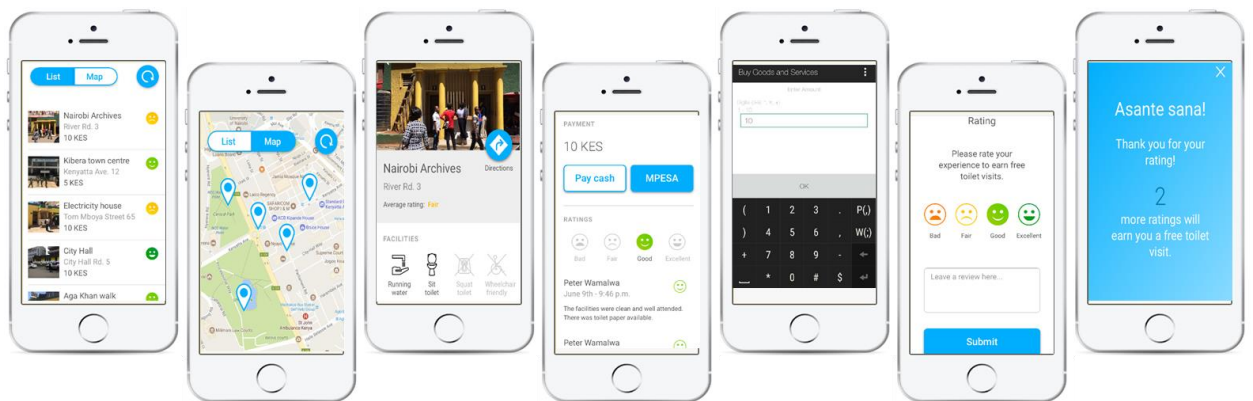




Peer-to-peer business models to meet sanitation needs

An applied research project for the Kenyan market



Lorah Njagi, Ana Perez Aponte, Charles Ogalo, Hester Foppen, and Ilse Gortemaker

Inclusive Business Sweden, Aqua for All, and Unilever

October 2017

Contents

1	Acknowledgment	3
2	Summary	3
3	Key Definitions	5
4	Background	6
5	Introduction	7
5.1	Objectives.....	8
6	The challenge in the Kenyan context	8
6.1	Approach.....	10
6.1	Methodology.....	11
6.1.1	<i>Desk study</i>	11
6.1.2	<i>4D Workshops</i>	11
6.1.3	<i>Face-to-face interviews</i>	12
6.1.4	<i>Focus Group Discussions (FGDs)</i>	16
7	Peer-to-peer business models and technologies	16
7.1	Rationale for a mobile app	17
7.2	Research Hypotheses	17
7.3	Researched hypotheses.....	18
7.3.1	<i>Lack of access to clean public toilets affects user behaviour</i>	18
7.3.2	<i>Willingness to pay</i>	19
7.3.3	<i>Public interest</i>	20
7.3.4	<i>Market size</i>	20
7.3.5	<i>App relevance and potential</i>	21
7.3.6	<i>Smartphone and internet</i>	22
7.3.7	<i>Peer reviews/ratings</i>	22
7.3.8	<i>Payment methods</i>	24
7.3.9	<i>Incentives for owners</i>	26
8	Barriers and triggers	26
8.1	Affecting the use of public toilets	26
8.2	Affecting the adoption of an app to find clean toilets.....	28
8.3	Barriers to using an app to find public toilets and how to address them.....	31
9	Prototype development	32
9.1	Prototype 1.0	33
9.2	Prototype 2.0	34
9.2.1	<i>Prototype 2.0 flow</i>	35
9.3	Prototype Testing.....	37
9.3.1	<i>User Study</i>	37
9.3.2	<i>User Study Findings</i>	38
10	Conceptual business models for the app	42
10.1	The ‘pay as you go’ Model.....	42
10.2	The subscription model.....	44
10.3	The public-private partnership (PPP) model	45
11	Conclusion	47
12	References	49

1 Acknowledgment

This research project, conducted by Inclusive Business Sweden and Aqua for All, has been supported by Unilever and funded by TRANSFORM.

TRANSFORM is a joint initiative between Unilever and the UK's Department for International development to support market-solutions for low-income household needs. Find out more at www.transform.global. We thank them for the support of this project.



This research project was also facilitated by the contributions of public toilet owners, public toilet managers, public toilet users and other public toilet stakeholders through interviews conducted in Nairobi, Kenya.

2 Summary

Uber, the world's largest taxi company, owns no vehicles. Airbnb, the world's largest accommodation provider, owns no real estate. Peer to peer (P2P) business models such as these have achieved scale globally, and fast. These P2P business models provide an organised way for collective consumption and sharing of resources.

This research project explored the potential of utilising P2P technologies and models to encourage behavioural change and sharing of sanitation services in developing markets where access to sanitation is low, while mobile and smartphone penetration is increasing.

Shared or public toilets are a primary means of access to sanitation for many people in urban areas in developing countries. If they are well operated, clean, convenient and safe, public toilets provide a reasonable solution for those who would otherwise have no access. In developing countries, when public toilets do not meet basic levels of cleanliness, many public toilet users sometimes opt for open defecation or the use of other unimproved facilities which do not ensure hygienic separation of human excreta from human contact.

The main hypothesis of this project was that if people have information about where to find and access clean public toilets near them, they are less likely to practice open defecation or resort to the use of unimproved facilities.

We looked at the Kenyan context, and explored how the use of a mobile application (app) could enable public toilet users to find and access a clean public toilet near them when they needed one.

We looked at common themes of P2P business models and how they could help address this problem. One of the key elements we looked at was peer reviews. We investigated the role of peer reviews for public toilets by users and how this could motivate public toilet businesses to better clean their toilets to avoid losing users to competitors. By investigating the main triggers and barriers of using public toilets and of using a mobile app to find clean

toilets in the city, we identified the key issues affecting public toilet users, owners and managers, and the options for addressing these issues most effectively in a such a solution. Another element of P2P business models we looked at was the transparency of the payment system used. Almost all toilet owners interviewed felt that there was a lack of transparency of their actual daily earnings - they relied on reports from their toilet managers who collected users' payments in cash. They would prefer a more transparent system but have not found an appropriate one yet. More transparency would help owners to get a better overview of the costs and more so income, which would make their business more profitable, and in turn give them the ability to invest more in the maintenance of their toilet facilities.

We learned that while public toilets in Nairobi might be available in many areas, the main reason why toilet users chose not to use them sometimes was that they were often unclean.

We also learned that a 'light' app with minimal data consumption and was easy to use was key to user adoption. Users also stated other types of features that they deemed useful to them when choosing toilets, such as whether public toilets were 'sitting' or 'squatting' toilets.

These insights led us to the development of the final version of the prototype, which we developed and tested through an iterative process.

We tested the project hypotheses and conducted user tests around both the concept and the prototype as it evolved. Both the concept and prototype app were received positively by users and other stakeholders.

Another important element of this research was the exploration of three conceptual business models: the 'pay as you go' model, the subscription model and the PPP model.

The 'pay as you go' model is similar to how the toilet businesses currently run, where toilet users pay per use, but would now have an added review system and digital payment option.

With the subscription model toilet users would be able to subscribe on a weekly or monthly basis to use certain public toilets in the city, in addition to also having a review system and a digital payment option.

The PPP model would provide the service of mapping public toilets in the city on the app and keeping track of city residents' satisfaction of existing sanitation services and collecting data on sanitation use in the city to local governments and municipalities.

All three business models have their merits, but based on the situation in Kenya we would recommend the PPP model. While this model has its challenges, aligning the business solution with the ambitions of the authority responsible for public toilet policy in the city could have a wider reach and yield more fundamental changes in the long term.

The next step of this research project is pilot testing of the fully functional mobile app, combined with a corresponding business model, in order to assess the feasibility and effectiveness of such a solution.

3 Key Definitions

Base of the Pyramid (BoP): BoP is defined as those people that earn less than 8 US dollars per day. They are value demanding consumers, resilient and creative entrepreneurs, producers, business partners and innovators. Because they are largely excluded from formal markets, there is a strong demand for innovative products, services and technologies that provide access to basic needs (BoP Innovation Center).

Improved sanitation: Refers to facilities designed to hygienically separate excreta from human contact.

Safely managed sanitation: Refers to improved facilities that are not shared with other households and where excreta are safely disposed of in situ or transported and treated offsite.

Basic sanitation: Refers to use of improved facilities that are not shared with other households.

Limited sanitation: Refers to use of improved facilities shared between two or more households.

Unimproved sanitation: Refers to use of pit latrines without a slab or platform, hanging latrines or bucket latrines.

M-PESA: Is a mobile phone based money transfer run by the largest mobile network operator in Kenya, Safaricom. It allows users to deposit, withdraw, transfer money and pay for both goods and services easily with a mobile device.

Peer to Peer (P2P) business models: This refers to business models providing an organised way for collective consumption and sharing of resources.

Public or shared toilets: For purposes of this project and report, public or shared toilets refer to toilets which are open to the general public and charge a fee for use.

Public toilet facility: This refers to a structure that comprises of a number of individual toilets, often ranging between 2 and 10.

Public toilet owners: This refers to private companies, community based organisations (CBOs), the Nairobi City County and other organisations who run revenue generating public toilet services to users for a fee.

Public toilet managers: Refers to employees of public toilet owners who are engaged in the day-to-day running of the public toilet facilities.

Public toilet users: Refers to individuals who pay a fee to use the services of a public or shared toilet.

WASH: Stands for Water, Sanitation and Hygiene. WASH is an area with significant potential to improve health, life expectancy, student learning, gender equality, and other important issues of international development (UNICEF).

4 Background

As of 2015, 2.3 billion people did not have access to basic sanitation services, with 892 million being without any facilities at all and continuing to practise open defecation. 600 million people used a limited sanitation service, that is, an improved facility which is shared with other households.¹

One of the targets of Goal 6 of the Sustainable Development Goals is to achieve access to adequate and equitable sanitation and hygiene for all and to end open defecation by 2030. Access to sanitation has grown globally, with 68% of the population having access to improved sanitation facilities in 2015 compared to 59% in 2000.²



Current data shows that sub-Saharan Africa and Southern Asia are the two main regions with the biggest problem of low sanitation coverage. Nearly half of all people using unimproved sources live in sub-Saharan Africa and one-fifth live in South Asia.³

In sub-Saharan Africa 33% of the urban population depends on limited or shared sanitation. In 17 sub-Saharan countries, the rates of people using limited sanitation is on the increase.⁴

Below is a table giving a snapshot of the scale of the sanitation challenge:

In 2015, 2.3 billion people globally did not use an improved sanitation facility	In 2015, 892 million people lived without any facilities at all, and continued to practice open defecation	In 2012, at least 1.8 billion people were exposed to drinking water sources contaminated with faecal matter	Inadequate sanitation is estimated to cause 280 000 diarrheal deaths annually
For every \$1 invested in sanitation, there was a return of \$5.50 in lower health costs, more productivity and fewer premature deaths (2012)	The economic impact of the lack of sanitation has been estimated at up to US\$80 billion annually for Africa	More young people dying from diarrhoea every year than from HIV/AIDS, malaria and measles combined ⁵	In urban areas in sub-Saharan Africa the population using shared sanitation doubled from 64 million to 128 million ⁶
Main Source: Report of the Secretary-General, "Progress towards the Sustainable Development Goals", E/2016/75			

¹ World Health Organization (WHO) and the United Nations Children's Fund (UNICEF). 2017. Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. Geneva. Licence: CC BY-NC-SA 3.0 IGO

² United Nations. 2015. The 2030 Agenda for Sustainable Development [https://sustainabledevelopment.un.org/sdg6] Accessed November 25, 2016

³ ONE. 2017. Water & Sanitation, The Challenge [https://www.one.org/international/issues/water-and-sanitation/] Accessed September 29, 2017

⁴ T Rheinländer, F Konradsen, B Keraita, P Apoya & M Gyaopong. 2015. Redefining shared sanitation. Bulletin of the World Health Organization. [http://www.who.int/bulletin/volumes/93/7/14-144980/en/] Accessed September 29, 2017

⁵ United Nations Children's Fund (UNICEF) and the World Health Organization (WHO). 2012. Progress on Drinking Water and Sanitation: 2012 Update. [http://www.unicef.org/media/files/JMPreport2012.pdf] Accessed November 25, 2016

⁶ WHO/UNICEF. 2015. Data Estimates: Joint Monitoring Programme for Water and Sanitation.

Access of each household to at least one toilet is ideal, however, sharing of toilet facilities is the current reality for many people in cities in developing countries, a situation which will continue for some time due to a variety of factors, such as a chronic lack of adequate investment in sanitation.

Shared sanitation facilities refer to facilities of an otherwise acceptable type, shared between two or more households.⁷ Limited sanitation may therefore be considered part of the global transition to universal access to improved sanitation.

Despite the existence of shared facilities in developing countries, many people without other means of access to toilets, still choose to openly defecate instead of using shared facilities. This is often influenced by factors such as lack of cleanliness of shared facilities, poor maintenance of these facilities, gender privacy concerns and difficulty finding the nearest toilet.⁸

5 Introduction

Inclusive Business Sweden, Aqua for All and lead researcher for WASH innovations, Charles Ogalo carried out this research project titled the ‘Peer-to-peer business models to meet sanitation needs’. Unilever provided technical and operational support to this research project.

