Collaboration in city logistics using interactive simulation

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Participatory Modelling

- Complex problem
- One side of the story
- Involvement & Empowerment
- Commitment

Research Questions

- Modeling is a complex exercise for a complex problem
  - How to leverage knowledge from city logistics experts (unfamiliar with modeling)?
  - Can a group of different stakeholders agree on the estimation of the impacts?
- Two perspectives to better involve experts into participatory modeling:
  - A concept: Open Models
  - A tool: Interactive Simulation

Open Models

Given my fondness for computers, I always find it a bit regrettable when I reach that conclusion: that I don't need a computer, but only an envelope and a pencil. But facts must be faced. Intelligent approximation, not brute force computation, is still the key to effective modeling.

Herbert A Simon, Prediction and Prescription in Systems Modeling, 38 OPER. RES. 7–14 (1990), http://www.jstor.org/stable/171293.

Open Models

« Perfection is achieved, not when there is nothing more to add, but when there is nothing left to take away. »

Antoine de Saint-Exupéry

How to build an Open Model ?

- Be lazy (or smart)
  - Missing constraints
  - Missing parameters
- Benefits of being lazy
  - Simple
  - Open for discussion
  - Engage the users (e.g. exploring time windows constraint)

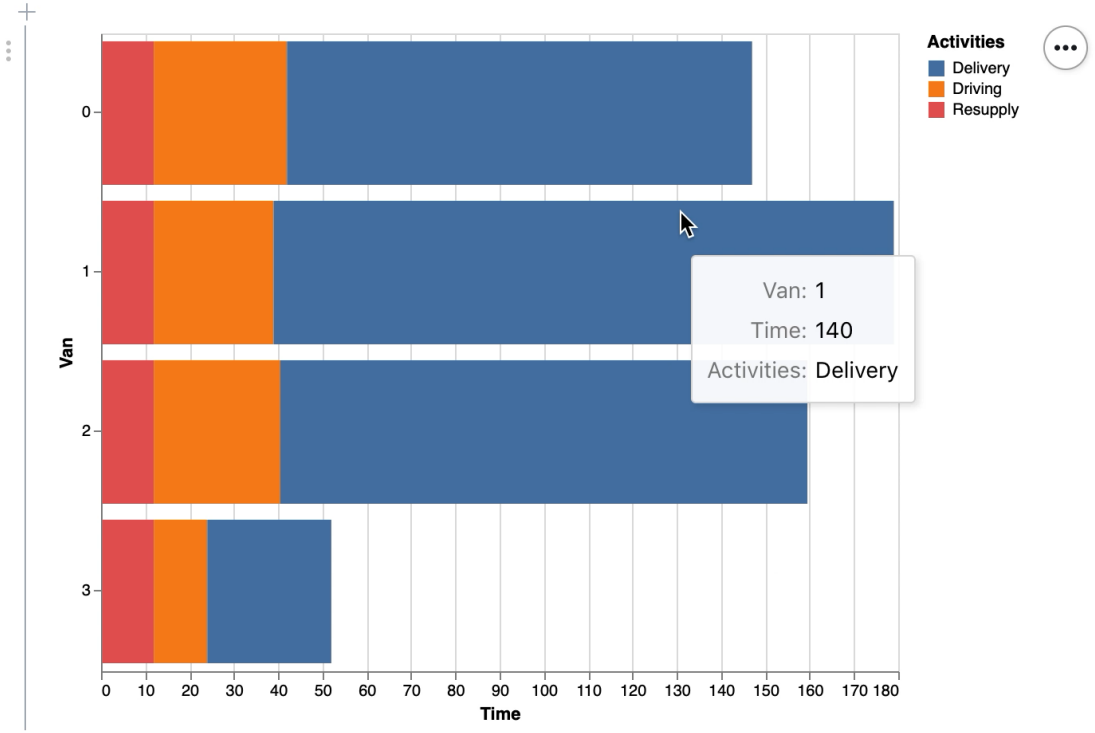
Interactive Simulation

Daily shift — Vans

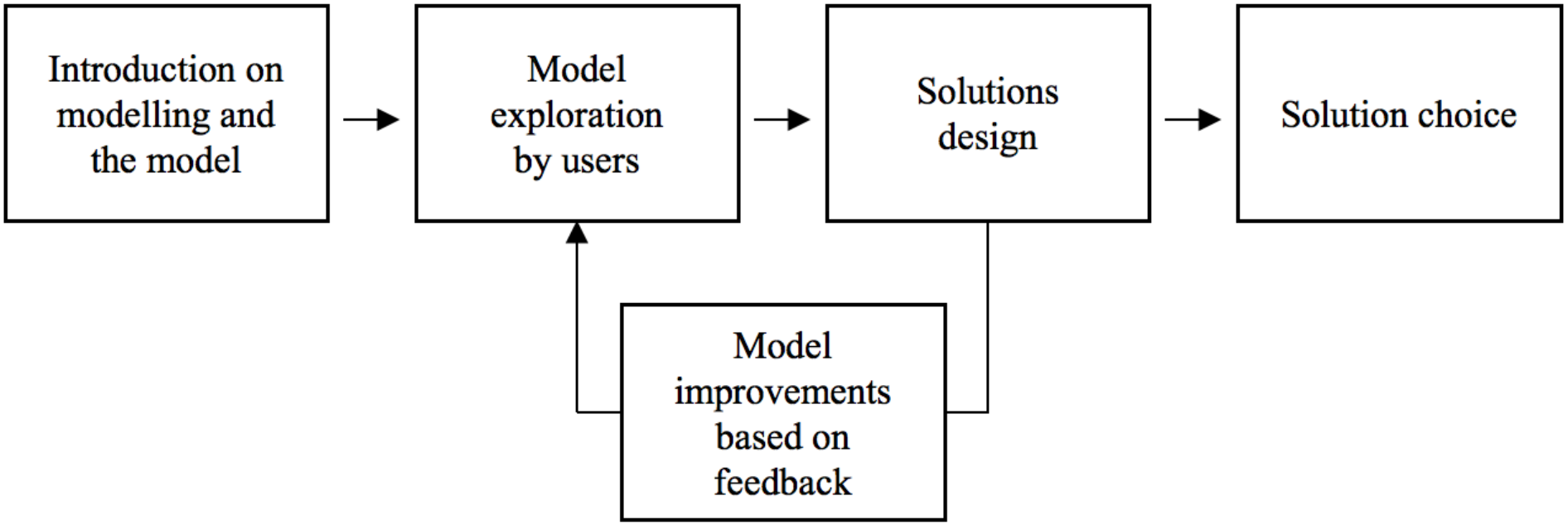
Vehicle speed (km/h) : 20

(Re)supply duration (min) : 12

Delivery duration (min) : 7



Participatory Modelling Process



Experiment Objectives

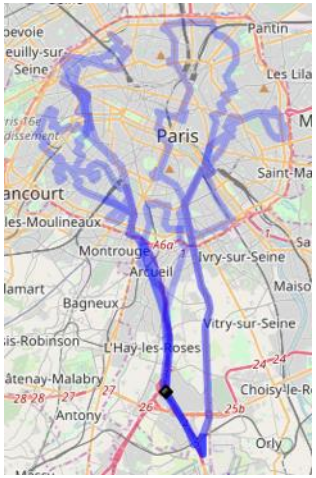
- Previous experiment showed users' capacity to understand a model thanks to interactive simulation
- For this experiment:
  - How do users react to be in the role of a designer?
  - Are experts different from students?
  - Is it easier for users to break down the exercise?

