

Smart Waste

Simple, effective and economical waste management through technology

a **Banyan Nation*** initiative

**Banyan Nation is an award winning recycling venture that is changing the way India recycles, thinks about plastics, waste management and sustainability.*

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The Problem

India is reeling under a waste management crisis!

Generation

- • No Source Segregation – recyclables are mixed with organic and hazardous waste

Collection

- • Inconsistent Door to Door Collection
- • Illegal Dumping at Street Corners

Transportation

- • Informal Sector (for dry waste)
- • Municipality/Contractors (for the rest)

Management

- • Illegal Dumping
- • Unscientific Landfilling
- • Backyard Informal Sector Recycling

Municipalities

Waste Management is a Cost Center

Pay 800-1200 in Waste Management Fees

Little to No fees from citizens and businesses

Waste generated is projected to reach 436 MM TPA by 2050 requiring land the size of Hyderabad!

Current Mitigation Strategies

A step in the right direction, but not enough!

Govt

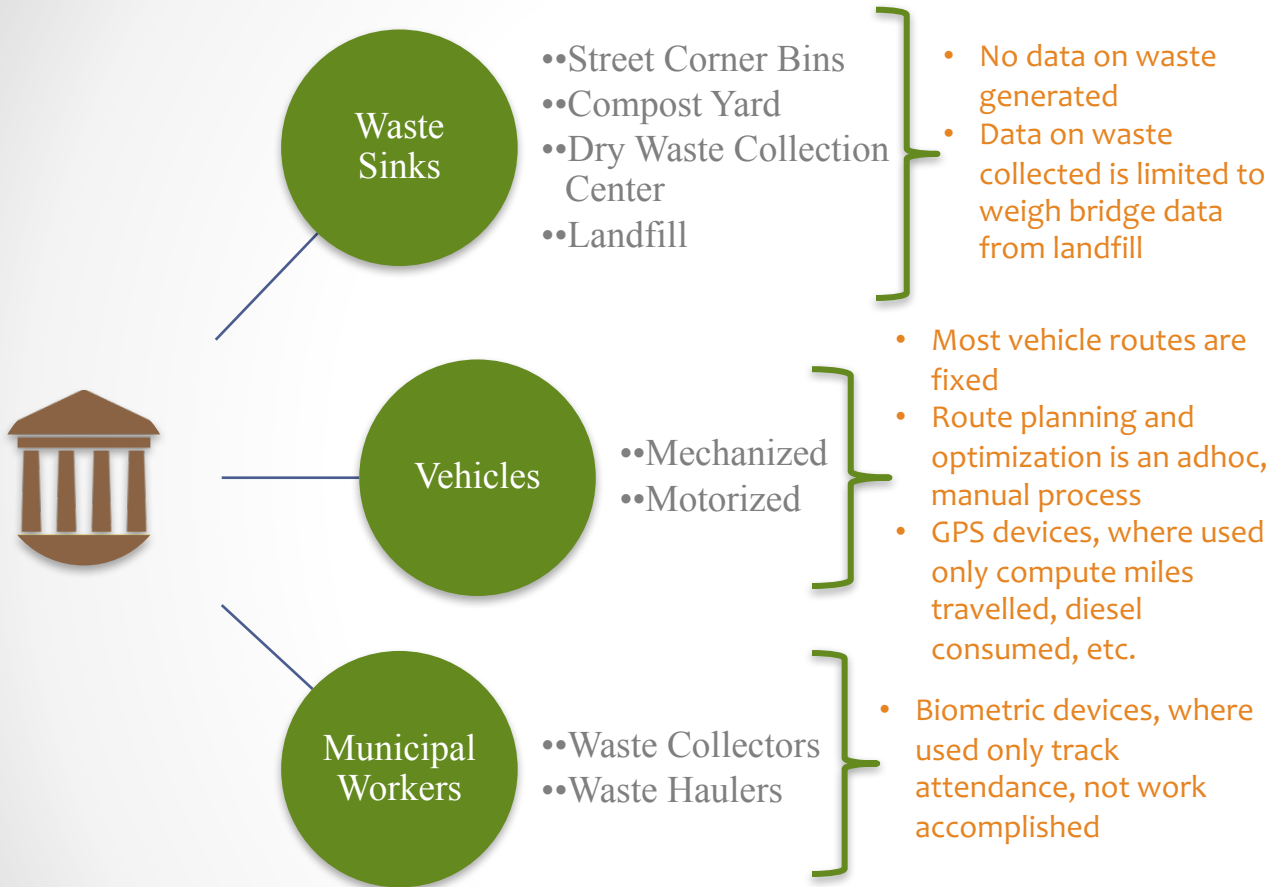
- • Swachh Bharat Mission has allocated **7000+ Cr** for Solid Waste Management till 2019.
- • Smart City Mission has identified **Solid Waste Management as a core infrastructure element**, requiring cities to incorporate “smart solutions” to solve the chronic waste management problems plaguing most cities in India.
- • MoEF has released **Solid Waste Management Rules, 2016** that mandate source segregation, user fees, extended producer responsibility, formalizing the informal sector, etc.

Cities

- • Smaller cities such as Pune, Panaji, Mysore, etc. that generate 50-1500 TPD are employing **de-centralized waste management models** to maximize landfill diversion and reduce costs
- • Some such as Warangal (~250 TPD) have even incorporated smart elements such as **Biometrics (to track worker attendance)** and **GPS (to track truck movements)**

Gaps in Current Solutions

Decentralized, but Adhoc and Reactive Waste Management Model!



Warangal (Case Study)

800k population

~250 TPD waste generated

58 Wards

~2000 workers

~200 Swachh Dhoots

~100 Vehicles

14 DRCCs

1 Compost Yard

1 Unscientific Landfill

The disconnected, sparse and mostly offline nature of this data means that no correlations can be drawn between Attendance, Waste Collected, Waste Hauled, and Waste Processed, making it almost impossible for Warangal to plan better and operational efficiently, let alone reduce costs.

The Solution

Banyan's Smart Waste Management Platform!

Awareness

Aggregation

Analysis

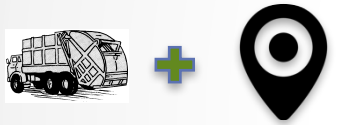
Outcome



Bin Sensor monitors fill level of street corner bins

- Data is mined in real-time to predict when bin will reach predefined level
- Predictive algorithms automatically generate demand-based schedules and optimized routes for trucks

Reduces diesel consumption, thereby reducing the cost of hauling garbage



GPS devices track location of garbage trucks

- Monitor route deviations, trips, miles travelled, diesel consumed, etc.



Biometric devices track worker attendance

- Identify best and worst performers

Transparency increases accountability and reduces absenteeism, increasing collection coverage and efficiency



Mobile Apps monitor extent of source segregation

- Understand consumption patterns to optimize distribution of garbage bins, and other collection/processing points

Increases resource utilization, segregation efficiencies and landfill diversion

Banyan's Smart Waste Management platform takes a holistic (360°) approach to waste management, providing cities (municipalities) with critical data and insights to improve planning, optimize operations and reduce costs

How does it work?

Demo

Upload a Map of your city

Upload standards-based KML file with ward boundaries clearly defined

58 wards found. Click Import to import. ✕

Choose File wards.kml

Upload

First ingest baseline planning data in the following order:

- Ward Map
- Ward Details
- Employee Details
- Vehicle Details

To track daily operations and draw insights, upload:

- Daily Attendance
- Daily Trips

Warangal Wards:
Hover over a ward

Import Cancel

Ingest Planning Data

Statically upload census, workers details, truck details, etc. via pre-defined excel templates

58 record(s) found. Click Import to import. ✕

Ward Details

Choose File warangal-w...alls.xlsx

Upload

First ingest baseline planning data in the following order:

- Ward Map
- Ward Details
- Employee Details
- Vehicle Details

To track daily operations and draw insights, upload:

- Daily Attendance
- Daily Trips

Ward ID	Population	Households	Establishments
W1	49563	12518	42
W2	82931	20365	97
W3	43586	11046	54
W4	12596	3118	50
W5	27227	6797	47
W6	8426	2027	9
W7	13519	3136	264
W8	7816	2256	195
W9	8396	2034	181
W10	13603	3440	157

Import Cancel

How does it work?

Demo

Ingest Operational Data

Connect existing data sources or statically upload data such as Attendance, etc.