The research project explored the potential of utilising peer-to-peer technologies and models to encourage behavioural change and sharing of sanitation services in developing markets where 40% of people do not have access to a toilet,⁹ but where smartphone penetration and mobile money adoption is increasing.¹⁰ We referred to existing sharing economies at the base of the pyramid (BoP) – people earning less than \$ 8 per day- to explore how using digital tech and business models can be used to formalize, scale and remove barriers to sharing and using toilets.

Studies were carried out in Kenya, one of the African countries that have come the furthest with internet and smartphone penetration.¹¹ Africa in general is expected to have a 40% smartphone penetration by 2017.¹² Only about 31% of the population in Kenya has access to improved toilets.

⁷ United Nations Children’s Fund (UNICEF) and the World Health Organization (WHO). 2012. Progress on Drinking Water and Sanitation: 2012 Update. [<https://www.unicef.org/media/files/JMPReport2012.pdf>] Accessed November 25, 2016

⁸ Kenya Water for Health Organization (KWAHO). 2015. Final Report: Citizens Report Card Study. Final Report prepared by Emerald Environment limited, commissioned by KWAHO Nairobi, KWAHO. Kenya

⁹ World Bank Group / InfoDev. 2014. Mobile at the Base of the Pyramid: Ghana, Mozambique, Nigeria, Zambia.

¹⁰ Group Special Mobile Association (GSMA). 2015. The Role of Mobile in Improved Sanitation Access. Mobile for Development Utilities Programme

¹¹ Sophia Zab. 2015. Whitepaper: The Growth of the Smartphone Market in Kenya, Jumia Kenya.

¹² M&C Saatchi Mobile. 2013. Whitepaper: Inside-Mobile-Africa

5.1 Objectives

The objectives of this research project were to deliver the following:

- 2-3 potential P2P business models identified and documented
- A user-experience prototype developed for testing hypotheses on P2P models with the following potential benefits:
 - A modern, scalable and simple solution for promoting toilet availability and use
 - Provides an easy way to identify toilet availability nearby
 - The processing of payments for toilet use
 - Encourages and incentivised entrepreneurs to share / establish toilet services
 - A review and/or scoring system that can promote toilet cleanliness and safety
 - Can be used in conjunction with sanitation campaigns
 - Provides a platform for local governments, foundations & international businesses to get involved in the sanitation crisis – including allowing easier access for identification of toilet needs by location & local sanitation data
- User-based study documented showing what worked well, lessons learned & consumer feedback
- A detailed research paper on the potential of P2P models for sanitation in the developing world
- Next stage proposal for a functioning prototype and testing through a pilot

To achieve these goals, we incorporated both broader research into the field, as well as collecting user feedback of potential P2P solutions.

6 The challenge in the Kenyan context

This research project took place in Nairobi, Kenya which has a population of about 4 million.¹³ Almost 2 million of Nairobi residents' primary means of access to sanitation is through shared/public toilets. An additional 0.8 million people use unimproved facilities or practice open defecation. Unimproved facilities are those which do not ensure hygienic separation of human excreta from human contact such as pit latrines without a slab, hanging latrines, bucket latrines etcetera.

As shown in the table below, the number of people whose primary access to toilets is through shared facilities (limited sanitation), is higher than the number of those with access to improved facilities.

¹³ CIA World Factbook. 2015. Kenya

Kenya	Sanitation Coverage Estimates (2015)		
	Urban (%)	Rural (%)	Total (%)
Improved facilities	31	30	30
Shared/public facilities	48	19	27
Other unimproved	18	36	31
Open defecation	3	15	12
Source: WHO/UNICEF JMP, 2015			

Existing public facilities ideally ought to provide sanitation access to all people lacking improved access, but that is not always the case.

Public toilets in Nairobi are run by the Nairobi City County, private companies, Community Based Organisations and NGOs. The City County is the most dominant owner of public toilets, and the organisation also has oversight of all other public toilet owners in the city. Iko Toilets is the largest private company running public toilets in the Nairobi central business district, while Sanergy is the largest private company that owns public toilets in Nairobi's informal settlements. Some of the County's toilets are also leased and run by private organisations which have entered into agreements with the County which typically run for 3 years.

Most public toilet businesses had either 1 or 2 employees who were primarily responsible for cleaning the toilets and collecting payments from users. The average number of users of public/shared toilet facilities in commercial areas and residential areas varied from around 400 to 500 customers per toilet facility. The average number in one facility in a residential area, Umoja, was much higher at 1,300 customers per day. Both public toilets in residential areas and commercial areas had a rush hour in the mornings and evenings.

Most public toilets were open from 5/6am to 9/10pm. There were almost no public toilets open during the night. Many users in residential areas who solely rely on public toilets plan their toilet needs around these opening hours, and use buckets or other items as makeshift toilets during the night which they then empty outside in the morning.

The majority of public toilets had additional services as part of their own business, or were positioned nearby other owned businesses whose customers frequently needed a public toilet. In commercial areas such as the city centre, these services included shoe shining facilities, a kiosk or a small clothing store. In residential areas, these included shower facilities or nearby greengrocers.

The majority of public toilets had the traditional flush function disabled as a way of water conservation by the public toilet owners. Instead, the pour flush method was preferred where a drum of water and a bucket was provided for users to pour water into the toilet bowl after use.

In many low and middle-income settings, relatively little is known about local perceptions and cultural barriers for using shared sanitation. Research in other low-income countries

shows that crowding, age, gender, privacy, maintenance standards, cleanliness, cost, distance and a range of sociocultural and economic factors can all affect the acceptability of public/shared toilets¹⁴.

During interviews with users we learned that while public toilets in Nairobi might be available in many areas, the number one reason why toilet users chose not to use them sometimes, was that they were often unclean. There was a general perception by users in Nairobi that public toilets are dirty. When prodded further, many users felt justified to relieve themselves discreetly in an open area nearby when that was the case.

Therefore, during this project, we explored how a digital solution and P2P business models could be applied to address the challenge of the *inadequate cleanliness and poor maintenance of public toilets/facilities*.

6.1 Approach

The research incorporated two main components:

Human-centred Design (HCD) based research;

- Current behaviours, practices and models
- HCD design and co-creation activities that create potential scenarios for technology-based P2P models
- Potential benefits and challenges of such solutions
- Analysis of scenarios through the 4A's framework – Awareness, Access, Affordability and Availability
- Exploration of related opportunities (and challenges), such as toilet supplies

Concept design, prototyping and testing;

- Further design activities based on output in HCD phase
- Co-creation of a conceptual business model
- User-experience prototyping for hypothesis testing
- Setting up for a potential pilot

¹⁴ a) Tumwebaze IK, Orach CG, Niwagaba C, Luthi C, Mosler HJ. 2013. Sanitation facilities in Kampala slums, Uganda: users' satisfaction and determinant factors. *Int J Environ Health Res.*;23(3):191–204

[<http://dx.doi.org/10.1080/09603123.2012.713095>] pmid: 22873693

b) Kwiringira J, Atekyereza P, Niwagaba C, Günther I. 2014. Gender variations in access, choice to use and cleaning of shared latrines; experiences from Kampala Slums, Uganda. *BMC Public Health*;14(1):1180. [<http://dx.doi.org/10.1186/1471-2458-14-1180>] pmid: 25407788

c) Nelson KB, Karver J, Kullman C, Graham JP. 2014. User perceptions of shared sanitation among rural households in Indonesia and Bangladesh. *PLoS ONE.*;9(8):e103886. [<http://dx.doi.org/10.1371/journal.pone.0103886>] pmid: 25090096

6.1 Methodology

The project was carried out in 6 phases:

Phase 1: Planning & administration	Phase 2: Initial research & solution recognition	Phase 3: Design and development	Phase 4: In-country research	Phase 5: Prototype solution development	Phase 6: Dissemination
<ul style="list-style-type: none"> - Define and refine objectives, activities, approach and structure - Detailed planning and budgeting - Set partnership agreements - Financial management and administration - Audit 	<ul style="list-style-type: none"> - Study previous research and projects on the topic - Study current needs, behaviours, practices and models of sanitation, in the BoP sector generally, and in Kenya - Analyse existing research gaps - Inception report 	<ul style="list-style-type: none"> - Analyse how potential P2P model responds to defined need - develop hypotheses for testing - Identify possible implementation & adoption challenges, & options for addressing - Identification of related opportunities - Development of 2-3 conceptual business models (including Design and Develop workshops) 	<ul style="list-style-type: none"> - HCD and co-creation activities that create potential scenarios for technology-based P2P models - Analyse potential benefits, hinders, barriers and challenges of potential solution in Kenya - Analysis of scenarios through the 4A's framework - Field study - IBS in Kenya (March 2017- April 2017) 	<ul style="list-style-type: none"> - Development of user-experience (non-functioning) prototype(s) - Prototype and hypothesis testing - Feedback through interviews - Analysis of prototype test - Development of pilot proposal 	<ul style="list-style-type: none"> - Finalise paper - Publish paper open source - Present paper to stakeholders and conferences

6.1.1 Desk study

This was primarily carried out in Phases 1 and 2 to formulate the initial research and solution recognition of the project. The desk study mainly consisted of background research on:

- Sanitation in developing countries and in Kenya
- Behaviour change in WASH
- Peer-to-peer models

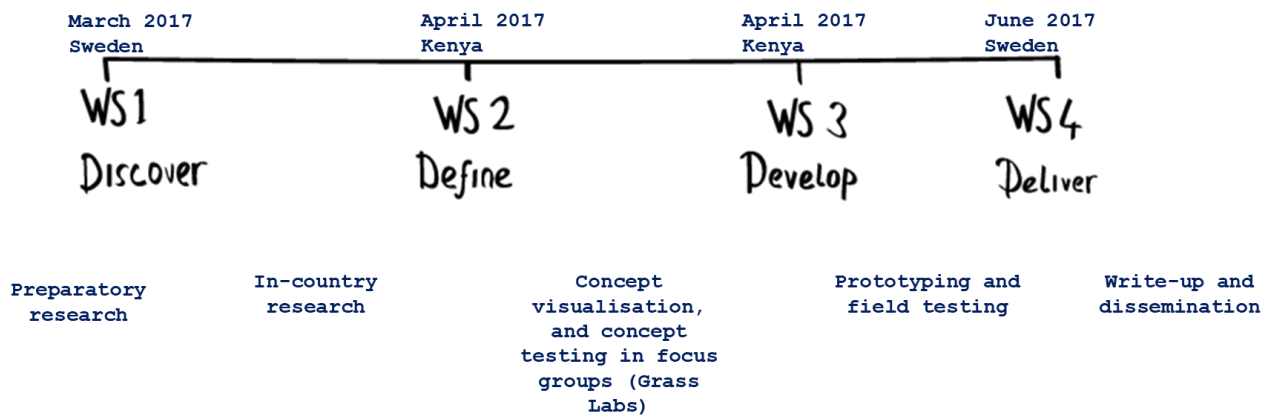
6.1.2 4D Workshops

During phases 3, 4 and 5, 4-D (Discover, Define, Develop and Deliver) workshops facilitated by Dutch organisation, the BoP Innovation Center were carried out. The 4D

model is an approach which breaks down the project into four distinct stages: Discover, Define, Develop and Deliver:

- Discover: provided expansion of space for different ideas of the project to be shared
- Define: focused on identifying user-needs, then identifying and defining priority areas to address
- Develop: focused on the development of prototype solutions based on the insights obtained
- Deliver: will be focusing on project objectives to deliver the final solution

The workshops were run with the project team and the Grass Company, a Kenyan research and market insights organisation, which provided local support services to the project team during the hypothesis and prototype testing in the In-country research and Prototype solution development & testing phases.



6.1.3 Face-to-face interviews

During the project's phase 4 and 5, face-to-face interviews were conducted with public toilet users, public toilet owners, public toilet managers and other stakeholders.

A total of 137 users were interviewed during this project, in both residential and commercial areas of Nairobi.

a. Public toilet user interviews:

Public toilet users refer to individuals who pay a fee to use the services of a public or shared toilet.



107 of the public toilet users were interviewed during phase 4, the in-country research phase. 65 of these were interviewed in face-to-face interviews, 26 through online questionnaires and 16 in focus group discussions (FGDs).

The other 30 public toilet users were interviewed during phase 5, the prototype solution development & testing phase.

Users were interviewed in the following areas:

- Commercial areas: Central Business District, the city’s Bus Station and Gikomba market.
- Residential areas: Umoja, Kawangware, Kibera and Mukuru wa Kayaba.

We identified two distinct groups of users based on where and when they used public toilets:

Resident users	Mostly live in low income settlements in the city e.g. Kibera and Mukuru. Many lack private household toilets and thus rely on public toilets in the vicinity of their homes.
Commuters users	Typically commute from the larger Nairobi area, and use public toilets while in the city or travelling through the city on their way to commercial areas to work, the market, school or to their businesses. Also includes commuting resident users.

A public toilet user journey

James wakes up every morning, carries his personal items to go to the shared bathroom near his home between 5am and 7am.

This is during rush hour, so he stands in line for between 15 and 30 minutes every day before it’s his turn.

He pays KES5 to use the toilet and KES10 to use the shower (KES=Kenya Shillings).

He runs a small kiosk near his home. During the day, he goes to the same public toilet, or to another one a few streets away from his kiosk and pays the same amount of money.

At the end of the day he ensures he has used the toilet before it’s too late in the evening, because it closes at 8pm for the night.

By the end of each day he spends between KES 25-KES30.

James thinks that the toilets could be cleaner but that he has no power to influence the owner.

b. Public toilet owner interviews

Public toilet owners refer to private companies, community based organisations (CBOs), the Nairobi City County and other organisations who run revenue generating public toilet services to users for a fee.

