Evaluating Technology in Context:

Mobile Apps for Waste Pickers

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D-Lab: Waste

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Introduction

Motivations for Research

As part of the MIT D-Lab Practical Impact Alliance (PIA) Inclusive Recycling Working Group, MIT D-Lab, along with project collaborators Danone and BoP Innovation Center, hopes to create a mobile app to address the challenges of waste picker cooperatives in southeast Brazil. In order to inform the development of their app, the project collaborators requested a survey of existing waste picker related apps around the world, as well as in-depth case studies. The goal of our research is to understand what apps exist, what functions they perform, and in what settings.

Research Question Development

Rationale: waste picker roles and challenges

We began by exploring the many motivations behind the creation of waste picker apps, as a way of refining our research question and deliverables.

Waste pickers are an important piece of the global waste management system. Through the collection, sorting, resale, and repurposing of discarded materials, waste pickers earn an income while contributing to local economies and reducing solid waste [1]. Benefits to societies extend further, including improved sanitation and health for communities and reduced costs to municipalities through diversion of large quantities of materials [2]. In recent years, waste pickers have achieved increased recognition and economic power through self-organization, activism, and lobbying for regulatory change [3]. Broadly speaking, however, the global community of waste pickers still suffers from a lack of resources and infrastructure to agglomerate and handle waste collection and sorting, limited to no protection around fair pricing of materials, and negative societal perceptions, among other challenges [1].

Figure 1 provides a broad overview of the exchange of recyclables, equipment, and money between waste pickers, middlemen, and the end buyer, usually a recycling plant.

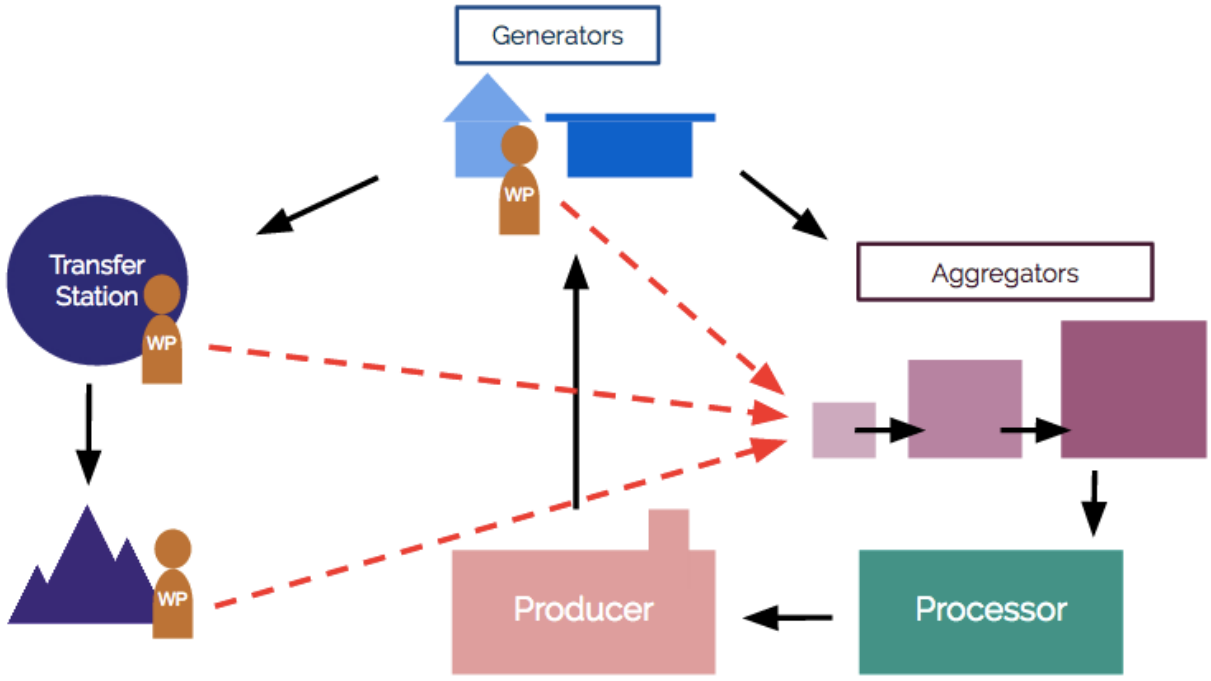


Figure 1: .The exchange of recyclables, equipment, and money between waste pickers, middlemen, and the end buyer.

Apps

In the past decade, waste cooperatives, nonprofits, the private sector, government, and other public actors have made collaborative attempts to address some of these challenges through the development of software or mobile applications (apps). These apps are in various stages of development and implementation in communities from Brazil to India to Canada [4]. Functionalities of the apps include facilitating connections between households and individual waste pickers, cutting out middlemen in supply chains, and indicating where materials are available for pickup. The diverse range of development processes, functions, and successes of these software speaks to the importance of understanding unique contexts and community needs in the development of these technologies. At the same time, similarities in challenges and types of solutions reflect the potential for cross-contextual comparison of successes and struggles. Figure 2 depicts where in the world waste picker apps are located, based on our research and conversations with collaborators.

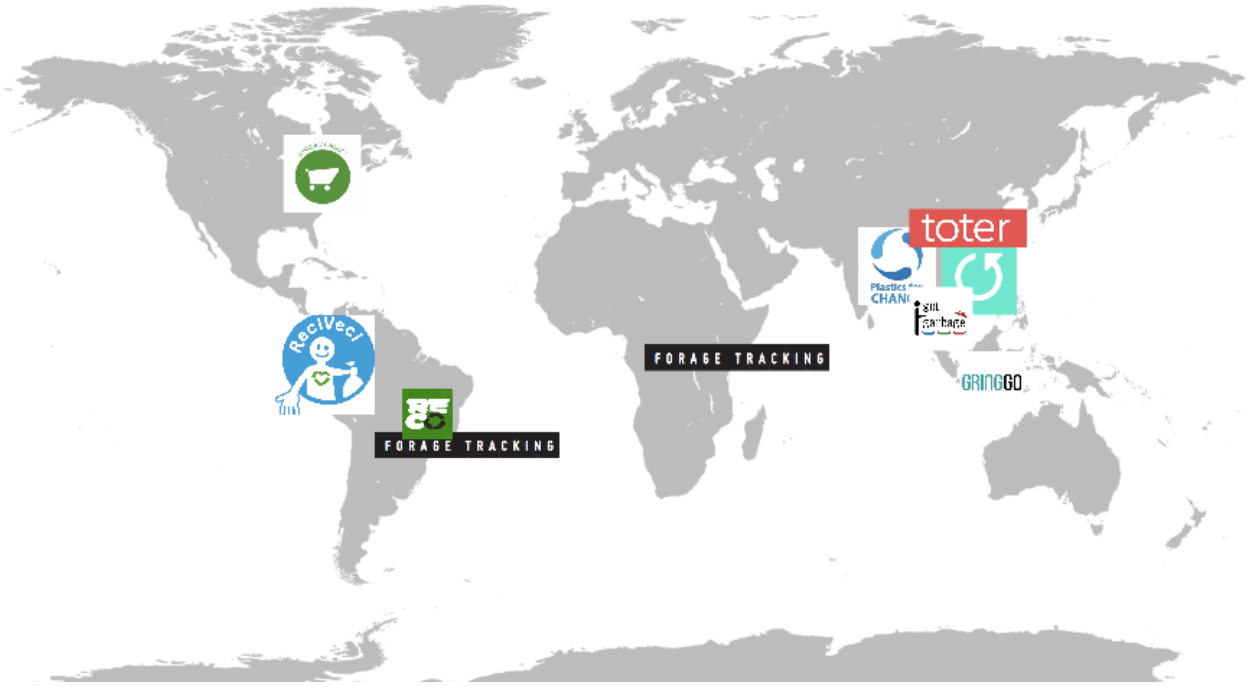


Figure 2: Location of waste picker apps studied.

Research Gaps and Project Deliverables

Currently, while there are research materials regarding global waste picker communities and cooperatives, and some information on technical solutions to their issues, there is little information regarding, to put it simply: what works, where, and why. Furthermore, this information does not exist in a central, uniformly synthesized resource. Therefore, our research questions were twofold:

1. In a given context, what about the structure of the technology/app makes it effective? Specifically, what are the challenges waste pickers face (public perceptions, unfair pricing, safety, infrastructure), who are the actors involved in waste collection, and what are the policy context and history surrounding waste pickers in this particular community?
2. How can we standardize the way we ask and answer these questions? Can we create a tool/framework for others to evaluate their own solutions or applications for waste pickers in other contexts?

After collecting information about the various apps, we attempted to capture the trends we saw. We have compiled several summary documents and charts, included in separate sections and embedded within the in-depth cases. An introduction to the cases briefly explains our approach.

Contained in this report are:

- comprehensive case studies of the selected apps, developed through background research and interviews with developers;
- an overview of the various apps that exist;
- a summary document that depicts the factors that influence particular functionalities of the app and their outcomes in a given community; and
- a template to serve as a framework to guide the development and study of future apps.

Limitations of Report

We would like to discuss the limitations of our case studies as well as point out areas for future research. One of the most glaring limitations of these case studies is that we were unable to speak with the waste pickers, households, or businesses that have actually used these mobile apps. We based our findings largely on interviews with founders, news reports, and academic literature. These case studies would benefit from a better understanding of how useful these apps are to the average user. Another limitation of these studies is the novelty of the subject of our research. There are only a few mobile applications for waste pickers that exist, and some do not yet have full functionality (see the RECO and GRINGGO case studies). It is difficult to gauge the long-term impact of many of these apps, given that they all have started within the past three years or so. We also had a lack of response from some contacts, as well as a limit on our own time and resources. Despite these limitations, we believe these case studies provide a useful overview of existing mobile applications for waste pickers and insight to those considering their own technological solutions to address the challenges these workers face daily.

References

[1] Dias, Sonia, and Melanie Samson. Informal Economy Monitoring Study Sector Report: Waste Pickers. WIEGO. 2016. http://wiego.org/sites/wiego.org/files/publications/files/Dias-Samson-IEMS-Waste-Picker-Sector-Report.pdf.

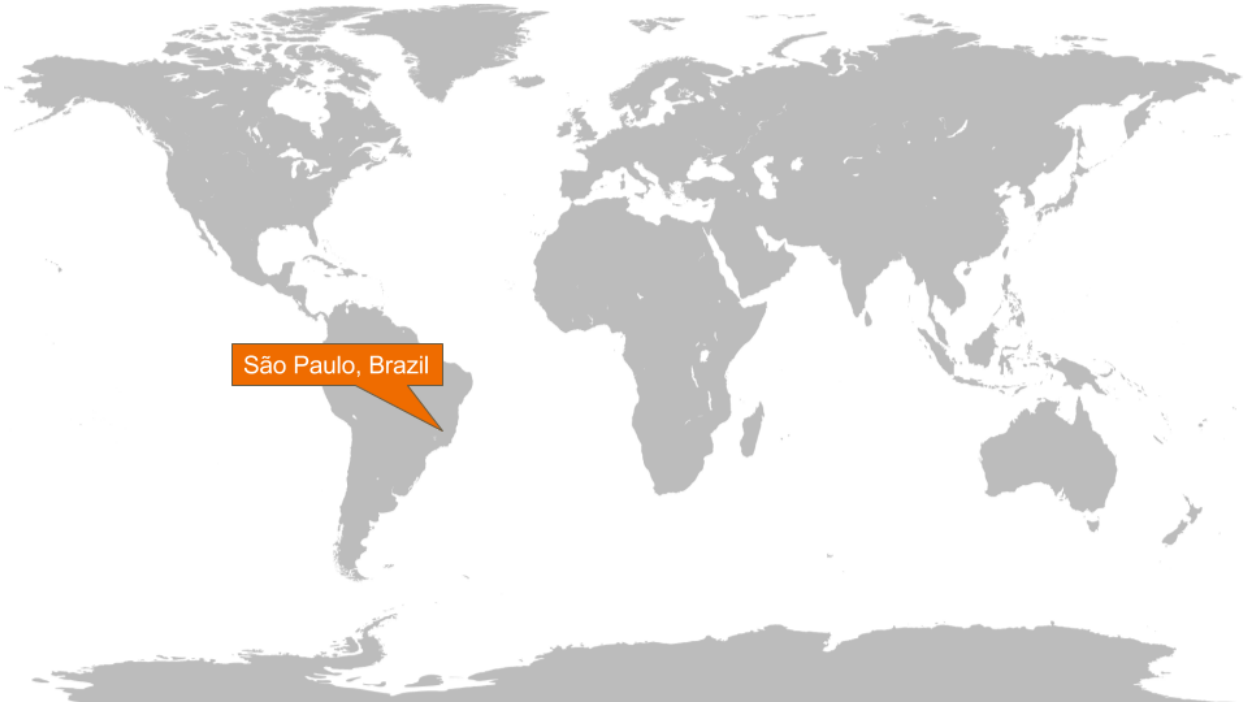
[2] WIEGO, Wastepickers: The Right to Be Recognized as Workers. 2013. 102nd session of the International Labour Conference. 2013. http://wiego.org/sites/wiego.org/files/resources/files/WIEGO-Waste-Pickers-Position-Paper.pdf.

