

Enhancing Waste Management in Technical and Vocational Jobs through Information Technology

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Technical and vocational skilled workmen provide essential services for smooth running of a society. The services add value to the economy and social status of the society. However, the operations of technical and vocational skilled workmen generate wastes that have negative impacts on the environment. There is a research need to determine measures of managing the wastes effectively. Therefore, this paper describes ways of enhancing waste management in technical and vocational jobs through information technology. Research data are derived from questionnaire survey. The questionnaire seeks opinions of 540 respondents on solid wastes that are generated from technical and vocational jobs and ways of improving solid waste management in technical and vocational jobs using informational technology. The data are analysed using the relative contribution index. The findings indicate that crumbs from auto mechanic workshops and scraps from computing, handsets and related materials repair workshops as well as metallic scraps from electrical and electronic technicians are solid wastes that have very high impacts on the environment. Enabling adequate repair of electronic gadgets and the promotion of the use of best practice for technical and vocational jobs are the most significant ways information technology enhance waste management in technical and vocational jobs. Also, promoting the use of machines for optimization of designs, and the application of technologies like LeftoverSwap, LeanPath, FoodStar and Love Food Hate Waste to lessen waste of food are other ways information technology enhances waste management in technical and vocational jobs.

1. Introduction

Technical and vocational job is a skilled career that is obtained through a non-university degree training and certification. Some examples of technical and vocational jobs are fashion designing, hairstyling, bookkeeping, accounting, auditing, bricklaying, plumbing, electrical and electronics repairing. Others are medical laboratory job, electrician job, auto mechanic job, construction management, business and office management. The jobs add economic and social values to the society (CEDEFOP, 2011). However, the continuous generation of solid wastes from the operations of technical and vocational jobs and the impact of the solid wastes on the environment (Goorah et al., 2009) have attracted research attentions in the recent times.

Solid wastes make up all the wastes arising from human and animal activities that are in a common and regular way solid, thrown out as useless or unwanted. They are by-products of process lines or materials that may be demanded by law to be thrown out in the trash (Okecha, 2000). The waste can be categorised in some ways, on the basis of sources, related to surrounding conditions or the health of the Earth risks, utility and physical property. It could be classified into city-based solid wastes, industrial solid wastes and farming-based solid wastes. CIPS (2007) classified waste into general refuse, paper and paper products, production scraps, building/construction wastes and special wastes. Alam and Ahmade (2013) opined that types of solid wastes are residential, construction and demolition, industrial and municipal services wastes. Many developing countries are today fighting to clear mounting heaps of solid waste from their surrounding conditions, especially in their city centres. The peace and security of the centres are being messed up by the over flowing dumps of unattended heaps of solid wastes coming from household or domestic or kitchen sources, markets, shopping and business centres. The scenario violates the clean air and health laws.

More than 32 Mt of solid waste are generated in Nigeria every year, out of which only 20 - 30 % is disposed normally (Bakare, 2016). The careless and dangerous disposal of the wastes cause obstruction of sewers and drainage networks, including the water bodies. The solid waste comes from the residential homes, business centres, local businesses, workers who makes beautiful things, and traders, which throws trash or other things on the ground within the environment. Improper collection and disposal of city-based wastes is a threat to human survival.

The solid wastes, which are non-biodegradable and non-compostable biodegradable, emit greenhouse gases and toxic fumes that causes pollution (Cosmato, 2010). Chadar and Chadar (2017) discussed the causes and effects of solid wastes pollution. They said that solid waste pollution is caused by overpopulation, urbanization, affluence and technology. It causes numerous diseases to humanity. They concluded that effective management of solid waste is vital for adequate reduction of environmental pollution.

Agunwamba (1998) discussed the problems of solid waste management in Nigeria. The paper highlighted certain important issues that must be addressed in order to realise a successful solid waste management. It was pointed out that the absence of adequate policies, enabling legislation, and an environmentally stimulated and enlightened public are the basic problems of solid waste management in Nigeria. There are insignificant impact of government policies on the environment since the policies are poorly implemented; as well as inadequate public enlightenment programs coverage, concentration, and steadiness to readdress the indifferent communal approach towards the environment. The paper opines that successful solid waste management promotes the living standard of the society.