The City County is the most dominant owner of public toilets and has oversight over all other public toilet owners in the city. The majority of the County's toilets have been leased to private companies and organisations, and leases typically run for three years.

Many of the public toilet owners however, are smaller companies or organisations.

10 owners of public toilet facilities were interviewed during phase 4, the in-country research phase of this project:

- Nairobi City County
- Iko Toilets (largest private company running county-leased public toilets in the Nairobi central business district)
- Umande Trust
- Sanergy (largest private company that owns public toilets in Nairobi's informal settlements)
- One Stone Youth Group
- Umoja clothing shop & public toilet
- Tena Estate hair salon & public toilet
- Kibera Biocentre (run by local group and leased from Umande Trust)
- Mukuru wa Kayaba Biocentre (run by local group and lea by Umande Trust)
- KWAHO (who have previously developed and transferred ownership of public toilets to local community based organisations in Nairobi)



A public toilet owner journey

Mugo runs a self-owned company which has entered into a Public Private Partnership (PPP) agreement to run a public toilet which is owned by the Nairobi City County. His company's PPP with the city is for the management of 12 public toilet facilities which are located within the central business district. His agreement with Nairobi City County is for 3 years, which he hopes to renew.

Mugo has a small office from where he manages the administration of his business. He tries to visit the public toilet facilities that he is running as often as he can. However, he mostly relies on his managers to know the status of his facilities. At the end of every day the public toilet managers report their revenues. His customers pay the toilet fee in cash. He is aware that many of his managers underreport the facilities' earnings and he would prefer to have a more transparent payment system. He is also aware that although his employees are expected to keep the public toilet facilities clean, they don't always do it as well as they should. He tries to address this by doing checks of the facilities but has noticed that the managers will mostly clean as they should when they know that he will be coming to check on the facility. He hopes to increase his number of customers in order to grow his revenue and is willing to make improvements. He is interested in keeping track of what his facilities' users think of his facilities in order to improve services.

c. Public toilet manager interviews

Public toilet managers refer to employees of public toilet owners, and are engaged in the day-to-day running of the public toilet facilities. They collect the fees paid by toilet users and are responsible for cleaning the facilities.

5 public toilet managers from the following facilities were interviewed during phase 4:

- Jevanjee public toilets
- Bus Station public toilet I
- Bus Station public toilet II
- Makadara Law Courts public toilet
- Youth group toilet, Jericho Estate

A public toilet manager journey

Abel is a member of a youth group which was awarded a 3-year lease to run a public toilet facility in the city. He and the other members of the group take turns managing the day-to-day running of the business.

Abel arrives at their public toilet facility at 4.30am every morning. He cleans the toilets and prepares the rolls of toilet paper while waiting for the water vendor to deliver the day's water supply on a push cart. If they are short of supplies for the day such as toilet paper or soap, he purchases those at a nearby kiosk.

He opens the public toilet facility for business at 5am.

Abel is responsible for collecting payments and allocating toilet paper to users who come to their facility. He collects KES10 for every use. He is also responsible for cleaning the facility during the day and is supposed to clean hourly. He doesn't always get around to doing it because sometimes he is busy.

They could hire someone else to help with the cleaning, but the group splits earnings from the business every week and getting another employee would be an expense and they feel that they cannot afford. He closes the facility at 10pm.

d. Interviews with other sector stakeholders

Nairobi City County was also interviewed in their capacity as the sector’s oversight authority.

An interview was also conducted with Practical Action, a non-profit organisation in Kenya that works on improving access to sanitation and waste services for the urban poor to get another view of the landscape of the public toilet sector and what its key challenges were.

6.1.4 Focus Group Discussions (FGDs)

FGDs are in-depth interactive sessions which were held with the public toilet users, owners and managers.

Three FGDs were conducted in total; the first was held with public toilet users, the second with public toilet owners and a third with another group of public toilet users, with a total of 16 participants in total.



7 Peer-to-peer business models and technologies

Uber, the world’s largest taxi company, owns no vehicles. Airbnb, the world’s largest accommodation provider, owns no real estate. Peer to peer (P2P) business models such as these have achieved scale globally, and fast. P2P business models provide an organised way for collective consumption and sharing of resources, characteristics which could potentially be beneficial for sanitation.

While sharing models are increasingly used in developing markets, we explored whether P2P models have the potential to systemise and incentivise toilet use. The wider view of this research was to investigate the possibilities of P2P business models that could also work in other developing countries.

P2P Model Characteristics	Potential Benefits for Sanitation
Low-cost delivery of technology through mobile phones	Potential for an affordable and scalable technology solution to provide more people with inexpensive access to toilets
Use of location enabled mapping system	Easy to find nearby toilet facilities, and easy to establish and promote the offer of toilet services
Using an integrated and transparent payment process or subscription model	Integrated payment method for toilets
Using a review system, including scoring and a comments function that can be by all users	Incentivise that toilets are clean and well maintained, and provides additional security/safety

Ease of subscribing as a provider	Incentivise the establishment of new toilet facilities as a new source of income for toilet entrepreneurs
Collecting data from users	Data on sanitation needs and behaviour available to government and organisations

7.1 Rationale for a mobile app

We developed a prototype of a mobile app that helps public toilet users find clean public toilets, and rate their experience of public toilets across the city. Ideally the cleanest toilets would attract more users through supply and demand, thus generating more revenue for public toilet owners. Such an app could reduce the number of people practicing open defecation or using an unimproved facility because they cannot find a clean shared toilet near them. Due to the public nature of reviews, toilet owners and managers would be more motivated to clean their facilities to avoid losing users to cleaner toilets close by.

For toilet users

It would help to prevent open defecation by providing social proof about which toilets are clean

For toilet managers

It would motivate them to better clean their toilet facilities to keep business up and gain public recognition of their work. The comparative feedback with other nearby public toilets would likely also evoke feelings of competition motivating them to clean better

For toilet owners

it would get them to improve their toilet facilities to attract new users who could potentially first hear about their facility on the app. The comparative feedback with other nearby public toilets would also likely motivate collaboration with their managers to keep cleaner facilities

7.2 Research Hypotheses

Our overall hypothesis was that if people have information about where to find a clean public toilet near them they would be more likely to use toilets consistently and less likely to practice open defecation or resort to use of unimproved facilities.

This overall hypothesis was broken down into the following sub-hypothesis:

A. Current situation and business model related sub-hypotheses

1. **Lack of access to clean public toilets affects user behaviour:** Inaccessibility to clean public toilets is a barrier to sharing. Users do not consistently use available public toilets because they are dirty, or they perceive them to be dirty.
2. **Willingness to pay:** Public toilet users are willing to pay to use public toilets, and are willing to pay more for cleaner toilets.

3. **Public interest:** Government/government agencies have a positive attitude towards innovative business models that facilitate public sanitation such as a platform to find and rate public toilets.
4. **Smartphone and internet:** There is good penetration of smartphones which is growing, and will be sufficient by year 2020; and that the cost of mobile data is not prohibitive.
5. **Market size:** There are a sufficient number of toilets, users and income to meet the minimum threshold that can support a commercially viable business solution for finding and rating public toilets.

B. P2P technology/business model related sub-hypotheses

6. **App relevance and potential:** Public toilet users are willing and able to use a mobile app that could help them find clean public toilets in the city.
7. **Peer reviews / ratings:** Public toilet users currently rate and consider other users' ratings of other services while making purchasing decisions, and are willing to rate their public toilet experience.
8. **Payment methods:** Mobile money service, M-PESA, is the preferred mode of payment for public toilet service; and users prefer pay-per-use payments over subscriptions.
9. **Incentives for owners:** Public toilet owners are interested in attracting more users to their facilities in order to increase their earnings, and are willing to do more to attract additional users.

7.3 Researched hypotheses

We tested our hypotheses during the project primarily through face-to-face interviews and the focus group discussions in in-country research phase 4 and through further face-to-face interviews during prototype testing in phase 5.

A. Current situation and business model related sub-hypotheses

7.3.1 Lack of access to clean public toilets affects user behaviour

The inaccessibility to clean public toilets is a barrier to sharing. Users do not use available public toilets because they are dirty, or they perceive them to be dirty.

We interviewed toilet users to gain insight into users' overall experiences of using public toilets, the price of using public toilets, the ease/difficulty of finding public toilets, the important characteristics of public toilets to users and reasons for not using public toilets when that was the only available option.

Additionally, we interviewed public toilet managers and owners to learn how their businesses worked, the number of toilet facilities public toilet owners they had in their network, number of public toilet users who used their facilities, what they charged and their capacity and interest in new customers.

When asked about their experience of public toilets, almost all users felt that while they were lucky to have them as opposed to having none, they were often very dirty.

All the public toilet users we interviewed cited cleanliness as the most important characteristic to them about a public toilet. This was followed by distance, cost and safety respectively.

Based on user interviews, the number one reason why they would choose not to use a public toilet when one was available was because it was very dirty. When the closest available toilet was in poor condition, people felt justified to relieve themselves discreetly nearby. Most users could find a public a toilet near them by asking around, but there was no guarantee that it would be clean, and there was no way of identifying a clean toilet close by.

Of the group who identified themselves as non-users, 84% stated they would not use shared/public toilets because they are dirty.

A majority of the managers we interviewed acknowledged that public toilets have had a bad reputation in the past, however they felt that this had improved over the past few years.

The general feeling by toilet managers was that their users needed them, otherwise users would have no other option but open defecation.

Design principles

Given that there is no existing system from which to one can find all public toilets in Nairobi, enabling users, owners and managers to add public toilets on the mobile app's platform would be help crowdsource mapping of public facilities.

This is similar to Trip Advisor where travellers can add a restaurant or hotel to the site, and owners and managers can also list their business.

7.3.2 Willingness to pay

Public toilet users are willing to pay to use public toilets, are willing to pay more for cleaner toilets

We interviewed public toilet users on their willingness to pay more for a toilet that was cleaner, safer or closer; and if so, by how much.

We learned that the standard price for a toilet visit in many low-income settlements was KES5, and the majority of residential users were not willing to pay more regardless of whether public toilets were kept cleaner or not.

The standard price for a toilet visit in many commercial areas was KES10. More than half of commuter users were willing to pay more if public toilets were cleaner; an average of KES25 (lowest amount quoted being KES20 and highest being KES30).

Design principles

Although some users stated that they would be ready to pay more for cleaner public toilets, it should not be understood to mean that charging more is feasible, but rather that cleanliness was important to toilet users.

7.3.3 Public interest

Government/government agencies have a positive attitude towards innovative business models that facilitate public sanitation such as a platform to find and rate public toilets.

We conducted an interview at City Hall in Nairobi with the Nairobi City County's Environment, Water and Energy department.

Our aim was to find out whether government or government agencies were supportive of innovative business models that could facilitate public sanitation, such as a mobile app to find and rate public toilets. In an interview with the County's Assistant Director for the department of Environment, Monitoring, Compliance and Enforcement, they expressed interest in solutions that could improve user experiences. They were also positive about the potential use of user reviews to evaluate levels of cleanliness of public toilets being run by private companies in the city.

Design principles

The mobile app could potentially be a useful tool for the County of Nairobi, therefore engaging with the County prior to full development of the final solution to explore for example what kind of data collection would be important to them and could be incorporated into such a solution would be worthwhile. The interest also provides a foundation for the establishment of a pilot with the County's toilet facilities.

7.3.4 Market size

There are sufficient number of toilets, users and income to meet the minimum threshold that can support a commercially viable business solution for finding and rating public toilets.

According to an interview with Nairobi City County's Environment, Water and Energy department, the City County owns 68 toilet facilities in the city, however, there is no

official number of public toilets in Nairobi. A report by the Standard Digital newspaper estimated that there are 150 toilet facilities in Nairobi city.¹⁵

Design principles

Although the number of public toilets appears to be not particularly high, there is potential for building commercially viable solutions that include a mobile application to find and rate public toilets in Nairobi. However, it is probably safe to say this success would to a large degree require some collaboration with the Nairobi City County. Furthermore, for the long-term viability of the business model, the solution would need to be scalable wide outside Nairobi to other parts of Kenya and Africa.

7.3.5 App relevance and potential

Public toilet users are willing and able to use a mobile app that could help them find and rate clean public toilets in the city

We interviewed users, owners and managers on their views on users being able to use a mobile app to find their facilities and rating public toilets with the aim of finding the cleanest one near them.

More than half of commuter users were willing to use an app to find clean public toilets and rate public toilets they visited despite mobile data charges. Next to all resident users were willing to use such an app, but, majority would only do so if it did not cost them anything, for example, mobile data.

Design principles

The mobile app idea was welcomed by users and they gave the following input in regard to the final development of the such a mobile app:

- Data consumption is important to users: Users reiterated that the App should be light in its data consumption, and in storage space on one's mobile phone.
- Ease of use was key: The mobile app should be easy to navigate and not have unnecessary options as this was confusing.
- Useful information: Toilet type was important to users. They wanted to know whether public toilets were 'sitting' or 'squatting' toilets beforehand. A number of users had a preference for squatting toilets which they deemed to be more hygienic.

¹⁵ James Mwangi. 2017. Let's talk crap: Nairobi city has 150 public toilets for 5 million people. Kenya

- App aesthetics and Design: Blue and white colours were the preferred colours for the app, and were associated with cleanliness."

7.3.6 Smartphone and internet

There is good penetration of smartphones which is growing, and will be sufficient by year 2020; and, that users are willing to use their mobile phone data to find and rate public toilets.