[3] WIEGO. Informal Workers in Focus: Waste Pickers in Brazil. 2011. www.inclusivecities.org/wp-content/uploads/2011/.../Waste-Pickers-in-Brazil-3-11.pdf.

[4] Lee, David, Kevin Kung, and Carlo Ratti. Using Mobile Phones to Map Waste Handling Dynamics in Mombasa. 2015. web.mit.edu/cron/project/CUPUM2015/proceedings/Content/pss/364_lee_h.pdf.

Case Studies

RECO



Location:
São Paulo, Brazil

Organization:
NGO/Non profit, Pimp My Carroça

Target Users:
Households/small scale generators

Key Functionalities:

- GPS waste picker locator (static)
- Database of waste pickers
- Database of waste facilities
- List of recyclable material streams
- User login/interaction

The Context

Brazil as leader in recognition of waste picker rights

Brazil has a particularly strong history of recognizing informal networks as part of municipal waste management systems. By organizing, protesting, and lobbying lawmakers, particularly following the end of Brazil's military rule in 1985, waste pickers have been able to push for and benefit from federal, state, and municipal level initiatives. According to the network Women in Informal Employment: Globalizing and Organizing (WIEGO), Brazil's National Waste Pickers Movement (MNCR) comprises approximately 600 cooperatives, which employ 80,000 waste pickers, or *catadores*. Taken together, the cooperatives perform an important service for the waste economy and the environment, collecting about 90% of Brazil's recycled materials [1]. The waste picker cooperatives, or membership-based organizations (MBOs), are an important source of social support, in addition to employment, for waste picking communities [2]. It is worth noting that while 31.1% of waste pickers around the country are women; over half of cooperative members are in fact women [3].

The legal and regulatory framework in Brazil facilitates waste pickers' recognition within a traditionally informal working context, relative to other countries [4]. Brazil's National Solid Waste Policy, Law 12.305/2010, approved in July 2010 after much debate, explicitly indicates a role for waste pickers in sustainable management of solid waste at the same time that it mandates extended producer responsibility and national, regional and local solid waste management plans [5]. The National Solid Waste Policy builds upon several preceding federal actions and pieces of legislation, which acknowledge waste pickers' role in waste collection systems while providing protections and rights: in 2001, the role of *catador de material reciclável* was recognized as a profession in the Brazilian Occupation Classification, the official federal professional registry; in 2007, legislators passed Law #11.445/07, which deems bidding unnecessary for waste picker cooperatives, granting them a fairer chance of competing with private entities attempting to contract with municipal waste collection agencies; and in 2006, Presidential Decree #5940/06 secured waste pickers' right to source separated materials in federal buildings, enabling protection where particular organizations or buildings try to limit waste pickers' access [4].

Waste and waste pickers in São Paulo

As Brazil's largest city, São Paulo has been an important site for work around waste pickers: approximately 20,000 waste pickers are estimated to work in São Paulo. The municipality is technically responsible for collection of the approximately 10,000 tons produced per day [6]. Law 12.300/2006 encourages the inclusion of waste pickers in segregated materials collection services through partnerships with the public and private sectors, as well as the creation of waste picker cooperatives and associations [7]. São Paulo is home to the country's first registered waste picker cooperative, Coopamare, founded in 1989, which has

gained additional visibility as the first waste picker cooperative to take part in a shared management of separated materials collection with a municipality [8].

Regardless of the many measures achieved through waste picker unions and organizing, waste pickers still face significant challenges. Social stigma, lack of fair pricing, and lack of safety continue to be major hurdles. Furthermore, approximately three thousand waste pickers act as part of cooperatives in the city [6], which leaves thousands of independent waste pickers working alone. Many waste pickers choose not to be part of cooperatives, preferring the autonomy, or because they feel that participating in cooperatives actually causes more trouble than it does good [9]. This makes them even more vulnerable to the dangerous conditions and economic exploitation faced by waste pickers broadly [6]. Independent waste pickers will sell the materials they collect to intermediary actors, or bring them to *ferrovelhos* (junk yards). While some of these middleman treat waste pickers well (or are waste pickers themselves), most are powerful individuals that take advantage of waste pickers, offering prices that are not reflective of the full value of the materials the waste pickers collect.

The App

Information about RECO was collected via interviews with the app developer and a staff member in November of 2016 [10, 11], as well as materials shared between the app developer and the researchers.

Origin Story

Pimp My Carroça (PMC) is a non profit in São Paulo that provides support to the city's population of independent waste pickers [12]. Since 2007, graffiti artists have partnered with waste pickers to decorate their *carroças*, waste carts, to start a conversation with the public about the importance of waste pickers to society. The organization also provides reflective gear and health services to the catadores to make their work safer. According to a member of the staff, the organization began receiving calls from São Paulo residents aware of PMC's work about where to take their recyclables. Seeing the demand for a way to connect with waste pickers directly, as well as an opportunity to address some of the economic concerns associated with independent waste picking, PMC teamed up with a student from the Massachusetts Institute of Technology (MIT) to develop a mobile app for waste pickers. In January of 2015, RECO was born.

Purpose

RECO is still in its very early stages, but aims to be, according to its founders, "an Uber for waste pickers." Users of the app, primarily individuals and households who generate waste,

can look at a map that displays waste picker locations, and call up the waste picker nearest to them who collects the type of materials they are hoping to dispose of. If a user prefers to transport materials themselves, or if no waste pickers are available, he or she can also locate the collection center nearest to them to dispose of their trash. The software exists as a website [13], as well as an app for Android, downloadable via Google Play [14].

Target Area of Waste Collection Process

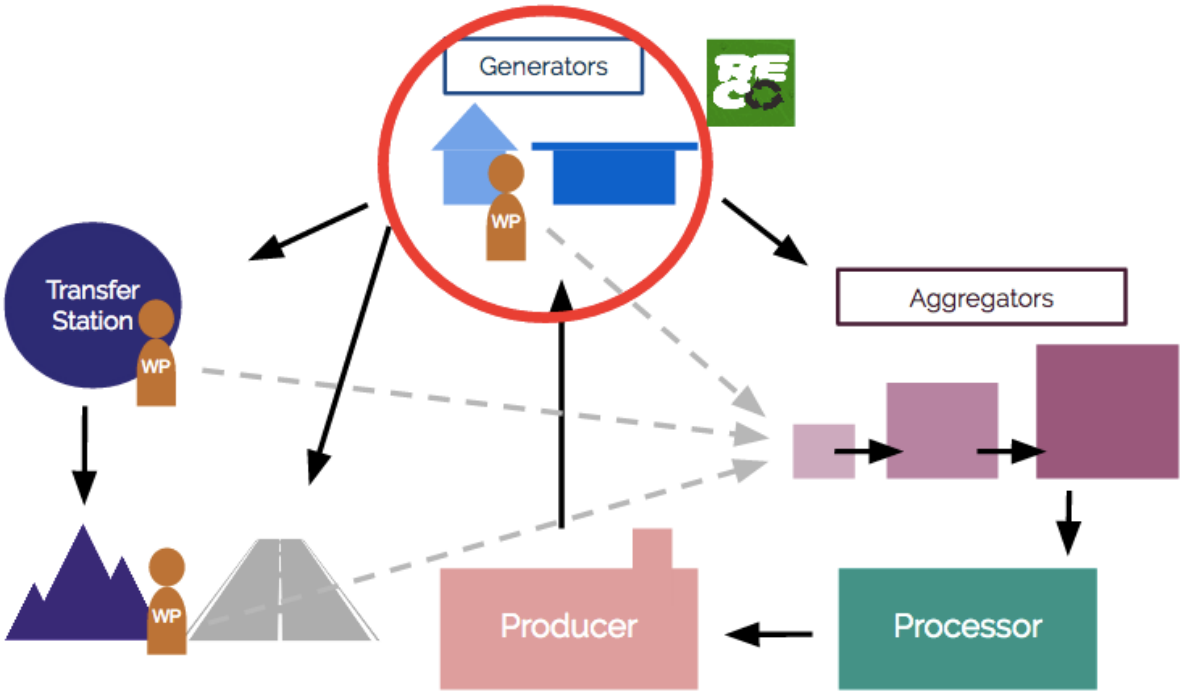


Figure 1: RECO operates at the generator to waste picker connection, indicated by the red circle.

Primary Functionalities

At the present time, RECO has the following capabilities:

- GPS waste picker locator (static)
- Database of waste pickers
- Database of waste facilities
- List of recyclable material streams
- User login/interaction

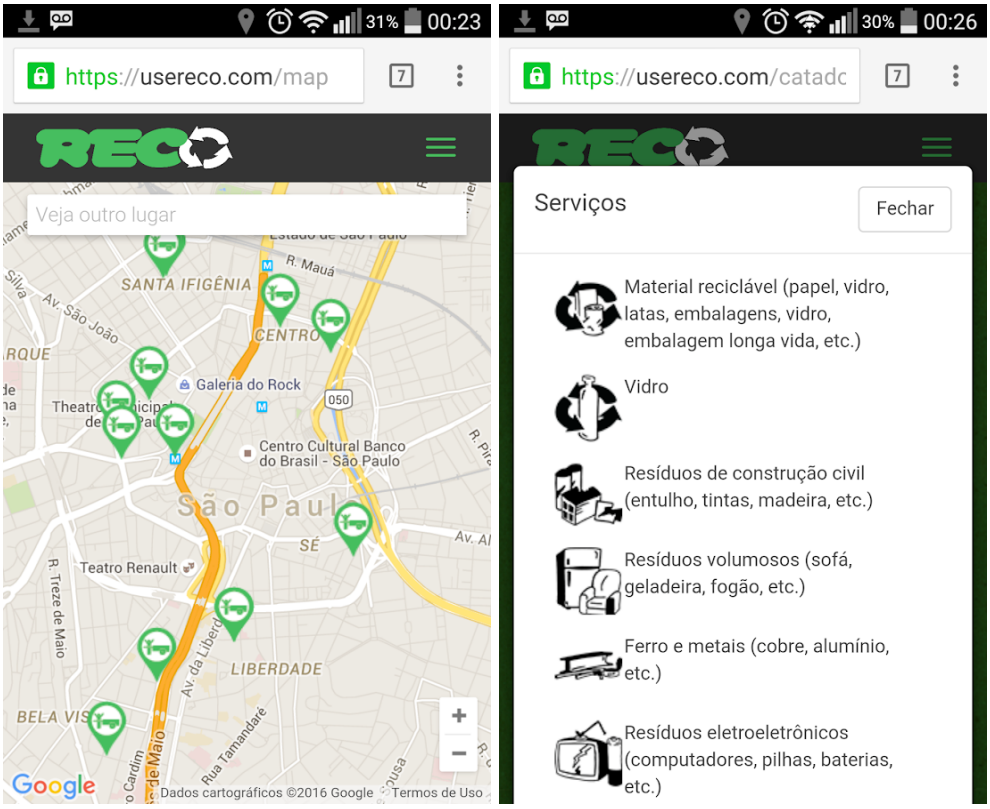


FIgure 2. Screenshots of RECO's waste picker locator and material streams functionalities. (Source: [14])

Waste picker profiles were obtained through the organization's contact with individual waste pickers. The profiles contain information about the waste picker's names and contact information, as well as what materials they collect. The map displays a static location for each waste picker, indicating an area in which the waste picker usually spends time. The maps also displays the locations of dry waste collection sites and other locations to bring recyclable materials. Users can login and create a profile, providing a way to facilitate interaction and crowdsourcing of additional input of information to the app.

Future Functionalities

PMC hopes eventually to have a real-time tracker for waste pickers, price estimates based on real-time market value of materials, and a platform for waste pickers to login and interact with the software. The inability to develop these functionalities at the present moment derives from difficulties associated with the app's development, to be addressed below..

Waste Picker Challenges Mapped to Functionalities

The major challenges (purple) that the app attempts to address are captured by Figure 3, below. The big picture solution to these problems (orange) maps to the specific functionalities (blue) of the app itself.

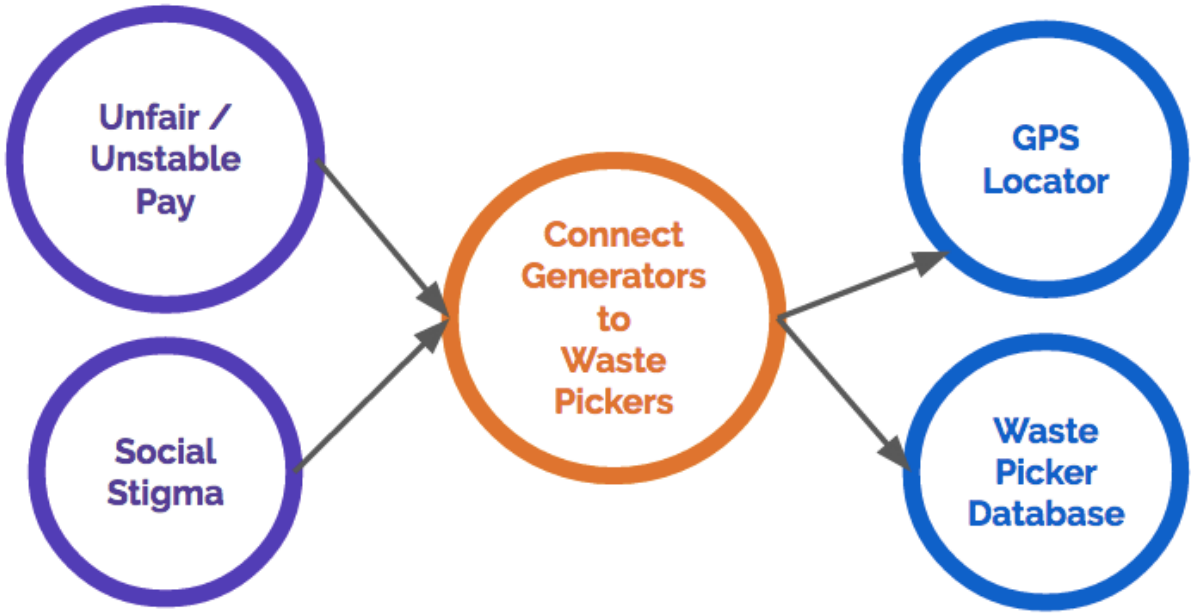


FIgure 3. RECO addresses waste picker challenges of unfair/unstable pay and social stigma by connecting generators to waste pickers. It does this through the GPS locator and waste picker database functionalities.