28 record(s) found. Click Import to import. ×

Daily Attendance

Choose File Daily Atten...9-7-16.xls

Upload

First ingest baseline planning data in the following order:

- Ward map
- Ward details
- Employee details
- Vehicle details

To track daily operations and draw insights, upload:

- Daily Attendance
- Daily Trips

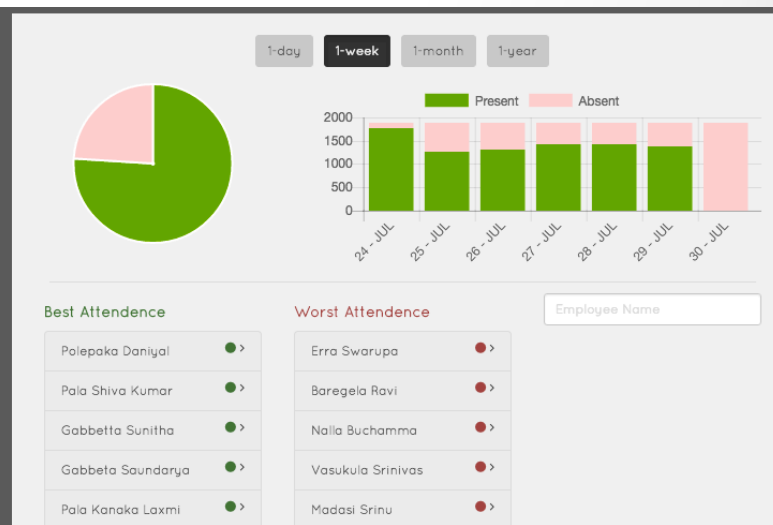
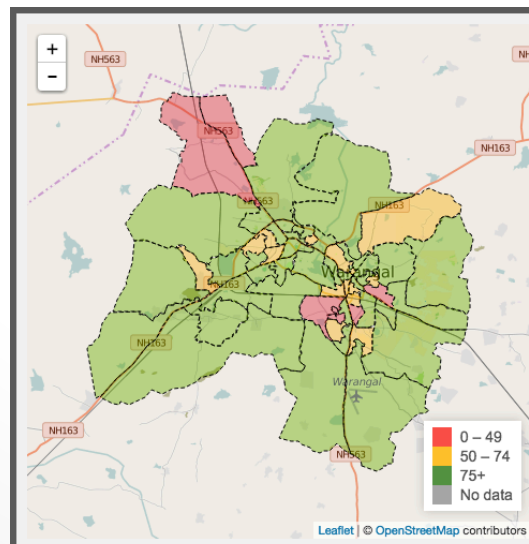
Employee ID	Employee Type	Employee Name	Present (Yes/No)	Date
291	Sanitation Worker	MUNIGALA SARAIAH	Yes	29/7/2016
292	Sanitation Worker	MITTAPALLY RAVI	Yes	29/7/2016
293	Sanitation Worker	SHAGANTI SWAMY	Yes	29/7/2016
294	Sanitation Worker	SILIVERU LAXMI NARAYANA	Yes	29/7/2016
295	Sanitation Worker	MADASU KOMURIAH	Yes	29/7/2016
296	Sanitation Worker	MEKALA MANAMMA	Yes	29/7/2016
298	Sanitation Worker	POLEPAKA RAGHUNA	Yes	29/7/2016
301	Sanitation Worker	POLEPAKA SOUNDRYA	Yes	29/7/2016
302	Sanitation Worker	SANGI LAXMI	Yes	29/7/2016
304	Sanitation Worker	VASKULA LATHA	Yes	29/7/2016

Import

Cancel

Visualize to Analyze

Time-series Heat Maps and Ward-level drill downs provide a bird's eye view of how your city is performing



Market Size and Opportunity

Swachh Bharat Mission

- • 4000+ urban areas
- • 7000+ cr. Investment by Gol
- • 5 year period

Smart Cities Mission

- • 100 cities
- • 20-600 cr. Investment by cities
- • 5 year period

Jaipur

600 Cr investment

10% savings targeted

Indore

20 Cr investment

10 cr. p.a. savings
targeted from year 6
onwards

Coimbatore, Kakinada, Belgaum, Jabalpur

GPS truck routing

Revenue Model

Platform

- • Plugs into existing infrastructure
- • Flat fee based on size of the city and complexity

Turn-Key

- • Platform + Hardware (Biometrics, GPS, etc.)
- • Flat Fee + Annual O&M for devices

Licensing

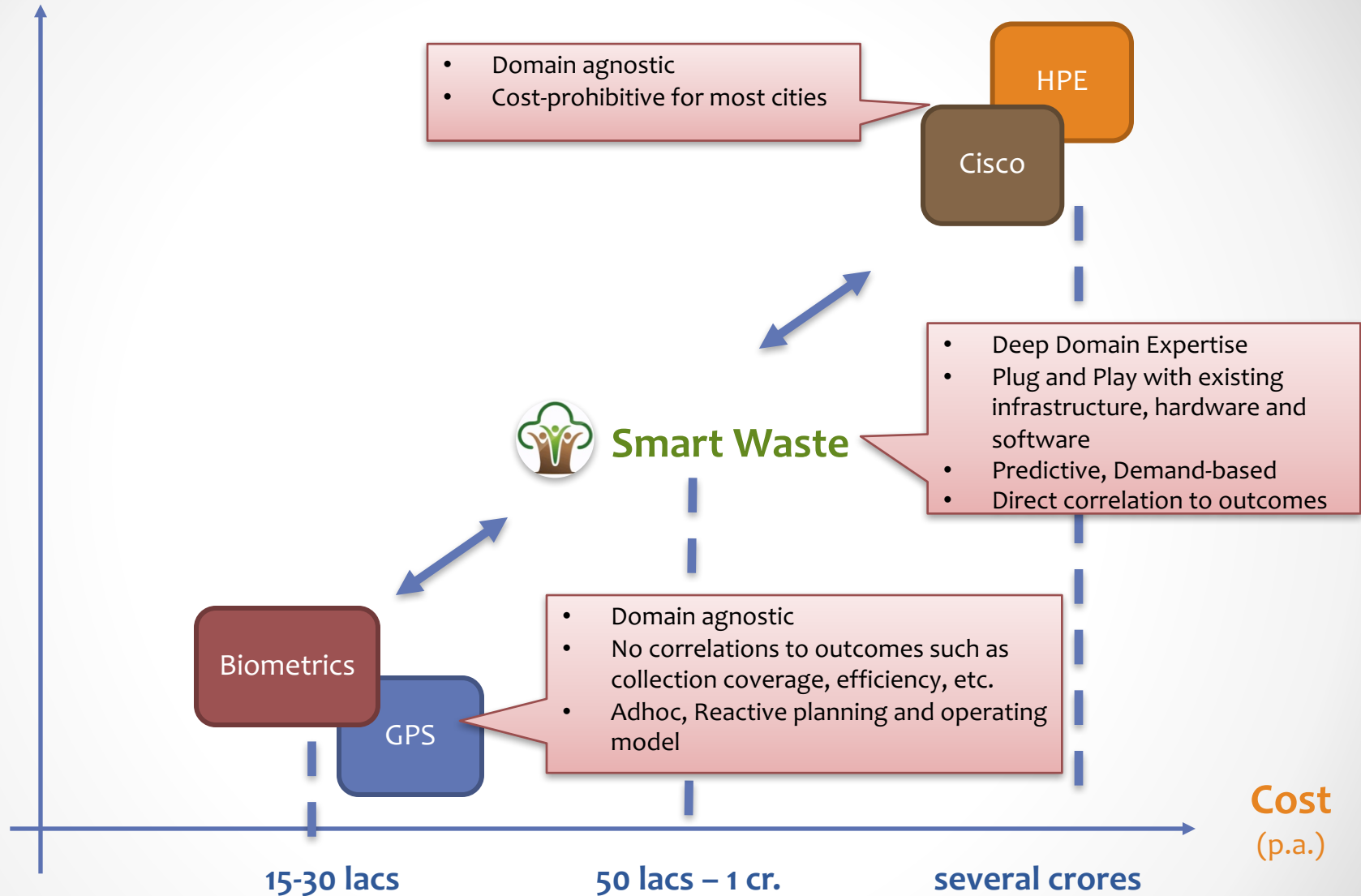
- • To System Integrators (Cisco, HPE, Sterlite, etc.)
- • Plug into Command & Control Centers
- • Flat Fee

Rev Share

- • With Cities/Municipalities
- • Success Fee on \$ saved or revenue generated from waste management

Competition

Features



Competitive Advantage

Modular

- Layer over existing infrastructure, an incremental cost for cities
- Can be offered as a standalone turn-key product
- Can plug into a larger command and control platform such as Cisco, HPE, etc.

Domain Driven

- Deep sectoral experience of Founders & team
- Holistic (360 deg.) approach to waste management

Flexible Pricing Model

- Pricing based on size of the city and complexity of waste management infrastructure

Technology

- Built on the Open Source technologies
- Multi-Tenancy model
- Cobrand-able
- Cloud Hardware Agnostic

About Banyan Nation

Banyan Nation is a waste management and recycling technology venture that is rooting out inefficiencies in India's waste value chain by innovating across different stages, right from collection and recovery to recycling. Our vision is to change the way India manages its waste and treats valuable natural resources.