Uwadiogwu and Chukwu (2013) conducted an investigation on strategies to combat the problems stemming from solid waste management. Three hundred and ten households were used for the study. The findings indicate that citizen mobilization and environmental education, strengthening waste management agency, government support, waste management legislation, infrastructural and management improvement, application of science and technology, monitoring and surveillance, policy and planning implications are the strategies for ensuring adequate solid waste management.

Imam et al. (2008) assessed the status of solid waste management in Abuja city of Nigeria. The study identified adverse economic, institutional, legislative, technical and operational constraints are factors that affect solid waste management in the region. The findings of the study shows that a dependable waste assembly service, waste collection vehicles are required. The vehicles are needed to handle the growing waste generation. The wastes need to be arranged at source as much as possible to minimise disposal cost. It was observed that synergy among the communities, the informal sector, the formal waste collectors and the solid waste authorities are necessary for proper solid waste management.

Guerrero et al. (2013) carried out a study on the challenges of solid waste management in the developing countries. The study was poised to determine the stakeholders' behaviour that influence waste management process and to analyse the factors on waste management system. The results highlighted stakeholders that are pertinent in the waste management systems and several causes of waste management.

Ejaz et al. (2010) assessed the negative environmental impacts of improper solid waste management in Rawalpindi. Inappropriate solid waste management in Rawalpindi causes infectious diseases, obstruction of drains, and loss of biodiversity, including land and water pollution.

Sankoh et al. (2013) studied the environmental and health impacts of solid waste disposal in Freetown of Sierra Leone. They collected and analysed data from 298 residential homes less than fifty Mt near dumpsites and 233 residential homes more than fifty Mt away from dumpsites. Their findings revealed that both residents near and far away from the dumpsites suffer ailment like malaria, diarrhoea, chest pain and cholera probably because of pollution from the dumpsites.

Khankhaje et al. (2017) disclosed that the practice of reuse of waste materials is a dependable approach towards effective minimisation of the undesirable effects of waste on the environment. Also, good choice of naturally friendly finishing and decoration material like paint enhances cleaner and sustainable environment (Dodo et al. 2015). Egba et al. (2017) added that proper restructuring of the activities of professionals in the technical and vocational industry is essential for effective reduction of waste towards cleaner and sustainable neighbourhood in Nigeria.

Wilson et al. (2012) conducted a comparative analysis of the data collected from twenty cities in six continents using the integrated and sustainable waste management approach. They reported that the sustainable waste management approach is suitable in building up existing recycling rates in a city of interest, and in taking measures for effective control of waste growth in the city.

Ikhlayel and Nguyen (2017) conducted investigations on water resource and solid waste management for sustainable development using integrated approaches. They reported that integrated thinking could help in achieving effective waste management for sustainable development.

On usage of information technology in waste management, Hannan et al. (2015) revealed that the use of Information Technology (IT) in waste management has been receiving significant research attention in the

recent time because of the need for automated data acquisition, processing and storage. They reviewed information technologies usage in solid waste monitoring and management, and classified IT based solid waste management approach into four categories to include spatial technologies, identification technologies, data acquisition technologies and data communication technologies.

There is insufficient research on the usage of IT in the management of wastes from vocational jobs in a developing country like Nigeria. Therefore, this paper aims at identifying ways of enhancing waste management in technical and vocational jobs using IT. The objectives are to identify solid waste in technical and vocational jobs and rank the impacts of the solid wastes on the environment, and to determine ways of enhancing solid waste management in technical and vocational jobs through informational technology.

2. Methodology

The survey research approach was used. A questionnaire survey was designed to collect data from the opinions of the respondents on solid wastes that are generated from technical and vocational jobs and rank the impacts of the wastes on the environment, and ways of enhancing waste management in technical and vocational jobs through information technology. The target population is all technical and vocational teachers and skilled workmen in Ebonyi state of Nigeria. Two hundred technical and vocational teachers and registered skilled workmen were randomly and carefully drawn across each of the three senatorial zones in Ebonyi state to achieve a good representation of the population. Three technical and vocational experts from the department of Technology and Vocational Education in Ebonyi state University, Abakaliki subjected the 27 statement items that were designed by the researchers to content and construct validation to achieve a significant reliability of the instrument. The questionnaire copies were administered to the six hundred respondents. Five hundred and forty copies of answered questionnaire were returned, found fit, and utilized for data analysis. The demography of the respondents is presented in Table 1.