We investigated the accessibility of public toilet users to smartphones and their use of other apps. We also considered whether the cost of mobile data was likely to be prohibitive to potential users of the mobile app and their willingness to incur mobile data costs.

Almost 60% of resident users interviewed had smartphones and internet access. Many in this group of users however preferred not to carry their smartphones with them while they were on the move because they were afraid of being robbed, and instead only used the devices at home to send emails and watch videos and then carried with them simpler feature phones (dumbphones). The majority of resident users would only use the app if it didn't cost them mobile data to do so.

70% of commuter users interviewed had smartphones, and internet access. More than half of commuter users were willing to use an app to find and rate public toilets that they used despite data charges. Almost all smartphone users had android phones.

Design principles

While the average number of users interviewed was somewhat high at 60-70% the average smartphone uptake in Kenya was estimated at 44% in 2016 by Google's Consumer Barometer, therefore it is worth exploring how a similar solution could be accessible to users with feature phones.

The cost of mobile data was a concern for all public toilet users, therefore the final mobile application needs to be lightly designed, giving users as much control as possible over data consumption.

7.3.7 Peer reviews/ratings

Public toilet users do rate and consider other users' ratings of other services while making purchasing decisions, and are willing to rate their public toilet experience

We interviewed users on whether public toilet users currently recommend good public toilets to others, whether public toilet users trust reviews of other services and whether they would submit a review of a service such as their public toilet experience through face to face interviews.

We also tested user experience of the mobile app prototype's rating process and both the use of stars and icons was clearly understood indicators of degrees of cleanliness of public toilets.

User generated reviews are a typical characteristic of P2P business models. Research shows that people generally trust peer recommendations more than they trust business-owner driven assertions of quality such as advertising.

Positive reviews are a form of advertising for a business, therefore public toilet users would likely go to toilets that are rated as clean by other public toilet users. Negative reviews would give public toilet owners and managers the opportunity to address their customers' concerns around the cleanliness of their facilities.

This is intended to stimulate market behaviour in the public toilets market where the cleanest toilets would attract more users.

Other users' reviews would thus be proof to other users of the status of any given public toilet in the city.

The majority of users interviewed stated they would use an app to find the closest clean public/shared toilet if such an app existed. Toilet owners believed that ratings would bring about a healthy competition and would help them to improve the quality of service to their clients. Almost all toilet managers felt that they had been doing a good job of keeping their facilities clean and would appreciate a platform where they got recognition for their efforts.

Almost all users were familiar with the concept of peer reviews and ratings, whether verbal or digital. The majority of users were highly trusting of user reviews of other services.

The most important information that users would like to receive before choosing a public toilet was the level of cleanliness followed by distance and then price. The majority of residential users already verbally recommend good shared toilets to other friends and family. Users were willing to submit reviews to a mobile app for public toilets, particularly if they got incentives like free toilet visits as a reward.

Design principles

We interviewed users on the use of stars and 'smiley face' icons to indicate levels of cleanliness, both of which were clearly understood. A few users preferred the smileys because they associated stars with bad luck.

While 60% of residential users and 70% of commuter users interviewed had smartphones, it is worthwhile to consider how users with basic feature phones could access the same service.

Public toilet owners had concerns about false ratings for example by competitors, therefore the final solution should address this by including a verification process such as the use of a phone number or similar methods used by other P2P services to limit fake reviews.

One of the main challenges of the rating system is going to be how to motivate public toilet users to keep rating public toilets on the app. One idea is to offer a free toilet visit after a user rates toilets on the app a certain number of times.

7.3.8 Payment methods

Mobile money service, M-PESA, is the preferred mode of payment for public toilet service; and users prefer pay-per-use payments over subscriptions

We interviewed users to find out how public toilet users currently pay for public toilets and their views on subscription versus pay-as-you-go models.

We also interviewed owners to find out how public toilet owners currently charge toilet fees, if they had other preferences of payment methods and their views on subscription versus pay-as-you-go models.

Most public toilet businesses had 1 or 2 toilet managers running the business daily and were responsible for collecting payments from users and cleaning the toilets (sometimes the manager was also an owner).

The average fees for a toilet visit are:

- 10 Kenya Shillings (0.08Euro) in commercial areas, such as the city centre, market areas
- 5 Kenya Shillings (0.04Euro) in residential areas such as Kibera and Mukuru slums

Although the use of mobile phone-based money transfer service M-PESA¹⁶ is prevalent for most other payments in the city, almost all toilet owners, managers and users currently prefer cash payments for toilet fees instead of mobile payments. Over 90% of transactions were in cash.

The main reasons were:

- Users felt the transaction amounts were too small for the time it takes to make a normal mobile payment each time someone went to the toilet
- Owners didn't like that it would cost them money to withdraw their daily earnings from their M-PESA account.

However, a number of toilet owners were willing to explore cashless payment systems and had in the past, but they had mixed feelings about such systems, as two had been withdrawn from the market suddenly leaving them mistrustful of other cashless payments.

Most toilet facilities had the pay-as-you-go model. A few public toilet owners used subscription models for some of their users, where users paid per week or per month. This was however not the general preference by owners, as revenue earned per user was higher in the pay-as-you-go model.

Most users would prefer a subscription model instead of the current pay-as-you-go model. Those that were apprehensive about the subscription model were worried that they

¹⁶ M-PESA is a mobile phone-based money transfer run by the largest mobile network operator in Kenya, Safaricom. It allows users to deposit, withdraw, transfer money and pay for both goods and services easily with a mobile device.

wouldn't be able to have enough money saved up every week or month to pay for the subscription.

An integrated payment method for services is a common feature of P2P business models. It makes it easy for customers who find services on mobile platforms to also make payments in one go. It is often followed by the opportunity to review the service upon completion of the transaction.

Public toilet owners who were not also the daily managers of their public toilet businesses relied on their toilet managers to declare how much they had collected every day. Almost all transactions were in cash and the final tally of the day was often solely based on what the managers said they collected.

Almost all toilet owners interviewed said that there was a lack of transparency regarding actual earnings and would therefore prefer a more transparent system.

Design principles

For the development of a final app and subsequent pilot, a cash transaction capability such as is the case with Uber in Kenya should be included for stakeholders who do not wish to change how they carry out their transactions, however, there is a need to explore other cashless payment systems that provide more transparency of payments in the sector. This is particularly the case for toilet owners who are not also managers of their facilities.

There is potential for exploration of quick and easy cashless methods, provided they address the concerns held by users and owners. An example is the use of M-PESA 1Tap. With M-PESA 1 Tap, users use a card, phone sticker or wristband which they tap at toilet facilities to pay for use and is connected to their mobile account. It is much faster than making traditional M-PESA payments, which would address users' concerns about time.

Alternatively, M-PESA could be used to pay for credit for toilet visits, where the app could be charged with M-PESA to allow for multiple uses at toilets, and then recharged when required.

This would however not address owners' concerns about charges they would incur to withdraw their M-PESA earnings, but given that the maximum amount they could be charged to withdraw their earnings is KES330 (2.7Euro), it may be acceptable if it meant that they could get more users.

Subscription models are typically cheaper for users than pay-as-you-go models, and are a good way of ensuring that users can afford to access public toilets consistently. Many users would not admit that they did not always afford to pay the toilet fee, but in casual conversation after the interviews it sometimes would come up.

A model that has the possibility of enabling access whenever users needed to go at an affordable price would be appreciated by many users. Is there room to for subscription models which could subsidize the subscriptions for users for example through co-payments from corporates or donor organisations? The possibility is worth exploring.

7.3.9 Incentives for owners

Public toilet owners are interested in attracting more users to their facilities in order to increase their earnings, and are willing to do more to attract additional users

Positive reviews are a good way to attract new customers, and while negative reviews can be unpleasant, they generally push businesses to do more to keep current customers happy and to signal to potential customers the kind of service they can expect if they do decide to go there. The more customers one has, the more revenue a business generates.

We interviewed public toilet owners and managers to find out if they were interested in attracting more users to their facilities in order to increase their earnings, and are willing to do more such as clean better, to potentially attract additional users.

Most toilet owners wanted to increase the number of users that visit their facilities in order to grow their revenue and were willing to make improvements to achieve this. That was the main reason they were interested in keeping track of what their users thought of their facilities in order to improve services.

Toilet managers were not very keen on additional users - possibly because this meant more cleaning for them. What was appealing to the majority was public acknowledgement and recognition for the work that they do to try and keep public toilets clean, because they felt that they did a good job in general.

Design principles

Public toilet managers have the possibility to generate more revenue at their businesses if steps were undertaken to improve their facilities. However, this perk does not necessarily benefit managers, and since toilet managers generally felt that toilet users needed their facilities, keeping users happy is not considered a top priority.

Management of the triggers of both owners and managers is important to ensure the success of a solution. While owners are the decision-makers of the businesses, lack of cooperation by the day to day managers of facilities could affect the success of a solution where the cleanliness of toilets was more transparent.

8 Barriers and triggers

8.1 Affecting the use of public toilets

77% of the public toilet users interviewed stated that they would use an app to find the closest clean public/shared toilet if such an app existed.

We examined individual, social, cost and environmental motivators of the current behaviour influencing the use of public toilets in order to identify the barriers and triggers of using public toilets and the potential levers for the adoption of an app to find clean public toilets in the city.

Overview of factors that support or constrain the use of public toilets by users		
	Barriers	Triggers
Individual motivators (awareness/ acceptance)	<ul style="list-style-type: none"> - Believe that all public toilets are not clean - Dirty toilets and lack of water associated with risk of diseases and infections - Toilets are not well maintained 	<ul style="list-style-type: none"> - Access to information about cleanliness - Other welfare campaigns
Individual motivators (convenience/ confidence)	<ul style="list-style-type: none"> - Unable to find a clean toilet - Not able to find a toilet nearby - Not able to find a toilet open at night - Inconvenient / not safe to ask around when trying to find a public toilet - Lack of good customer care - Not having different stalls for both sexes - Lack of privacy and comfort - Busy at rush hours 	<ul style="list-style-type: none"> - Easy way to identify a clean toilet nearby - Safe way to find a clean toilet nearby - Access to additional services e.g. showers
Social motivators (self/society)	<ul style="list-style-type: none"> - Lack of trust (cleanliness and safety) - Poor verbal reviews from other users 	<ul style="list-style-type: none"> - Recommendations by others - Sharing reviews of public toilets
Costs (not only monetary) vs Rewards (payoff)	<ul style="list-style-type: none"> - Price (monetary) - Toilet too far away (time consuming) - Queues for public toilet (time consuming) - Dirty toilet (health risks) 	<ul style="list-style-type: none"> - A clean and safe toilet nearby - Good price e.g. subscription model (get discounts, plan expenses of the month, no need to carry cash)
Environmental motivators (existing habits & reinforcers)	<ul style="list-style-type: none"> - At night public toilets are closed 	

8.2 Affecting the adoption of an app to find clean toilets

Overview of factors that support or constrain adoption of an app to find clean toilets	
Barriers	Triggers
<p>Individual motivators (awareness/acceptance)</p> <ul style="list-style-type: none"> - Frequent toilet users know where toilets are located - Frequent toilet users know how well/poorly maintained the toilet is 	<ul style="list-style-type: none"> - Ability to identify a clean toilet close by (although most residential users can find a toilet nearby, there is no guarantee it would be clean). - Ability to review/give feedback on toilet services - Ability to locate new public toilets
<p>Individual motivators (convenience/confidence)</p> <ul style="list-style-type: none"> - Prefer cash payments (pay-per-use model) - Prefer not to bring their smartphone with them (residential users) 	<ul style="list-style-type: none"> - Rewards and loyalty benefits
<p>Social motivators (self/society)</p> <ul style="list-style-type: none"> - Frequent toilet users know how well/poorly maintained the toilet is 	<ul style="list-style-type: none"> - Their comments can help others know about the toilet maintenance - Ability to potentially influence toilet manager
<p>Costs (not only monetary) vs Rewards (payoff)</p> <ul style="list-style-type: none"> - Data consumption costs, particularly for residential users compared to commuter users (majority of resident users would only use the app if it didn't cost them mobile data to do so) - Time to rate - Time to use mobile payment 	<ul style="list-style-type: none"> - Prior information on cleanliness of a public toilet (followed by info on distance and price) - For commuters: info on additional facilities of a public toilet - Resident users would only digitally review toilets if incentivised to do so (commuter users would also appreciate being incentivised when submitting their review) - Good price e.g. subscription model (get discounts, plan expenses of the month, no need to carry cash) - Personal reward to help others - Personal reward to influence toilet managers to better maintain toilets

Environmental motivators (existing habits & reinforcers)	- Frequent toilet users know where toilets are located	
	- Frequent toilet users prefer paying cash instead of M-PESA	- Have smartphones
	- Frequent toilet users prefer not to bring smart phone with them	- Regular use of other Apps
	- Some leave smartphones at home (use it as a home device) and carry around a feature phone	

Overall public toilet users seem positive about an app to find a clean toilet nearby. Prior information on cleanliness of public toilets, followed by distance and price seems to be an important trigger to using such an app. Information on which other facilities are available at a public toilet nearby would also be appreciated by users.

The use of mobile data is a concern particularly for residential users who need additional incentives to use the app.