Challenges and Next Steps

Given its origins in a non profit, RECO faces major challenges around funding. The lack of steady revenue stream makes maintenance of the software difficult. The web version of the platform was not functioning at the time of this research, and despite intentions to get RECO off the ground and expand functionalities, the app remains in largely the same state as it was after its development one year ago. PMC relies on volunteer labor for development of the app, as well as for many other aspects of its work. At the time of the interview, PMC did not have funds to hire a private developer.

The staff member interviewed also mentioned the lack of mobile or smart phone usage among waste pickers as a major impediment to success. PMC hopes to arrange for an agreement with a cell phone company to donate phones to waste pickers connected with

the app, at the very least to be able to provide a phone number to include in the waste picker profiles.

Success Factors

The challenges that app developers faced, given their position within a non profit, also gave rise to the success factors of the app. Established relationships and prior work with waste pickers based on a mission of empowerment through art allowed PMC to obtain significant information on individual waste pickers and their locations without a major research effort (as compared to other apps studied throughout the course of this research). Given that currently, the app's primary goal is to locate waste pickers and collection centers, access to this information was crucial to getting the app off the ground, even with limited functionality. The non profit status of the organization also facilitated a connection with MIT and means that they are eligible for support through institute and foundation funding and volunteer labor.

References

[1] Women in Informal Employment: Globalizing and Organizing (WIEGO), "Waste Pickers: The Right to be Recognized as Workers," 2013.

[2] Ana Carolina Ogando et al., "Executive Summary - Informal Economy Monitoring Study: Waste Pickers in Belo Horizonte, Brazil," July 2013.

[3] Pimp My Carroça. "O panorama de resíduos sólidos no Brasil." Accessed December 11, 2016. http://pimpmycarroca.com/residuos-no-brasil/.

[4] Sonia M. Dias, "Overview of the Legal Framework for Inclusion of Informal Recyclers in Solid Waste Management in Brazil" WIEGO Policy Brief No. 6, May 2011. http://wiego.org/sites/wiego.org/files/publications/files/Dias_WIEGO_PB6.pdf.

[5] National Congress of Brazil. Law 12.305/2010; National Policy on Solid Waste. http://www.justicaeleitoral.jus.br/arquivos/lei-12-305-2010-pnrs/view.

[6] Grimberg, E., Coleta Seletiva e inclusão de catadores: Fórum do Lixo e Cidadania da Cidade de São Paulo. Experiências e Desafios, São Paulo, Instituto Polis, 2007. www.polis.org.br/uploads/1008/1008.pdf.

[7] Legislative Assembly of the State of São Paulo. Law 12.300/2006. http://www.al.sp.gov.br/repositorio/legislacao/lei/2006/lei-12300-16.03.2006.html

[8] Situação Social das Catadoras e dos Catadores de Material Reciclável e Reutilizável. IPEA, 2013. http://www.ipea.gov.br/portal/images/stories/PDFs/situacao_social/131219_relatorio_situacaosocial_mat_reciclavel_brasil.pdf.

[9] Personal communication with Pimp My Carroça staff, November 23, 2016.

[10] Interview with Pimp My Carroça staff, November 23, 2016.

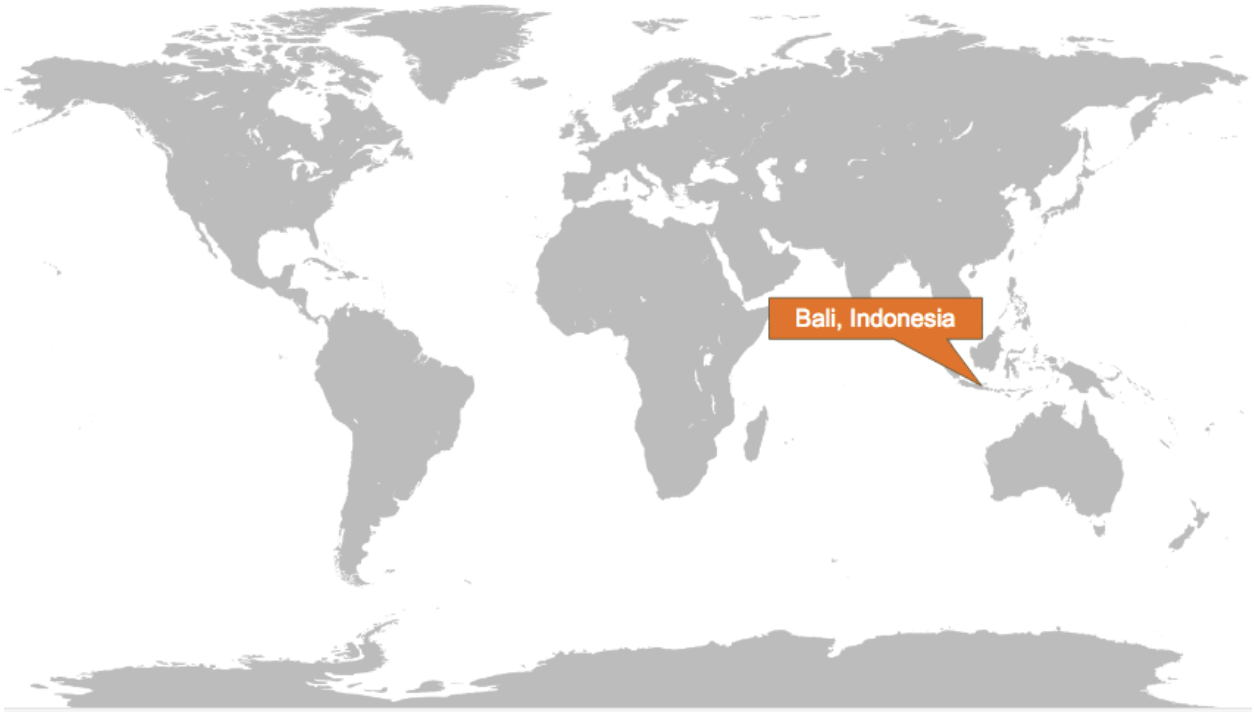
[11] Interview with RECO developer, November 16, 2016.

[12] Pimp My Carroça. Accessed December 7, 2016. http://pimpmycarroca.com/como-atuamos/.

[13] Use RECO. Accessed October 25, 2016. https://usereco.com/.

[14] RECO. Google Play. Accessed December 1, 2016. https://play.google.com/store/apps/details?id=com.id100wtyq1dsa5c31vkl7ji&hl=en.

GRINGGO



Location:
Bali, Indonesia

Organization
Private, startup

Target Users
Households/small scale generators

Key Functionalities:

- Display market value of materials
- Database of waste facilities/waste pickers
- List of recyclable materials
- Individual user login/interaction
- Service request form

The Context

Bali: Hub for Tourism

The island of Bali, Indonesia is known internationally as a hub for tourism. After the tourists leave, however, a country that already struggles with waste disposal is left with tons of garbage that the tourists leave behind, on top of the garbage production of its own people [1]. The waste stream of Indonesia, historically comprising mostly organic materials, like many countries has shifted rapidly in the last 40 years to include man made plastics, glass, and metals that do not decompose easily and that the municipal solid waste collection systems in the country are not able to handle effectively [2]. Indonesia has a population of 230 million and produces 184,000 tons of solid waste on a daily basis, but 90% of solid waste in Indonesia is disposed of in open dumps [3]. Often, waste is burned, causing harmful human health and environmental effects [4].

Waste Pickers in Indonesia

Waste pickers in Indonesia, known as *pemulung*, or scavengers, work largely out of these dumps, often living on top of or near the dumps in unsafe conditions. The number of waste pickers estimated to operate within dumps is approximately 50,000, which does not include the various other settings in which they work, namely the 59,000 *Tempat Penumpukan Sementara* (TPS), temporary transfer stations (which have varying degrees of control by municipalities) [5,6]. The *pemulung* are seen as a problem by law enforcement and the public. They are considered a nuisance to waste management by removing valuable material from dumps, when they actually contribute between 9-15% reductions in recycled materials, saving municipalities time, money, and other resources [7]. The pemulung, however, may not reap the full benefits of their work, although exposed more directly to the dangers of waste picking. The complex hierarchies of actors in the recycling process, as well as the necessity of agglomerating large enough quantities of materials, mean that pemulung must sell to *pengumpul*, middlemen, who maintain significant power due to their exclusive relationships with recycling facilities [8]. While some waste pickers have steady jobs under a particular "big boss" [9], independent waste pickers who are not followers of a boss are subject to much more variable revenue.

Regulatory Framework

National waste laws exist to regulate municipal solid waste and hazardous waste: Act 18/2008, and Act 32/2009, respectively. Act 18/2008 delegates solid waste collection to city and regional governments. Implementing this law through regulation is proving to be a slow process, however; to achieve the goal that all open dumps be closed by 2013 still requires specific legal and/or regulatory mechanisms [10]. The government has introduced a waste bank system, *bank sampah,* which encourages waste generators to bring their

source separated trash to a designated location to be weighed and valued. In exchange, the generator receives money [11]. The government hoped to introduce an electronic system to facilitate the exchanges in January of 2016, but the status of this system is unclear.

The App

Information about GRINGGO was collected via publically available materials, as well as an informal interview with the founder/CEO.

Origin Story

GRINGGO developers saw a particular need for more effective waste management systems in the face of increased tourism on Bali. The restaurant and hotel industries, in particular, engage in Illegal disposal of waste [12]. GRINGGO, initially known as CashForTrash, was developed at Startup Weekend Bali, in November of 2014. After receiving funds from private sources based in the US, the business went through various iterations and team members, eventually changing its name to GRINGGO and shifting its scope to concentrate on the city of Denpasar on Bali. The app developer is based in Vienna, Austria, and the team members are expats and local entrepreneurs.

The company has achieved recognition in the past year by the Denpasar municipal government, which aims to incorporate the app into the municipal waste management structure. In 2016, GRINGGO conducted a survey to map the various waste banks and other collection sites in the municipality, information which is now part of the functionality of the app [13].

Purpose

GRINGGO hopes eventually to provide a wide range of services that cover the various formal and informal actors within the waste management system in Bali. Currently, the app targets small-scale generators (households and businesses) by making it easier to find and arrange for waste disposal. It hopes to provide fair pricing to buyers and sellers of waste, including waste pickers.

The GRINGGO software is available on the company's website [14], as well as an app for iPhone [15] and Android [16].

Target Area of Waste Collection Process

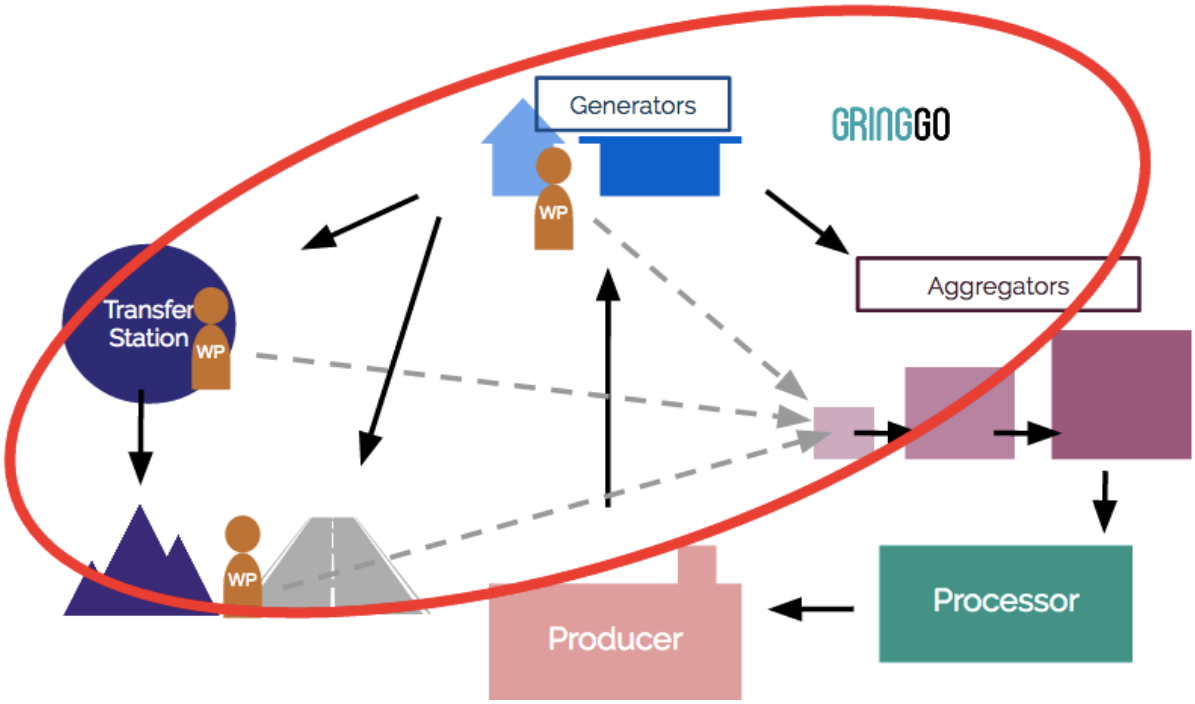


Figure 1. GRINGGO operates across many spaces within the waste collection flow, including the generator to waste picker, waste picker to aggregator, and generator to aggregator connections, as indicated by the red circle.

