TidySantCugat

A data based product

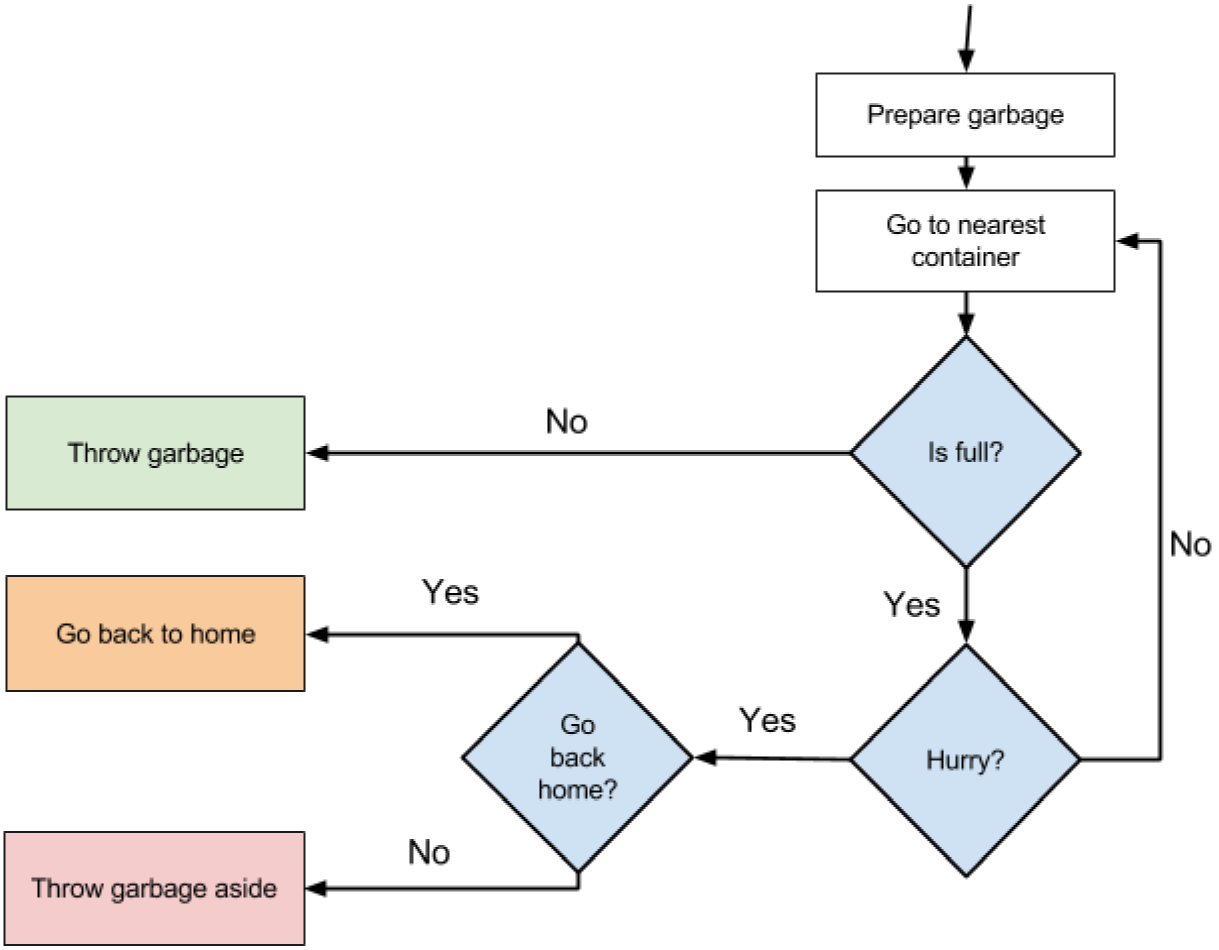
The traditional way of garbage collection

This product aims to transform the garbage collection public service to a collaborative task instead of an old scheduled task. Right now the process model of the garbage collection has the following steps:

Process of Users

1. The user prepares the garbage and goes to the nearest garbage container
2. If the garbage container is full:
   a. He/she throws the garbage aside the container (failure scenario with extra costs for administration)
   b. He/she comes back to home with the garbage (failure scenario with extra costs for users)
3. If the garbage container is not full the garbage is thrown (success scenario)

The event 1 can trigger at any moment of day but usually there are some time frames such that the probability is high (like 7-9 of morning, before people goes to work). The following flow diagram explains more detailed the behaviour of a user:



Process of Garbage collectors

Usually there is a logistic plan to optimize in some way the collection. The most simple plan is based on this rules for the targeted zone:

