

# Waste Management in Smart Cities



# TEAM

## The Manager

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## The Business Man

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## The Marketing Guy

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## The Engineer

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our enterprise



**SMART  
WASTE**

# WASTE COLLECTION PROBLEMS IN LISBON

- **Overloaded waste containers** → Especially in tourist areas and historic neighborhoods, where waste generation is very high.
- **Inefficient collection routes** → Trucks collect waste in areas where containers are not yet full, increasing costs and CO<sub>2</sub> emissions.
- **illegal dumping of bulky waste** → Furniture, appliances, and other large items are abandoned on the streets, making public spaces messy and dirty.
- **Lack of enforcement** → Some residents and businesses dispose of waste outside designated times and locations.

# OUR SOLUTIONS

1. Smart Waste Containers with IoT Sensors
2. Optimized Collection Routes
3. Alerts and Automated Notifications
4. Data-Driven Decision Making
5. Integration with a Mobile App
6. Improved Recycling and Sustainability



# BUSINESS MODEL canvas

<p><b>Key Partnerships</b> </p> <ul style="list-style-type: none"> <li>-City Council</li> <li>-Waste Management Companies</li> <li>-Sensor Suppliers</li> <li>-Telecom Providers (Sensor Connectivity)</li> </ul>	<p><b>Key Activities</b> </p> <ul style="list-style-type: none"> <li>-Route Optimization</li> <li>-App Development and Maintenance</li> </ul>	<p><b>Value Propositions</b> </p> <ul style="list-style-type: none"> <li>-Reduced Waste Collection Costs</li> <li>-Fewer Unnecessary Collection Trips</li> <li>-Cleaner and Smart Cities</li> <li>-Improved Efficiency and Sustainability</li> </ul>	<p><b>Customer Relationships</b> </p> <ul style="list-style-type: none"> <li>-Ongoing Technical Support</li> <li>-Contracts Maintenance</li> </ul>	<p><b>Customer Segments</b> </p> <ul style="list-style-type: none"> <li>-Municipalities</li> <li>-Private Waste Management</li> <li>-Industrial Park Operators</li> </ul>
<p><b>Key Resources</b> </p> <ul style="list-style-type: none"> <li>-Sensors</li> <li>-Cloud Server</li> <li>-Optimization Algorithm</li> <li>-Technical Team</li> </ul>	<p><b>Channels</b> </p> <ul style="list-style-type: none"> <li>-Direct Sales to Municipalities</li> <li>-Waste Companies</li> </ul>			

**Cost Structure** 

- Sensor Development
- App Development
- Staff Salaries
- Cloud and Connectivity Costs

**Revenue Streams** 

- Sensor Installation
- App Subscription
- Public Contracts

# KEY PARTNERSHIPS

- **City Council:** Provides authorization to install sensors in public spaces and may support integration into smart city initiatives;
- **Waste Management Companies:** Use the sensor data to optimize collection routes, reducing operational costs and improving efficiency;
- **Sensor Suppliers:** Supply the hardware and help tailor sensor features to meet the project's technical and environmental requirements;
- **Telecom Providers (Sensor Connectivity):** Enable reliable data transmission from the sensors via technologies like NB-IoT or LoRaWAN, ensuring continuous connectivity.

# KEY ACTIVITIES

- **Route Optimization:** Uses sensor data (e.g., bin fill levels, GPS) to calculate the most efficient waste collection routes. This reduces fuel consumption, operational costs, and environmental impact by avoiding unnecessary pickups.
- **App Development and Maintenance:** Involves creating and updating mobile/web apps for both citizens and operators. These apps support bin monitoring, route tracking, issue reporting, and system alerts, ensuring smooth and user-friendly operation.

# KEY RESOURCES

- **Sensors:** Devices installed in bins to measure fill levels and send real-time data;
- **Cloud Server:** Online platform that receives, stores, and shares sensor data;
- **Optimization Algorithm:** Calculates efficient collection routes based on bin status and location;
- **Technical Team:** Team responsible for developing, integrating, and maintaining the entire system;

# CHannels

- One of the ways we will use to promote our product is through our website, where it is possible to purchase the product.
- Another way to market our product is through meetings with the companies responsible for waste collection, in order to promote our solution.

## IoT Fill-Level Sensor

### FOR WASTE BINS

A smart sensor to monitor the fill level of waste bins and enable efficient collection based on real-time data.