Table 1: Demography of the respondents

Characteristics	Gender		Years of practice		Total
	Male	Female	< 20 y	> 20 y	
Registered skilled workmen	335	125	322	138	460
Technical and vocational teachers	50	30	58	22	80
Total	385	155	380	160	540

The Relative Contribution Index (RCI) technique was used to analyse the data. The RCI was calculated using the formula shown in Eq(1).

$$RCI = \frac{\sum w}{A \times N} \quad (1)$$

Where; w represents the weight assigned to a variable by a respondent (w ranges from 1 to 5), A denotes the highest weight, and N signifies total number of respondents.

3. Analysis and results

3.1 Demographic analysis of the respondents

The analysis of the demography of the respondents shown in Table 1 indicates that 85.19 % of the total respondents are registered technical and vocational skilled workmen, while 14.81 % are teachers of technology and vocational subjects. 71.30 % of the total respondents are males, and 29.63 % have been in practice for more than 20 y.

3.2 Analysis of solid wastes from technical and vocational jobs and their impacts on the environment

The analysis of the solid wastes from technical and vocational jobs and their ranked impacts on the environment is presented in Table 2. The impacts are measured with RCI. The results show that crumbs from auto mechanic workshops and scraps from computing, handsets and related materials repair workshops were identified as the solid wastes from technical and vocational jobs that have the highest ranked impacts on the environment with an average RCI of 0.83. Other wastes with average RCI higher than 0.80 are metallic scraps from electrical and electronic technicians, material waste from HVAC technicians, pieces of bricks from bricklayers, offcuts from sheet metal and metal fabrications and waste from food and eatery jobs. Also, fragments of metals from blacksmithing including pieces of woods and nails from carpentry and woodworks are solid wastes that create significant impact on the environment with an average RCI higher than 0.80. The wastes from misuse of medical

laboratory consumables by technicians, pieces of paper and writing materials from bookkeeping, accounting and auditing jobs, including fragments of cables from electricians and offcuts of PVC pipes from plumbers constitutes wastes with an average RCI higher than 0.70. Other wastes with average RCI higher than 0.70 are pieces of cloths and tailoring accessories from fashion designers, material waste from business and office management, and material waste from hairstyling, cosmetics and beautification works. Material waste from art and design jobs, and waste from photography jobs have average RCI higher than 0.65. The fact that all the solid wastes from technical and vocational jobs that are listed in Table 2 have RCI above 0.6 indicate that the wastes have significant impact on the environment. It implies that the environment of Ebonyi state in Nigeria is in danger of pollution because of ceaseless generation of solid wastes from technical and vocational jobs within the state. The finding is in line with the report of Sankoh et al. (2013) that solid wastes within the environs of Freetown in Sierra Leone cause malaria, diarrhoea, chest pain and cholera ailments for the general public of Freetown.

Table 2: Solid wastes from technical and vocational jobs and their weighed impacts on the environment

Wastes from technical and vocational jobs	Registered skilled workmen		Technical and vocational teachers	
	RCI	Rank	RCI	Rank
Metallic scraps from electrical and electronic technicians	0.86	1	0.83	1
Wastes from misuse of medical laboratory consumables by technicians	0.69	16	0.71	15
Pieces of paper and writing materials from bookkeeping, accounting and auditing jobs	0.71	14	0.75	12
Fragments of cables from electricians	0.75	11	0.77	10
Offcuts of PVC pipes from plumbers	0.74	12	0.77	10
Material waste from HVAC technicians	0.80	7	0.81	5
Pieces of bricks from bricklayers	0.82	4	0.81	5
Material waste from art and design jobs	0.67	17	0.66	18
Pieces of cloths and tailoring accessories from fashion designers	0.77	10	0.75	12
Fragments of metals from blacksmithing	0.81	6	0.78	4
Material waste from business and office management	0.71	14	0.71	15
Pieces of woods and nails from carpentry and woodworks	0.78	9	0.80	8
Crumbs from auto mechanic workshops	0.83	3	0.83	1
Material waste from hairstyling, cosmetics and beautification works	0.72	13	0.74	14
Waste from photography jobs	0.65	18	0.68	17
Offcuts from sheet metal and metal fabrications	0.80	7	0.81	5
Waste from food and eatery jobs	0.82	4	0.79	9
Scraps from computing, handsets and related materials repair workshops	0.84	2	0.82	3