Experiment Methodology

- Step 0 - Use case presentation and problematic
- Step 1 - “Paper” model
- Step 2 - Interactive simulation
- Step 3 - Interactions between participants

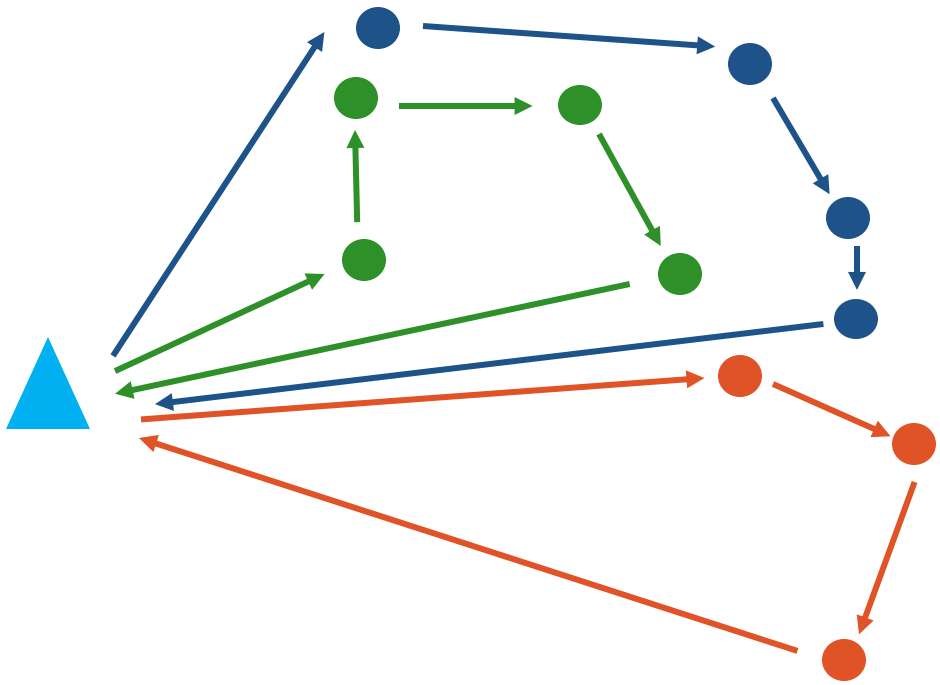
Use Case

- Restaurants deliveries
  - Nb clients: 200
  - Vehicle capacity: 15 clients
  - DC: suburbs (Rungis)
  - Dropoff duration: 11 min
- E-commerce deliveries
  - Nb clients: 200
  - Vehicle capacity: 50 clients
  - DC: city (Beaugrennelle)
  - Dropoff duration: 2 min



Model: Capacited Vehicle Routing Problem

- One distribution center
- n points to deliver
- Infinite number of vehicles
- Vehicles have limited capacity
- Optimization strategy: minimizing the total driving distance
- Output: driving distance



Five Regulations

- Vehicle size: trucks are forbidden.
- Time windows: deliveries are only allowed between 9:00 and 11:30 am.
- Land reserve for logistics: warehouse is far from the logistic demand.
- Motorization ban: only EURO 5 and 6 motorizations are allowed.
- Sustainable development: the clients lower their consumption.

Experiment Methodology

- Step 0 - Use case presentation
- Step 1 - “Paper” model
  - Biggest impact for restaurants or e-commerce?
  - How confident are you?
- Step 2 - Interactive simulation
  - Biggest impact for restaurants or e-commerce?
  - How confident are you?
- Step 3 - Interactions between participants
  - Biggest impact for restaurants or e-commerce?
  - How confident are you?