Buy Now



### FILL-LEVEL MONITORING

Waste is collected based on the fill levels of individual bins, optimizing route planning and reducing overflows.



IoT Sensor



Real-Time Data



Optimized Collection

# CUSTOMER SEGMENTS

## Municipalities:

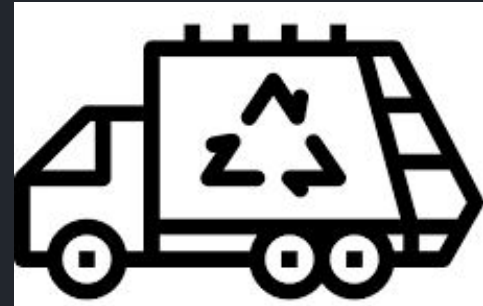
- **Who they are:** City Councils and Parish Councils responsible for urban management and solid waste collection.
- **Needs:** Reduce collection costs, improve public service efficiency, and make the city cleaner and smarter.
- **What we offer:** Real-time container monitoring, optimized route planning, and data for sustainability reports.



# customer segments

## Private Waste Management Companies:

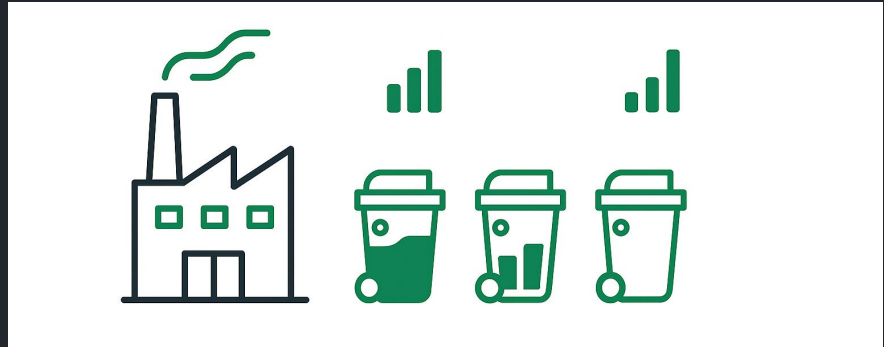
- **Who they are:** Companies subcontracted by municipalities or private operators responsible for industrial parks, shopping centers, or events.
- **Needs:** Reduce unnecessary collections and improve logistics.
- **What we offer:** Management app with real-time data, reduced operational costs, and route optimization based on actual data.