Primary Functionalities

Currently, GRINGGO has the following capabilities:

- Display market value of materials
- Database of waste facilities/waste pickers
- List of recyclable material streams
- Individual user login/interaction
- Service request form

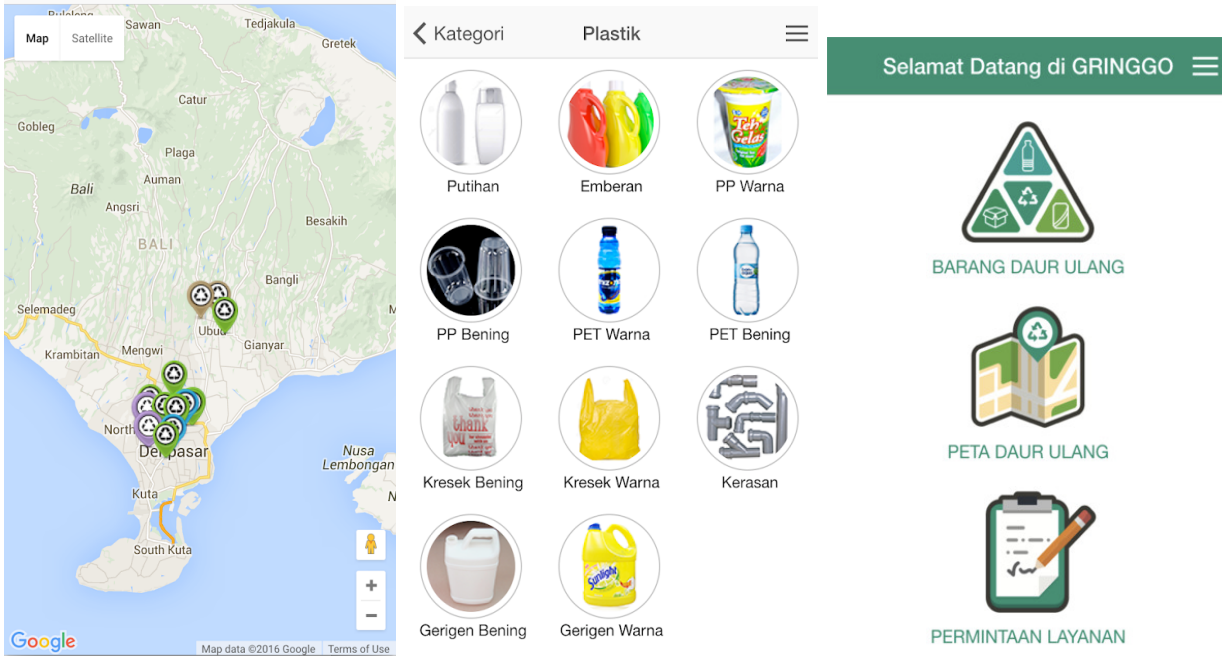


Figure 2. Screenshots of the waste facility map and market value display functions, and user interface. (Sources [15,16])

A service request form allows users of the app to request garbage pickup directly at their residence or place of work. The app also has a comprehensive map of 42 trash banks, 165 sanitary landfills (TPST), 160 intermediate waste collectors (pengepul) and 17 transfer "Depo," as well as numerous other trash receptacles where generators can take their materials. Users can post pictures of the facilities and receptacles to allow for easier identification. Where applicable, company or facility names and contact information are listed. Uniquely, the app displays the current market value of specific types of recyclable materials.

Future Functionalities

While the app does not have a mechanism for specifically targeting individual waste pickers just yet, descriptions of the app indicate that waste collectors and contact information will be included eventually in the map of disposal sites.

Waste Picker Challenges Mapped to Functionalities

The major challenges (purple) that the researchers feel the app attempts to address are captured by Figure 3. The big picture solution to these problems (orange) maps to the specific functionalities (blue) of the app itself.

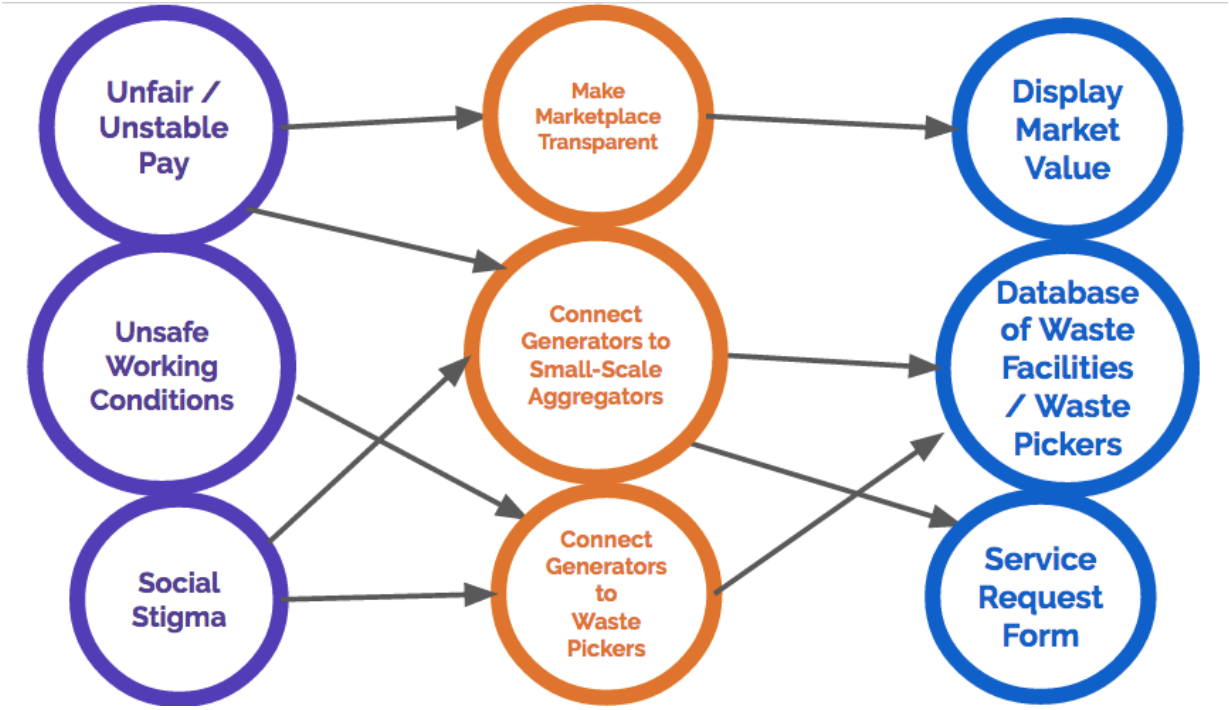


Figure 3. GRINGGO addresses the waste picker problems of unfair/unstable pay, unsafe working conditions, and social stigma by making the marketplace more transparent, connecting generators to small-scale aggregators, and connecting generators to waste pickers. It does this through its market value display, waste facility and waste picker database, and service request functionalities.

Challenges

GRINGGO receives support (in terms of personnel and funding) from individuals and groups outside of Indonesia. The founder commented that a lack of local technical skill was a challenge, in addition to competition among other globally-oriented startups for funding. Another interesting challenge was the constraint of needing to design and market the app to generators rather than to waste pickers. The tremendous social stigma around waste picking provoked negative reactions among generators, with regard to the idea of using an app meant to help waste pickers rather than the generators themselves [17].

Success Factors

While money is a continual challenge, with its startup model and the entrepreneurial drive of its founders, GRINGGO seems to be securing funding successfully from various sources, and has a means for sustaining its business on the ground. A partnership with municipality of Denpasar has granted the company some visibility, and will secure them a role in the

municipal solid waste scene going forward.

References

[1] Geoff Chambers. "Bali struggling to cope with mountains of waste left behind by Australian tourists." *The Daily Telegraph.* July 6, 2015. Accessed December 6, 2016. http://www.dailytelegraph.com.au/news/nsw/bali-struggling-to-cope-with-mountains-of-waste-left-behind-by-australian-tourists/news-story/ae885bcc2e12e57fe70f980d435ac28c
http://www.nytimes.com/2009/05/25/business/energy-environment/25iht-rbogbali.html

[2] Graeme MacRae and Ljiljana Rodic. The weak link in waste management in tropical Asia? Solid waste collection in Bali. *Habitat International,* 50, 2015.

[3] "Implementation of 3R in Indonesia." Fourth Regional 3R Forum in Asia "3Rs in the Context of Rio+20 Outcomes – The Future We Want." Ha Noi, Viet Nam, 18-20 March 2013.

[4] Hans Nicholas Jong. "Indonesia in state of waste emergency." *Jakarta Post*. October 9, 2015. Accessed December 6, 2016. http://www.thejakartapost.com/news/2015/10/09/indonesia-state-waste-emergency.html.

[5] R.O.L.E. Foundation (Rivers, Oceans, Land, Ecology). "Bali's Waste Crisis." Accessed December 6, 2016. http://rolefoundation.org/wastecrisis/.

[6] Indonesia Infrastructure Initiative. *Scoping Study for Solid Waste Management in Indonesia: Technical Report*. July 2011.

[7] *as cited in* Graeme MacRae and Ljiljana Rodic, 2015.

[8] Shunsuke Sasaki and Tetsuya Araki. Employer employee and buyer seller relationships among waste pickers at final disposal site in informal recycling: The case of Bantar Gebang in Indonesia. *Habitat International 40*, 2013.

[9] Ibid.

[10] "Implementation of 3R in Indonesia." 2013.

[11] Heru Nainggolan. "Facing Desperate Waste Problems, Indonesia Hustles to Find Answers." *Indonesia Expat*. October 26, 2015. Accessed December 10, 2016. http://indonesiaexpat.biz/featured/facing-desperate-waste-problems-indonesia-hustles-to-find-answers/.

[12] Anisa Menur A. Maulani. "Can the new waste disposal app bail out Bali from its waste problem?" *E27*. May 31, 2016. Accessed December 2, 2016. https://e27.co/saving-paradise-how-this-uber-for-waste-disposal-startup-plans-to-clean-up-bali-20160531/.

[13] GRINGGO. "About Us." Accessed December 10, 2016. http://gringgo.co/about.

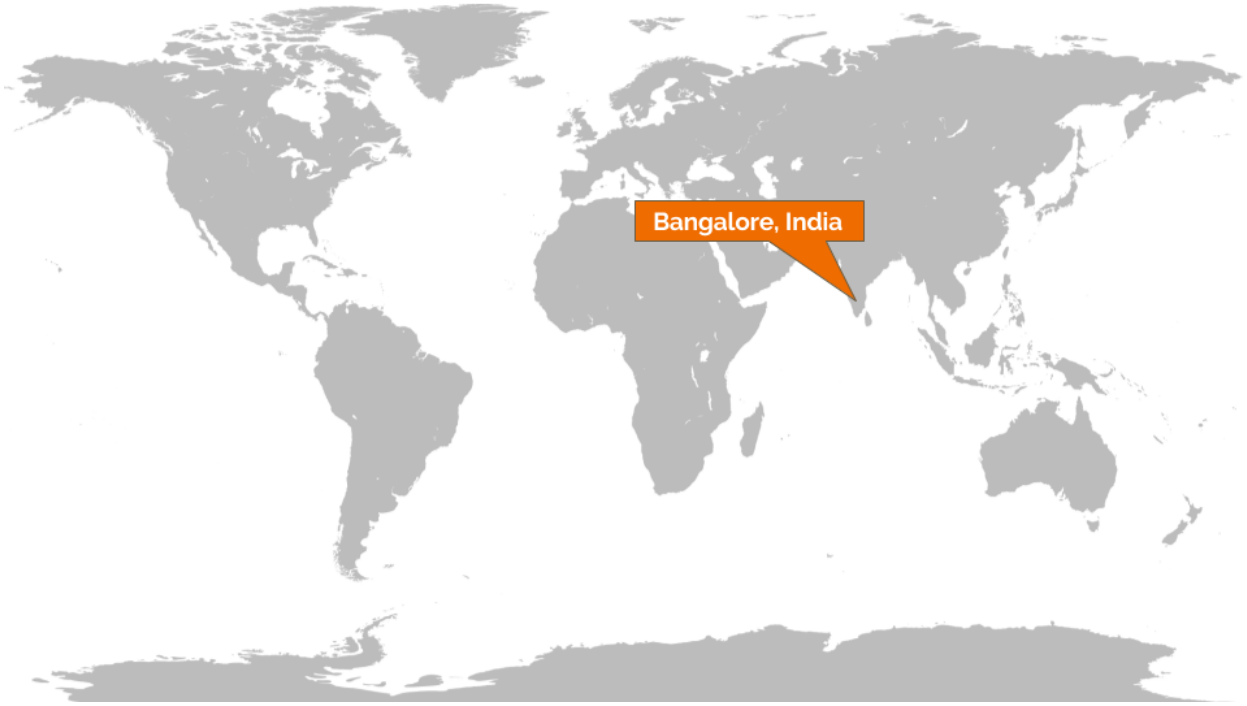
[14] GRINGGO. “For Business.” Accessed December 6, 2016. http://gringgo.co/business.