Overview of factors that support or constrain acceptance of an app by toilet managers		
	Barriers	Triggers
Individual motivators (awareness/acceptance)	<ul style="list-style-type: none"> - More cleaning work for them - More transparency in payments system (most managers were not transparent with toilet owners about how much was collected every day) 	<ul style="list-style-type: none"> - Interested in increased revenue at their facilities as this would lead to higher salaries for them - Interested in increasing loyalty from current clients
Individual motivators (convenience/confidence)	<ul style="list-style-type: none"> - Prefer cash payments (pay-per-use model) 	<ul style="list-style-type: none"> - Cashless facilities are less likely to be robbed
Social motivators (self/society)	<ul style="list-style-type: none"> - Getting bad reviews from users 	<ul style="list-style-type: none"> - Public recognition of their work
Costs (not only monetary) vs Rewards (payoff)	<ul style="list-style-type: none"> - More clients will mean more costs (water and paper) 	<ul style="list-style-type: none"> - Good reviews typically mean an increase in business - Increased loyalty
Environmental motivators	<ul style="list-style-type: none"> - Mistrust of new technology 	<ul style="list-style-type: none"> - P2P based apps are getting more popular

(existing habits & reinforcers)

Overview of factors that support or constrain acceptance of an app by toilet owners		
	Barriers	Triggers
Individual motivators (awareness/ acceptance)	<ul style="list-style-type: none"> - Lack of engagement with their business - Not willing to adopt new technologies 	<ul style="list-style-type: none"> - Other toilet owners are using an app
Individual motivators (convenience/ confidence)	<ul style="list-style-type: none"> - If not interested in increase traffic 	<ul style="list-style-type: none"> - Would prefer mobile payment
Social motivators (self/society)	<ul style="list-style-type: none"> - Manipulation of ratings (by competitors) 	<ul style="list-style-type: none"> - Ratings would bring healthy competition - Ratings would help improve quality
Costs (not only monetary) vs Rewards (payoff)	<ul style="list-style-type: none"> - Costs of mobile payments - Conflicts with employees 	<ul style="list-style-type: none"> - Get public appreciation for their work - Better maintenance of their toilets by the managers
Environmental motivators (existing habits & reinforcers)	<ul style="list-style-type: none"> - Not willing to change their cleaning schedule or payment methods 	<ul style="list-style-type: none"> - Mandatory condition by Nairobi City County

In general, public toilet users were mainly concerned about whether such an app would cost them more, in terms of amount of data they would need to spend.

Both owners and users were positive about such an app. The managers posed the main challenge because although they were interested in any solutions that could benefit them directly e.g. which could lead to them getting higher pay, they were not interested in an increase in number of users per se.

Alternative incentives for managers could include awards such as for the ‘best toilet’ or ‘toilet of the month’ as recognition for their efforts by owners or the app, since majority expressed getting public appreciation and recognition for their work as something that was meaningful to them.

8.3 Barriers to using an app to find public toilets and how to address them

We summarised what we believe are the key barriers, into the four solution elements of the 4As framework, to clearly define suggestions for how to address challenges to adoption of the app. The 4As is a conceptual framework which identifies conditions that ought to be fulfilled in order to achieve success with any given product or service offering for customers/users¹⁷.

These conditions ensure our solution is aligned with the values sought by public toilet users, and can be summarised as: Availability, Affordability, Awareness and Acceptability. It facilitates the progression of a preliminary idea into a feasible solution.

The barriers hindering the adoption of the solution by public toilet have been classified into these four elements, including the suggested ways of addressing them.



Most significant barriers for adoption of the app and how we shall address them		
4As	Barriers	Options for Addressing Barriers
Availability: <i>Getting the solution to the users</i>	- Smartphone accessibility is limited for some potential users	- Start by focusing on groups where smartphone accessibility is higher
	- Toilet managers not open to their facilities being featured on the App	- Provide incentives for toilet managers such as a rewards system for best rated facilities, recognition of individual managers running the facilities, etcetera - Offer additional services for toilet owners on the app, such as the possibility to order soap and other business inputs more easily - Opportunity for toilets managers to gain recognition for their job - Opportunity for increasing traffic - Opportunity for toilet owners to

¹⁷ Anderson, J., & Billou, N. 2007. Serving the World's Poor: Innovation at the Base of the Economic Pyramid. Journal of Business Strategy, Volume: 28, Issue: 2 , 14-21

		gain control on payments
Affordability: <i>Enabling the users to purchase/use the solution</i>	- Consumption of mobile data (majority of resident users would only use the app if it didn't cost them mobile data to do so)	- Design of a "light" app for users - No need to geolocate a toilet if user knows where to find it. App user has direct access to toilet rating and/or mobile payment
	- Final app owner decides not to make it available for free	- Develop a business model where app access is free - Bring an investor/partner on board - Percentage fees to be paid by toilet owners in return for improving toilet usage
Awareness: <i>Making the users aware of the solution</i>	- Frequent toilet users know where public toilets are located	- Campaign to promote other benefits of the app i.e. subscription models
	- Frequent toilet users know how well/poorly maintained toilets are	- Campaign to promote the information available on the app that users can access i.e. regarding the cleanliness, distance and price of services, and additional facilities at public toilets.
Acceptability: <i>Encouraging the users to adopt the solution</i>	- Resident users only willing to rate toilets online when being incentivized for it	- Explore options of incentives for residential users, such as, free toilet visits after a number of ratings
	- Prefer cash payments	- Negotiate discounts for loyal users if pay with mobile
	- Prefer not to bring their smartphone with them (residential areas)	- Negotiate discounts for frequent users if paid with mobile - Launch the app in commercial/business areas where people usually carry their phones - Explore the possibility of making the service available on feature phones also
	- Lack of trust; users don't believe that their feedback will change toilet owners or other users' behaviour	- Campaign to promote the importance on how users can influence businesses

9 Prototype development

During the in-country research phase, we conducted face-to-face interviews and co-creative focus group discussions with public toilet users and owners to learn more about the current situation in Nairobi and to explore how we could create a digital solution that would:

- Enable public toilet users to find the closest clean toilet

- Enable independent rating of public toilet cleanliness by users
- Reduce the barrier to sharing of public/shared toilets
- Increase uptake and adoption of technology to spur public toilet use
- Improve management and cleanliness of public toilets

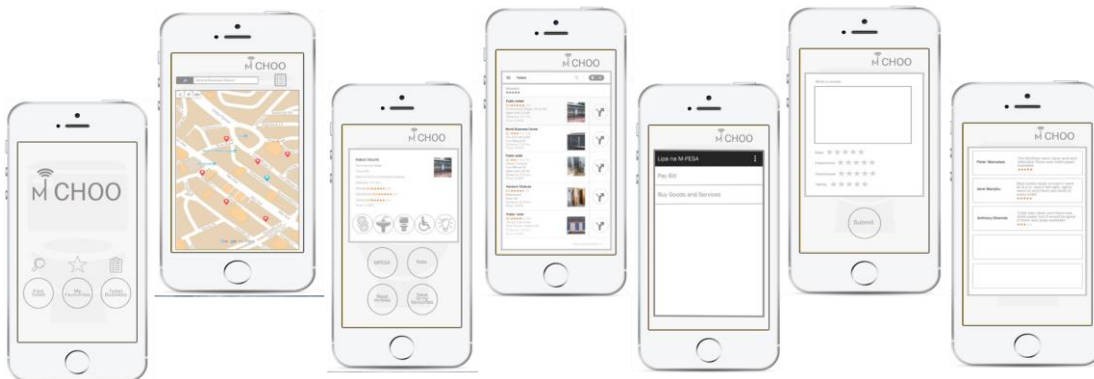
We began by sharing our preliminary ideas about how such a solution could look like with users and owners, and as the field study progressed, we created a rough version of the first prototype, prototype 1.0 based on the initial interviews.

We then developed an updated version of the prototype, prototype 2.0 based on the collective feedback received from all the subsequent interviews and the focus group discussions.

9.1 Prototype 1.0

Prototype 1.0 was designed during the in-country research following initial interviews to toilet users and owners. The aim of developing the first version prototype during the field study was:

- To apply the human centred design process to progressively create a solution that incorporated real-time user feedback which resonated with users' current situation and needs
- To test stakeholder feedback on the concept and preliminary visualisation of a mobile app for finding and rating public toilets in the city before investing additional resources
- To input user feedback into development plans of the app as insights were gathered



Prototype 1.0

Following the completion of prototype 1.0, we held focus group discussions with public toilet users to get preliminary feedback on the prototype. We received the following main feedback during the previous stage:

- Data consumption is important to users: Users reiterated that the app should be lighter than prototype 1.0 in its data consumption, and in storage space on one's mobile phone
- Ease of use was key: The app should be easy to navigate and not have unnecessary options as this was confusing
- Useful information: Toilet type: It is important to users to know whether the public toilets are 'sitting' or 'squatting' toilets. A number of users have a preference for squatting toilets which they deemed to be more hygienic.
 - Information on lighting in the toilets was not important because most public toilets were not open at night.
- App aesthetics and design: Blue and white colours were the preferred colours for the app, and were associated with cleanliness.

9.2 Prototype 2.0

During the In-Country Research phase we analysed our findings, the feedback received from public toilet users and owners, after which we compiled the identified barriers for adoption of the App and based on this, we adapted the prototype over several weeks, which led to the updated: **prototype 2.0**.

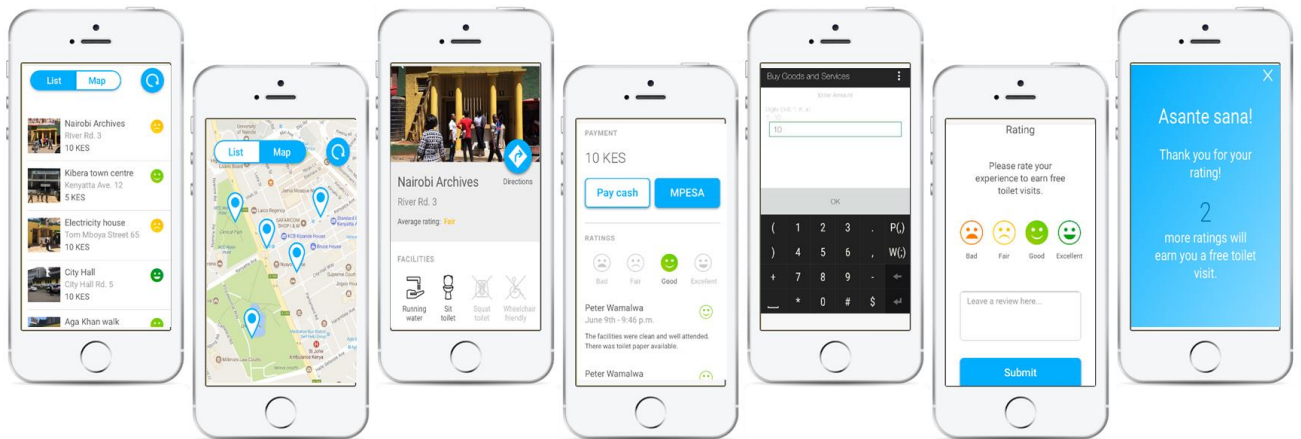
Prototype 2.0 aims to address the most significant user-centric barriers identified through the 4As framework in the previous phase on how to make the solution: Available, Affordable, Acceptable and users Aware of its existence.

Prototype 2.0 was tested with public toilet users. More specifically, the study focused on commuters since they were identified as the most likely group to adopt the app early during the previous phase. Public toilet owners and managers were not part of the user test but they will be included in the next stage of the project where we will explore more extended services to toilet owners and manager's needs.

The updated features of prototype 2.0 based include:

1. **Affordability:** Light data consumption in the updated prototype which means that users have control of when their app updates information about nearby toilets by having a refresh button. Users also have the possibility of getting a list of nearby toilets instead of a map, and need only activate the map for directions if they need to, in order to reduce data usage.
2. **Easier to use:** There are a reduced number of screens compared to prototype 1.0 and simpler rating process. We removed some information which users deemed unnecessary from the previous version and that focused on 3 main features:
 - Toilet type (sitting or squatting toilet available)
 - Availability of running water
 - Has wheelchair access
3. **Multiple payment options:** We have included the possibility for toilet fee transactions to be carried out as both cash and mobile money payments.

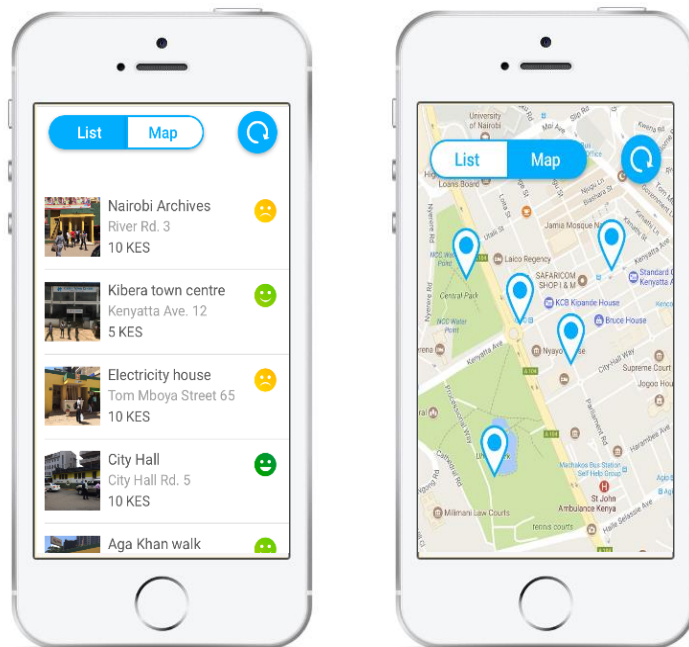
- Incentives: To increase acceptance, we have also included the possibility of incentivising users to rate public toilets, for example through earning free toilet visits after a number of ratings.



