sherwood, S.M. Okuda and D.C. Swanson, 1991. Factors influencing household recycling behavior. Environ. Behav., 23: 494-519.

Scott, D., 1999. Equal opportunity, unequal results: Determinants of household recycling intensity. Environ. Behav., 31: 267-290.

Vining, J. and E. Ebreo, 1990. What makes a recycler? A comparison of recyclers and nonrecyclers. Environ. Behav., 22: 55-73.

Wendy, L.B., 2009. Asset management and sustainability at the University of Richmond. http://www.educause.edu/ero/article/asset-management-and-sustainability-university-richmond.