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ICT based waste management model for university dormitories

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Abstract

Fast modernization coupled with ever increasing population growth has made waste management a bigger concern. The objective of this research is to find out the economic profitability of recyclable waste and its positive environmental, social, economic impact. We have tried to provide an inimitable link between the waste producers and waste recycling industry. Primarily we have focused on the students of dormitories of BUET, University of Dhaka (DU) and Jahangirnagar University (JU) – three of the most leading education institutes in Bangladesh with the largest number of students. The integration of ICT with cash on delivery system has made this model unique than the traditional waste management system. The monetary profit that can be made from this process is worthy of making it viable as well as an emerging venture which was never seen in Bangladesh before.

INTRODUCTION

Waste management has become a burning issue in this rapidly growing world and Dhaka being capital of Bangladesh, a developing country has fallen in this pitfall of undesired urbanization [1][2]. Bursting population, growing economy, rise in community living standards and revolutionary technologies, only hastened the municipal waste production but there is no sufficient and effective way of its management. Especially, in Dhaka city, Dhaka City Corporation (DCC) is the only authority for waste collection and transportation. In recent years, several community based waste management service is growing due to lack of desired service from DCC. Despite almost 50 percent of the daily generated waste remain uncollected in the city [3]. In particular, the university dormitories have no working waste management system as dormitories can be considered as a Petri dish of the entire capital, since a large number of people are living in a small area from different part of the country. This research has been made with a vision on the 17000 students living in dormitories in Dhaka city to see if an ICT based waste management system can be developed which will work out the waste management problem as well as provide with a support to help economic development and with an aim to mitigate environment pollution.

The research has been done primarily on the dormitory students of BUET, DU and JU. The proposed electronic system consists of entities like student bodies, recycling industries, and recyclable waste products. Their information will be all stored in a central server. The survey has shown that, if a system can be developed by which people will get paid by giving away their wastes, people will deter from littering it around their campuses, which is both beneficiary for them financially and environmentally as well as the whole society. According to the research, a third party will conduct the transaction who will give an amount of money to the people in change of waste materials and then sell it to recycling companies directly without any intermediate vendors. This will make monetary profit for both sides.

THEORETICAL FRAMEWORK

In past few years, there have been quite a few waste management models introduced, including three separate colored bins model in Europe, Japan [4] and integrated waste management model in Canada [5]. The proposed waste management model here is, basically, the combination of idea of technology, economics and social aspect of Bangladesh. ICT based work will help everyone find an easier, faster and more efficient way of communication. Development schemes cover not only our organization but also many unemployed people of the country.

It is very important at the same time to gain people's willingness in this model. Quite a few surveys have been made visiting several halls (dormitories) to get people's response on this regard.

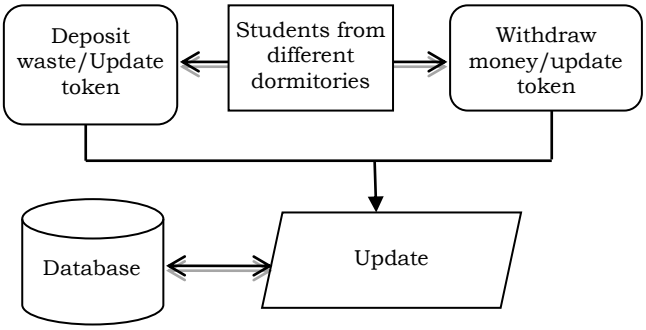

Fig.1. Schematic diagram of the model

A. Integration of ICT

The most significant factor in this waste management model is the integration of ICT. This separates the model with any other one (compared to current non ICT based dumping model). As stated above, the residential students are also being benefitted economically since they are getting paid for their wastes.

Strategies have been made for the integration of ICT to come up with a complete ICT-based waste management model with supplementary cash-deposit service. [Fig.1] The plan includes:

- A central computer server connecting the halls, a headquarter for general purpose
- Individual account and account number for every subscriber, stored to the main server with proper details
- A website to access the server through internet
- Punch card/id card for the subscribers according to their account numbers for economic safety
- Pickup cart/car for waste collection, travelling to each dormitory once in a week
- Emergency pickup request via website or phone call during occasions or necessary times
- Tokens for the subscribers to cash out deposited online money from their accounts
- Instant cash out system from designated booths or HQ
- Facility to share credits between accounts

The total project implementation details is shown is Table-1. The following diagram [Fig.2] shows the interconnections among the stakeholders.

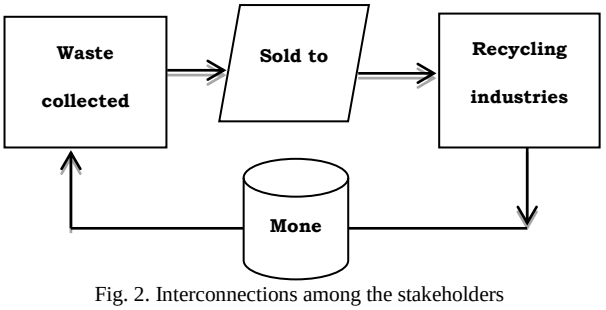

Fig. 2. Interconnections among the stakeholders

DESCRIPTION OF SURVEY

A. Research method

Our research is based on field study and is organized as the following:

- Selection of dormitories
- Collecting information about generation of wastes per day from the random students of the dormitories of the mentioned universities
- Consulting with recycling companies to get information of prices to sell wastes.