Prototype 2.0

9.2.1 Prototype 2.0 flow

Step 1: Find a public toilet nearby and select preferred toilet



Users can open the app on their mobile phone and click on the refresh button on the top right corner to view public toilets near them, including seeing the cleanliness rating, price and image of the facility.

Users can then click on the public toilet of choice either on the list or the map.

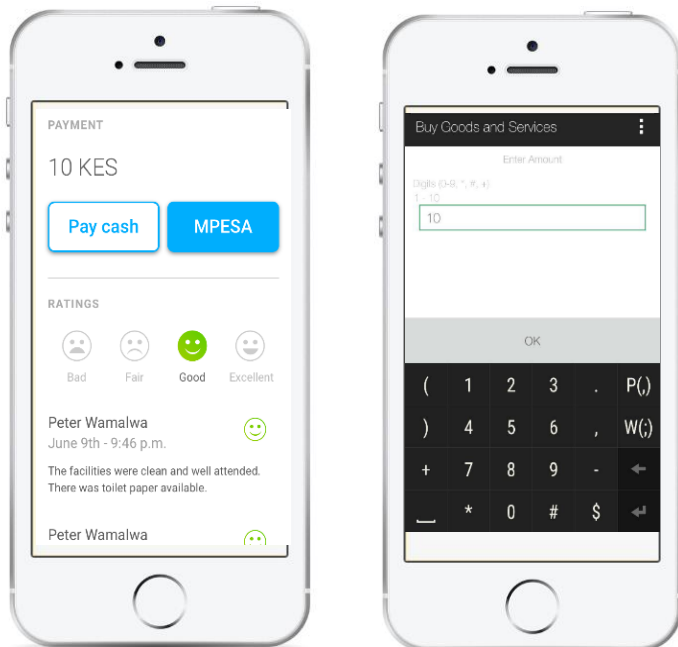
Step 2: View details of selected public toilet: rating, price, directions and additional features



By clicking on a public toilet, users can see additional information, such as availability of running water, whether there is a sitting or squatting toilet available, and whether the facility is disability-friendly.

If desired, users also get directions to the public toilet selected.

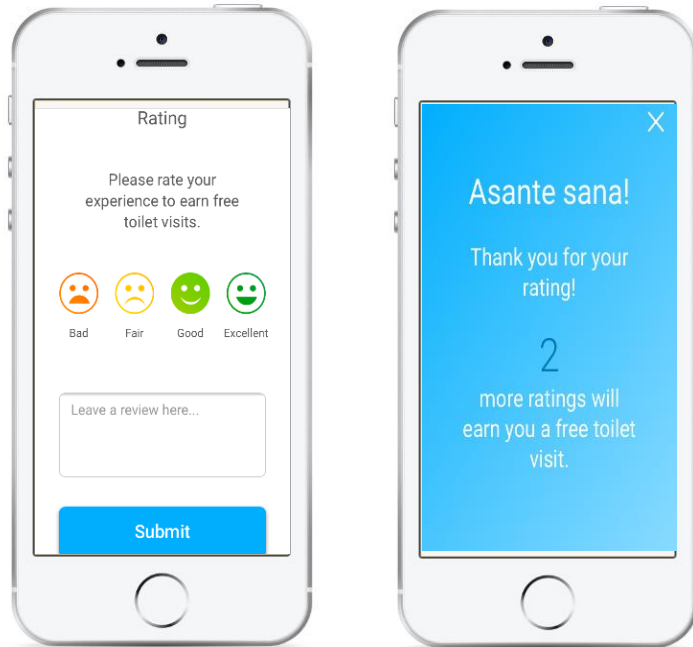
Step 3: Payment of toilet fee for selected toilet



Users are able to make both cash payments and make mobile payments via the app to toilet owners.

The decision to include both payment methods was because a majority of public toilet fee transactions are paid in cash. However, toilet owners were keen to explore the possibility of including more transparent payment methods such as through mobile payment service M-PESA.

Step 4: Rating of public toilet and incentive for ratings



Users are prompted to rate the public toilet they have visited.

The aim is also to provide incentives for users to rate public toilet services.

9.3 Prototype Testing

Over the period of one week during July 2017, we conducted a round of user interviews to test the updated prototype 2.0.

9.3.1 User Study

We conducted face to face interviews with 30 commuter public toilet users in Nairobi. Users got to interact with prototype 2.0, which was followed by interview questions about both the concept of the solution, and prototype 2.0 which they had just interacted with.

User demographic

User group: Commuters; toilet users from Nairobi and neighbouring counties who travel into the city on their way to work, the market, school or to their businesses.

During the in-country research we found that more than half of commuter users were willing to use an app to find and rate a clean toilet near them, in spite of data charges, on top of that, 70% of commuter users interviewed had smartphones (and carried them with them), and internet access.

Gender: 50% M, 50% F

Age: 25- 45

Occupation: More than half of the interviewees were employed in the informal sector e.g. plumbers and cleaners, 25 % in the formal sector as accountants, bankers etc and the rest were students.

Use of public toilets: 70% used shared toilets when commuting, 30% while at work. 60% used the public toilets 1-5 times a week.

Interview questions to users were centred around the following:

1. General View: Inquiry into what users thought of the concept of a mobile app to find clean public toilets in Nairobi
2. Usefulness: Whether such an app would be helpful to them or felt it was needed
3. Ease of Use: Whether users felt the updated prototype was intuitively easy to use
4. Perceived cost: To enquire how users felt about consumption of data in order to locate and rate public toilets, particularly in view of the changes made in development of prototype 2.0
5. Compatibility: Whether users felt that given their current lifestyle and current situation, they would use such an app
6. Subjective norm: To get an understanding of whether societal pressure plays a role in decision making of which apps and solutions users were using
7. Behavioural intention: Whether users felt that they could actually use such an app

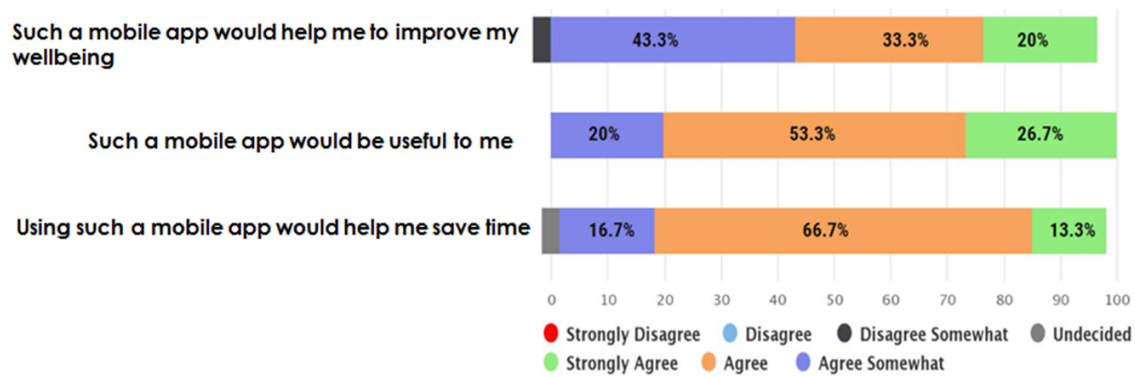
As a follow-up to the semi-open style of questions that we used previously during the previous in-country research phase, user responses were more structured and framed around the seven-point Likert scale. This is because the aim was to measure public toilet users' attitudes and get an overall measurement of users' sentiments on the proposed solution and to collect specific data on factors that contribute to that sentiment, which the Likert scale is suitable for. Our questions mostly required users to respond to several statements where the range of possible answers was 'strongly agree/agree somewhat/agree / undecided/disagree somewhat/ disagree / strongly disagree'.

We also measured whether the commuter users, in addition to being the highly likely early adopters, would also be likely to influence other public toilet users in adoption and use of the app.

9.3.2 User Study Findings

General views and perception on usefulness

More than half of users felt that such an app would help to improve their wellbeing. The majority of users (80%) also felt that such a mobile app would be useful to them and would help them by saving them time when they needed to look for a public toilet.

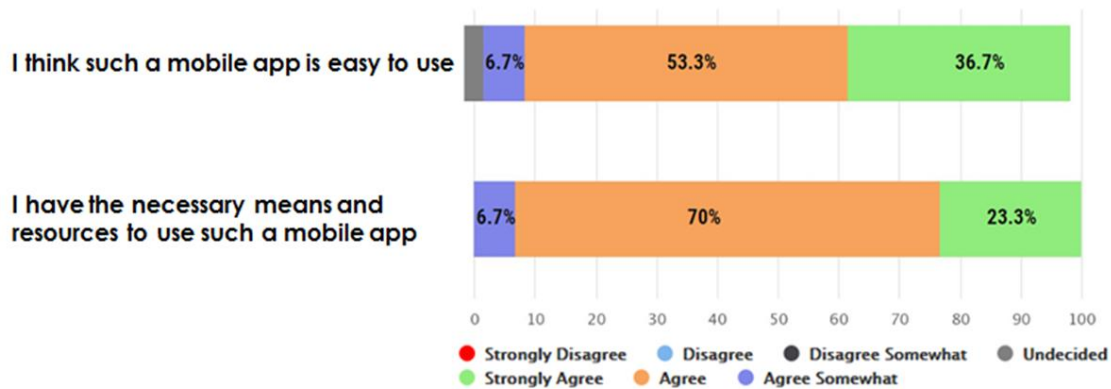


Ease of Use

Almost all of the users (90%) felt that the prototype 2.0 app was easy to use. 93% also felt that they had the necessary resources to use such an app.

Users’ positive response to the updated prototype is believed to be because this version of the prototype was recreated based on the feedback received from users during the previous in-country research phase.

The prototype 2.0 focused on primarily including the essential features that users had expressed interest in during the in-country research phase thus making the app lighter and easier to use.



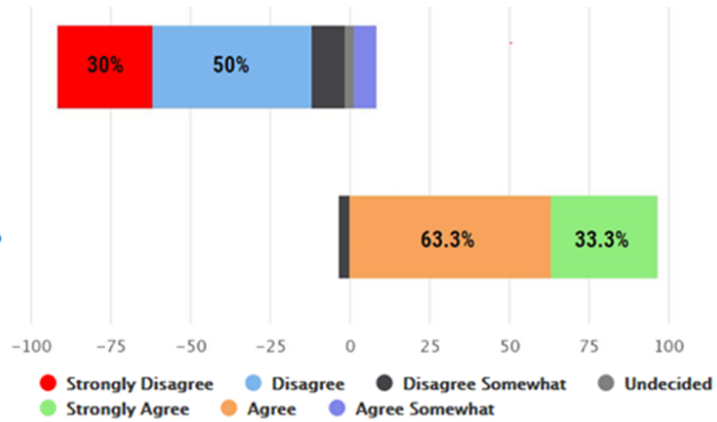
Perceived cost

Over 90% of users felt that they had the financial and technological resources to use such an app.

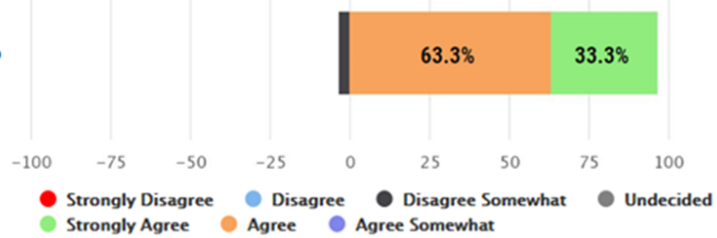
During the in-country research phase we learned that users were concerned about the potential cost of using such an app. We addressed this in the recreation of prototype 2.0 by including a *refresh* feature which would enable users to control their data consumption so that the app wouldn’t consume data unless they chose to.

As a result, the majority of users felt that such an app would not cost them a lot of money to use.

I believe that using such a mobile app will cost me a lot of money



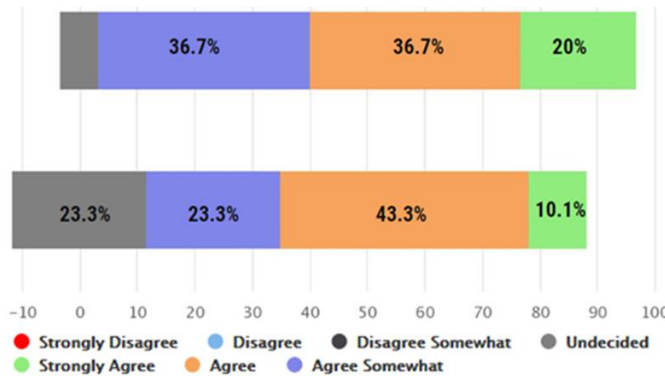
I have the financial and technological resources required to use mobile internet services.



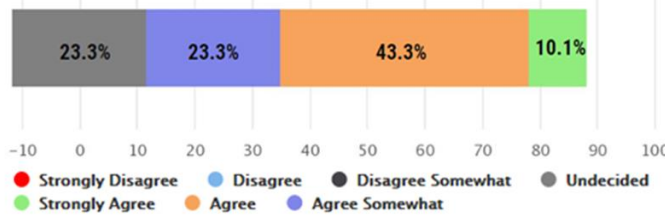
Compatibility

More than half of users felt that such an app would be a good fit with their current lifestyles. It is important to note that almost all users interviewed with smartphones had android phones.

I believe that using such a mobile app will fit well with my lifestyle.