[15] Andreas Hausleitner. GRINGGO. App Store. https://itunes.apple.com/es/app/gringgo/id1080398314?l=en&mt=8.

[16] Andreas Hausleitner. GRINGGO. Google Play. https://play.google.com/store/apps/details?id=co.gringgo.gringgomobile.

[17] Conversation with GRINGGO CEO. Monday, November 21, 2016.

I Got Garbage



Location:
Bangalore, India

Organization:
MindTree, Ltd.

Target Users:
Households/waste pickers

Key Functionalities:

- User login/interaction
- Service request form
- Educational resources
- Business analytics platform

The Context

Informal Waste Management in India

Waste management in India is a difficult and rampant problem. Columbia University reported in 2012 that about 91% of India's municipal solid waste is dumped in open landfills [1]. Columbia also estimates that 17.5% of the waste that ends up in landfills consists of recyclables such as paper, plastics, cardboard, metal, and glass [1].

In the midst of this waste management landscape, the informal sector is making huge contributions. The Columbia study estimates that the informal sector recycles 56% of the recyclables generated in large cities in India, and that 20.7% of recyclables handled by the formal system are recycled by the informal sector [1]. The informal sector in India provides both economic and environmental benefits to Indian cities. Every ton of recyclables collected daily by the informal sector saves urban areas $500 per year and avoids 721 kg of CO2 emissions per year [1].

The informal waste management sector is also extremely widespread in India. A study done by the SNDT Women's University and the Chintan Environmental Research and Action Group found that one percent of India's population is involved in the waste informal sector. The study also estimates that the number of waste pickers in India is greater than that of any other country in the world [2]. As discussed previously, these waste pickers still face many challenges in their work. The Chintan study identified several existing efforts to help waste pickers, including the formation of cooperatives, the issue of photo ID cards, and the continual research of the informal sector [2].

Bangalore, like much of India, is facing a garbage crisis. Bangalore generates almost 4,000 tons of garbage per day and has only two official landfill sites [1]. Like many cities in India, however, there is also a robust informal recycling network made up of about 20,000 waste pickers who recover recyclables and keep them from being sent to landfills [4].

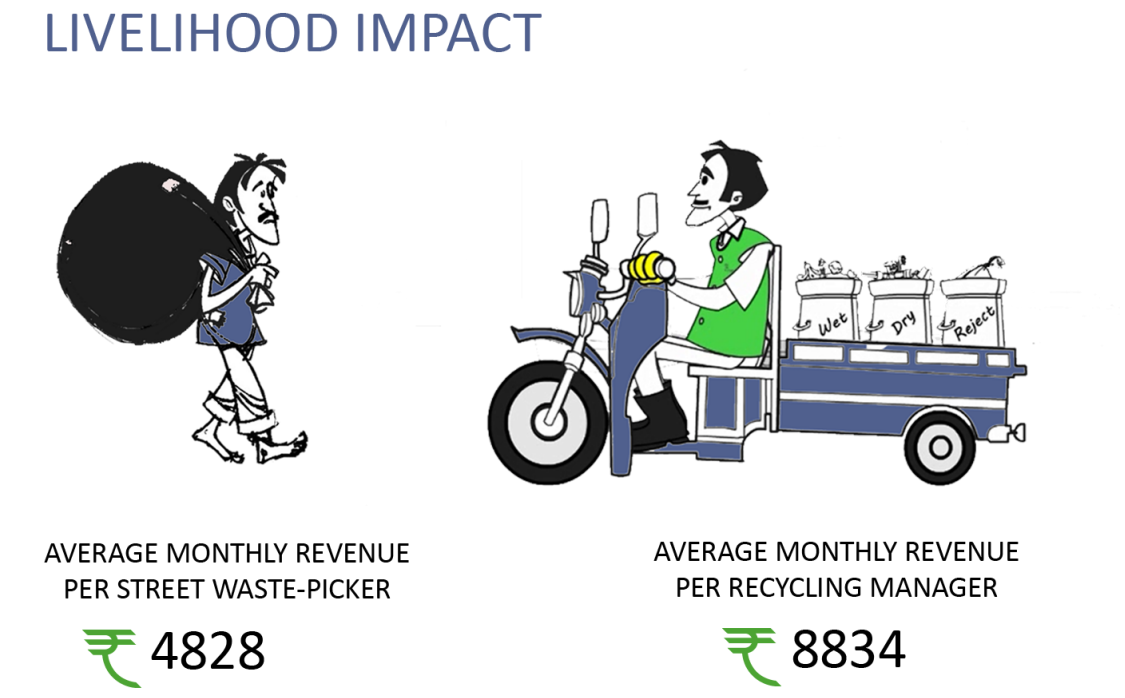
This is the landscape of the informal waste management sector in which I Got Garbage operates. I Got Garbage uses its mobile and web-based technology to empower citizens to manage their waste efficiently and to empower waste pickers to become recycling managers who can help citizens send less waste into Bangalore's landfills.

The App

Origin Story

In 2013, Prashant Mehra, a former employee at an IT consulting firm called MindTree, had an idea. After spending time living in a small village in India and seeing the garbage crisis first hand, he knew he had to help in some way, and he wanted to use technology to do it.

Mehra's idea, I Got Garbage, taps into the informal network of waste pickers in Bangalore to help citizens dispose of their waste in a responsible manner, while also increasing the income of waste pickers. I Got Garbage, an initiative sponsored MindTree, is a web platform that allows businesses and apartment complexes to hire a waste picker as their recycling manager. These recycling managers take dry waste to a dry waste collection center where it is sorted and passed on to recyclers. They send wet waste to be converted into biogas and compost.



Source: [3]

I Got Garbage provides alternative waste management services to Bangalore citizens with the promise that their waste will be handled in a responsible way. At the same time, the app empowers waste pickers by providing a more stable framework for them to do their important work [4]. As of June 2014, I Got Garbage had about 5, 251 waste pickers and 6, 907 households registered in their system [5].

Purpose

I Got Garbage's goals are focused mainly on improving the livelihoods of waste pickers and addressing the waste management crisis. I Got Garbage's objective is to move the workplace of waste pickers to people's doorsteps, away from unsafe and unsanitary landfills. By creating a platform to connect waste pickers and waste generators, the company hopes to create a steady and easily-accessible source of recyclables for waste pickers to sell. I Got Garbage achieves this by hiring waste pickers to be recycling managers and offering waste management services to households.

Target Area of Waste Collection Process

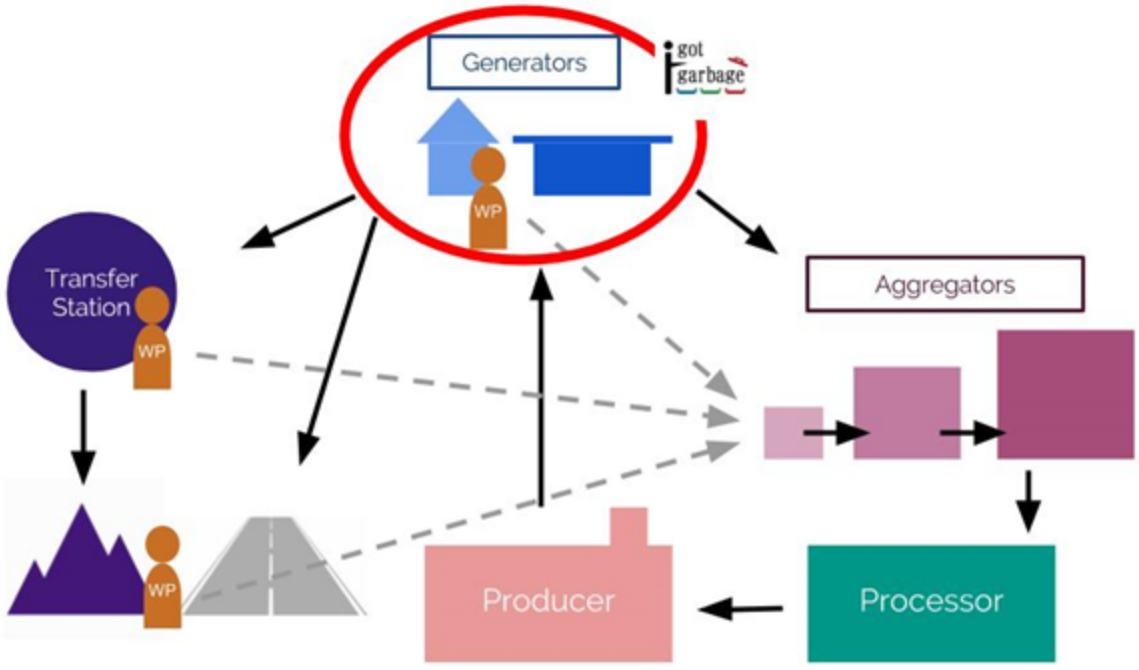


Figure 1: The I Got Garbage platform focuses on facilitating connections between waste generators and waste aggregators.

Primary Functionalities

Tools for Responsible Waste Management

I Got Garbage has a web-based application for consumers to hire a recycling manager to come and pick up their waste. Users can create an account and request a recycling manager to regularly pick up their waste.

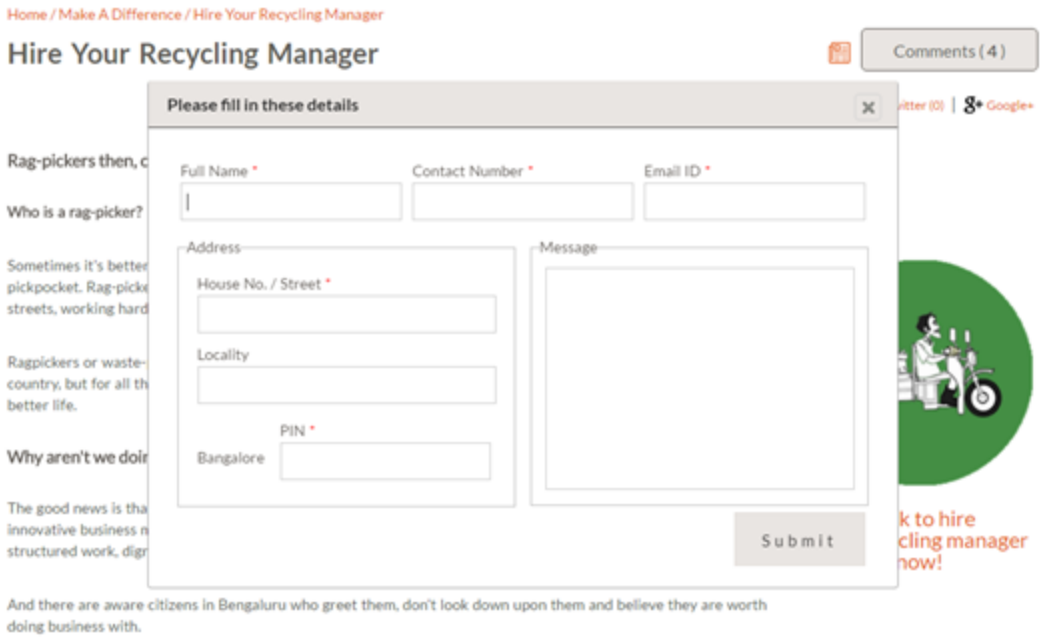


Figure 2. A screenshot of the recycling manager request form on I Got Garbage's website. Apartments and businesses can use the I Got Garbage website to request waste management services provided by waste pickers.

I Got Garbage also has a Dry Waste Collection Center (DWCC) locator for households to find the nearest DWCC where they can donate their recyclables. In addition to these functionalities, the website provides educational resources to learn about waste pickers, how to segregate recyclables, as well as how to compost, among other waste management topics.