B. Selection of dormitories

Huge student bodies of the dormitories are the major waste producers in the university campus. The problem became acute as there resides a large number of students, numerically 17000 approximately. In our study, we have selected six dormitories from three of the topmost universities of Bangladesh- *Bangladesh University of Engineering & Technology (BUET)*, *University of Dhaka (DU)* and *Jahangirnagar University (JU).*These 6 dormitories have a good number of residential students and have good IT access comparatively to other dormitories in the Dhaka division.

Bangladesh University of Engineering and Technology [BUET]: BUET, is one the leading public universities in Bangladesh, with around 1000 students getting enrolled in undergraduate and postgraduate programs to study engineering, architecture and science. There are eight residential halls in BUET to provide accommodation facilities. One is for the young teachers, one is for female students and rests are for the male students. [6] In our survey, we have taken two big halls- Titumir Hall (male students' dormitory, accommodating almost 550 students in 90 rooms) and Chhatree Hall (female students' dormitory, accommodating almost 600 students) into account.

Dhaka University [DU]: University of Dhaka, also known as Dhaka University (DU) is the highest academic echelon of Bangladesh. It is the largest public university with almost 33,000 students. There are 22 halls and hostels for the residential students. [7] We have selected two of the largest male dormitories of DU for the survey- Shahidullah Hall (accommodating around 1000 students) and Fazlul Haq Muslim Hall (accommodating around 800 students).

Jahangirnagar University [JU]: Jahangirnagar University is a renowned public university situated at Savar. It is a fully residential university of Bangladesh. It has 7 dormitories for male students and 6 for female students. [8] Among the 13 we have selected the largest 2 dormitories of JU- A.F.M Kamaluddin Hall (for male students) & Jahanara Imam Hall (for female students).

C. Survey at dormitories

Public reactions: The positive response among the people surveyed represents the viability of this model. In the survey, from the six dormitories, we took data from 3 groups of almost 200 students in each dormitory. The average age of the participants was around 22 years. We emphasized on their willingness on this model and about the waste produced everyday as well. The phenomenal result we have achieved on peoples' willingness for the implementation of this model is shown below. [Fig.3]

Much of the advancement we have made with our project is due to the appreciation of students for our work. Without their cooperation much of our work would be in vain. And the environmental effect in this work will be greatly felt. We could persuade them by running a campus wide campaign, distributing leaflets, creating Facebook events and in overall creating a general goodwill towards our work.

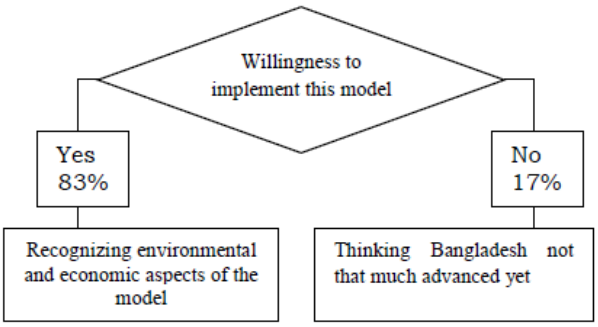

Fig. 3. Peoples' willingness for the implementation

Table 1. Implementation detail of the waste management model

Tasks	Activities	Required Materials	Major Skills
Server Creation	Creating a central internet-based server to control all the work.	Computer, internet connection	Web development, Java programming, database skills
Networking	Building ICT based network among the central and sub-sectoral areas.	Computer server	Web development
Communication Solution	Solution (CCS) for communication with the organization for the general public (waste suppliers)	Internet, telephone	Communication skills, internet using basics
Transportation Solution	Finding one or more transports (and divers) for disposal of wastes, store for the time being and transport them to the recycle factories	Cart, pickup van	General knowledge
Publicity	Reaching the project to the desired stakeholders (general public and recyclers) to get positive response from them	Internet, posters, leaflets.	Advertising skills
Market Analysis	Arranging surveys, calculating investment cost, easy of user adoption, market size and revenues for implementation	Market analysis tools or software	Marketing
System Analysis	Compare the revenues, cost, profit, loss, ratios etc.	System analysis tools or software	Economic basis, quantitative analysis

Table 2. Percentage of amount of wastes produced per day

University	Dormitory	No. of Resident Students	Waste produced/day (in %)					
			News Paper books	Paper & Note	Plastic	Glass	Metals	Cosmetics
BUET	Titumir Hall	550	39.13	8.69	30.43	20.74	1.01	-
BUET	Chhatree Hall	600	46.5	8.43	28.15	15.625	0.31	0.985
DU	Shahidullah Hall	1000	54	8.63	21.59	15.12	0.66	-
DU	Fazlul Haq Muslim Hall	800	46	10	25.94	17.49	0.57	-
JU	A.F.M. Kamaluddin Hall	700	45.3	8.3	30.4	15.1	0.9	-
JU	Jahanara Imam Hall	800	45	12.4	25.6	13.4	0.3	2.4

Statistical representation: Our survey only includes solid waste materials like newspapers, paper books, notebooks, bags, bottles (glass & plastic), ceramic materials, cosmetics containers, metals etc. The survey was conducted on quantity basis (gm/kg/ton) of products. To avoid any biasness we took the survey three times and using the following formula calculated standard deviation of data from the mean where we got 5% deviation from the mean [9]:

$$s = \sqrt{\frac{1}{N-1}\sum_{i=0}^{n}(x_i - \bar{x})^2} \quad (1)$$

The comparativeness among the percentage of amount of waste produced in the dormitories per day is shown in Table 2.