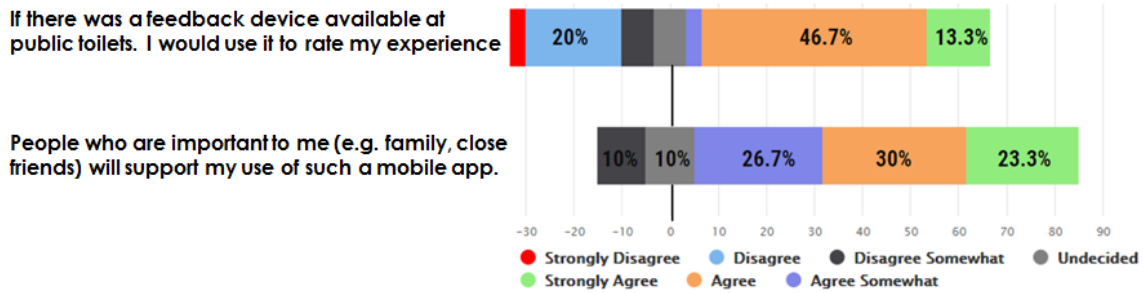


I believe that using such a mobile app suits well with my current situation.



Subjective norm

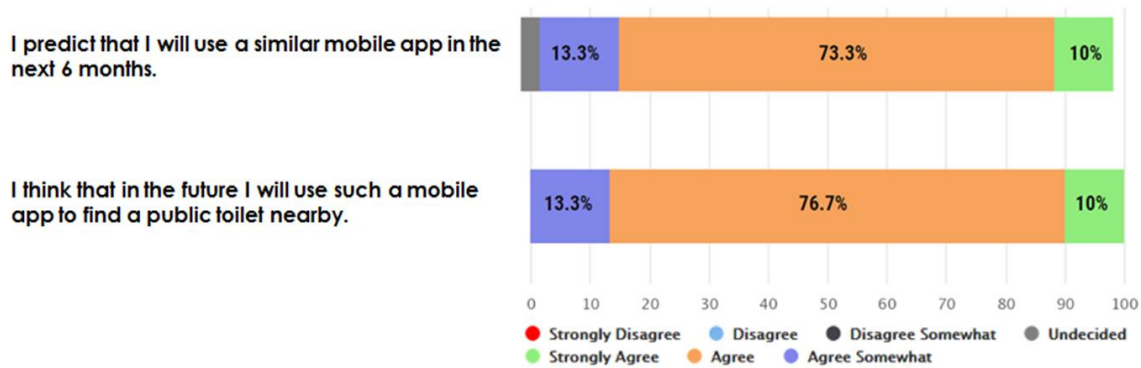
About half of users felt that society and people who were important to them e.g. family and close friends would support their use of such a mobile app. This was important because most users who regularly used other apps did so because their friends and family also used them, or was how they were first introduced to it.



Behavioural intention

Anticipation for such an app was high with most respondents (87%) being open to using such an app in the near future.

83% felt that they would use such an app in the next 6 months.

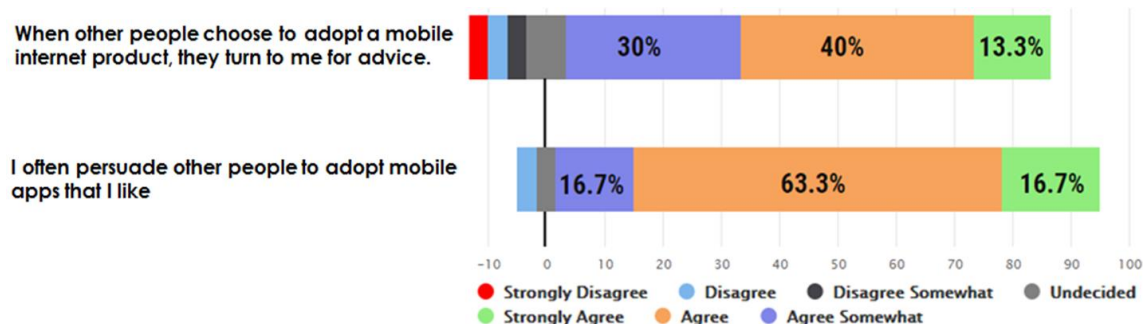


Early adopters and influencing others

We also tested whether commuter users were likely to influence others to use the app.

80% of the commuter users interviewed felt that they often persuaded other people to adopt mobile apps they liked. More than half also said that others consulted them on adoption of new mobile/internet products.

This was a good indication that commuter group of users is indeed the right group of users to begin with.



10 Conceptual business models for the app

For the mobile app solution to function sustainably, it needs to be complemented by an appropriate business model which articulates how the app would operate as a sustainable business. This includes elements such as what the sources of revenue would be, who the business' main customers would be, which services the app would offer and the expected costs.

The app's business models ought to take into account that the aim of public toilet businesses in Nairobi is to be profitable. Embedding a digital payment solution into the app for example could be a way to contribute towards this goal by enabling toilet owners to have more control of their revenue.

We have developed three conceptual business models for the app which are illustrated below through flow charts of the business concepts and business model canvases (globally utilised lean tool for describing and designing a business models) for each concept.

A social enterprise which is commercially viable, and whose main goal is to maximize the improvement of public toilets in the city would be the ideal vehicle for the business models.

10.1 The 'pay as you go' Model

The prototype developed during this project would be further developed into a fully functional platform where public toilet users would be able to find public toilets and based on other users' reviews could see which are the cleanest public toilets near them. The mobile app would also enable public toilet users to rate their experience of the public toilets that they visit.

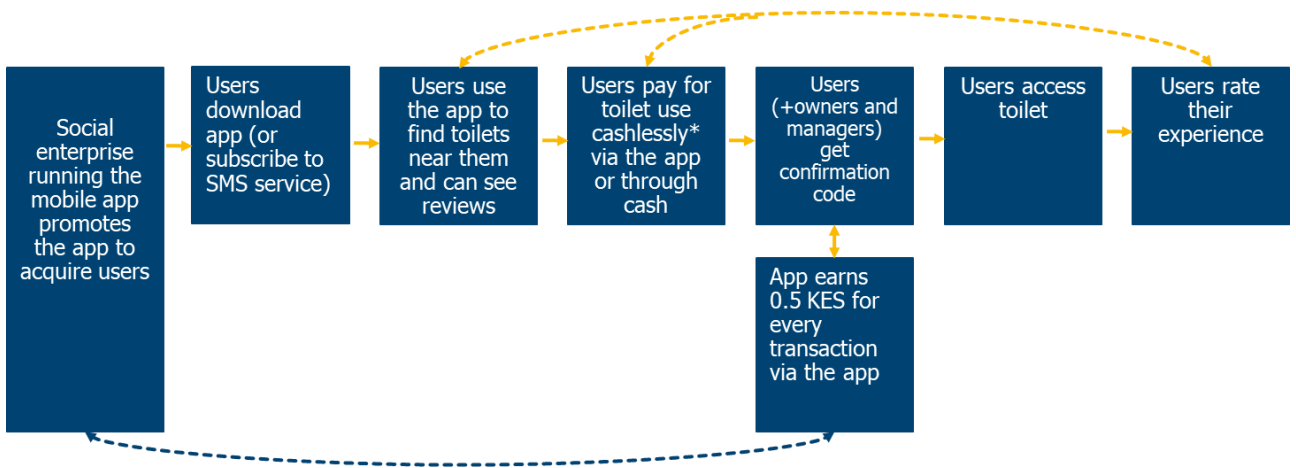
The app would be run by a social enterprise with the aim of encouraging more people to use existing public toilets in the city, by making it easy to find the cleanest public toilet depending on the location of the user.

The main user target group would be people going through the city who rely on public toilets while on the move.

The expectation is that the cleanest-rated public toilets would attract the most users, thus those with the most positive reviews would benefit from revenue growth.










The app would thus function as a user-driven marketing service for public toilet owners, based on the positive reviews of public toilet users. The toilet owners would thus be the app's primary customers.

Conceptual business flow chart



*Cashless system: to be determined after further consultations with toilet owners and managers. A potential solution could be *M-PESA 1 Tap* given that the maximum amount businesses could be charged to withdraw their earnings is KES330 (2.7Euro), and may be worth it to businesses particularly if it gets them more users. With *M-PESA 1 Tap* users could use a card, phone sticker or wristband connected their mobile account and is much faster than making traditional M-PESA payments which was a concern by users.

Conceptual business model canvas

 <p>KEY PARTNERS</p> <ul style="list-style-type: none"> Toilet users Toilet owners Nairobi City County Community/ health-based organisations 	 <p>KEY ACTIVITIES</p> <ul style="list-style-type: none"> Development of the app Mapping of shared/public toilets Marketing of the App to users and toilet owners Downloading of the App by users Use of the App to find toilets Rating of shared toilets by users 	 <p>VALUE PROPOSITIONS</p> <ul style="list-style-type: none"> A platform for users to review toilet facilities in their area/ in the city Increase demand for clean shared toilet facilities Increase income for toilet owners with clean facilities More transparency for toilet owners on user traffic 	 <p>CUSTOMER RELATIONSHIPS</p> <p><u>Co-creation of the App</u></p> <ul style="list-style-type: none"> Gathering user insights as part of the app development + HCD design <p><u>Mobile community</u></p> <ul style="list-style-type: none"> Access to other users' reviews 	 <p>CUSTOMER SEGMENTS</p> <ul style="list-style-type: none"> Public toilet users Public toilet owners
 <p>KEY RESOURCES</p> <ul style="list-style-type: none"> The app The collaboration with toilet owners Funding Reviews of toilet users 		 <p>CHANNELS</p> <ul style="list-style-type: none"> App available on Google Play <u>Accessibility for users:</u> <ul style="list-style-type: none"> Make registration/signing up possible at location of public toilets Local radio marketing Collaboration with Community Based/Health Organisations 		<p>REVENUE STREAMS</p> <ul style="list-style-type: none"> Small fee for transactions via the app Sale of consolidated consumer feedback data to toilet owners Charge toilet owners to have their facilities mapped on the platform
 <p>COST STRUCTURE</p> <ul style="list-style-type: none"> Development and maintenance of the app Marketing of the app to users and toilet owners Incentives for users to rate their experience (E.g. users get 1KES back for rating their experience) 			 <p>REVENUE STREAMS</p> <ul style="list-style-type: none"> Small fee for transactions via the app Sale of consolidated consumer feedback data to toilet owners Charge toilet owners to have their facilities mapped on the platform 	

10.2 The subscription model

Similar to the ‘pay as you go’ model, in this model the prototype would be developed into a functioning app and users would be able to find and rate public toilets.

The difference with this model is that public toilet users would be able to subscribe for weekly or monthly subscriptions to use certain public toilets in the city.

The platform would be run by a social enterprise with the aim of making it cheaper for users to consistently use public toilets.

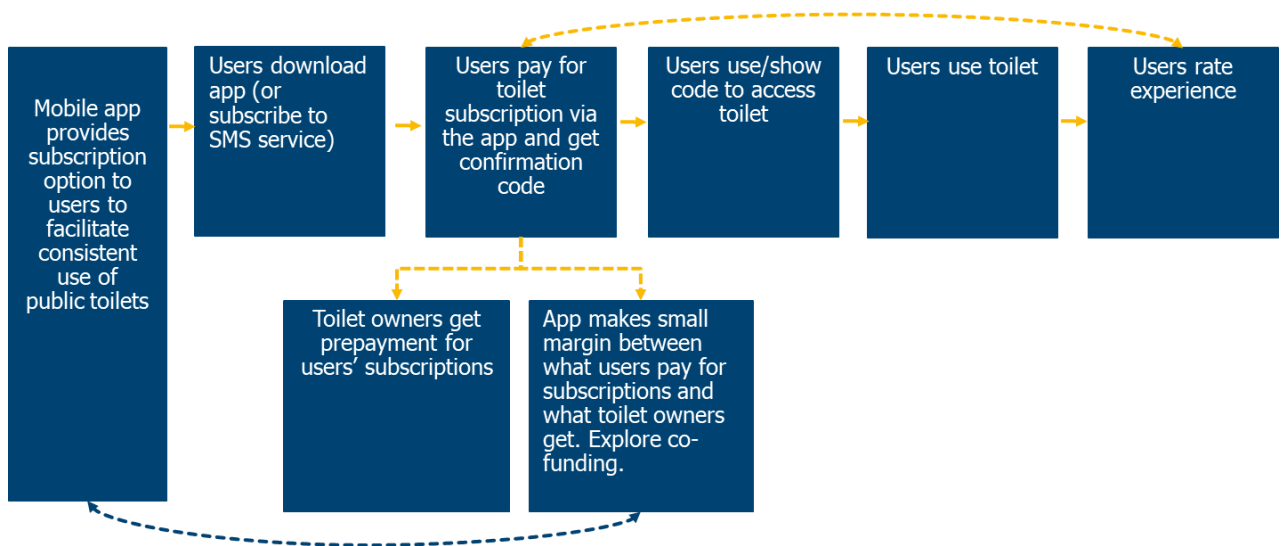
Users would download the app and subscribe to the public toilet of their choice and pay for their subscription on the app.

This model would require prior establishment of subscription agreements with toilet owners in the city who are interested in offering subscriptions to their users via the app.










With this model, the social enterprise could potentially source for co-funding to subsidize the subscription price paid by toilet users with the aim of making regular access available to as many users as possible.