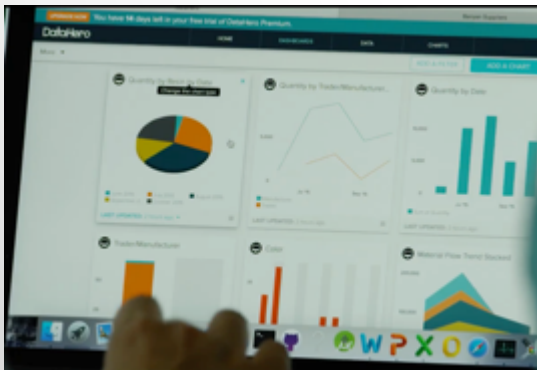
Our two-pronged approach includes recycling technologies and waste management technology:

Recycling Technologies

- • Focus on Plastics and E-waste – the most harmful components of solid waste for the environment
- • Increasing % of waste in India is plastics and e-waste
- • Plastics and e-waste deplete natural resources that can be recovered through recycling

Waste Management Technology

- • Gross inefficiencies in waste management systems across cities in India
- • Lack of proper data collection, tracking, and analysis leads to mismanagement of both waste and public funds
- • No holistic service providers with competencies in software and hardware



Team

Mani Vajipey, Co-Founder & CEO

- Seasoned business and technology professional.
- **Experience:** Qualcomm Inc.(design, development, testing and commercialization activities of mobile technologies – RF Embedded Systems) for Apple iPad and iPhone product lines.
- **Education:** MBA - UC Berkeley (Haas) and Columbia Business Schools; MS Electrical Engineering - University of Delaware; BTech Electrical Engineering - NIT, Warangal.



Raj Madangopal, Co-Founder & COO

- Technologist with global experience.
- **Experience:** Voltari (building teams, architecting technical solutions, designing, developing, and driving customer experience for \$100Million+ products with 10Million+ customers).
- **Education:** MS Mechanical Engineering - University of Delaware.



Rashi Agrawal, Director Partnerships

- Impact investor and strategy consultant.
- **Experience:** Impact Investment Exchange, Intelicap (Impact Investing); Campbell Alliance (Healthcare Strategy Consulting); NERA (Financial Services Consulting)
- **Education:** MBA - Columbia Business School; BS Electrical Engineering and BA Economics (dual major) - University of California, Irvine.



Venkata Krishna Vaka, Director Supply Chain

- Supply chain and informal sector inclusion expert
- **Experience at:** SKS Microfinance (working directly with Vikram Akula leading strategy and new initiatives of non-financial products aimed at bottom of the pyramid).
- **Education:** PGPABM - IIM Ahmedabad; BSc, Agri -Acharya N G Ranga Agricultural University, Hyderabad



Advisors

Plastics Technology

DuPont India Knowledge Center in Hyderabad provides plastic recycling technology support to Banyan in analyzing and testing the quality of supplies (scrap plastic) and output (Banyan's recycled plastic granules). Through DuPont's advice and mentorship Banyan has developed technology competencies in polymer engineering (use of appropriate additives like impact modifiers, compatibilizers, etc.) to meet customer requirements. The result is 100% customer retention. Based on customer feedback, Banyan's granules have reduced part rejection rates by over 3 times compared to the granules produced by the informal sector.



Business Mentorship (Strategy and Finance)

KKR Team advises Banyan closely on strategy, business development and financial planning. KKR was instrumental in helping Banyan raise \$800K in seed funding. In addition, KKR in partnership with IIX and Shujog (based in Singapore) work with Banyan in realizing Banyan's economic as well as social impact.



KOHLBERG KRAVIS ROBERTS & CO.

Business Mentorship (Recycling and Plastics)

Ron Gonen is the Co-Founder & CEO of the Closed Loop Fund, a \$100 mm fund that links the financial interest of companies that need recycled material back in their supply chain to municipalities who divert recyclable material from landfills into the recycling stream. Ron who is also the founder of Recycle Bank, a disruptive rewards for recycling company and an adjunct professor at Columbia Business School has been closely advising Mani since his days as a student at CBS when Banyan Nation was being incubated at Columbia's Greenhouse Incubator.



Business Mentorship (Smart City Initiative)

Prof V. Srinivas Chary is the Director of Urban Program at Administrative Staff College of India (ASCI), Hyderabad, India. Prof Chary has over 24 years of professional experience working with national, state and urban local bodies in India and outside. He was conferred Ashoka Fellowship for promoting continuous (24-7) water supply. He was a member of the Steering Committee on Urbanisation established by the Planning Commission for drafting approach paper for the 12th Five Year Plan (2012-2017). He is also a global steering committee member of the City Protocol and Smart City initiative of Barcelona.



2 Indians quit high-paying jobs in the US to tackle India's mounting garbage crisis

Jai Vardhan | June 29, 2014 at 8:00 am

9524 8839 202 61 422
Like Tweet +1 Share

Banyan is an informal sector in India that solves problems in the Indian economy through source segregation.



Independence Day Special
Photograph by A PRABHAKAR RAO

WASTE SIDE STORY

Mani Vajipey 34
Raj Madangopal 33
Founders, Banyan Nation, Hyderabad
Recycling Is Cool Started a revolution in garbage recycling with Banyan Nation in July 2013.

How They Are Changing India
By tapping into the informal sector recyclers using an android-based application to generate a comprehensive database of garbage handlers, Banyan Nation directly deals with them. The duo uses high-end plastic separation technologies for more effective and eco-friendly processing of recyclables. Besides Hyderabad, Vajipey and Madangopal plan to enter the electronic waste space by 2016.
by Mona Ramavat

Your Haas Network

Technology Trumps Trash
Mani Vajipey
Founder and CEO, Banyan Nation
Hyderabad, India



Mani Vajipey knew from his early days at Berkeley that he wanted to do something good for India and decided, based on prior visits there, to take his home country's waste-management woes. Vajipey used every opportunity of his Berkeley MBA program to plan for a startup that today uses technology and data to eliminate inefficiency, improve the quality of waste, and create jobs. Vajipey is a serial entrepreneur, a serial entrepreneur, a serial entrepreneur.

these collectors sell to street-level aggregators, who sell to larger distributors, who sell to processors. "We are trying to organize this very informal industry," he says. Under Banyan's plan, pickers still perform the bulk of the sorting but have more job stability. They sell to local aggregators, who can sell to Banyan for a higher price than they currently receive, Vajipey says. The company then processes and sells the materials directly. Banyan is currently focusing on plastics and already has a plant processing 1.5 to 2 tons of it daily. With investor support, in the next three to six months Vajipey hopes to expand both beyond Hyderabad and into the realm of e-waste recycling. —NS

Farm to Table to Small Screen
Patricia Wong, MBA 07
Creator, Farm to Table Family
Los Angeles, CA



When Patricia Wong started out as a consultant for Arthur Andersen after college, she never imagined she'd be a video star. But as the creator of the Public Broadcasting Service (PBS) video series "Farm to Table" and her personal YouTube channel "Farm to Table Babu Mama," she has become a familiar



MISSION CLEAN-UP

Mani Vajipey
CO-FOUNDER AND CEO, BANYAN NATION

Mani's story is similar to that of Shan Ravi Khan's character in Sweden. He was a successful systems engineer at a telecom company in California, USA. "But in the middle of the corporate grind, doing something for India was always at the back of my mind," he says. Of the many nagging issues, the one that ranked deeply was the waste management in India and the waste management. In 2009, Mani realised his true calling—to use his expertise and knowledge to resolve these problems. A stint at the dual MBA programme at Berkeley Columbia brought in many valuable

"INDIA IS AT THE FOREFRONT WHEN IT COMES TO RECYCLING. THANKS TO THE POOR WHO DEAL WITH GARBAGE."

