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SMART PHONE MOBILE APPLICATION MODEL FOR TOILET EMPTYING IN KAMPALA CAPITAL CITY AUTHORITY- UGANDA

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ABSTRACT

Management of sewerage in and around Kampala has been a big challenge that 44% of it has always been dumped in the rivers and lakes which has made the water unsafe for drinking, this challenge has persisted for long time. The main objective of the research was to design a mobile application model for fecal removal from filled up pits and help in integrating all the unregulated system that has been used for a long time. There has been several individuals and companies that have been handling this kind of activity but expensively and un-reachable by the majority poor urban community. This research adopted the design science research methodology to aid in the understanding and developing the artifacts or the model which aided in the development of the mobile application prototype to support the process of identifying and contacting pit emptying services. The existing system had both benefits and challenges, the benefits ranged from contacting the service providers through phone call and hence the customer could be dealing with someone they trust or know but the weakness was that if the customer did not know the service provider then would never get services and this led to the development of a model to integrate all the existing systems into one and reduce the time wasted in searching for service providers. The developed model was tested and validated and does fulfill the purpose hence there is need to fully develop the mobile up to handle the process effectively and this app should integrate the payment system and tracking system for the clients.

KeyWords

(Mobile, application, model, city authority, pit, toilet, emptying, management and sewerage)

INTRODUCTION

Pit Emptying is often unhygienic and expensive, leading to dangerous practices of overfilling the pit and/or flooding it out Jenkins et al., (2015) this leads to ground water contamination(Graham and Polizzotto, 2013), and in many cases the fecal sludge is dumped into water sources like rivers and lakes, with devastating effects on surface water quality (Semiyaga et al., 2015). Increasing eutrophication in low and middle income countries,

to a large degree caused by the nutrients contained in human excreta from cities (Nyenje et al., 2010), is raising awareness that the sanitation crisis is detrimental not only to public health, but also to the environment. This is reflected in the more comprehensive Post Millennium Development Goals for sanitation, which also involve water pollution control and resource recovery (UN Water, 2015), and are discussed in more detail in Larsen et al. (2016).

When the pit fills to within 0.5 meters (1.6 feet) of the top, it should be either emptied or a new pit constructed and the shelter moved or re-built at the new location (*François, 2003*). In peri-urban or urban areas, full pits are not abandoned but rather emptied so that the toilets can continue to be used at the same location after the emptying has taken place. The emptying can be done manually with shovels and buckets, with manually powered pumps or with motorized pumps mounted on a trucks which carries a tank for storage (Still, et al, 2012). For the fecal sludge to be ably pumped, water usually needs to be added to the pit and the content stirred up, which is messy and smelly yet, the requirements for safe pit emptying and fecal sludge management are often forgotten by those building pit latrines, as the pit will only fill up in a few years time. However, in many developing countries safe fecal sludge management practices are lacking and causing public health risks as well as environmental pollution. Fecal sludge that has been removed from pits manually or with vacuum tankers is often dumped into the environment indiscriminately, leading to what has been called "institutionalized open defecation".

According to the World Health Organization report (WHO report,2012), 2.4 Billion people still lack access to an improved source of sanitation, yet up to 95% of this population is covered by mobile networks and unique subscriber market penetration is above 63%, i.e. more than 4.7 Billion people have at least one mobile phone number. With more than 411 Million registered mobile money accounts, mobile is also increasingly changing the landscape of financial inclusion. As a result, some people can browse the internet on their smart phone, get connected to the rest of the world and receive mobile money remittances from relatives leaving in faraway countries, while they still don't have any safe solutions to fulfill one of the most basic human needs, going to the toilet. This is a paradoxical situation for millions today living in emerging markets. In many cities, private emptying service providers operate either legally or illegally, but with no legal discharge location, or no existing treatment facilities, resulting in no option but to discharge fecal sludge directly into the urban environment.

