Modelisation et Optimisation de la Distribution Urbaine de Marchandise

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The ANR Project MODUM

Project General Informations

ANR program	*Villes durables 2010*
title	*Mutualisation et Optimisation de la Distribution Urbaine de Marchandises*
coordination	Roberto Wolfler Calvo, LIPN, Université Paris 13
start, due date	01/12/2010 – 30/11/2014
web site	http://www-lipn.univ-paris13.fr/modum/

Partners

- LIPN Université Paris 13
- SFL École des Mines de Saint Etienne
- LET Université Lyon 2
- CERMICS ENPC ParisTech

Context

Statement

The efficiency of freight transport systems in urban areas is a complex subject

Challenges

Implementing large-scale centralized systems raise two major challenges:

- logistics management
- information flow

Observations

This project is based on two observations

- Experiments and Scientific literature were rare (2010)
- Information sharing in large-scale complex systems it is now possible (ICT)

Context (2)

In the future

In the next years we will see the implementation of freight system that are integrated in urban area and mutualized.

But:

Lack of data

Modeling this type of system and quantifing the expected gains is challenging, because there is not such system in the real world yet.

Therefore the adopted approach is to simulate the operation of the system

MODUM

The objective of the project was to explore these issues, focusing on the three facets: *economic*, *environmental* and *social*.
(i.e., define its operation, organization and question the role of different actors)

The project MODUM

Purpose

Feasibility study of a new City Logistics System

- a ring of publicly held Urban Distribution Centers (UDC) (two-echelon, single-tier)
- low-polluting vehicles at both UDCs and Self-service Parking Lots (SPL)
- economic, social, environmental feasibility

Innovative aspects

- massive circulation of flows of goods takes place around the City
- minimization of empty miles

The project MODUM (2)

System Highlights

- mutualized distribution
- environmental targets

Objectives

- suite of tools to prove the efficiency of the proposed Distribution System:
  - strategic/tactical optimization: location of UDCs and ring design
  - operational optimization: daily basis services, time dependency
  - simulation: evaluation and demonstration
- real data models, impact analysis