Raj came on board of Banyan Nation and in 2013 they set up base in Hyderabad. For the duo, there was ample work to be done in India's waste management. The country is a land of 1.2 billion people and it comes from the forefront when it comes to waste management. The poor who deal with it are the kabadwalas. They take the waste from the kabadwalas (scrap dealers) and sell it to plastic companies. They started. Mani and Raj approached the government at over Hyderabad to study the waste management. They always had an app to map them and obtain their contact numbers, the materials they deal in and the costs at which they trade them. "We process about two to two-and-a-half tonnes of plastic every day. What makes Banyan Nation different is that we adhere to pollution control norms, pay taxes and do not practise unethical methods like child labour." Mani is also battling some frustrating challenges, such as delays caused by red tape. "Two years ago, we had participated in a waste-to-energy contract with Rourkela Steel Plant, but there has been no action on that front. On paper, the government wants to clean up cities, but in reality they have other vested interests." Not one to be demoralised, he is now working out ways to take Banyan Nation to other Indian cities.
By Upneet Pansari

Pan-India recognition for social impact and technology inclusive business model

Thank You

Mani Vajipey, Co-Founder & CEO

mvajipey@banyannation.com | +917702600311

Raj Madangopal, Co-Founder & COO

rajmadangopal@banyannation.com | +919949453896

Appendix

Global Smart Waste Management Models

Smart Waste and Recycling System for Public Places



- • Solar Powered, Cloud Connected, Automatic Compaction
- • Customizable for different types of waste
- • Management Console + Apps
- • Flat Fee (\$4000) + Extended Service Package
- • Reduces trips by 80%
- • In all 50 US states + 47 other Countries

Uber for Trash



RUBICON

- • Connects Customers with independent haulers that bid on their business.
- • Reduces waste and recycling costs for customers, empowers small businesses and maximizes landfill diversion
- • Management Console + Apps
- • \$95 MM Raised over 4 Rounds (next Billion \$ Startup)

Waste Analytics at your finger tips

enevo

- • Bin Sensors (ultrasonic sonar technology) to monitor fill levels and optimize collection schedules and truck routes
- • Cloud based monitoring and analytics
- • \$26 MM raised

Workflow Engine



Smart Waste Management Platform

Awareness



Smart Waste
Sensors



Smart Waste
Mobile Apps



3rd Party
IoT sensors



3rd Party
APIs



3rd Party
Data
Sources

Aggregation



Smart
Waste
Open APIs

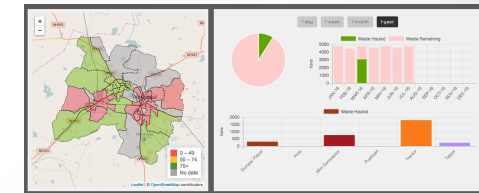
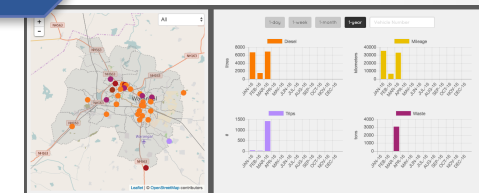
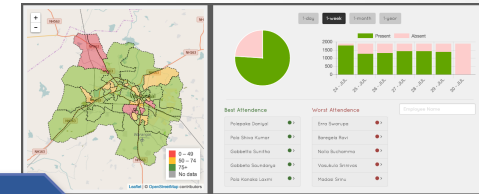
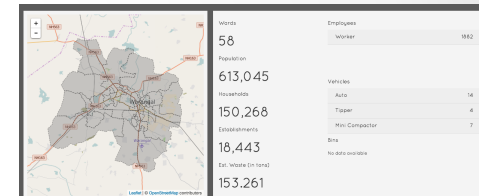


Smart
Waste
Data Store



Smart Waste
Analysis
Engine

Analysis



Smart Waste
Data Viz.

SWM Indicators

Indicator	Benchmark
Household level coverage of Solid Waste Management services	100%
Efficiency of collection of municipal solid waste	100%
Extent of segregation of municipal solid waste	100%
Extent of municipal solid waste recovered/recycled	80%
Extent of scientific disposal of municipal solid waste	100%
Efficiency in redressal of customer complaints	80%
Extent of cost recovery in SWM services	100%
Efficiency in collection of SWM charges	90%

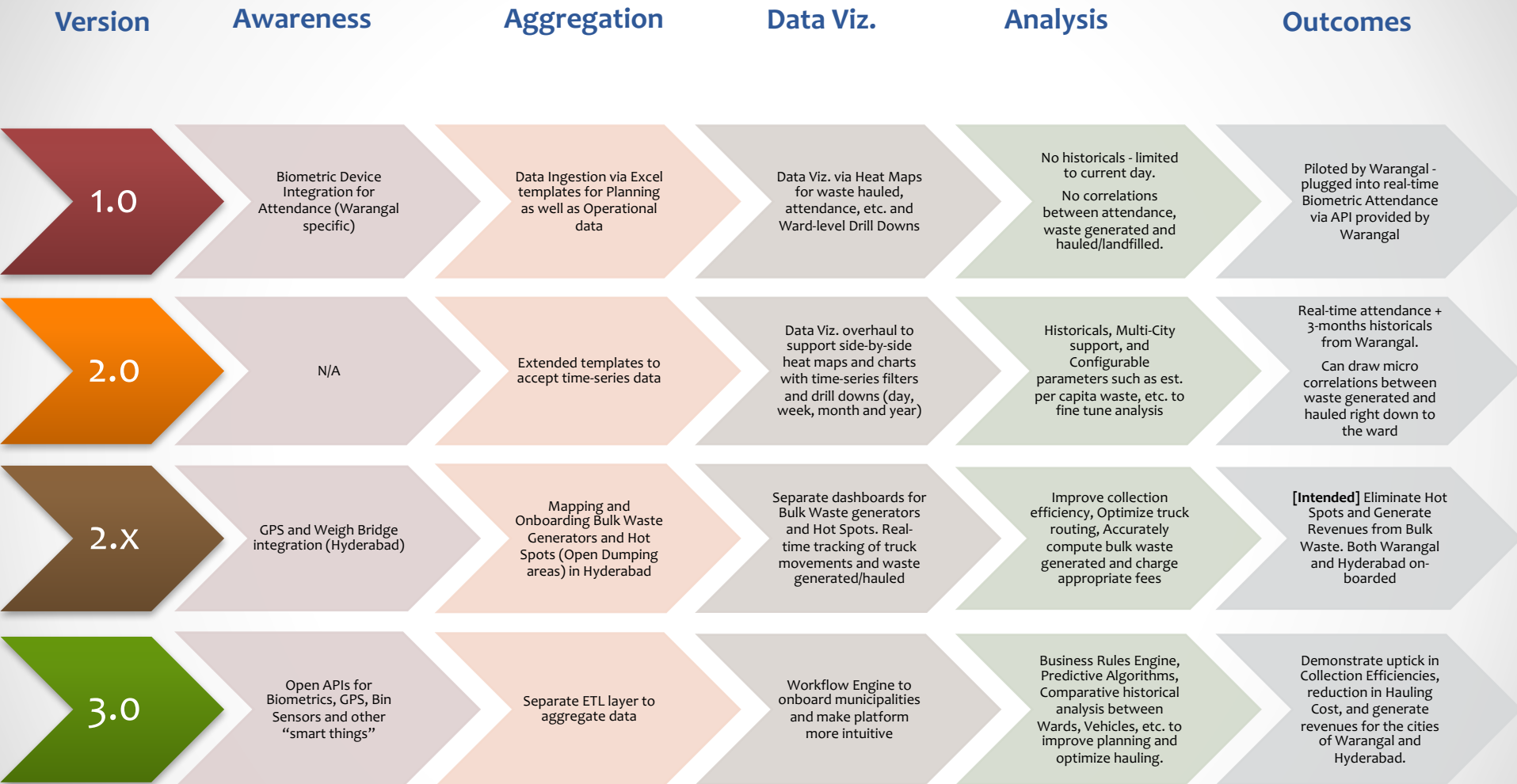
Municipal Solid Waste – Sweeping, Collection & Transportation