While this model has the potential of making individual toilet visits for users cheaper compared to the pay as you go model, it should be noted that toilet owners will likely be opposed to it if it means making less money per visit for them. A way of addressing this could for example be by promoting the fact that by getting upfront payments of toilet subscriptions, management of their working capital/cashflow could be easier or that the potential growth in user numbers could mean growth in total revenue overall.

Conceptual business flow chart



Conceptual business model canvas

 <p>KEY PARTNERS</p> <ul style="list-style-type: none"> Toilet owners Toilet users Nairobi City County Community/health based organisations 	 <p>KEY ACTIVITIES</p> <ul style="list-style-type: none"> Negotiating subscription terms with toilet owners Marketing of the app to toilet owners Marketing of the app and subscriptions to users Downloading of the app Use of the app to find toilets Rating of toilets by users 	 <p>VALUE PROPOSITIONS</p> <ul style="list-style-type: none"> Toilet owners have more revenue stability through prepaid subscriptions Increase demand for existing shared toilet facilities Users get toilet services at a lower rate than pay-as-you-go Enables users to give feedback on shared toilet facilities in their area 	 <p>CUSTOMER RELATIONSHIPS</p> <ul style="list-style-type: none"> With users on development of App With owners on subscription model terms and operation 	 <p>CUSTOMER SEGMENTS</p> <ul style="list-style-type: none"> Public toilet users Public toilet owners
 <p>KEY RESOURCES</p> <ul style="list-style-type: none"> Collaboration with toilet owners The app Funding Review of users 		 <p>CHANNELS</p> <ul style="list-style-type: none"> App available on Google Play <u>Knowledge access for users:</u> <ul style="list-style-type: none"> - Make registration/signing up possible at public toilets - Local radio marketing - Collaboration with Community Based/Health Organisations 		
 <p>COST STRUCTURE</p> <ul style="list-style-type: none"> Development and maintenance of the app Mapping of the public toilets on platform Marketing of the app to users and owners Signing up of subscription model users 		 <p>REVENUE STREAMS</p> <ul style="list-style-type: none"> Margin on transaction between subscription from users and prepayment of subscription to owners. Co-funding to subsidize toilet subscriptions from external sources e.g. corporate sponsorships, grants. 		

10.3 The public-private partnership (PPP) model

This model would also be run by a social enterprise whose aim would be to provide a service to local authorities who have control or oversight over public toilets in their cities, such as the Nairobi City County.

The value proposition would be for the app map all public toilets in the city and to enable the local government/municipality to keep track of city residents' satisfaction of existing sanitation services.

In the previous business models, the social enterprise would generate revenue from the transactions carried out via its platform, but in this model, the municipality would be the paying customer. The development of this model would entail further discussions with municipalities to understand and incorporate their existing data needs into the solution.

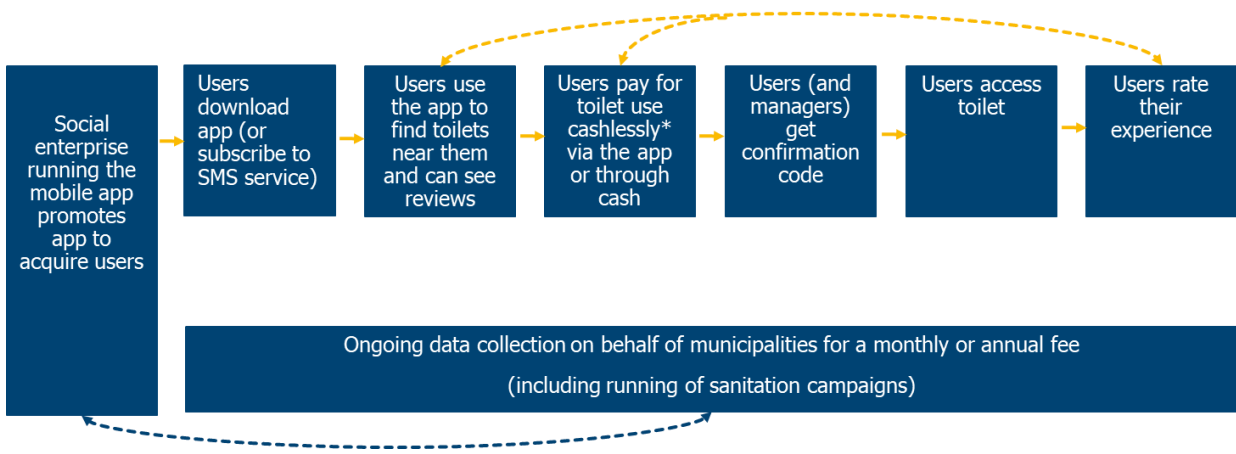
One of the upsides of this model is that once proven in one municipality, the solutions could potentially be replicated in other municipalities. It would also likely be easier to register all existing public toilets on the app if the oversight authority is a collaborating partner in delivery of the solution.

Caution is however advised when considering contracting with local governments. In this case, it is important for the social businesses to consider factors such as:








- Local governments in many developing countries have severe financing challenges, which could affect their capacity to be a regularly paying customer

- Additional legal requirements or approvals may be required to advance this model which could take a long time
- Local governments/ municipalities have to be ready to pay for the service for this model to work.

Conceptual business flow chart



Conceptual business model canvas

 <p>KEY PARTNERS</p> <ul style="list-style-type: none"> • Nairobi City County • Toilet users 	 <p>KEY ACTIVITIES</p> <ul style="list-style-type: none"> • Determining data needs of the municipality • Development of the app • Mapping of public toilets • Marketing of the app to users • Downloading of the app by users • Use of the App to find toilets • Rating of shared toilets by users 	 <p>VALUE PROPOSITIONS</p> <ul style="list-style-type: none"> • Data on sanitation and condition of public toilets in the city • Basis on which to apply pressure on public toilet lessees to keep toilets clean if they want their leases to run • Increase demand for clean shared toilet facilities 	 <p>CUSTOMER RELATIONSHIPS</p> <ul style="list-style-type: none"> • With the municipality on development of the app, and other aspects of the app that could be useful • With users of the app 	 <p>CUSTOMER SEGMENTS</p> <ul style="list-style-type: none"> • Nairobi City County and other municipalities • Public toilet users
 <p>COST STRUCTURE</p> <ul style="list-style-type: none"> • Development and maintenance of the app • Marketing of the app to users • Incentives for users to rate their experience (e.g. free toilet visits) 		 <p>REVENUE STREAMS</p> <ul style="list-style-type: none"> • Charge municipalities a monthly or annual fee to run the service 		

11 Conclusion

Public toilets are the primary means of access to affordable sanitation for many people in densely-populated urban cities in developing countries. It is important that these toilets are well operated and well maintained for the convenience and safety of users.

While it is primarily the responsibility of governments or municipalities in many developing countries to provide access to sanitation to the populace, private-sector efforts are needed to help tackle deficiencies of available sanitation services.

Public toilet private-sector solutions will have the greatest impact if carried out in collaboration with the responsible government agencies and existing stakeholders responsible for provision of sanitation, provided there is an enabling environment.

In Nairobi's context, this would ideally be with the Nairobi City County, other public toilet owners, public toilet managers and public toilet users. An increase in the number of users accessing clean public toilet facilities in Nairobi would directly benefit users (access and hygiene) and owners (revenue growth), however it may not necessarily afford direct benefits to managers e.g. through an increase in earnings. Public toilet managers in Nairobi are responsible for the day-to-day cleaning of public toilets, therefore also incentivising this group directly may be key in the success of any solution.

A solution that gives users the choice of finding a clean public toilet, based on the reviews of their peers, is the first step in pushing toilet businesses to step up their efforts in keeping public toilets clean. Mobile and smartphone penetration is significant enough and growing to enable use of a solution that in our view is a mobile app. Peer reviews in other industries, now more than ever, influence customer choice and behaviour, and this could work similarly with public toilets. How businesses respond to reviews tends to build the revenue and reputation of the business.

Specific design elements of a mobile app can address the challenge of finding a clean public toilet for many users, however, we found that this solution would work best with commuter users who were the clear group of early adopters, and secondary for residential users in low income settlements who were less willing to incur mobile data charges.

A universally accepted cashless payment solution on the app should be explored as it could ensure more transparent transactions in the sector. The transparency of a digital payment process would enable toilet owners to get better control of their businesses, which may help to make sanitation models more profitable and in turn help to facilitate higher investments and better maintenance of toilet facilities.

While the initial focus of the project was on developing a mobile app for users to find clean public toilets nearby using a digital review and payment system, during the in-country research it became clear that there was also a need for toilet owners to gain more financial control over their businesses, and to improve the quality of their business through better maintenance of their facilities. It therefore appears relevant to also set up a system to better connect toilet owners with their toilet managers who are responsible for collecting payments and maintenance of the toilets.

Furthermore, it would be useful to explore other Internet of Things (IoT) options besides smartphones for users to rate toilets, as not all users (particularly residential users) may be likely to bring their smartphones with them or willing to spend mobile data.

The overall reception to the idea of an app was welcomed by users, however pilot testing of a fully functional app and conceptual business model in a real-world context with key stakeholders in the sector is critical. For the pilot test, we would therefore like to:

- Establish partnerships with:
 - a social business/entrepreneur that could run the app
 - an ICT developer to build the app
 - an academic partner to measure the impact of such a solution
 - the Nairobi City County and other toilet owners
- Run a pilot test of the app and proposed business model(s) with the identified partners. The aim of the pilot would be to assess the functionality and effectiveness of the solution before deployment.

In conclusion, the development of implementation of peer-to-peer technologies for sanitation shows real potential for improving the access, cleanliness and frequency of use of public sanitation facilities in Kenya. Such a solution could benefit both toilet users and owners alike, and result in broader hygiene and environmental benefits for the community. However, further feasibility testing and piloting would be required to confirm that this model is scalable and viable in a broader context across Kenya and beyond.

12 References

1. World Health Organization (WHO) and the United Nations Children's Fund (UNICEF). 2017. Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. Geneva. Licence: CC BY-NC-SA 3.0 IGO
2. United Nations. 2015. The 2030 Agenda for Sustainable Development [<https://sustainabledevelopment.un.org/sdg6>] Accessed November 25, 2016
3. ONE. 2017. Water & Sanitation, The Challenge [<https://www.one.org/international/issues/water-and-sanitation/>] Accessed September 29, 2017
4. T Rheinländer, F Konradsen, B Keraita, P Apoya & M Gyapong. 2015. Redefining shared sanitation. Bulletin of the World Health Organization. [<http://www.who.int/bulletin/volumes/93/7/14-144980/en/>] Accessed September 29, 2017
5. United Nations Children's Fund (UNICEF) and the World Health Organization (WHO). 2012. Progress on Drinking Water and Sanitation: 2012 Update. [<http://www.unicef.org/media/files/JMPreport2012.pdf>] Accessed November 25, 2016
6. WHO/UNICEF. 2015. Data Estimates: Joint Monitoring Programme for Water and Sanitation.
7. United Nations Children's Fund (UNICEF) and the World Health Organization (WHO). 2012. Progress on Drinking Water and Sanitation: 2012 Update. [<https://www.unicef.org/media/files/JMPreport2012.pdf>] Accessed November 25, 2016
8. Kenya Water for Health Organization (KWAHO). 2015. Final Report: Citizens Report Card Study. Final Report prepared by Emerald Environment limited, commissioned by KWAHO Nairobi, KWAHO. Kenya.
9. World Bank Group / InfoDev. 2014. Mobile at the Base of the Pyramid: Ghana, Mozambique, Nigeria, Zambia.
10. Group Special Mobile Association (GSMA). 2015. The Role of Mobile in Improved Sanitation Access. Mobile for Development Utilities Programme.
11. Sophia Zab. 2015. Whitepaper: The Growth of the Smartphone Market in Kenya, Jumia Kenya.
12. M&C Saatchi Mobile. 2013. Whitepaper: Inside-Mobile-Africa
13. CIA World Factbook. 2015. Kenya
14. A. Tumwebaze IK, Orach CG, Niwagaba C, Luthi C, Mosler HJ. 2013. Sanitation facilities in Kampala slums, Uganda: users' satisfaction and determinant factors. *Int J Environ Health Res.*;23(3):191–204 [<http://dx.doi.org/10.1080/09603123.2012.713095>] pmid: 22873693
B. Kwiringira J, Atekyereza P, Niwagaba C, Günther I. 2014. Gender variations in access, choice to use and cleaning of shared latrines; experiences from Kampala Slums, Uganda. *BMC Public Health*;14(1):1180. [<http://dx.doi.org/10.1186/1471-2458-14-1180>] pmid: 25407788
C. Nelson KB, Karver J, Kullman C, Graham JP. 2014. User perceptions of shared sanitation among rural households in Indonesia and Bangladesh. *PLoS ONE*.;9(8):e103886. [<http://dx.doi.org/10.1371/journal.pone.0103886>] pmid: 25090096
15. James Mwangi. 2017. Let's talk crap: Nairobi city has 150 public toilets for 5 million people. Kenya [<https://www.sde.co.ke/thenairobi/article/2001227927/let-s-talk-crap-nairobi-city-has-150-public-toilets-for-5-million-people>] Accessed June 07, 2017
16. M-PESA: it is a mobile phone-based money transfer run by the largest mobile network operator in Kenya, Safaricom. It allows users to deposit, withdraw, transfer money and pay for both goods and services easily with a mobile device.
17. Anderson, J., & Billou, N. 2007. Serving the World's Poor: Innovation at the Base of the Economic Pyramid. *Journal of Business Strategy*, Volume: 28, Issue: 2 , 14-21