A 2013 Rapid Market Assessment report carried out by Water For People in partnership with Captiva, a Business Development Service provider company in Kampala, revealed that manual laborers simply use a broken jerry can and rope to empty pit latrines. Such manual emptying of pits is not only unhygienic, but labor intensive and time consuming. Many households resorted to releasing sludge into the community drainage systems,

or abandoning the facility altogether and resorting to open defecation, leading to waterborne diseases like diarrhea and cholera.

Individuals and companies are cashing in by collecting feces from homes and delivering it to waste treatment plants (Tajuba, 2017). There is no room to open a new pit in towns like in villages like latrine when the old one gets full, there is no such space in urban areas, requiring urban dwellers to empty pit latrines whenever they fill up. Most of the latrines are shallow because Kampala is surrounded by many wetlands so they get full easily

According to African Development Fund publication (2018) on Kampala, they are different emptying services/Technology available such as Forever Sanitation's pit latrine emptying service which fills a market gap in the slums of Kampala: there was previously no cost-effective and accessible way to do this. The program uses a simple technology and charges a fee for its service, ensuring the company's long-term sustainability. Water for People remains a non-profit organization and a player in the safe water and sanitation sector. NWSC currently runs two major sewerage plants in Kampala – *Bugolobi Sewage Treatment Plant* and the one in *Lubigi*. The Lubigi plant has the capacity to treat 5,400m³ (5.4 million) wastewater a day, while the Bugolobi plant, which was constructed in the 1940s and upgraded in 1970, has capacity to treat 33,000m³ of wastewater a day. There are other satellite waste stabilization ponds in Bugolobi, Naalya Estates and Ntinda Ministers' Village, in Kampala.

KCCA tried to improve the sanitation by carrying out home sanitation visits from January 2017 to June 2017 in order to assess household sanitation in the City. The assessment sought guide investment in sanitation at a City wide scale. KCCA committed to increasing access to improved sanitation in the City and has invested in key sanitation improvement areas including but not limited to; Solid waste collection, transport, safe disposal and treatment, Construction of toilets in public primary schools, communities and health centers, Hygiene promotion and enforcement and refurbishment, operation and maintenance of free public toilets for the high transient population, especially within the central business district (CBD). As a result, there was an improved household health, hygiene and environmental sanitation, reduction in environmental pollution and sanitation related diseases, increased business and entrepreneurship for household sanitation services. A pilot was done by KCCA with support from GIZ and Swiss Development Cooperation and was recently launched in January 2017.

On-going advances in Information Technology (IT) are increasing the scope for IT-based mobile assistive technologies to facilitate the independence, safety, and improved quality of life of the people. Technology has the potential to enhance individuals' ability to participate fully in community activities and to live independently. With advancement in new technologies, mobile devices have grown in popularity to become one of the most common consumer devices. Cell phones especially smart phones have become very important part of modern life as many people need to make a call, send a message and access other services like service providers of toi-

lets, waste collection team at anytime from anywhere but this has been a problem since there is no search application which integrates services providers with the clients hence depending on the contacts they have. For those who do not have the contacts of the toilet emptying service providers remain with their full toilets and sometimes they begin to over flow.

Problem statement

Fecal pit emptying services in and around Kampala are unregulated, inadequate and largely unknown or unaffordable by the urban poor in informal settlements. Consequently, it is estimated that 56% of human waste (Fecal sludge) is safely collected, transported, disposed, treated and also the services are expensive resulting into pit latrines overflows Jenkins et al, (2015) leaving the 44% disposed in lakes and rivers hence causing water contamination and spreading diseases to the population.

Objective of the study

The objective of this study was to design a Smart Phone Mobile based Toilet Emptying model to aid the service providers in tracking and reaching wider clients to reduce on disposing of the waste to the water sources.

Subject scope

Designing an android smart mobile phone based toilet emptying application research was targeting to solve the problem of pit sludge overflows in the KCCA by collaborating sewage systems emptying service providers to enhance efficiency in sewage emptying service delivery by bringing them closer to clients on the same platform. It includes a pool of sewage emptying service providers, clients (Landlords and tenants), GIS component, all their contacts and addresses.