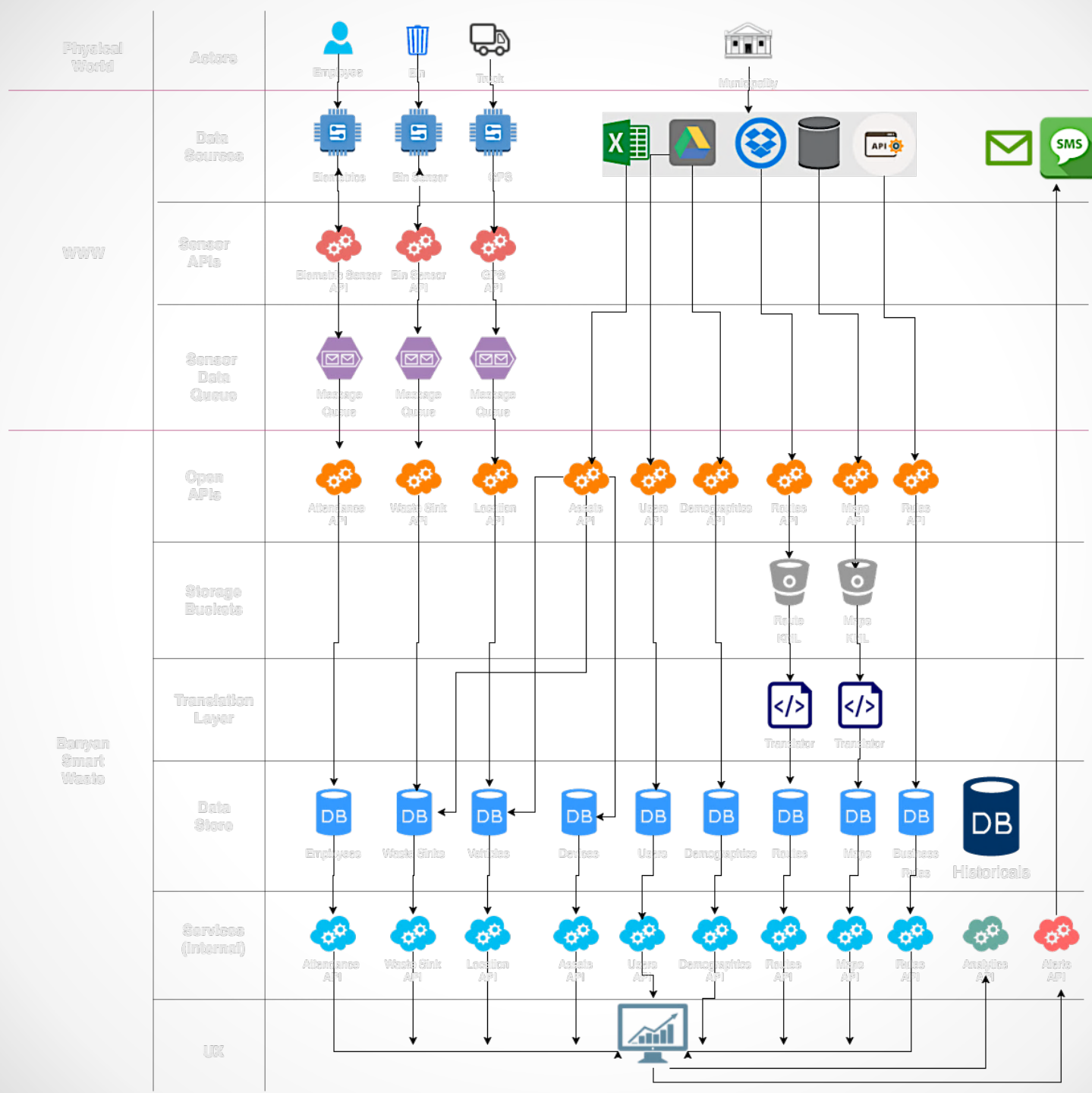
- Whether ICT based staff attendance system in place
- Whether Staff vacancy shortfall against a Swachh City Plan/DPR recommended positions
- Logistics put in place for daily waste collection by government sanitation workers/private contractors
- Debris on Call system:
 - Whether a separate system to collect C&D waste in place
 - Whether waste treatment/disposal facility/ arrangement in place
 - Whether separate user charges are notified and collected
- Whether sweeping undertaken twice a day on commercial area roads
- Daily collection and transportation plan in place for shops and other establishments in commercial areas
- Shops and other establishments in commercial areas are covered by door to door solid waste collection system
- Do you have direct collection system for bulk garbage generators in commercial areas (viz. hotels, banquet halls etc.)

Municipal Solid Waste – Sweeping, Collection & Transportation

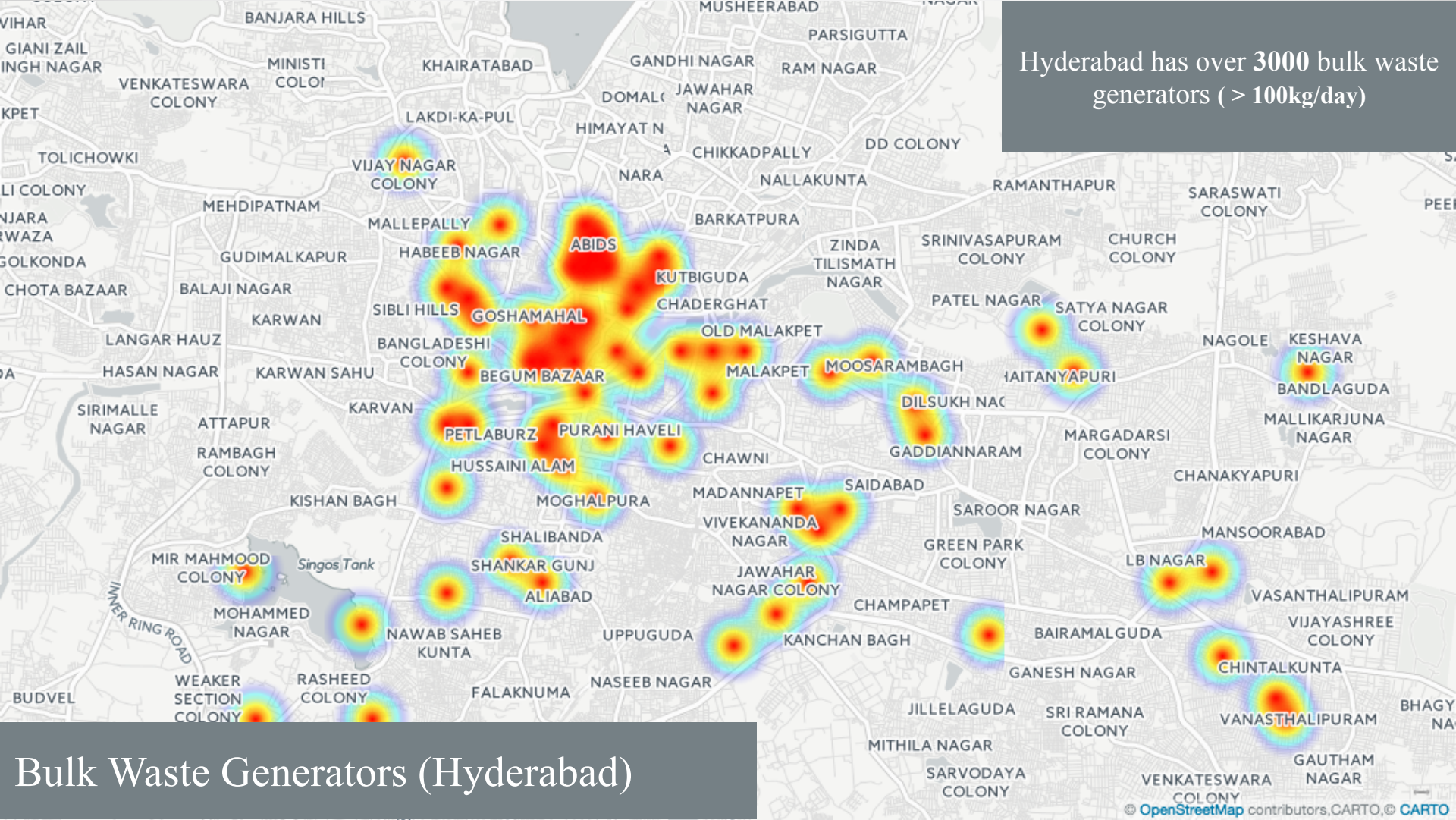
- Availability of collection bins in commercial areas
- Whether User charges in commercial areas
- Waste segregated at source in commercial areas
- Proportion of total solid waste generation that is regularly collected. (Total waste collection over generation)
- Once a day sweeping and cleaning from residential areas done
- Daily collection and transportation plan in place for residential areas
- Residential areas are covered by door to door solid waste collection system
- Do you have direct collection system for bulk garbage generators in residential areas
- Availability of collection bins in residential areas
- Whether User charges in residential areas
- Waste segregated at source in residential areas (Low weightage)
- Road map for waste transportation as per Swachh City Plan/DPR
- Scientific study and Micro movement planning done for efficient transportation
- All garbage trucks/vehicles are tracked

Roadmap





Hyderabad has over **3000** bulk waste generators (> 100kg/day)



Bulk Waste Generators (Hyderabad)

Seed Data

- • Ward Map: AutoCAD => KML
- • Ward Details with census data, est. per capita waste generated, etc.
- • Vehicle Details such as vehicle #, ward(s) assigned to, etc.
- • Geo-tag all Bulk Waste Generators and Hot Spots, and acquire data pertaining to waste generated including type of waste, quantity, frequency, etc.