The System Architecture

scenario and demands

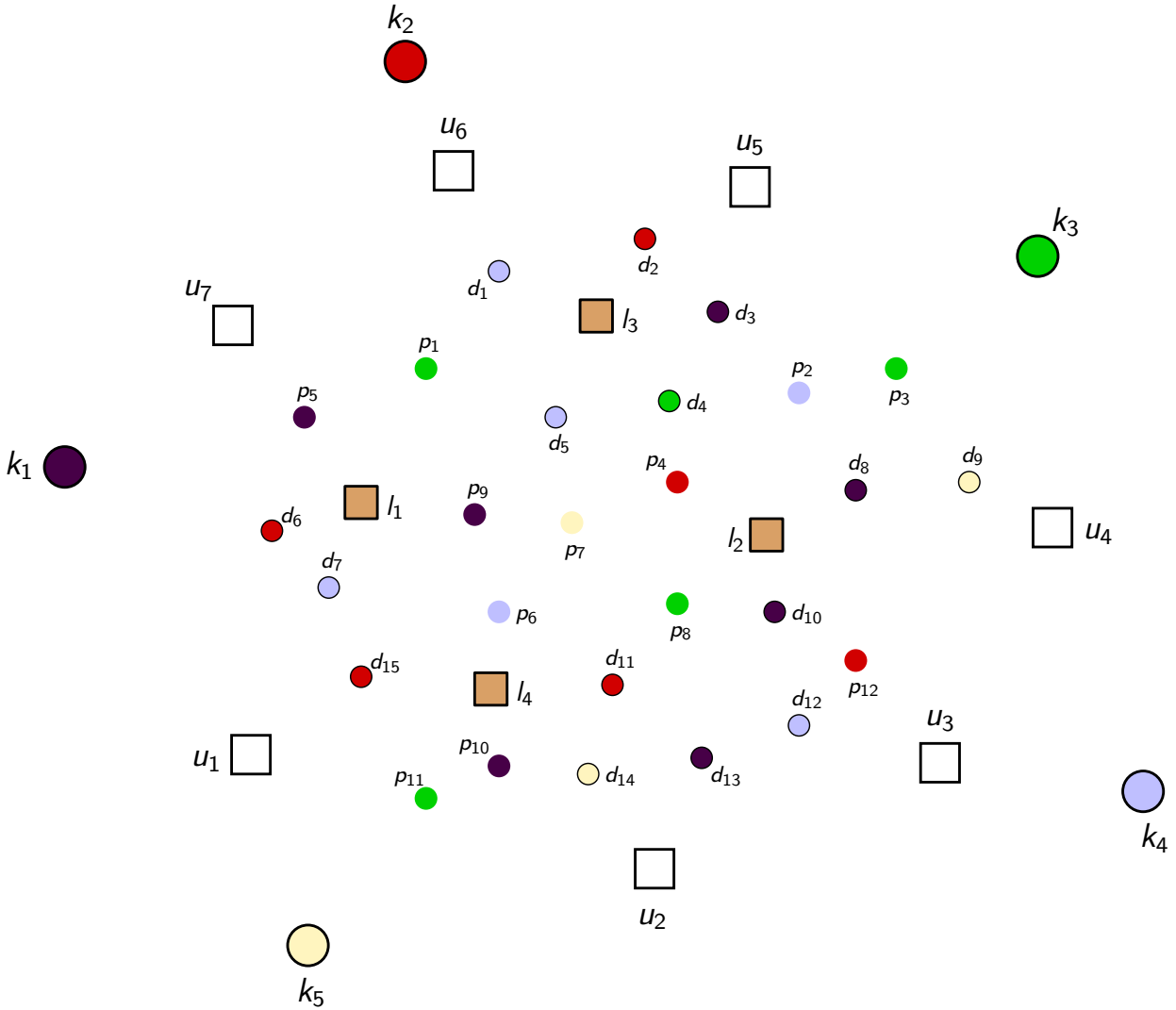

Figure: The initial Data

The System Architecture

the network

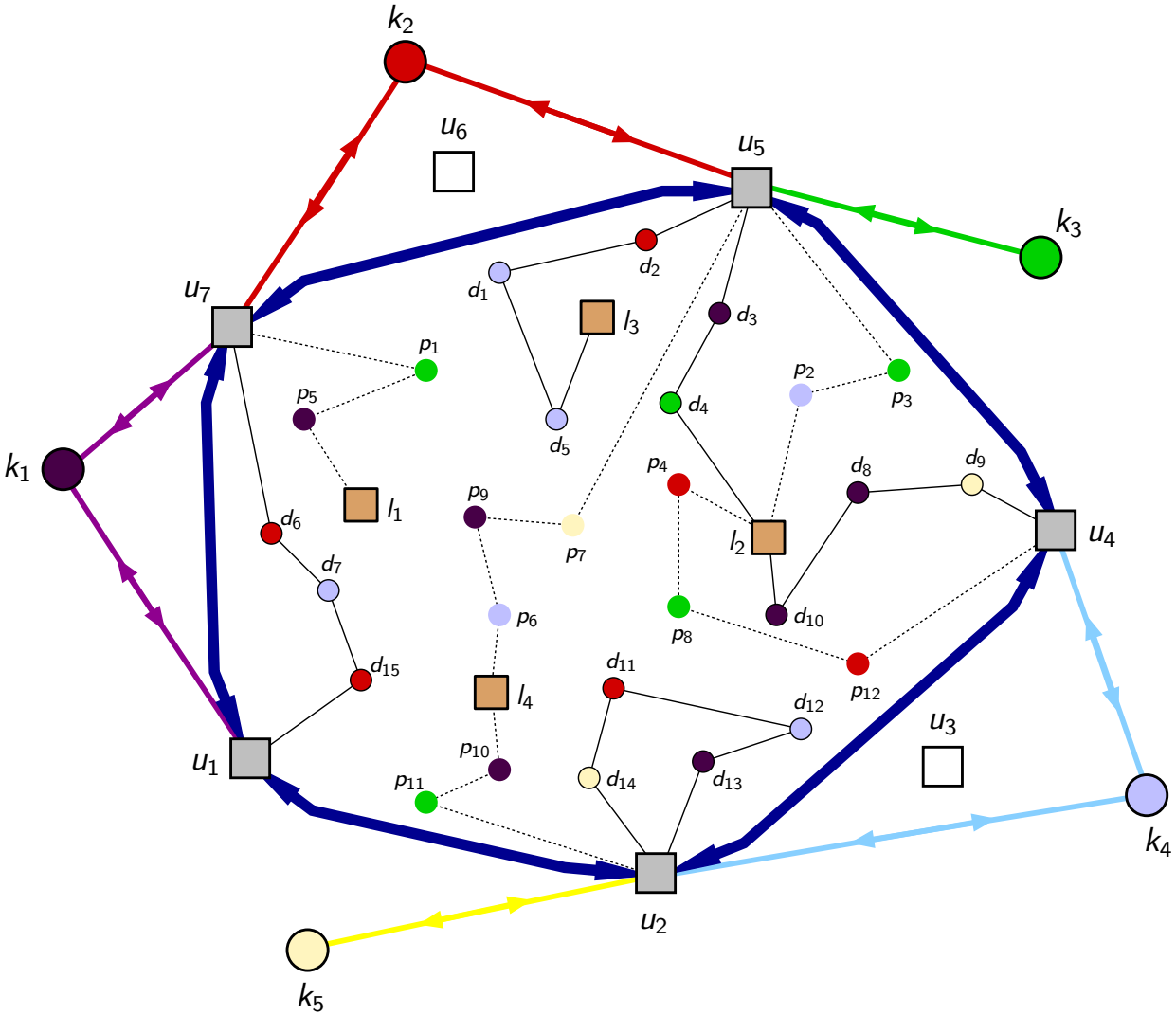

Figure: A possible configuration of the system

The tasks

DSS

SW Framework of optimization/simulation tools to prove the efficiency of the proposed system (partner who takes care of):

- real data models and impact analysis (LET)
- strategic level: location of UDCs, ring design, aggregated data on goods (LIPN)
- operational level: daily basis services, time dependency and constraints (SFL)
- simulation tools to evaluate/improve the methods (LVMT)

Interdisciplinarity

- state of the art: literature on routing problem applied to city logistic
- definition of the system under study
- generation of realistic data for simulate de system behavior

The DSS

The data

The objective is to retreive/generate all the data necessary for running the simulation and the whole dss

The strategic problem

The objective is to set the strategic decison (long term decisions) to the *optimal* values

The operational problem

The objective is to test the robustness of the system by (re)optimizing the real time decisions

The Web-GUI

The objective is to define the graphical user interface making the system available throught the web

The Data

The objective

To prepare the data necessary for running the model of the logistic system under study

Data

- Definition of a meta-city similar to *agglomeration lyonnaise* (around 777 points)
- Quantity demanded for each zone:
  - Number of tons in input and output for each zone and type of activity
  - Vehicles:
    - those used and their characteristics;
    - function of correspondance between capacity, unloaded quantity and PTAC.

The Data (2)

Data generation

- O/D Matrices of flows between zones
- Time window constraints
- Potential nodes for locating CDUs
- Time windows for pickup and delivery for each demanding node
- Time for loading and downloading at CDU and for each client
- An upper bound on the length of the routes
- Travel time matrix between nodes