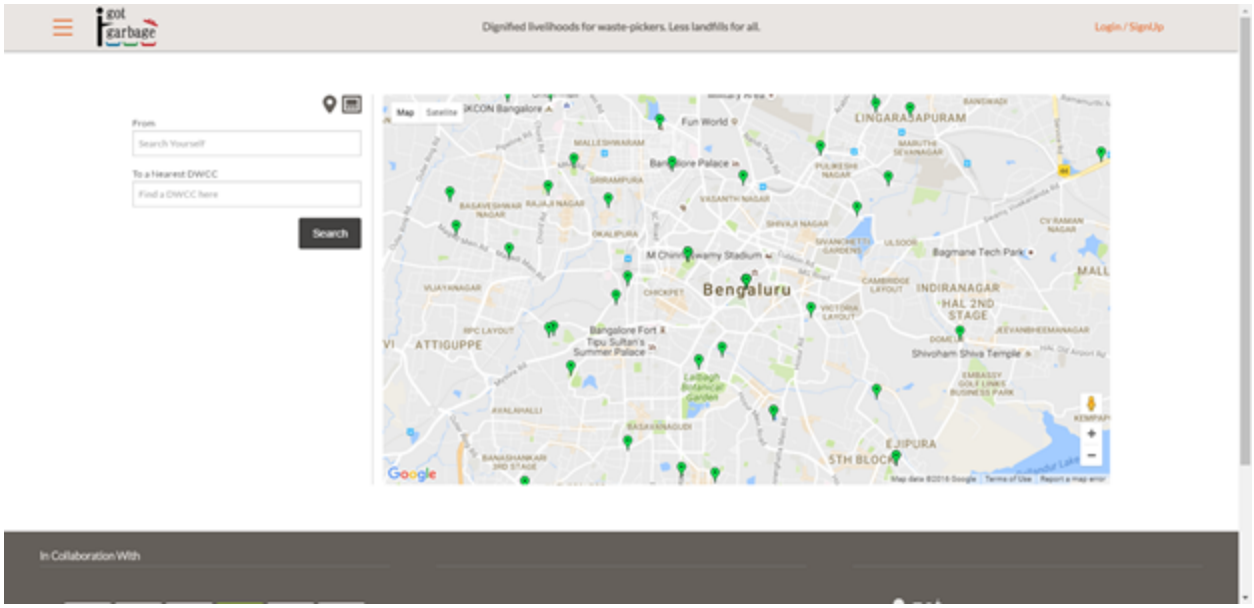


Figure 3. A screenshot of the Dry Waste Collection Center (DWCC) locator. The I Got Garbage website allows a householder to find a nearby DWCC where they can donate their recyclables.

Enterprise Resource Planning for Waste Pickers

In addition to their website, which provides tools for waste generators, I Got Garbage also has technology to increase the efficiency of its own business. I Got Garbage has created and maintains a database of local scrap dealers in Bangalore so waste pickers know where they can sell the recyclables they collect from households [6]. Waste pickers can use a cell phone that costs as much as Rs. 4,000 to access this database and find the right buyer for the materials that they have [6]. In addition, I Got Garbage uses an algorithm to assign their registered waste pickers to the most efficient collection route [6]. Similar to the Kabadiwalla Connect case study, I Got Garbage uses technology to address logistical hurdles from the aggregator perspective as well as the generator perspective.

Waste Picker Challenges Mapped to Functionalities

The major challenges (purple) that the app attempts to address are captured by Figure 4. The big picture solution to these problems (orange) maps to the specific functionalities (blue) of the app itself.

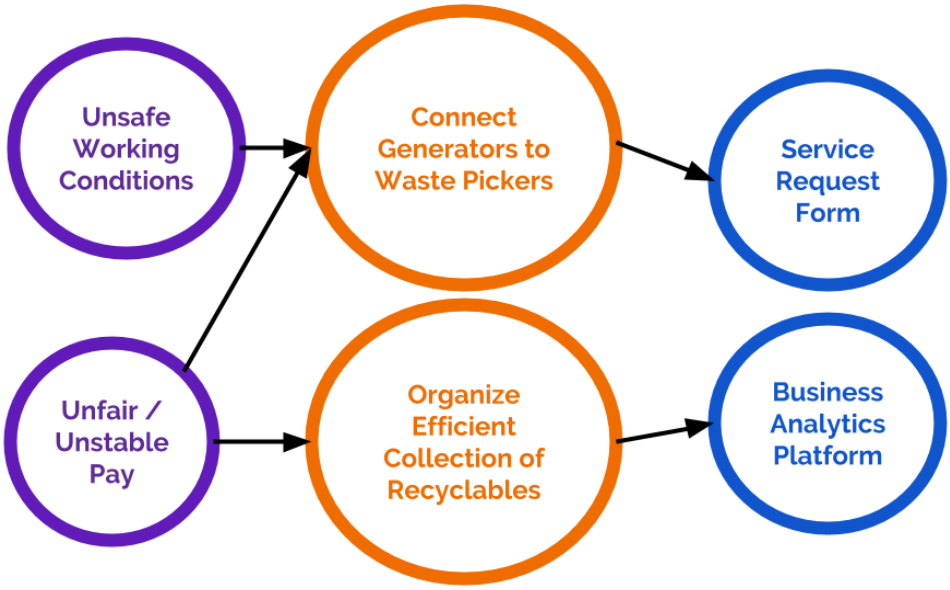


Figure 4. I Got Garbage addresses the waste picker problems of unfair/unstable pay and unsafe working conditions by connecting generators to waste pickers and organizing a more efficient collection method of recyclables. It does this through its service request form and business analytics platform.

Challenges and Next Steps

I Got Garbage has been looking to expand its solution to 27 other cities [7]. The challenges associated with this expansion relate to the centrality of context to app function and success in a given place. I Got Garbage is currently looking into ways to recreate its system, given the different contexts of each of these places.

Success Factors

We identified the following factors as crucial to the success of I Got Garbage's technological applications:

- Support from private organization
- Local partnerships
- Sustainable business model

I Got Garbage is an initiative that came out of and is sponsored by MindTree. Resources within the company have allowed I Got Garbage to begin and continue its work.

I Got Garbage has formed partnerships with many local organizations. These organizations include waste cooperatives like Hasirudala [8] and even apartment organizations, like Apartment ADA [9]. I Got Garbage is able to connect and work with waste pickers through its

connections with NGOs and waste picker co-ops. Partnerships with organizations such as Apartment ADA help I Got Garbage create connections with its customer base.

A business model is also tied to the web application. I Got Garbage sells waste management services to households and uses technology to help create more connections for its business and to run the business effectively. In this case, the technology is for the business more than something that stands alone.

References

[1] Annepu, Ranjith. Sustainable Solid Waste Management in India. Master's thesis, Columbia University, 2012. 48.

[2] SNDT Women's University and Chintan Environmental Research and Action Group. "Recycling Livelihoods: Integration of the Informal Recycling Sector in Solid Waste Management in India." 19. 2008. Accessed December 12, 2016. http://swachcoop.com/pdf/Recycling_Livelihoods_2008.pdf.

[3] "Livelihood Impact." I Got Garbage. 2014. Accessed December 12, 2016. http://www.igotgarbage.com/content/Livelihood-Impact-01169971818/0.

[4] "Make a Difference." I Got Garbage. Accessed December 12, 2016. http://www.igotgarbage.com/content/102

[5] Chandran, Rahul. "Mindtree Offers Technological Solution to Bangalore's Garbage." Live Mint. June 18, 2014. Accessed December 12, 2016. http://www.livemint.com/Companies/LCvawXeAhv8MySA2Uhkp9O/Mindtree-champions-technological-solution-to-Bangalores-gar.html.

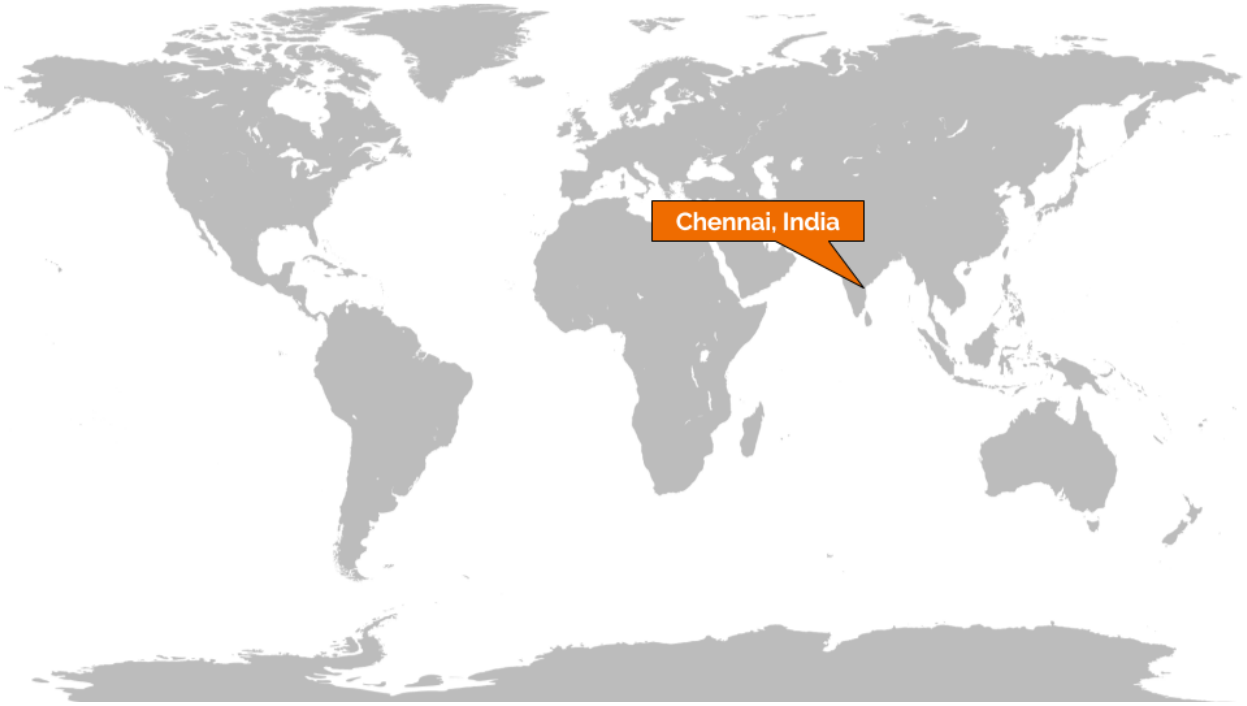
[6] Swamy, Rohan. "Got Garbage? This Website Is Happy to Help." Gadgets 360, June 26, 2014. Accessed December 12, 2016. http://gadgets.ndtv.com/internet/features/got-garbage-this-website-is-happy-to-help-548186.

[7] New Cities Summit 2015. Talk given by Prashant Mehra. I Got Garbage. 2015. Accessed December 12, 2016. http://www.newcitiesfoundation.org/global-urban-innovators-alumni/i-got-garbage/.

[8] Hasirudala. Accessed December 12, 2016. http://hasirudala.in/.

[9] "Our Partners." I Got Garbage. 2014. Accessed December 12, 2016. http://www.igotgarbage.com/content/106.

Kabadiwalla Connect



Location:
Chennai, India

Organization:
Kabadiwalla Connect

Target Users:
Households/small scale aggregators

Key Functionalities:

- Kabadiwalla locator (static)
- Kabadiwalla contact information
- List of material streams accepted
- User login/interaction
- Educational resources

The Context

Kabadiwallas

In Chennai, India, it is not uncommon to see your friendly neighborhood *Kabadiwalla*, or local scrap dealer, roaming the streets with a large cart full of recyclables. These *Kabadiwallas* buy recyclable materials from householders and waste pickers and sell them to larger scale aggregators for a profit.

(Source:[1])

But as ubiquitous as *Kabadiwallas* are in Chennai, they, like waste pickers, face marginalization and social exclusion [2]. However, these *Kabadiwallas* are part of the informal recycling network in India that largely contributes to recycling rates in the country**.** In Chennai specifically, *Kabadiwallas* are responsible for handling 33% of generated recyclables [3].

Kabadiwalla Connect did its own research on this ecosystem of small-scale waste aggregators and found some interesting information [3]. Most *Kabadiwallas* own a small storefront with 1-2 employees. On average, these storefronts have been around for approximately 12.5 years. *Kabadiwallas* in Chennai focus on residential collection and more than 55% of them have already organized a door-to-door pick-up collection system. This collection is usually done with a tricycle, mini-truck, or small motorized bike. It also turns out that 90% of *Kabadiwallas* own a smartphone.

In Chennai, about 380 thousand tons of recyclable waste are generated per year, and 90% of these recyclables is generated by households and shops [4]. Kabadiwalla Connect wants to help increase the connections between households and *Kabadiwallas* in order to reduce the quantity of recyclables that go into landfills.

The App

Origin Story

The founder of Kabadiwalla Connect, Siddharth Hande, saw the contribution *Kabadiwallas* were making to the waste management problem in Chennai and, with a grant from the World Economic Forum, set out to understand the complicated network of *Kabadiwallas* in Chennai. Hande and a team of others conducted an initial survey of 50 questions in four neighborhoods in Chennai [1]. After shortening the survey, they mapped 16 more neighborhoods. Using these data, they created an information system, showing where *Kabadiwallas* were located and what kind of materials they handled.

The creation of this information system was just the beginning of what Kabadiwalla Connect would eventually become. Kabadiwalla Connect now manages a Materials Recovery Facility (MRF) where they use technology to efficiently collect recyclables from *Kabadiwallas* and develop business insights. They also created and maintain a mobile app for consumers called RECYKLE that lets users find their nearest *Kabadiwalla* and provides educational resources for responsible waste management.

Purpose

Kabadiwalla Connect addresses the problems of information asymmetry and unfair and unstable pay through its two different technologies. Kabadiwalla Connect's technologies focus on connecting waste generators to small-scale aggregators, as well as connecting small-scale aggregators more directly to the formal recycling system through sales to its MRF.