Sensors/Things

- • GPS devices for haulers
- • Weigh Bridges in all transfer stations
- • Cloud-based tools/apps to capture data from transfer stations

Bulk Waste Module – Municipality Work Flow

Platform Updates

- Register/Seed new municipality i.e. Hyderabad
- Device Onboarding and Management
- Data Model changes to support bulk waste generators, hot spots and multiple municipalities

UX Design Changes

- Separate Admin Console for Hot Spots and Bulk Waste Generators
- Editable Ward Map to input ward details in place instead of separately ingesting census data
- Separate Dashboard with Bulk Waste Generator/Hot Spot location map with drill down
- Separate real-time Vehicle Tracking with Trip details
- Correlations between Waste Generated, Trips and Collection Efficiency

API Updates

- Device Manager API to discover, register and manage GPS devices and other “smart” things
- Real-time Location tracking API

Data Ingestion

- Weigh Bridge data (real-time via API)
- Bulk Waste Generator and Hot Spots data (via excel or other data source)
- Trip Details (real-time via API)

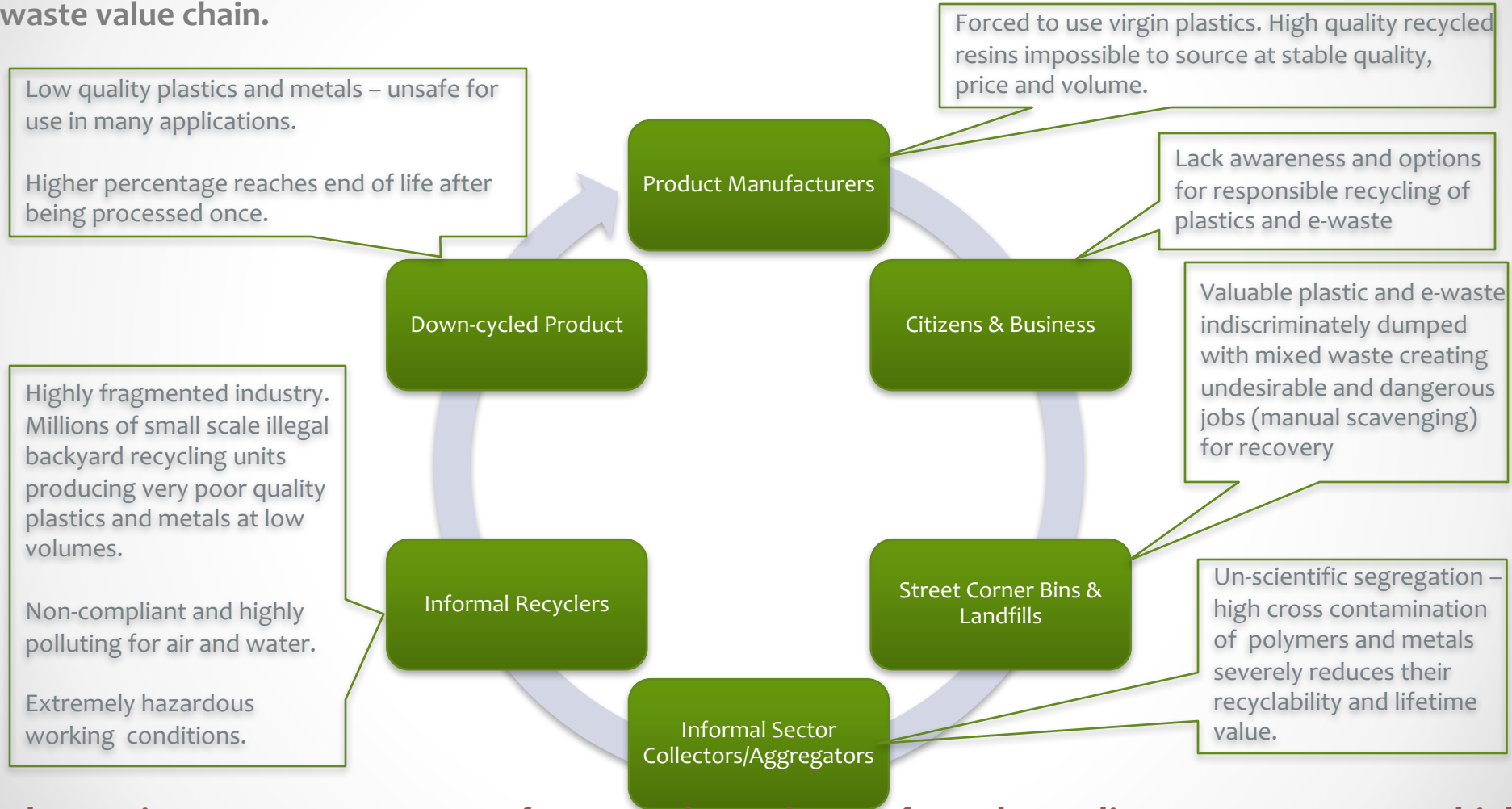
Bulk Waste Module – Banyan Work Flow

Recycling Technologies

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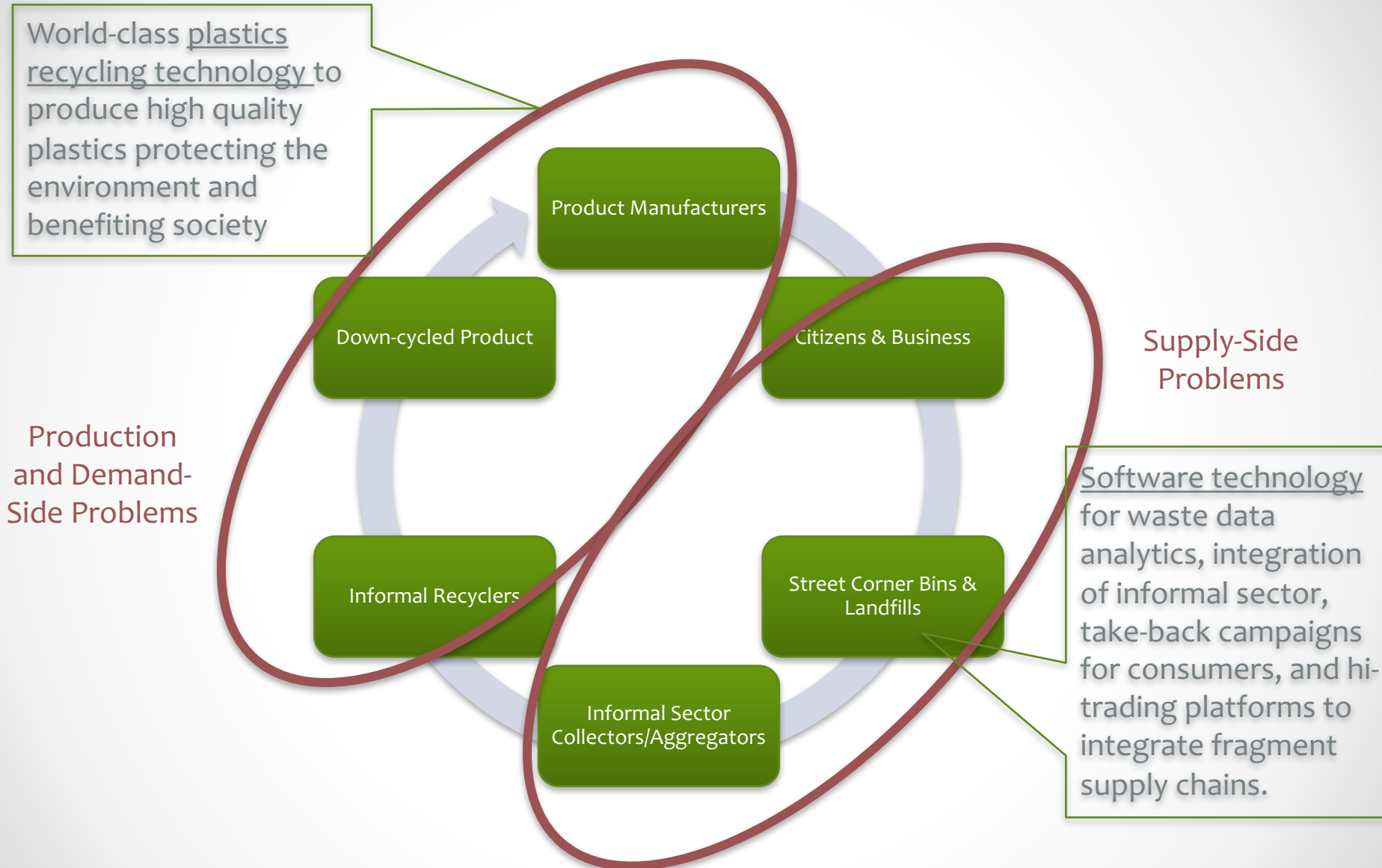
The Problem

India recovers & recycles double that of most developed nations – however very little to none of it translates into sustainable product manufacturing. In addition, recycling in India comes at a huge cost to the environment, the workers and society at large. There are several issues at each part of the e-waste value chain.