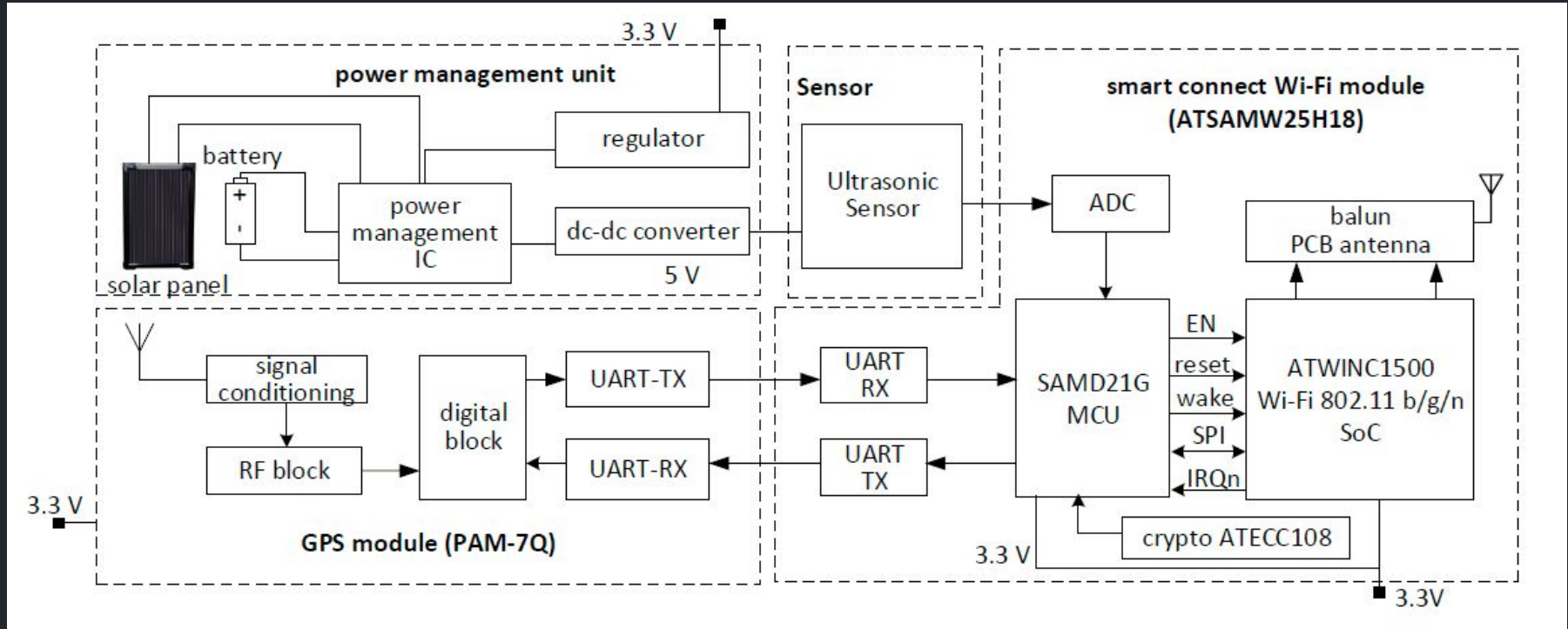
# CUSTOMER SEGMENTS

## Industrial Park Operators:

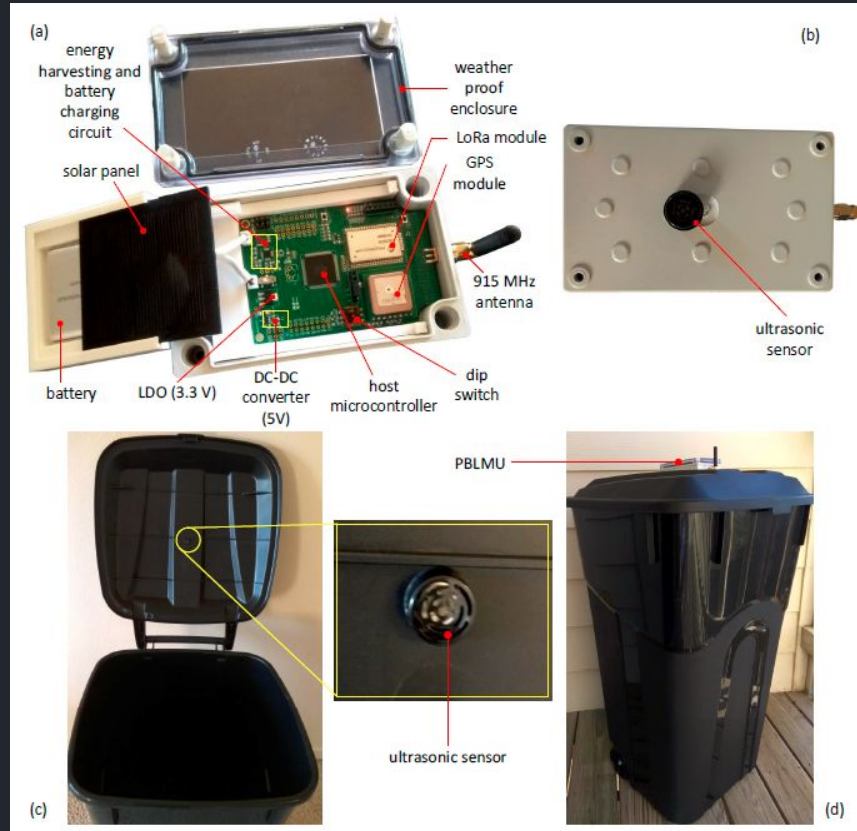
- **Who they are:** Managers of industrial parks that generate large volumes of waste and require efficient solutions.
- **Needs:** Avoid overfilled or underused containers, improve the industrial environment, and reduce operational costs.
- **What we offer:** Sensors adapted to industrial containers, centralized control platform, and automatic reporting.