Target Area of Waste Collection Process

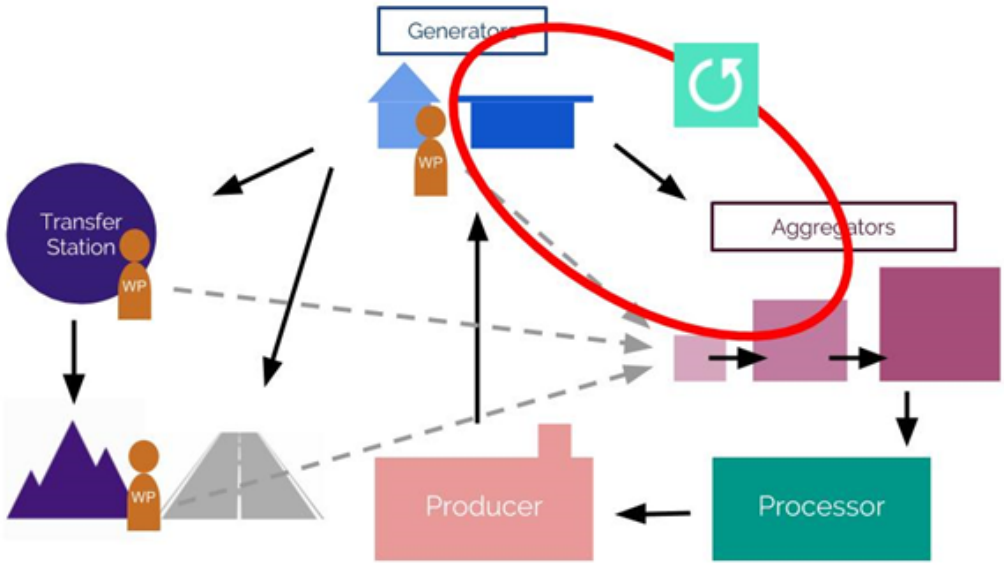


Figure 1: By providing a tool to locate nearby *Kabadiwallas*, RECYKLE helps to increase connections between waste generators and small-scale aggregators.

Primary Functionalities

RECYKLE

According to Kabadiwalla Connect's website, if every household in Chennai sold their recyclables to their local Kabadiwalla and composted, the amount of waste being sent to Chennai's landfills would decrease by 70% [5]. RECYKLE is meant to help connect householders to *Kabadiwallas* and educate the public on how to manage their waste responsibly.

Users can use the app to:

- Find their nearest *Kabadiwalla*
- Learn how to compost
- Find a list of common household recyclables
- Learn why and how to segregate waste
- Receive notifications about waste management events in the city
- Ask questions about waste management through the app's conversational interface

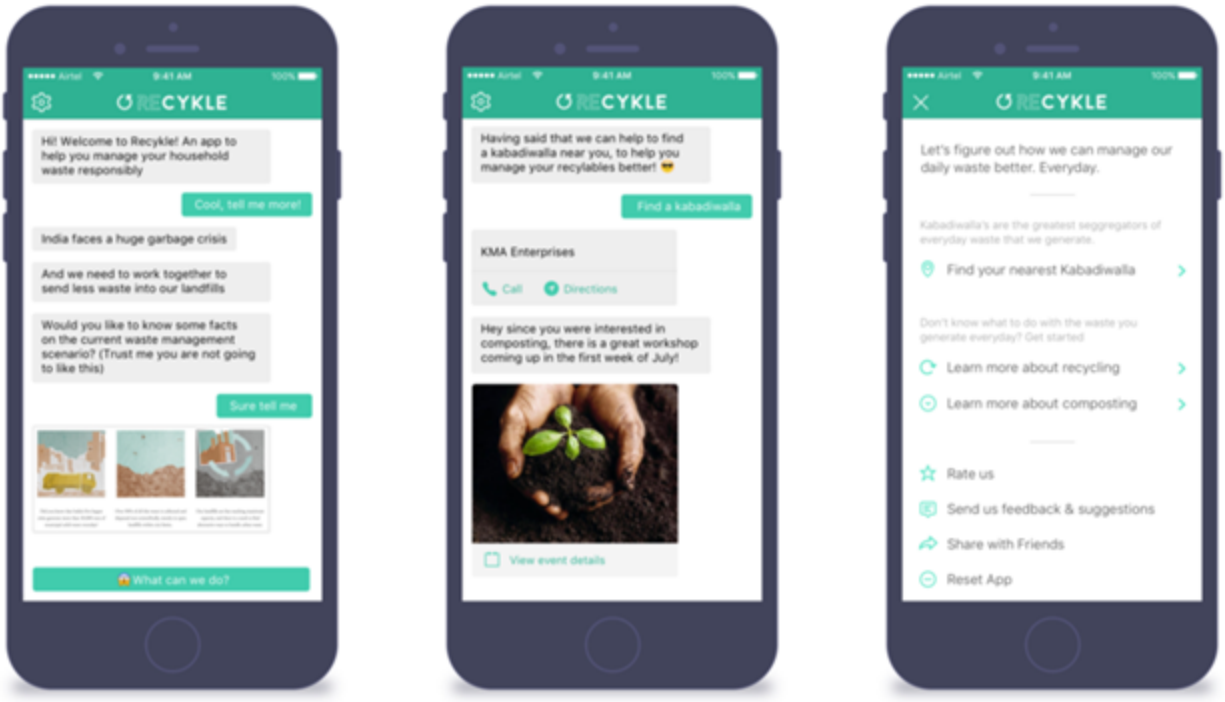


Figure 2: Screenshots of RECYKLE, Kabadiwalla Connect's consumer mobile application. The app is free and is available on Google Play and the Apple App Store. (Source: [5])

KLogistics and KConnect Administrator Platform

In addition to its consumer app, Kabadiwalla Connect also uses mobile technology to better manage its MRF operations. The organization has developed a mobile app for Kabadiwallas themselves to connect with Kabadiwalla Connect's administrative platform. Kabadiwallas can use this app to see the current prices are for recyclable materials as well as to report what materials a Kabadiwalla has collected and wants to sell. The goal of this technology is to encourage transparent pricing and to facilitate logistics [6].

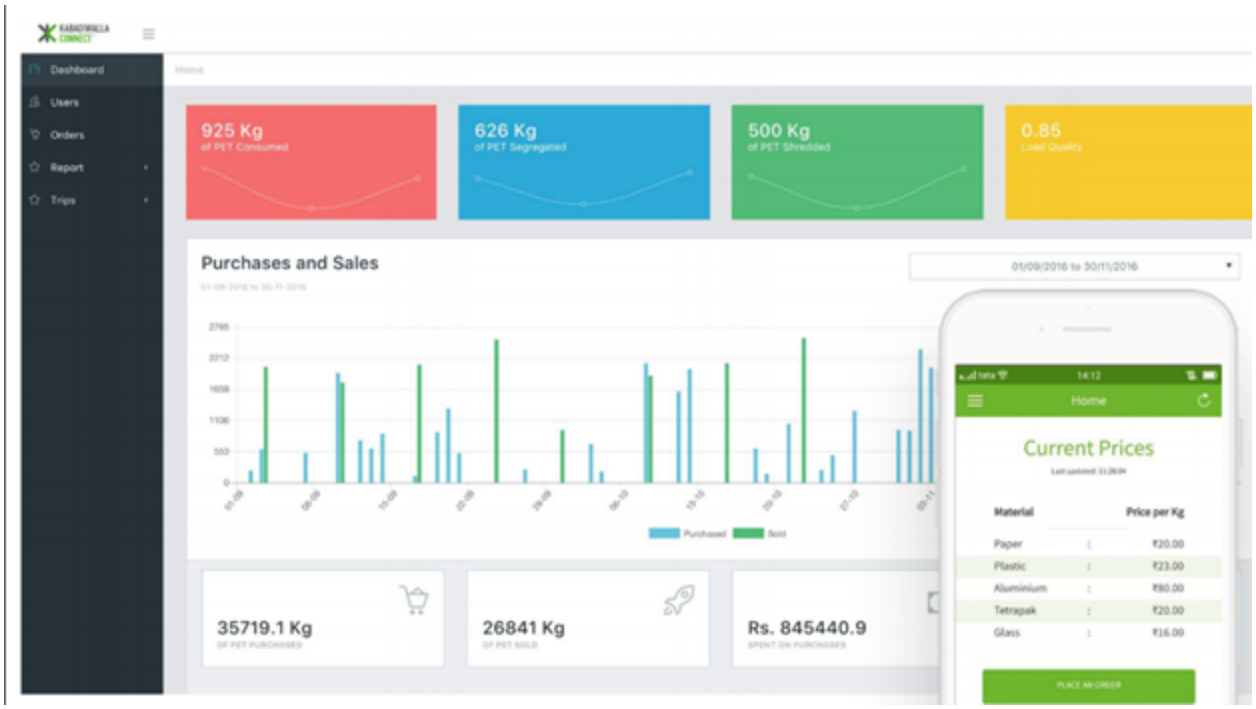


Figure 3. A screenshot of the administrative platform and the mobile application for the KLogistics app. *Kabadiwallas* can see what the prices are for a given material and Kabadiwalla Connect can keep track of sales. (Source: [6])

Waste Picker Challenges Mapped to Functionalities

The major challenges (purple) that the app attempts to address are captured by the following diagram. The big picture solution to these problems (orange) maps to the specific functionalities (blue) of the app itself.

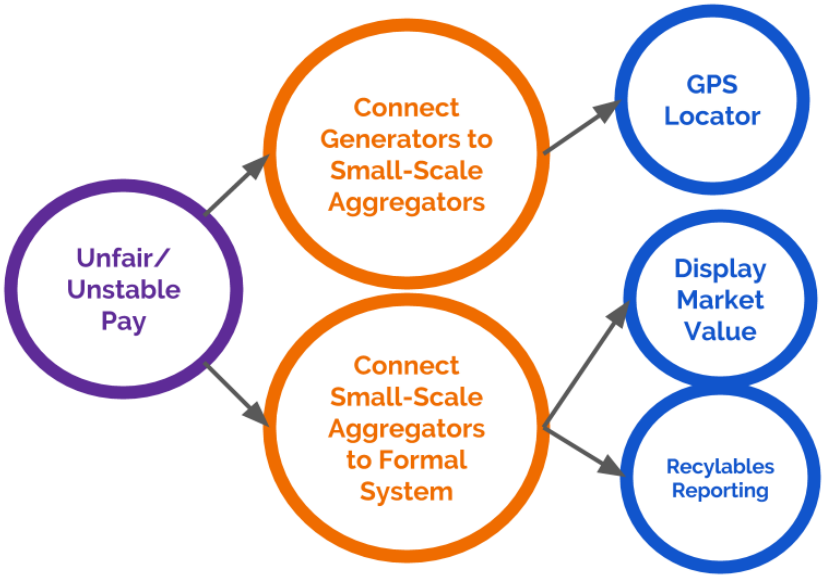


Figure 4. KC addresses the waste picker problems of unfair/unstable pay by connecting generators to small-scale aggregators, and connecting small-scale aggregators to its MRF. It does this through its GPS locator, market value display, and recyclables reporting capabilities.

Challenges and Next Steps

Currently, Kabadiwalla Connect's main goal is to continue the growth and management of its MRF. In order to make a decent profit in the recycling industry and to give a good price to *Kabadiwallas*, sufficient quantities of recyclables need to be collected. Kabadiwalla Connect handles around five tons of materials each month, but it needs to reach 35 to 40 tons in order to become profitable (as of July 2016). Hande and his team have identified about 1,200 kabadiwallas so far [7].

Success Factors

We identified the following factors as crucial to the success of Kabadiwalla Connect's mobile applications:

- Access to data through research
- Sustainable business model

For any mobile application, having data is crucial in building a tool to create meaningful connections. This is a particularly challenging aspect in the area of informal recycling systems, given that there is little information that has been formally collected and published. Kabadiwalla Connect was able to get data for its application through its own research efforts. Its initial survey of Chennai's Kabadiwallas, which was used to make their preliminary

information system, was made possible through a grant from the World Economic Forum. Now, through their recyclables reporting system on their KLogistics app, they are set up to collect huge amounts of data on the recyclables they buy from Kabadiwallas. One can imagine the long-term insights this kind of data can provide.

In addition to funding from outside organizations, Kabadiwalla Connect is able to help sustain itself through the operations of its MRF. By buying enough recyclables from Kabadiwallas (with sales being optimized through their mobile applications), Kabadiwalla Connect will hopefully be able to collect enough recyclables to make a profit by selling higher up the recyclables value chain. Reaching this profit margin is a current challenge for Kabadiwalla Connect and a goal that they are currently working towards.

References

[1] Sharma, Sriram. "This Chennai Startup Wants to Bring Local Kabadiwallas Online." Gadgets 360, March 10, 2016. Accessed December 12, 2016. http://gadgets.ndtv.com/internet/features/this-chennai-startup-wants-to-bring-local-kabadiwallas-online-811962?fb.

[2] Balaraman, Kavya. "Waste Networks: Economics, Informality, and Stigma." Kabadiwalla Connect. March 23, 2015. Accessed December 12, 2016. http://www.kabadiwallaconnect.in/blog/2015/3/23/waste-networks-economics-informality-and-stigma.