The System Architecture

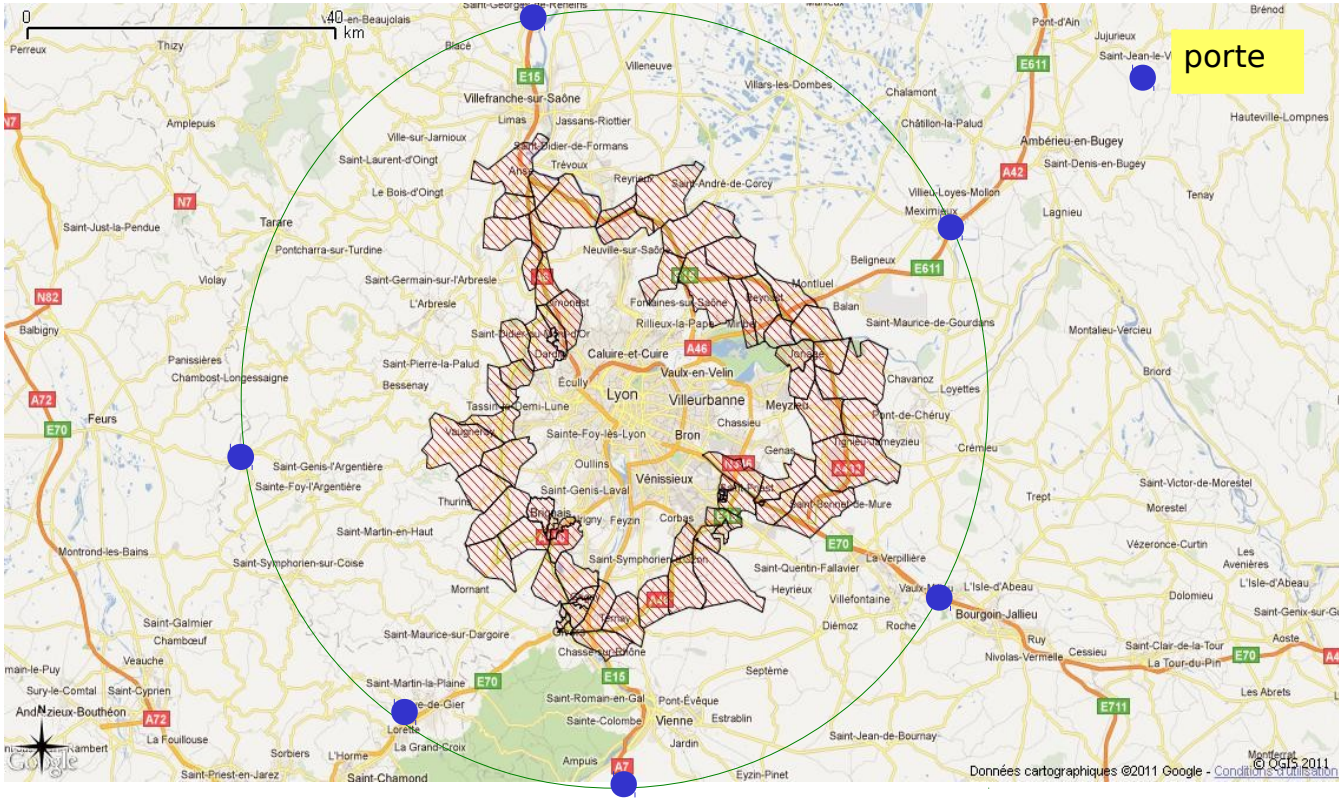

Figure: The Lyonnaise agglomeration

The Strategic problem

Method

Operation research with aggregated data

Objective functions

Costs, CO2 Emissions

Decisions

- UDCs
  - Locations
  - Size
  - Number
- Ring
- Flow (from port to UDCs) among UDCs

The operational problem

Method

Operation research and Simulation for generating real time data

Indicators

clients satisfied, time windows respected

Decisions

- Routes
- Flows
- Quantity loaded
- Quantity unloaded

Interviews

Typology of the 20 Interviews

- 5 public authorities
- 4 associations or federations of private actors
- 6 transportation and logistics companies
- 3 logistics real estate business and management of logistic platforms
- 2 others (public transport operator company and lockers)

Interviews (2)

Incentives and obstacles for using CDUs

- Regulation
- Logistics management
- Environmental awareness
- Competition - balanced by the market
- Funding
- Business Strategies
- Disclaimer and Privacy
- Human Relation

Results

1. DSS
2. Study of economic, ecological, regulatory, urban, cultural, sociological and sustainable development related issues and levers
   - Real cities data collection (FRETURB) and design of real world instances
   - Survey, interviews (Paris, Lyon) to real world actors (transporters, local authorities) who could be interested to take part in the project
3. Technology Transfer Activities:
   - Publication of articles in international journals (European Journal of Operational Research, Transportation Science)
   - Publication in a book
   - Publication of a article in national journal
   - Participation to national (ROADEF 2012-2013, PREDIT 04) and international (Odysseus 2012, VeRoLog 2012-2013, EURO 2013) conferences
   - Organization of Thematic Meetings