- Given:
  - Amount of citizens living in the zone (N)
  - Amount of containers (M)
  - Max mass of garbage that each garbage container can hold ($maxMass(x)$)
  - Average mass of garbage generated by a single citizen per day (μ)
- Assume:
  - Garbage is equally distributed among containers in zone regardless of its capacity since users tends to choose the nearest container
- Objective:
  - Containers should not hold more than its 80% of capacity
- Rules:
  - The container x has to be emptied every $t(x)$ where t is defined as:

$$t(x) = \frac{maxMass(x) \cdot 0.8 \cdot M}{N\mu}$$

Informally, each container has to be emptied with a frequency proportional to its capacity. Then one can adjust the amount of containers and their capacity to have the desired frequencies.
The general process model of the garbage collectors would be:

1. Start the route
2. For each targeted container
    a. Go to container
    b. Empty it
3. Go back to central

Consider that if the container is almost empty then it is a waste of resources.

Lacks of the current process model

1. Users have to take a decision with no knowledge of the status of the closest containers
2. Users, due to the frustration of a full container, can throw the garbage aside the container, fact that implies high costs of maintenance (because it requires manual collection by a worker, instead of a semi-automatic collection).
3. The assumption of that the garbage is equally distributed among containers is false. The reality is more like:
    a. Containers placed in more transited streets gets more garbage
    b. Containers are of different types and not all types gets fully at same rate
    c. It depends on local population density so things like tourism or close events could modify the time that takes a container to get full
4. The routes of garbage collectors are not as reliable as in a desk they look because we have:
    a. traffic density
    b. closed streets
    c. traffic accidents
    d. road works
    e. weather
5. It is not easy to predict when a garbage collector truck shall be fully and hence could not continue collecting garbage due to:
    a. Not all garbages containers are complete fully
    b. Garbage is compressed in modern trucks and not all kinds of garbages are equally compressible.

The conclusion is that (one more time) the planned process model probably does not match the actual process model, and anyway it lacks key features to be a final solution.

Unified Solution in 4 phases

It is clear that a new solution is required and the growth of new technologies are a chance to take advantage of them building a new business, a new model and save time to users and resources to public administration. The things that could help are:

- High rate of smartphone per citizen

- Democratization of data visualization
- Internet of Things applied to garbage collection industry

They key point is to know when containers get full as soon as possible and we have two chances:

- Ask users with a mobile app
- Integrate sensors of mass in containers

Both would work, but its implications are very different. Actually is not a disjoint choice, we can take both.

The solution is introduced in 4 phases in a increasing complexity, costs and utility. Also the 4 phases follows the 4 classical phases of data products: what happened?, why happened that?, what shall happen?, what we should do to maximize success? Also known as descriptive analytics, inference analytics, predictive analytics and prescriptive analytics.

A product design have to be ambitious always, but never place the firsts milestones too far in time. That is why we purposed 4 phases. At completion of first phase the product can be launched to production for customers and start collecting analytic data to analyze its adoption and engagement. So the second and further phases can be enhanced with the feedback of previous.

Phase I

This phase addresses the question “what happened?” the main objectives are:

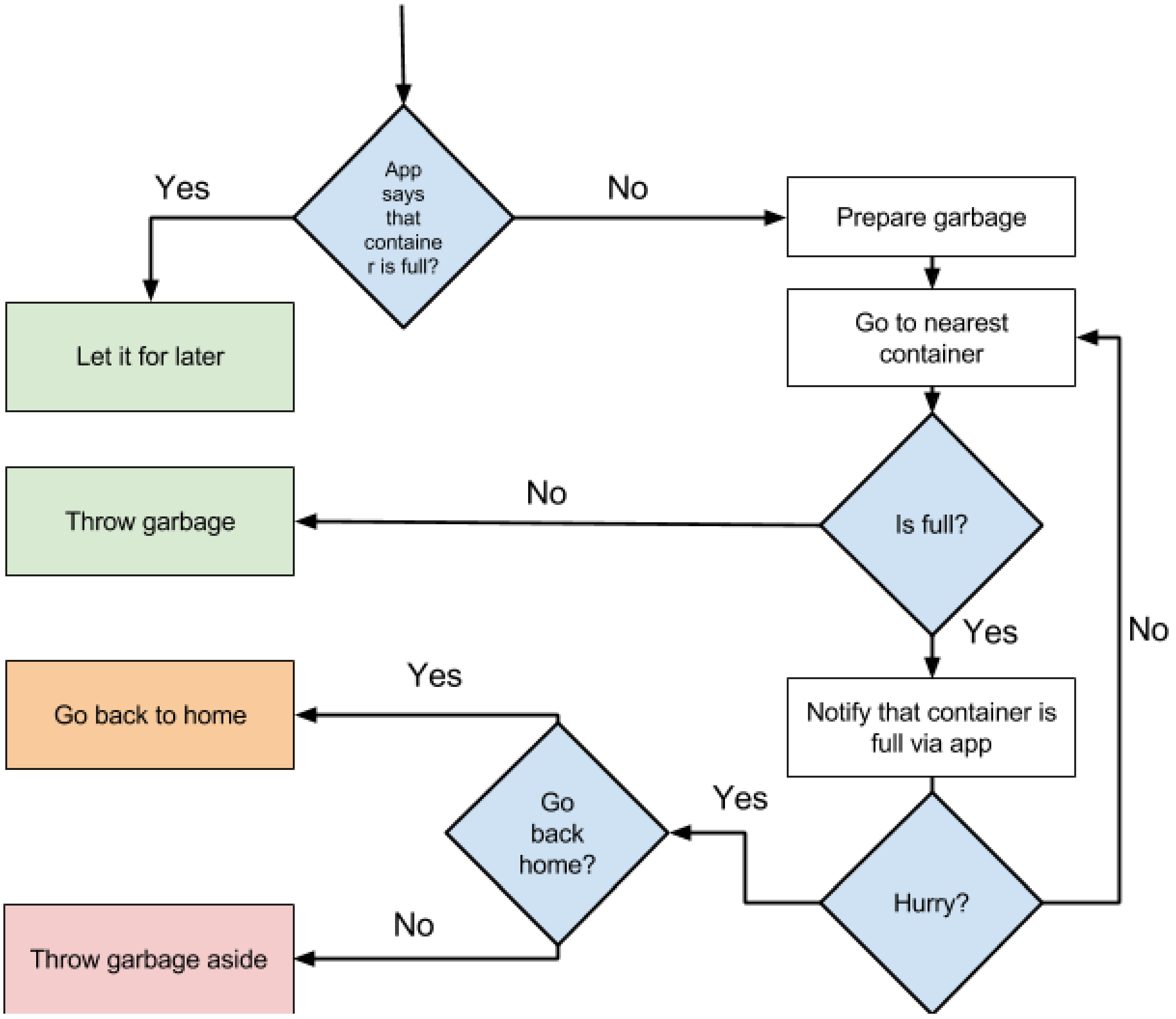
- Notify users when its closest containers are full
- Notify users when its closes containers are emptied
- Notify administration when a container is full

The garbage collection plan would be the classical. The benefits of this phase are:

- Users knows when to throw garbage and when not
- Administration knows when a garbage container has to be emptied

Required data:

- User input of full containers taken from apps
- Integrated system information of when a container is emptied (from trucks or container itself)
- Integrated system information of when a container is full from container’s sensors.



Phase II

This phase addresses the question “Why happened that?” and the main objectives are:

- When a container is full infer its cause among a these:
  - Issues in the garbage collection plan like latency, then notify users about the possible implications
  - Change of user’s behaviour, then review the garbage collection plan to match behaviour

The garbage collection plan would be the classical. The benefits of this phase are:

- Users knows the status of the service and therefore could make better decisions
- Administration is notified of issues in service and/or users and therefore has enough information to review plans

Required data (includes the one from previous phase):

- Geospatial data of garbage collectors to detect issues
- Traffic and weather data
- Data of incidences in garbage collection system

Phase III

This phase addresses the question “What shall happen?” and the main objectives are:

- Forecast the fill rate of containers so
    - Inform users of the fill rate of container at future hours (will be my container empty at night?)
    - Inform administration of the fill rate of all containers at future hours

The garbage collection plan would be the classical but reviewable. The benefits of this phase are:

- Users can plan its actions, so they can actually save time.
- Administration can prepare plans with anticipation due to forecast

Required data (includes the one from previous phase):

- Time series data of garbage mass of containers from sensors

Phase IV

This phase addresses the question “what we should do to maximize success?” and the main objectives are:

- Suggest users when to throw the garbage
- Automatize the garbage collection plans updates

The garbage collection plan would be the classical. The benefits of this phase are:

- Users knows the status of the service and therefore could make better decisions
- Administration is notified of issues in service and/or users and therefore has enough information to review plans

Open Data

All phases could be joined with a new open data web that integrates the data visualization and new row data. For example for phase I:

- Visualization of garbage collectors routes in a time-lapse for some time-window (yesterday, last week, …) via CartoDB maps
- Visualization of current status of containers in the zone via CartoDB maps