3.3 Ways of enhancing waste management in vocational jobs through information technology

The analysis of ways of enhancing waste management in vocational jobs through information technology is presented in Table 3. The analysis reveals that the registered skilled workmen share the opinion that enabling adequate repair of electronic gadgets, the promotion of the use of best practice for technical and vocational jobs and promoting the use of machines for optimization of designs are the most significant ways information technology enhance waste management in technical and vocational jobs. The three factors mentioned above have average RCI higher than 0.80. Technical and vocational teachers have the same view with registered skilled workmen, but added the promotion of the use of technologies like LeftoverSwap, LeanPath, FoodStar and Love Food Hate Waste to lessen waste of food to the list of the most significant means of enhancing waste management in technical and vocational jobs through information technology.

Other promising ways of enhancing waste management in vocational jobs through information technology are the use of technology aimed at prolonging life of fresh produce, enabling minimization of chances of reworks, and the optimization of cost of production of goods in vocational jobs with average RCI of 0.77, 0.76 and 0.76. Further, the results show that guiding against overproduction of goods in vocational jobs, and minimising generation of waste from the traditional system of storing information are additional ways information technology enhance waste management in technical and vocational jobs with average RCI of 0.75 and 0.74.

Table 3: Ways of enhancing waste management in vocational jobs through information technology

Ways IT enhance waste management in technical and vocational jobs	Registered skilled workmen		Technical and vocational teachers	
	RCI	Rank	RCI	Rank
IT promotes the use of best practice in technical and vocational jobs, thus minimising waste	0.82	2	0.81	2
IT enables adequate repair of electronic gadgets in order to reduce waste of material	0.83	1	0.81	2
The use of technology aimed at prolonging life of fresh produce reduces waste of food	0.78	4	0.76	6
IT minimises generation of waste from the traditional system of storing information	0.73	9	0.75	7
The use of machines for optimization of designs reduces material waste	0.80	3	0.82	1
The use of technologies like LeftoverSwap, LeanPath, FoodStar and Love Food Hate Waste lessen waste of food	0.77	5	0.80	4
IT minimizes the chances of reworks, thus reduces waste	0.74	8	0.78	5
IT guides against overproduction of goods in vocational jobs	0.76	7	0.73	9
IT enables optimization of cost of production of goods in vocational jobs for effective waste reduction	0.77	5	0.74	8

The results imply that information technology is a useful tool for effective waste management in technical and vocational jobs, especially in a developing country like Nigeria. The findings support the submission of Hannan et al. (2015) that information technologies could add meaningful value to solid waste management.

4. Conclusions

The paper presents the analysis of measures of enhancing waste management in technical and vocational jobs. A questionnaire instrument was used to ascertain the opinions of the respondents on solid wastes from technical and vocational jobs and rank the impacts of the wastes on the environment, as well as ways of enhancing waste management in technical and vocational jobs through information technology.

The results demonstrate that crumbs from auto mechanic workshops and scraps from computing, handsets and related materials repair workshops as well as metallic scraps from electrical and electronic technicians are solid wastes that create significant impact on the environment. Others are material waste from HVAC technicians, pieces of bricks from bricklayers, offcuts from sheet metal and metal fabrications and waste from food and eatery jobs, including fragments of metals from blacksmithing, as well as pieces of woods and nails from carpentry and woodworks.

Enabling adequate repair of electronic gadgets and the promotion of the use of best practice for technical and vocational jobs are the most significant ways information technology enhance waste management in technical and vocational jobs. Other ways are promoting the use of machines for optimization of designs, and the promotion of the use of technologies like LeftoverSwap, LeanPath, FoodStar and Love Food Hate Waste to lessen waste of food. It is recommended that future research be conducted on the development of information technology-based waste management framework for effective reduction of solid wastes in Ebonyi state Nigeria.

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