LITERATURE REVIEW

Toilet emptying mobile applications.

TOILET CLEANING CHECKLIST

This help in Log and manage all your toilet cleaning needs with our mobile app solution and it can be got in Google play store (ginstr,2014). This app is for toilet cleaning companies who are looking for a solution to efficiently check the toilet cleaning tasks. Furthermore, you can collect and transmit in real time to the responsible employee missing supplies, damages, and other important information.

Emptying service call center.

In Senegal, the public service organization (ONAS) has developed in partnership with local software company Manobi, a call centre enabling urban households in Dakar to call in when in need for a desludging services(USAID, 2014). These services aimed to improve linkages between service suppliers and clients but also sup-

port the development of a sanitation private sector and enhance the demand for mechanical service. Once an emptying call is registered, desludging operators can submit an offer and calls for the bids go out SMS, this requiring a low level of technology. The lowest bidder amongst the operators win the job.

Smart sensors to automate emptying services request.

Smart sensors are already in use in the developed country cities to track the activity of sewerage networks in order to prevent blockages. In the case of lower income settings and on site systems, there is need to develop a more cost efficient solution for smart sensor integration in sanitation infrastructure. M2M connectivity where sensors combined to a wireless connectivity (GSM or other shorter range wireless technology), could improve access to real time information on parts of the on-site sanitation infrastructure more difficult to monitor by humans i.e pit and septic tank levels. Such information would prove useful in commercial sanitation services where automated messages could help entrepreneurs provide timely responses, also able to better organize their route based on providers and customer's location.

Toilet emptying service available

“Fresh Pit. Fresh Pit is the leading emptying service provider in Uganda. We empty over 2,000 sanitation facilities each year. We provide services for both households and institutions. The range of services we provide includes: Emptying latrines and septic tanks, Thorough cleaning after emptying, Rubbish removal, Odour elimination, Slab repair (sanitationsolutionsgroup.com/fresh-pit)”.

Jerrican-like bucket. This uses rudimentary tools including a hook to scoops out matters and a drum where he pours the sludge from the latrine using a jerrican-like bucket. That is a job worth Shs300, 000 and it takes him and his two colleagues six hours to finish depending on the distance of a latrine to a NWSC designated dumping site (Tajuba, 2017). There are two types of latrines in Kampala, one which is lined with bricks and concrete, which he says is strong and easy to empty, and the other which is not lined. If the sludge is thick, pours water into the pit latrine to agitate it for easy scooping and he uses paraffin to kill off bacteria and bad smell. Gloves and gumboots here are handy to prevent direct contact with faeces.

Sanitation Solutions group Uganda. At Sanitation Solutions group in Bukoto, a Kampala suburb, over 10 men do the same work with a little more advanced technology. Turinawe, (2017) According to him, using a gulper, a long PVC stainless steel hand pump that works like a borehole to empty pit- latrines, they are able to empty a latrine in less than two hours. The charge is Shs30, 000 to carry 180 litres (one drum) of sewer from one's home to different dumping stations set up by the NWSC.

National water and sewage construction (NWSC). NWSC currently runs two major sewerage plants in Kampala – Bugolobi Sewage Treatment Plant and the one in Lubigi. The Lubigi plant has the capacity to treat 5,400m³ (5.4 million) wastewater a day, while the Bugolobi plant, which was constructed in the 1940s and upgraded in 1970, has capacity to treat 33,000m³ of wastewater a day. There are other satellite waste stabilization ponds in Bugolobi, Naalya Estates and Ntinda Ministers' Village, in Kampala. To dump 3,000 liters of sewer at Lubigi, NWSC charges Shs10, 000. From 3,000-7,000 liters, one is charged UGX 14,000, while for anything above 7,000 liters one is charged UGX 25, 000 (monitor of Thursday March 23 2017).