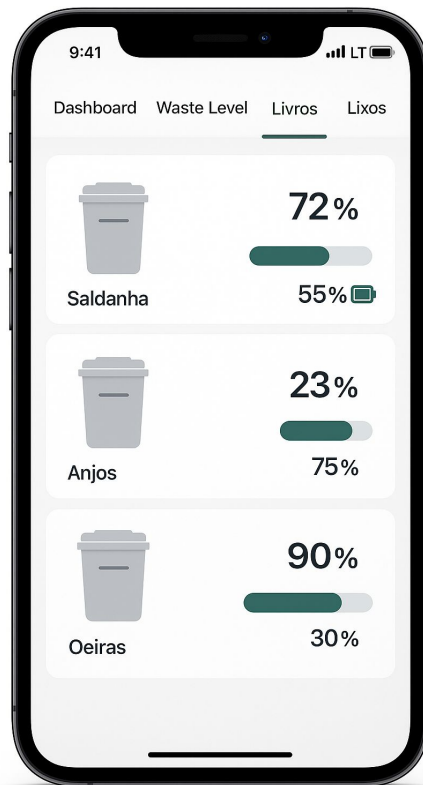
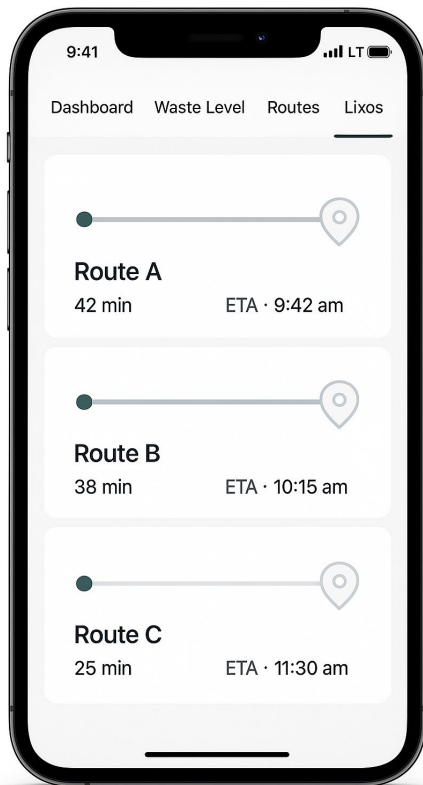
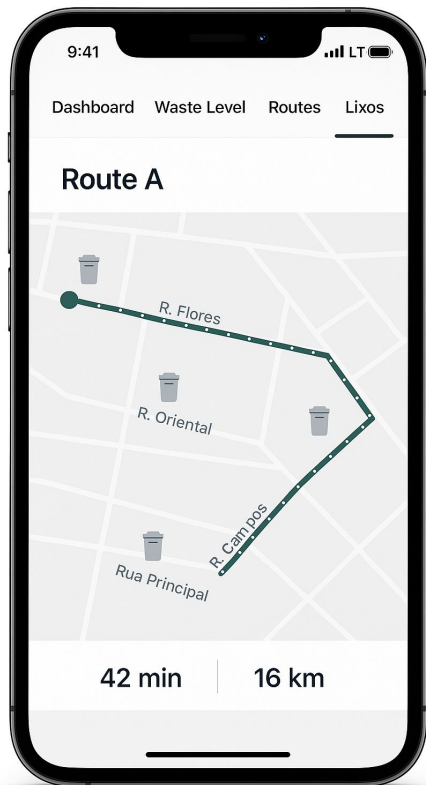
# BLOCK DIAGRAM OF MONITORING UNIT