Electronics, auto, & FMCG manufacturers do not have a formal recycling partner to source high quality recycled plastic at stable price, volume, and quality required to achieve their sustainable product and packaging goals.

The Solution





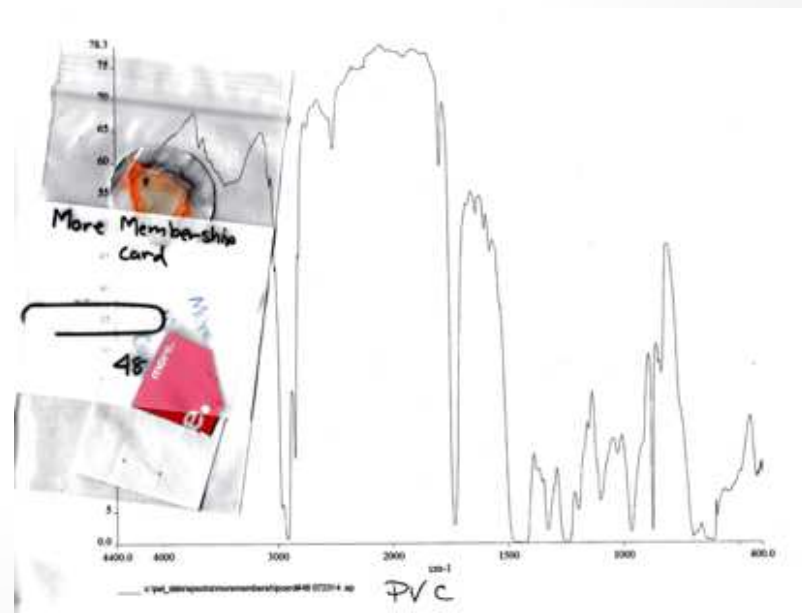
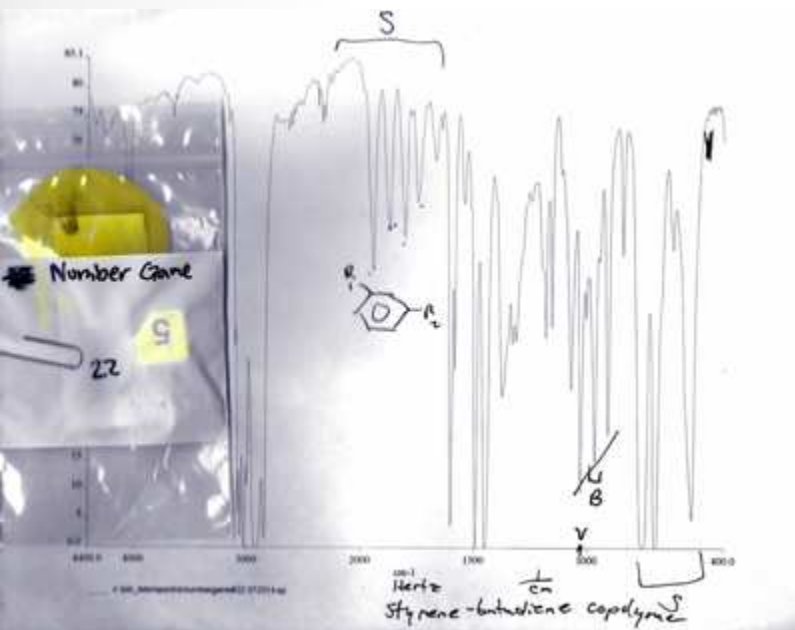
Banyan Solution: Better Plastic™

BETTER QUALITY

Scientific rigor in segregation, washing and extrusion allows Banyan to not only identify resins with a high degree of accuracy, but also prevent cross-contamination and product a consistent quality product.

BETTER PERFORMANCE

Addition of performance polymers allows Banyan to meet stringent thermal and mechanical properties, a must have in high performance applications such as automotive and consumer electronics.





Banyan Solution: Better Plastic™

BETTER FOR SOCIETY

An equal opportunity employer, Banyan provides safe and sanitary working conditions, fair wages, retirement benefits, and health insurance for its workers, setting a high bar for social responsibility, unheard of in a largely informal industry.

BETTER FOR EARTH

Stringent adherence to air and water quality indicators mandated by the pollution control board, ensures that Banyan's processes and products do not negatively impact the environment.



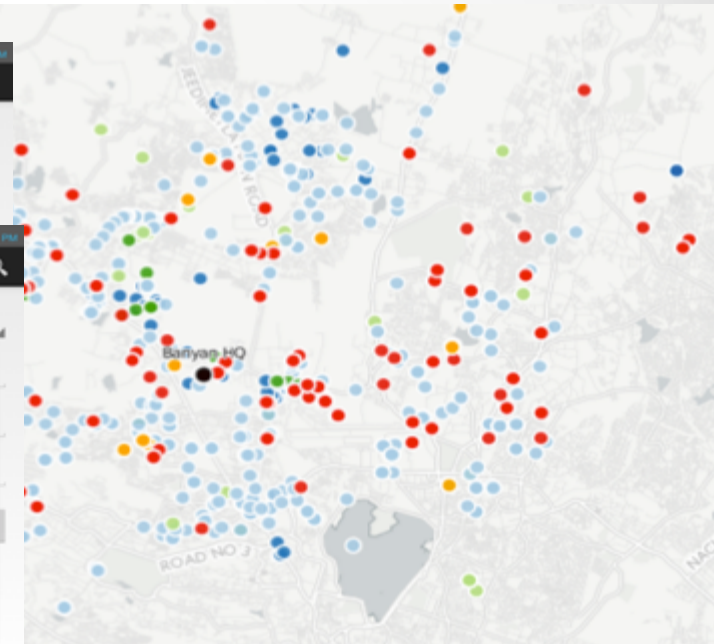
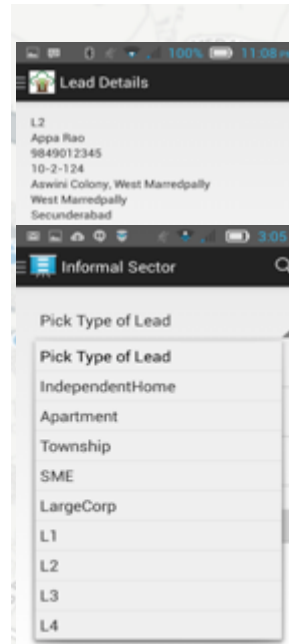


Banyan Solution: Better Plastic™

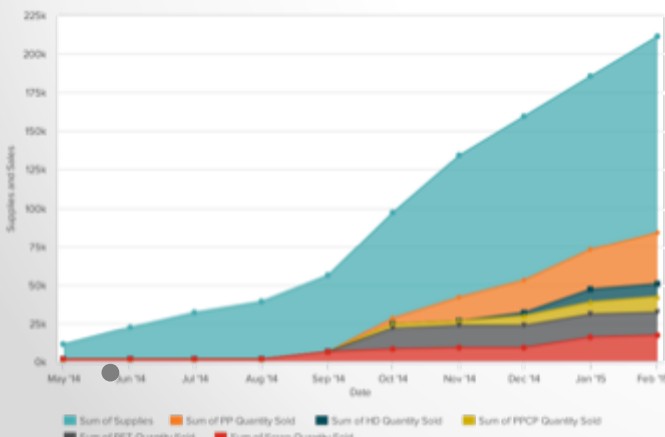
Supply Chain Integration and process management through technology

Informal sector integration through Android app: mapped and integrated 1500 kabadiwalas in Hyderabad.

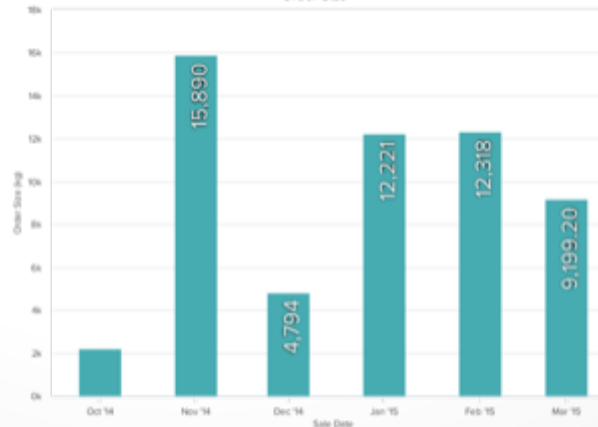
Banyan's proprietary ERP systems (material flow trackers, sales management tools, truck route optimizers, SMS trading platform) allowed us to drastically cut costs and maximize margins in what is traditionally a low margin business.