Results

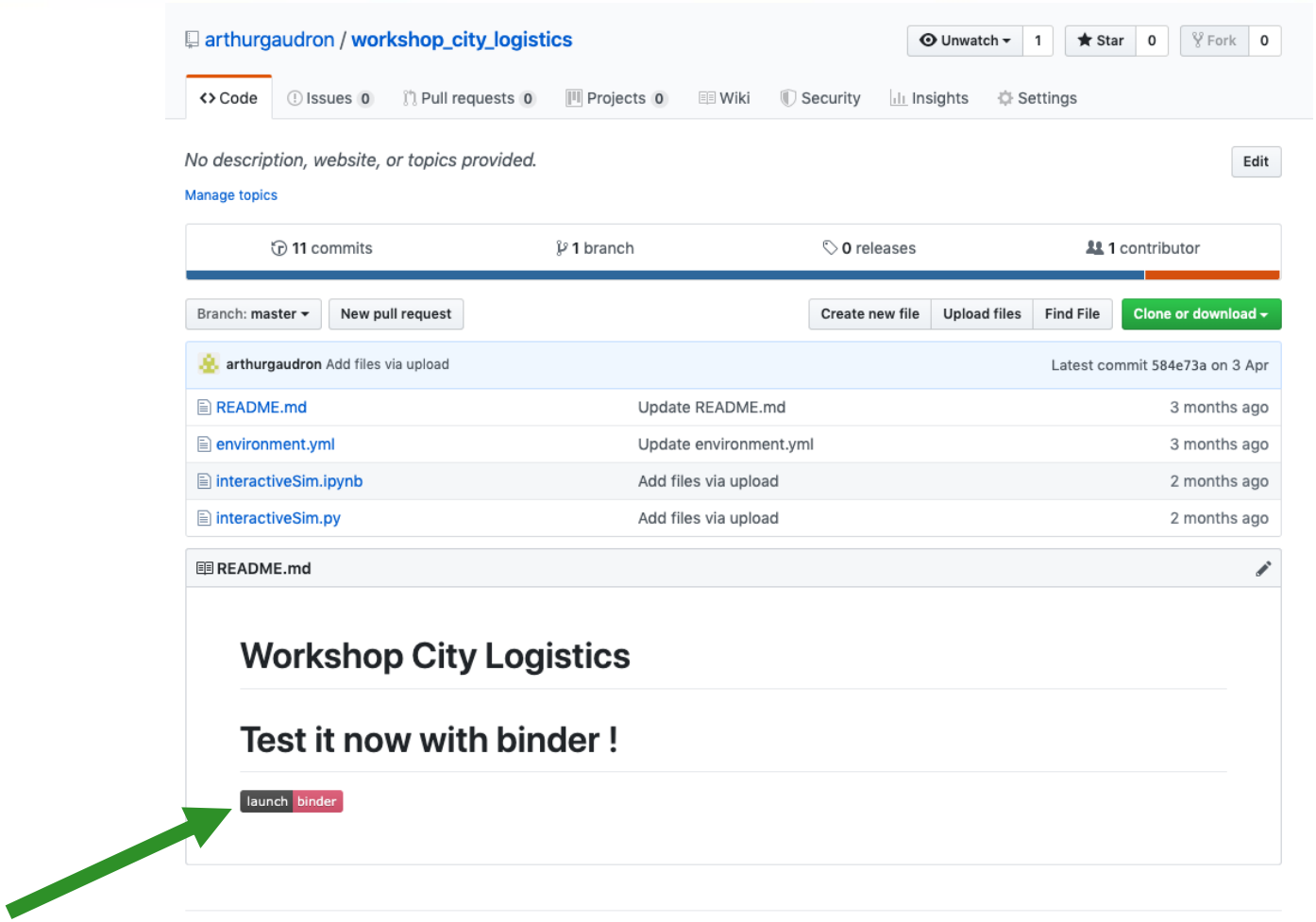
- How do users react to be in the role of a designer?
  - Understand the complexity of a simple model
  - Simple model are not simple enough
- Are experts different from students?
  - Students are more disciplined than experts…
  - Students are learning (e.g. motorization ban)
  - Experts are arguing (e.g. “what are your objectives?”)
- Is it easier for users to break down the exercise?
  - Gentle introduction on modelling
  - Users have more time to prepare their ideas for the interaction part

Conclusion

- A good platform for discussion and share knowledge between stakeholders
- It is possible to agree on the impacts…
  - Open Model can capture enough information
  - Interactive Simulation helps users to explore a model
- … as long as we don't say who is going to pay for the negative externalities!
- My two cents after this workshop: it is a question of responsibility
  - Cities
  - Researchers
  - Companies & Customers

Curious about technology googles ? https://smartenoughcity.mitpress.mit.edu/

github.com/arthurgaudron/



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Links and publications: arthurgaudron.github.io

Thank you!

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