# INSTALLATION ON A TRASH BIN



# APP

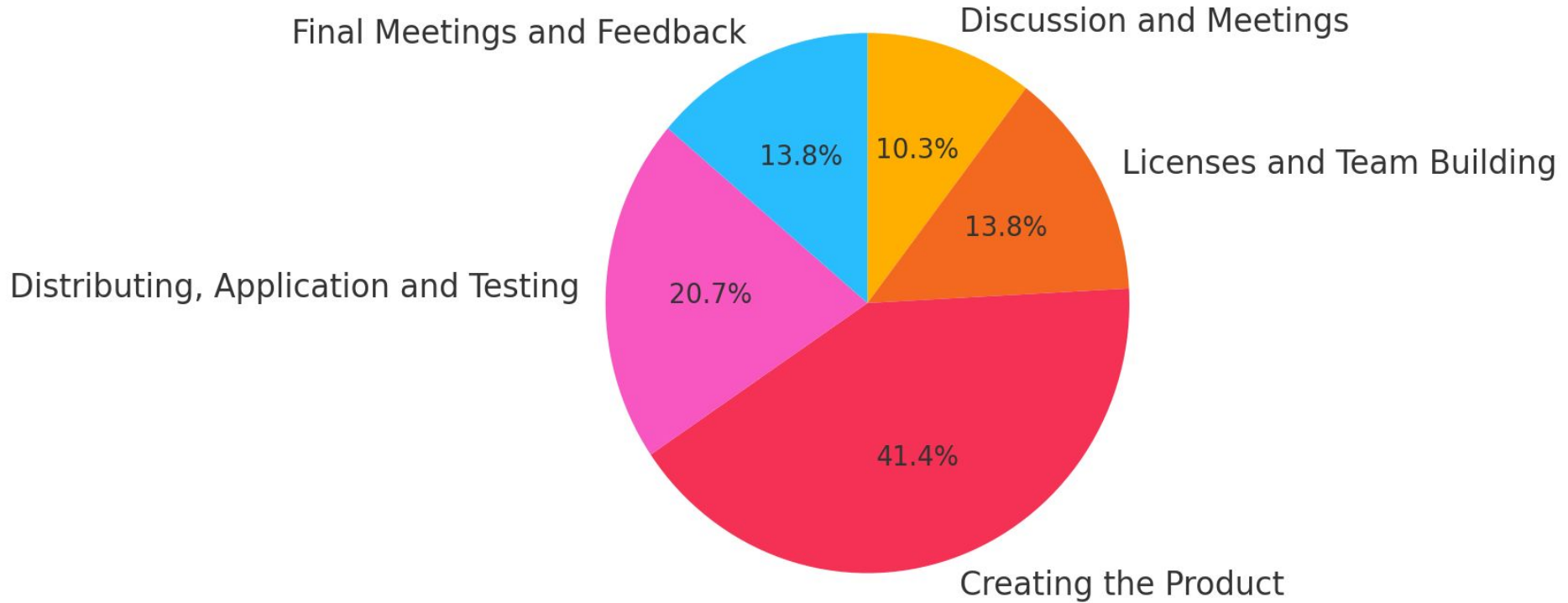


# TIMELINE TOOL

# TIMELINE FOR PROJECT

- Discussion and Meetings: 1.5 Months
- Licenses and Team Building: 2 Months
- Creating the Product (Hardware and Software): 6 Months
- Distributing, Application and Testing: 3 Months
- Final Meetings and Feedback: 2 Months

# Project Timeline Distribution (Chronological Order)



outcomes

<b>Category</b>	<b>Description</b>	<b>Estimate Outcome</b>
<b>Costs of Development (R&amp;D)</b>	App (route optimization, IoT) Hardware	20000 €
<b>Servers</b>	Servers to support the IoT and app network	1200 €, per year
<b>Sensors</b>	Hardware and installation	80 €, per sensor
<b>Technical Maintenance</b>	Sensor replacement & repair / Technical support	4000 €, per year
<b>Salaries</b>	Monthly employee Cost	2000 €

incomes

<b>Category</b>	<b>Description</b>	<b>Estimate Income, per year (€)</b>
<b>App Subscriptions</b>	Monthly payments by operators using the app	18000
<b>Municipality Contracts</b>	Regular payments for monitoring and route optimization services	50000
<b>Partnerships with Waste Management Companies</b>	Commercial agreements for system installation and support	20000
<b>Sales of Sensors and Technical Services</b>	Direct sale of sensors and related technical services	15000
<b>Government Funding and Grants</b>	Support for Smart City and sustainability projects	10000

OPERATIONAL FINANCIAL  
TIMELINE TOOL

# REVENUE

- CAC (Customer acquisition cost): €30
- PPU (Percentage of paying users): 100%
- ARPU / ARPPU (Monthly): €764 (Assuming we have 12 clients,  $\text{€}110,000 \div 12 \text{ clients} = \text{€}9,167/\text{year} \rightarrow \text{€}764/\text{month}$ )
- ASPPU (Initial Sensor Sale): €80 (Price per sensor plus installation)
- PASPPU (Annual Maintenance): €50
- Sales Periodicity: Every 12 months
- Monthly Churn Rate: 5%
- Direct Sales: 100%
- Indirect Channel Margin: 0%

# COGS

## 1. Monthly Direct Costs per Active User

- Includes technical support, platform access, system monitoring
- Technician salaries:  $\text{€}1,900/\text{month} \times 2 \text{ technicians} = \text{€}3,800/\text{month}$
- With 12 clients  $\rightarrow \text{€}3,800 / 12 = \text{approx. } \text{€}317 \text{ per client}$
- Estimated Value (rounded):  $\text{€}317$