D. Information from recycling companies

There are a number of recycling companies in Dhaka that recycle solid wastes. Panacea International Limited [10] and BD Recycling Limited [11] are two major recycling companies and both of them deal with solid waste materials. They buy materials from third party vendors who collect the products for them from scavengers. For this continuous cycle of buying they have less profit than when they buy directly from us. Generally they buy newspapers at 20 tk/kg, notebooks and papers at 22 tk/kg, plastic at 26 tk/kg, glass at 20 tk/kg, metals at 32 tk/kg and cosmetics at 28 tk/kg. On the other hand we encouraged the students to keep their wastes and we bought the wastes paying a very good rate such as newspapers at 15 tk/kg, papers and notebooks at 16 tk/kg, plastic at 20 tk/kg, glass at 16 tk/kg, metals at 28 tk/kg and cosmetics at 22 tk/kg. We sell the materials at a profit of 2 tk per kg adding with the price to the companies. This is shown in Fig. 4.

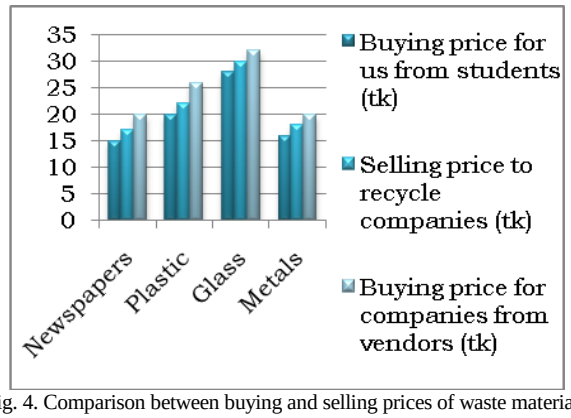

Fig. 4. Comparison between buying and selling prices of waste materials

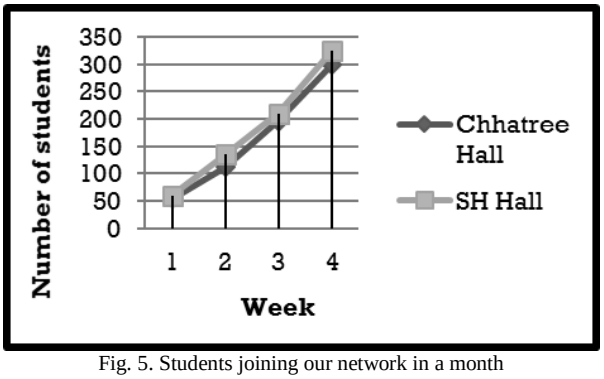

Fig. 5. Students joining our network in a month (Chhatree Hall and SH Hall)

RESEARCH RESULT

The research was conducted on the field survey of solid waste materials produced per day on the dormitories. We find that around 10 tons of solid wastes are produced every day in the dormitories which are more than enough for a campus to be polluted. Besides environment pollution, campus undergoes visual pollution and scenic beauty is lost. Our process of waste management has a very good outcome in the dormitories. Students are gradually being cautious of their environment and now they have a tendency of not throwing their wastes to any random open places. They are economically benefited through our process and that has accelerated our approach towards further implementation. Students who joined our network in a month just in Chhatree Hall and Shahidullah Hall are shown in [Fig.5] (Weekly basis).

Our approach towards environment safety has already got a positive overview in the dormitories. Approximately 40%-50% students have already been benefited from our process. Recycling companies have shown great interest in our procedure due to their greater profit turnover.

IMPACTS & DISCUSSIONS

The research results show that the waste management model has succeeded in creating awareness among the students of university dormitories and at the same time, helping the residential students to get some financial help. Many field workers can be employed in this project for financial benefits. Above all, the project is successful in creating the trend among the students of not polluting the environment intentionally rather storing the waste materials to keep the environment clean.

Implementing to a smaller area though, our project comes with the results to accomplish the objectives of us which, therefore, indicates the feasibility of this model in urban areas, although it is not that much easy to implement in rural areas due to lack of infrastructure and ICT engagement.

CONCLUSION

Our work has already shown results beyond our expectations. Our future ventures include, setting up small booths all around Dhaka city, increasing our client base, buying modern waste carrying transport and setting up a recycling factory ourselves which will deal with all possible kind of wastes. Extrapolation of our graphs shows, this can employ thousands of people and play a substantial part in environment and unemployment issues.

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