Forever Sanitation's pit latrine emptying service. Forever Sanitation's pit latrine emptying service fills a market gap in the slums of Kampala: there was previously no cost-effective and accessible way to do this. The program uses a simple technology and charges a fee for service, ensuring the company's long-term sustainability. Forever Sanitation is a company formed in 2013 to provide access to reliable, affordable, hygienic and clean pit-emptying services to every household in Kampala district and beyond.

Methodology

This study adopted Design science research (DSR) methodology in the approach (Reubens, 2016) with a goal to construct a new reality (i.e. solve problems) instead of explaining an existing reality, or helping to make sense of it (Iivari and Venable, 2009). While Van Aken & Romme, (2012) states that DSR looks to develop valid and reliable knowledge for designing solutions he leaves out the actual utilization and problem-solving capabilities. Both Horváth (2007) and Baskerville et al. (2015) bring out the dual mandate of the DSR: (1) to utilise the gained knowledge to solve problems, create change or improve existing solutions; and (2) to generate new knowledge, insights and theoretical explanations. This methodology was carefully selected due to the design of artifacts and models in this particular study and a prototype of the application shall also be developed to validate the model.

Data was collected through self-administered questionnaire which was designed in different languages to allow all people to respond easily in the language, they do understand best. There was a follow up interview which helped in clarifying issues which were contradicting.

Findings and results

This involves a thorough investigation of the existing systems, their strengths and weaknesses and this enabled us to mitigate the pitfalls and short comings.

From the study, the following weaknesses and strengths were found;

Strength of the existing systems

The existing has a few strengths and these include:

- i. Clients are able to contact service providers by calling them.
- ii. Clients are able to pay in cash.
- iii. Service providers are able reach clients and offer services.

Weaknesses of the existing systems.

The existing systems have a number of weaknesses and these are:

- i). It is time consuming since service providers are not gotten from the nearby places.
- ii). It is difficult to get service providers as clients have to look for the contacts of the service providers from referrals or their websites or go straight to their offices.
- iii). It does not give chance for clients to select a service which cheaper for him or her.
- iv). Service providers often fail to locate clients' places.

How get your customers

Below results show the response on how service providers meet with or get clients and as per the results 31.8% said that they get customers through Brokers or referrals, 4.5% said Websites, 22.7% said through of-fices, while 40.9% the highest number of response.

Table 1: How get your customers

How you get customers	Frequency	Percentage
Through Broker/referrals	14	31.8
Websites	2	4.5
Through Offices	10	22.7
Customers calling us	18	40.9
Total	44	100

Source: Primary data

Problems do you face when emptying your Pit Latrine/ toilet

TABLE 2: PROBLEMS FACED IN EMPTYING PIT LATRINE/TOILET

Problems faced in Emptying Pit latrine/Toilet	Frequency	Percentage
Delay in response	10	22.73
Lack of choices to select a cheaper provider	13	29.54
Service providers often fail to locate clients' places	11	25
Difficult in getting service providers	10	22.73
Total	44	100