## 2. Monthly Direct Costs per Paying User

- Same as above (all users are paying clients)
- Estimated Value:  $\text{€}317$

## 3. Asset Sale Gross Margin

- Installation included in sensor price
- Production cost per sensor  $\approx \text{€}48$
- Sale price per sensor:  $\text{€}80$
- Gross Margin: 40%

# SG&A

- Avg. Monthly Employee Cost: €1,900
- Team Size: 5 employees
- Office Space: 25 m<sup>2</sup>
- Rent (with services): €500/month
- Monthly Professional Services: €150 per 10 employees
- Monthly Software & Tech Licenses: €300/employee
- Monthly Insurance: €250/employee
- Monthly Communications: €150/employee
- Monthly IP Costs: €2,000

# CAPEX

## 1. Furniture for 5 Employees

- Desks, ergonomic chairs, storage units
- Total: €3,000 (€600 per person)

## 2. Servers, Printers & Network Equipment (for 10 employees)

- Business-grade router, NAS or small local server, multifunction printer
- Total: €2,500

## 3. Computers for Employees

- Laptops for software/app development and data analysis
- $5 \times €1,500 = €7,500$

## 4. Mobile Phones for Field Technicians

- Rugged smartphones for field monitoring and data collection
- $2 \times €400 = €800$

# VALUATION

- Estimated Annual Revenue: €113,000  
(App: €18k, Contracts: €50k, Partners: €20k, Sensors: €15k, Subsidies: €10k)
- Revenue Multiplier: 5×
- Estimated Valuation:  $€113,000 \times 5 = €565,000$
- Expected IRR: 25% (target for investors)

# THE BENEFITS OFF OUR PRODUCT

- Optimization of garbage collection truck routes
- Automatic warning system (Full Container)
- Money saving (Fuel / Personal / Maintenance of Vehicles )
- Cleaner City
- Avoid overflowing containers



# COMPANIES INTERVIEWED

- ValorSul - Amadora, Lisboa, Loures, Odivelas e Vila Franca de Xira
- AmarSul - Alcochete, Almada, Barreiro, Moita, Montijo, Palmela, Seixal, Sesimbra e Setúbal
- Lisbon City Council
- Algar - Algarve



# INTERVIEWS – TYPE OF QUESTIONS

- What is your opinion on implementing smart waste containers?
- Would this system be practical in your area of operation?
- Could it improve efficiency and reduce operational costs?
- What challenges do you foresee in its implementation?



# INTERVIEWS – ANSWERS/FEEDBACK

- Promising solution, especially for non-recyclable waste
- Reduces unnecessary truck trips and fuel consumption
- Helps prevent overflowing bins and hygiene issues
- Already tested successfully in selective collection
- Main challenges: high initial cost, weak network coverage, staff training
- Integration with current systems is feasible
- Citizens value smart solutions that promote cleanliness and sustainability

Article

## IoT-Enabled Solid Waste Management in Smart Cities

S. Vishnu<sup>1</sup>, S. R. Jino Ramson<sup>1,2,3,\*</sup>, Samson Senith<sup>4</sup>, Theodoros Anagnostopoulos<sup>5</sup>, Adnan M. Abu-Mahfouz<sup>6</sup>, Xiaozhe Fan<sup>2</sup>, S. Srinivasan<sup>3</sup> and A. Alfred Kirubaraj<sup>4</sup>

## Artificial intelligence for waste management in smart cities: a review

Bingbing Fang<sup>1</sup> · Jiacheng Yu<sup>1</sup> · Zhonghao Chen<sup>1</sup> · Ahmed I. Osman<sup>2</sup> · Mohamed Farghali<sup>3,4</sup> · Ikko Ihara<sup>3</sup> · Essam H. Hamza<sup>5</sup> · David W. Rooney<sup>2</sup> · Pow-Seng Yap<sup>1</sup>

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## Challenges and Opportunities of Waste Management in IoT-Enabled Smart Cities: A Survey

Theodoros Anagnostopoulos, *Member, IEEE*, Arkady Zaslavsky, *Senior Member, IEEE*, Kostas Kolomvatsos, Alexey Medvedev, Pouria Amirian, Jeremy Morley, and Stathes Hadjiefthymiades

THE END