Collaboration in city logistics using interactive simulation

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Participatory Modelling

• Complex problem
• One side of the story
• Involvement & Empowerment
• Commitment
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
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.

« 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

![Graph showing daily shift for vans with activities and time]
Participatory Modelling Process

- Introduction on modelling and the model
- Model exploration by users
- Solutions design
- Solution choice

Model improvements based on feedback
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: Capacitated 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
• 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

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Collaboration in city logistics using interactive simulation

Links and publications: arthurgaudron.github.io

Thank you!

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