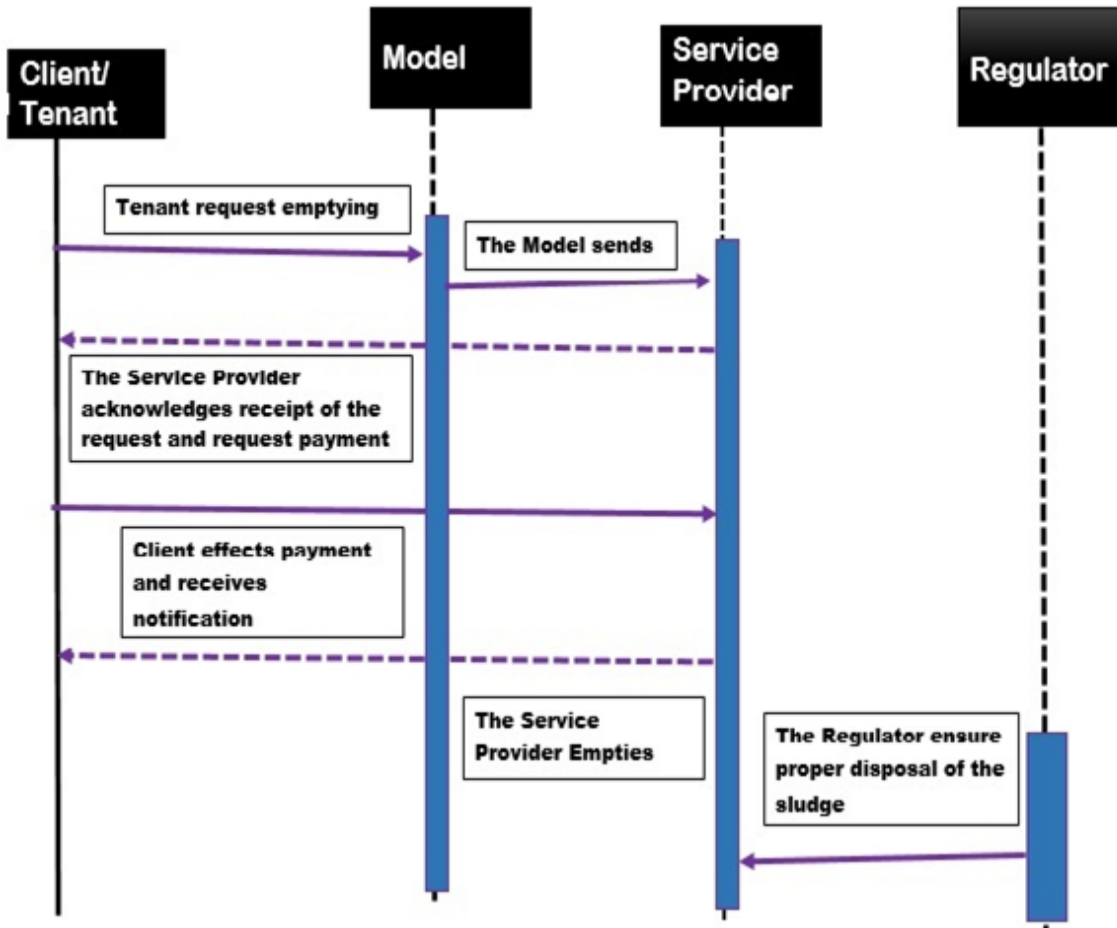
Source: Primary data

Respondents were asked about the **problems they face when emptying your Pit Latrine/ toilet and** as per the results,31.8% said that they get customers through Brockers or referrals, 4.5% said Websites, 22.7% said

through offices, while 40.9% the highest number of response.

Model for the mobile application

Figure 1 The application model



Model explanation

Client a tenant ie the landlord or lady intiates the process by sending a requestion through the application or the old method of calling it does not have a smartphone, the messasge shall be sent to the service provider and the service provider will respond with acknowledgement of receipt of the information and bills the customer who then makes payment through online system either mobile money, EFT or any other payment option available. The service provider will then acknowledge receipt of payment and then proceeds to empty the customer's septic tank and disposes it to the right place. All the processes above is regulated by a regulator to ensure environmental safety and fair charges for the customers.

Conclusion

Smartphone toilet emptying model was developed to help in collaborating sewage systems emptying services providers to enhance efficiency in sewage emptying service delivery by bringing them closer to clients on the same app. A model was developed to illustrate the whole process for the application which does include the roles of a regulator to avoid environmental contermination and also unfair charges to customers. The intended objective was fully achieved and application needs to be developed and deployed based on the above model.

They are smart phone toilet emptying services model should integrate other services like banking, mobile money services to supplement their operations ie if you want to call a client, you can buy airtime by going on mobile facility. Or if you want to pay for the service you just transact money from your bank account to your virtual account and pay.

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