[3] Khazvini, Farhaad. "The Story of Chennai's Kabadiwalla Ecosystem: Insights from Our Primary Data." Kabadiwalla Connect. August 11, 2015. Accessed December 12, 2016. http://www.kabadiwallaconnect.in/blog/2015/8/11/tthe-story-of-chennais-kabadiwalla-ecosystem-insights-from-our-primary-data.

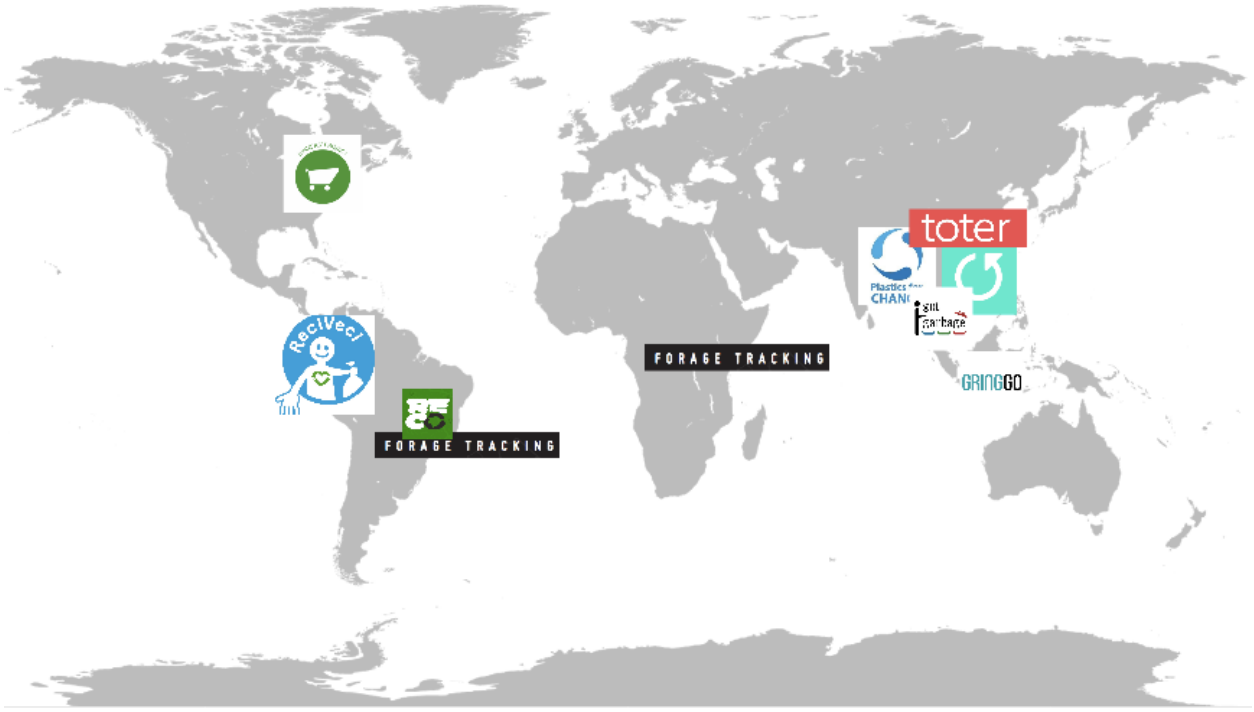
[4] Annepu, Ranjith. Sustainable Solid Waste Management in India. Master's thesis, Colombia University, 2012.

[5] "RECYKLE." Kabadiwalla Connect. 2016. Accessed December 12, 2016. http://www.kabadiwallaconnect.in/recykle/.

[6] Hande, Siddharth. Kabadiwalla Connect. PDF. Presentation Slides from LAUNCH Nordic Conference. 2016.

[7] Halais, Flavie. "How Kabadiwalla Connect Built a Business Model around Informal Waste Picking." CitiScope, July 14, 2016. Accessed December 12, 2016. http://citiscope.org/story/2016/how-kabadiwalla-connect-built-business-model-around-informal-waste-picking.

Summary of Mobile Apps



List of Mobile Apps:

- Binners' Project (Canada)
- Forage Tracking (Brazil/Kenya)
- GRINGGO (Indonesia)
- I Got Garbage (India)
- Kabadiwalla Connect (India)
- Plastics for Change (India)
- ReciVeci (Ecuador)
- RECO (Brazil)
- Toter (India)

App Summaries

Binners' Project (Canada)
Binners' Project is an organization that works to support waste pickers, or binners, in Canada. They are currently developing an app that is meant to increase economic opportunities for binners through a pick-up services program. It is based in Vancouver and Montreal.`

Website: http://www.binnersproject.org/

Forage Tracking/Foragistics (Brazil/Kenya)
Forage Tracking is a research initiative out of the MIT Senseable Cities Lab. Based on an earlier iteration in Mombasa, Kenya (called Foragistics), researchers used GPS tracking and mobile phones to map waste picker cooperative members' collection sites and routes in São Paulo and Recife, Brazil. A mobile app allowed potential partners to request waste pick-up from cooperatives. The initiative is currently in a somewhat dormant state.

Website: http://senseable.mit.edu/foragetracking/

GRINGGO (Indonesia)
GRINGGO is a web and mobile-based application for small-scale waste generators (households and businesses). A service request form allows users to request garbage pickup directly at their residence or place of work. GRINGGO includes a comprehensive map of trash banks, sanitary landfills (TPST), and *pengepul* (intermediate waste collectors), and displays the current market value of specific types of recyclable materials. It is based in Denpasar, Bali.

Website: http://gringgo.co/

I Got Garbage (India)
I Got Garbage is a web-based application that allows households to hire local waste pickers as recycling managers. It also provides Enterprise Resource Planning tools to optimize collection routes for waste pickers as well as help them find nearby scrap dealers. It is based in Bangalore.

Website: http://www.igotgarbage.com/

Kabadiwalla Connect (India)
Kabadiwalla Connect helps connect households to *Kabadiwallas* (local scrap dealers) through its mobile application, RECYCKLE. It also provides a mobile platform for *Kabadiwallas* to report recyclables that they have to sell. It is based in Chennai.

Website: http://www.kabadiwallaconnect.in/

Plastics for Change (India)
Plastics for Change is an organization that uses mobile technology to give waste pickers access to fair market prices for their recyclables. Their platform works to encourage a transparent market in sales between waste pickers and middlemen and to benefit all stakeholders. It is based in Bangalore.

Website: http://www.plasticsforchange.org/

ReciVeci (Ecuador)
ReciVeci is a mobile application designed to connect householders to waste pickers by helping a householder find their nearest waste picker. It also provides information for the householder to know what is and what is not recyclable.

Website: http://www.reciveci.ec/

RECO (Brazil)
RECO is a web and mobile-based application that makes connections between generators and independent waste pickers. RECO has a map that displays waste picker locations and contact information, as well as other collection facilities and a list of accepted recyclable materials. Users pay the waste picker for the materials collected. It is based out of the nonprofit Pimp My Carroça.

Website: https://usereco.com/; http://pimpmycarroca.com/

Toter (India)
Toter is a web-based and to-be phone-based application that allows users to request and schedule trash pick-up in their neighborhood or directly from their home. The user gets paid for the materials that are picked up, with deducted prices to ensure that Toter agents (including the 1,000 waste pickers that Toter works with) are able to earn a profit upon selling the materials to recyclers. The website displays current market rates for various materials. Toter is based in Hyderabad.

Website: http://toter.in/

Analysis Of Mobile Apps

Summary Charts

The following charts capture trends among the various apps in terms of functionality, target actors and relationships, and factors contributing to success.

Mobile App Functionalities

App Name	Location	GPS Locator (static)	GPS Locator (real time)	Waste Picker Database	Small-Scale Aggregator Database	Waste Facilities Database	Service Request Form	Accepted Materials Database	Market Value Database	Business Analytics Platform	Educational Materials
Binners' Project	Vancouver/ Montreal			✔			✔				
Forage Tracking	Mombasa/ Recife/São Paulo	✔	✔								
GRINGGO	Bali	✔			✔	✔	✔	✔	✔		✔
I Got Garbage	Bangalore	✔		✔		✔	✔			✔	✔
Kabadiwalla Connect	Chennai	✔			✔			✔		✔	✔
Plastics for Change	Bangalore			✔	✔				✔		
ReciVeci	Quito	✔		✔			✔				✔
RECO	São Paulo	✔		✔		✔		✔			
Toter	Hyderabad						✔		✔		

Actor & Relationship Targets

App Name	Location	Generator to Individual Waste Picker	Generator to Waste Picker Coop	Generator to small-scale aggregator	Small-scale aggregator to large-scale aggregator	Waste Picker to Small-Scale aggregator
Binners' Project	Vancouver/ Montreal	✔				
Forage Tracking	Mombasa/Recife/ São Paulo		✔			
GRINGGO	Bali	✔		✔	✔	✔
I Got Garbage	Bangalore	✔	✔			
Kabadiwalla Connect	Chennai			✔	✔	
Plastics for Change	Bangalore	✔	✔	✔	✔	✔
ReciVeci	Quito	✔	✔			
RECO	São Paulo	✔	✔	✔		
Toter	Hyderabad			✔		✔

Success Factors

App Name	Location	Private Company Investment	Local NGO Partnerships	Municipality Partnerships	Efficient Data Collection Tools	Sustainable Business Model	Public Relations	Legal Policy/ Frameworks
Binners' Project	Vancouver/ Montreal		✔				✔	
Forage Tracking	Mombasa/ Recife/ São Paulo				✔			✔
GRINGGO	Bali	✔		✔		✔	✔	
I Got Garbage	Bangalore	✔	✔		✔	✔		
Kabadiwalla Connect	Chennai	✔			✔	✔		
Plastics for Change	Bangalore	✔	✔		✔	✔	✔	
ReciVeci	Quito		✔					
RECO	São Paulo		✔				✔	✔
Toter	Hyderabad	✔			✔	✔	✔	

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Appendix A:
Mobile App Evaluation Template

During the development of our case studies, we created a template to help us evaluate the context of each of the mobile applications we studied more closely. Given our limitations in who we could talk to and what information we could find, our case studies do not contain the answers to all of the questions in this template. However, we hope that this template can provide a general framework and starting point for anyone who wants to consider and evaluate the context of an existing or future mobile app for waste pickers.

Contextual Background	
General Demographics	● Breakdown of waste picker population ○ male/female, ages ● How many waste pickers in the city
Sociopolitical Context	● What policies provide a structure for waste pickers to organize? Gain social recognition? Have negotiating rights with municipalities? ● What has led waste picker communities to this particular point in history? ● What are others' perceptions of waste pickers (e.g. householders, police, general public, etc.)?
Waste Picker Organization	● Cooperatives ○ How many cooperatives? ○ Size of cooperatives? ○ Interaction between cooperatives? ○ What are the important interactions/structures within a waste picker cooperative? ● Relationship between cooperatives and independent waste pickers? ● How many in cooperatives vs. independent
Waste Collection Process	● Where do the waste pickers collect their recyclable materials? (e.g. residences, dumps, street, businesses, etc.) ● Where do they bring it to/sort it? ● How do they transport it? ● How do they store it? (do they need to?) ● How do they prepare materials for sale? ● How long does it take to amass enough? ● Who do they sell it to? ● When and how often do they sell it? (Established partnership or sporadic?) ● How do they contact? (on the phone? At a certain meeting place?) ● Market dynamics? ○ What are the general rates? ○ How much do they need to collect to get a decent profit? ○ How do waste pickers become informed about prices/what is fair? ■ Fair according to whom?

	● Who are the buyers?
	  ○ Who are the middlemen?
	  ○ Who is the final buyer?
	● Who else is involved?
	  ○ Government
	  ○ Households
	● Who are the peripheral actors? (potential to be involved more?)
	  ○ Government
	  ○ Public (passersby)
	  ○ Households
	  ○ New buyers?
	● Estimated numbers of people they collect from and volumes collected

Mobile Application	

App Logistics	● How long has it been around?
	● Main functionalities? Purpose?
	● What resources are required to maintain the app?
	  ○ Is there a business model if any?
	● Is it tied to an organization?
	  ○ What kind (e.g. nonprofit, NGO, etc.)?

Purpose	● What challenges/problems does it address? ○ Adding value somewhere in the process, filling in a gap in the recycling process? ● Who initiated the development of the app?

Functionality	● How does it address those problems?
	  ○ What does it do?
	  ■ If I'm a user, how do I interact with the app?
	  ○ Who is the target user?
	  ○ What are the technical requirements for the app?
	  ■ Database?
	  ■ Software dev team (how much (wo)man-power and time?)?
	  ■ SMS or smart-phone?

Design Process	● Who was involved? Were end users part of the process? ● What were the steps? ● What changed in terms of goals, technical elements, etc?
Evaluation of	● What does it mean for each of the different actors for this

Success	app to be successful (waste picker, buyer, NGO, environmental policy person, municipal government, residents, app developer, etc.)? ○ Has this app been successful for each of those actors? ○ Why or why not? ○ (What is the measurement for that success?) ● What exactly does the app do or promote that makes it a success for any of these actors? ● Do you see people using your app? ● What do you see as barriers to the success of the app? ● Does the app increase earnings for waste pickers? ● Does the app increase volume collected?
Recommendations	● What's not working currently (according to different actors)? ● Additional challenges in context that are not addressed by app but could be?