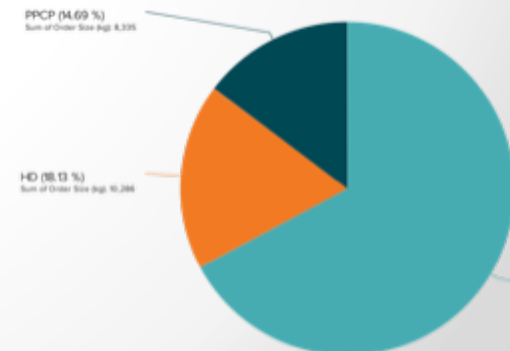
Supply and Sales Trends



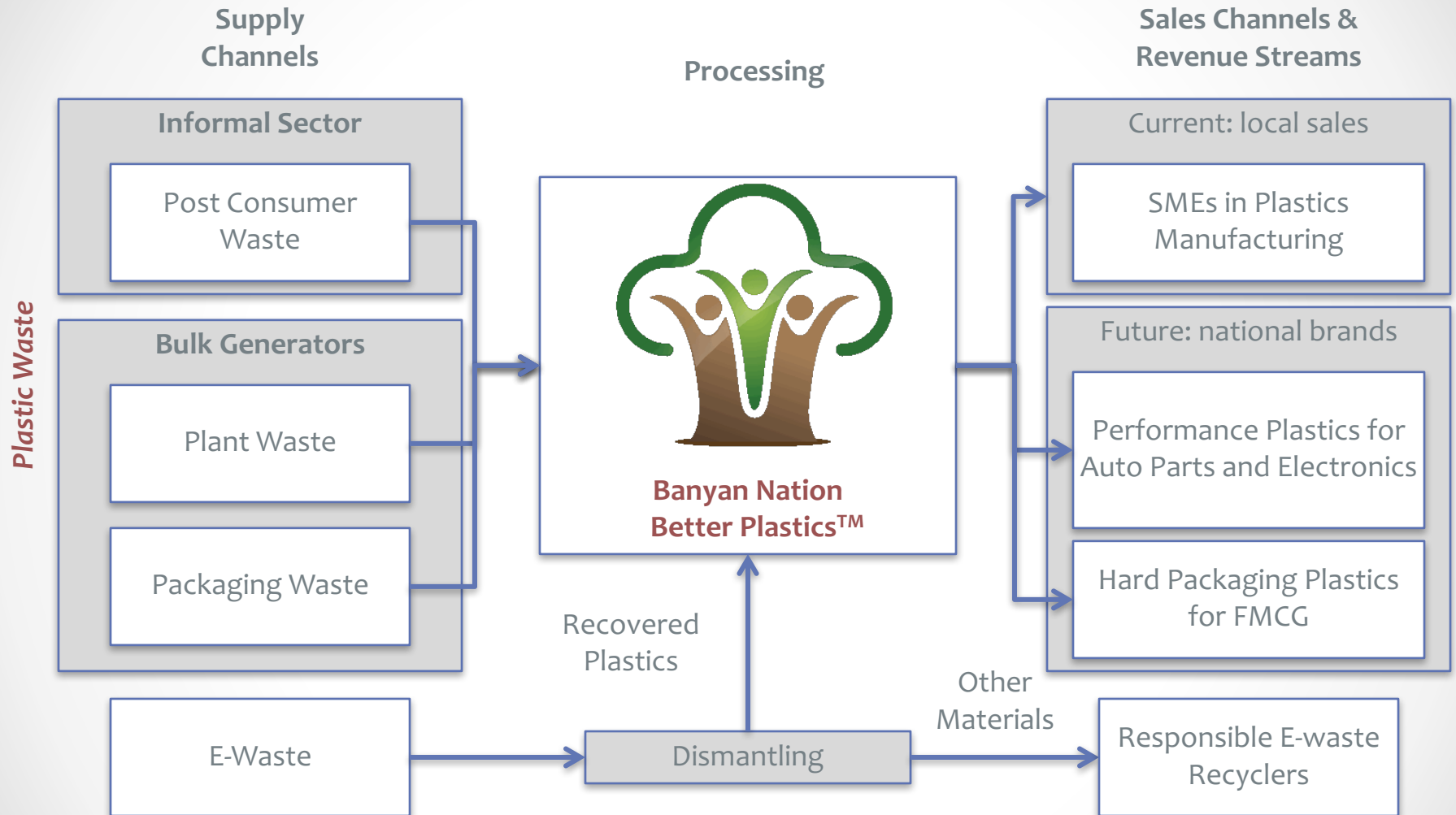
Order Size



Order Size by Resin



Recycling Business Model



Our Impact So Far

Business Impact

30 active customers and growing
~\$1 million in investment from private investors

18,000 sqft recycling facility in Hyderabad

300 tons per month production capacity

100 ton per month production ramp goal for 2016

Social and Environmental Impact

\$1.45 worth of Social Impact for every \$ invested in the company

1380 tons of plastic waste recycled

2760 tons of virgin plastics saved

1500 informal sector workers integrated into the value chain

25-30% savings for SMEs that use Better Plastic™

Pick Type of Lead

Pick Type of Lead

IndependentHome

Apartment

Township

SME

LargeCorp

L1

L2

L3

L4

Address

Find

Waste Composition

Pick Type of Waste

Min. Unit Cost Price

Max. Unit Cost Price

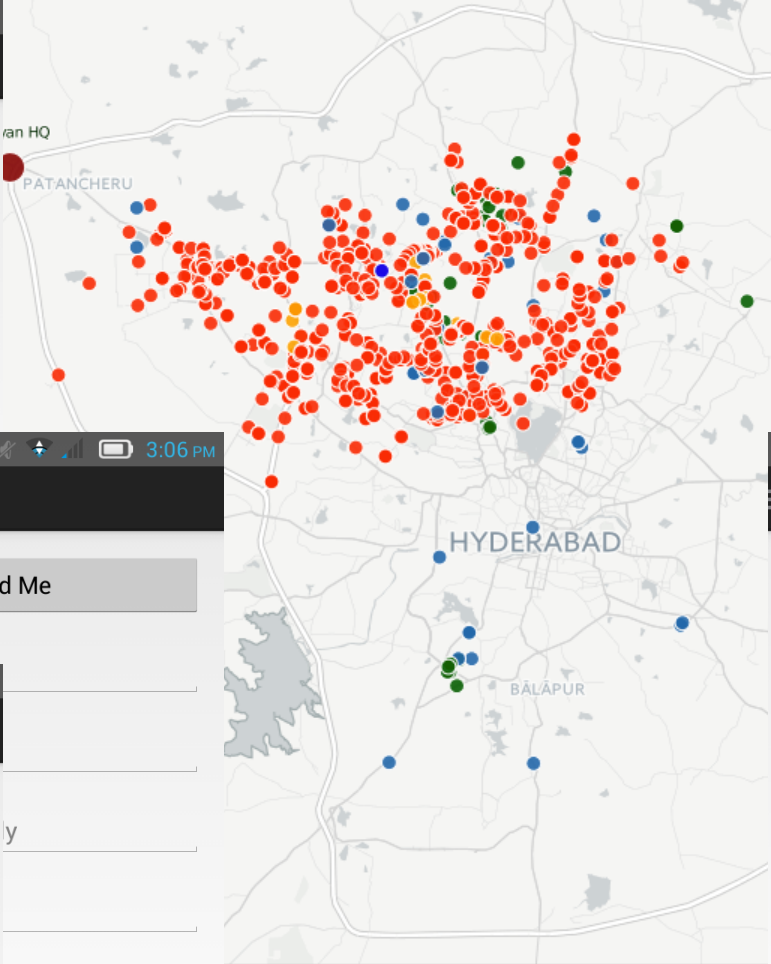
Min. Unit Selling Price

Max. Unit Selling Price

Quantity of Waste

Pick Supply Frequency

Pick Type of Processing



The image is a collage of five mobile application screenshots. The top-left screenshot shows a map interface with two green location pins and the label "GHATKESAR". The top-right screenshot is titled "Find Lead" and contains input fields for "John Doe", the number "9849012345", and dropdown menus for "Pick Type of Lead" and "Pick Locality". The middle-left screenshot is titled "Lead Details" and lists information for "L2 Appa Rao": phone number "9849012345", ID "10-2-124", address "Aswini Colony, West Marredpally", "West Marredpally", and "Secunderabad". The middle-right screenshot is titled "Edit Invoice Details" and features a table with three rows: "Books, 8.5, 125, 1062.5", "Cardboard, 8.0, 1250, 10000.0", and "Newspaper, 12.0, 500, 6000.0". The bottom-left screenshot shows a button labeled "Order Supplies". The bottom-right screenshot shows a button labeled "Done". Each screenshot includes a status bar at the top displaying system icons like signal strength, battery level, and time.

Informal Sector Mapping