How to build an alternative to sprawl and auto-centric development model through a TOD scenario for the Nord-Pas-de-Calais region? Lessons from an integrated transportation-land use modelling.

Fausto Lo Feudo
PhD candidate
in transport and urban planning

fausto.lofeudo@ifsttar.fr
introduction

questions and objectives of research

land use and transport integration

Transit Oriented Development

Land Use and Transport Integrated modelling

Tranus model for Nord Pas de Calais (France)
questions and objectives

issues

Urban sprawl

Car dependency

+ 1800 ha/y of urbanised land
17% of total land in 2010  (France 9%)

strategies

Land use and transport policies integration & coordination

political objectives

+ 500 ha/y of urbanised land by 2020

double TER (regional railway service) rate of frequentation

research questions

does TOD make sense for the NPDC region?
does a TOD regional plan limit urban sprawl and car dependency?

Nord Pas de Calais

tool

LUTI Modelling (Tranus)
cumulative and synergic effect of interaction factors (Litman, 2012)
various temporalities (Wegener, 1999)
Transit Oriented Development

- high density
- functional mixing
- priority to active mobility & PT
- urban design quality
Transit Oriented Development

from a car oriented paradigm to...

- physically transit oriented and not just adjacent (Cervero, 2012)
- multi-modal and polycentric development (Litman, 2012)
- tool to promote rail use (Nuzzolo 2010; Leysens, L’Hostis, 2011)
- TOD to reinforce node and place function (Bertolini, 1999)

obstacles:
- sharing and acceptance of TOD principles (concept interpretation)
- different solutions for different contexts (transferability & adaptation)
- institutional and operational barriers (coordination)
- time factor and gentrification (equity)

Source: ITDP Mexico
LUTI modelling

evaluate applicability and effects of a TOD regional plan in NPDC

implementation of a LUTI model

_a land use and transport integrated model is a theorized and formalized representation to analyze a territory in its spatial, economic and social aspects. (Laurent, 2012)_

base scenario (observed data) → implementation (hypothesis) and execution → calibration → futur simulations

observed data ≠ calculated data
LUTI modelling

classic models: exogenous land use data

LUTI models: land use data generated by the model
integration of various theoretical approaches:
spatial macro economics (*Von Thunen*); gravity and entropy models (*Lowry*); input-output model (*Leontief*); random utility model (*McFadden*); path choice algorithm (*Dijkstra*)

aggregated model - based on equilibrium between supply and demand
model hypothesis inspired by regional planning strategies
promote urban densification near transit and rail network; improve territorial attractiveness; make the regional a railway European hub; promote transit use

base scenario: 2009 (national census data)

scenario A «Trend Scenario»

scenario B «Regional TOD Plan»:
progressive densification in selected rail corridors and nodes (TOD zones)
improvement of PT frequencies: + 10% at 2017 and 2021; + 20% at 2025

scenario C «Regional TOD Plan + transit use incentives»:
progressive densification near selected rail corridors and nodes (TOD zones)
improvement of PT frequencies: + 20% at 2017 and 2021; + 30% at 2025
Integrated tariff (bus and rail)
Introduction of a tool for highways (0.08 €/km)
TOD potential rail corridors

rail station district insertion in urban fabric
(Van der Poorten & Nedellec, 2013)

- rail station
- not urbanised
- urbanised

integrated

two-headed

fragmented

- Armentieres
- Fretin
- Haubourdin
- Lesquin
- Seclin
- Comines
- Quesnoy-sur-Doule
- Orchies
- Saint Armand Les Eaux
- Brébiere-Vitry-Corbehem
- Lillers-Choques
- Ostricourt
- Dunkerque
- Hénin Beaumont
- Bauvin-Sanghin
- Loos-Lievin-Bully
- Santes-Wavrin
- Phalempin-Libercourt
- Hautmont
- Aulnoye
- Denain-Somain-Bouchain
### Structure of the Model

#### Households categories
- High Income
- Medium Income
- Low Income

#### Transport categories
- Home to work
- Home to service
- Exogenous O/D matrix
- External trips
- Trucks

#### Activity sectors
- Industry/constructions
- Tertiary service
- Tertiary public

#### Transport system
- Physical supply (infrastructures)
- Operative supply (PT services)
- Transport demand behaviours (preferences, value of travel & waiting time, etc.)

#### Land Use types
- Available land
- Monthly rental price (par type and zone)
- Mixed
- Residential
- Collective
- Activity
- Rural/detached
- Brownfield
hypothesis *TOD* scenario

Progressive densification

<table>
<thead>
<tr>
<th>Residential</th>
<th>5% in 2017</th>
<th>15% in 2021</th>
<th>20% in 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty land</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Urban mixed</th>
<th>5% in 2017</th>
<th>10% in 2021</th>
<th>15% in 2025</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TOD land</th>
<th>15% in 2017</th>
<th>25% in 2021</th>
<th>35% in 2025</th>
</tr>
</thead>
</table>

density TOD land = + 10/15% higher than urban mixed land
land use results - households

Scenarios:
- Scenario A - 2025
- Scenario B - 2025
- Scenario C - 2025

Households growth 2025:
- -25000 - -10000
- -10000 - -1000
- -1000 - 1000
- 1000 - 10000
- 10000 - 25000
- 25000 - 50000
- TOD Zones
- regional railway TER

Scale 1:750000
land use results - jobs

Scenario A - 2025

Scenario B - 2025

Scenario C - 2025

Job growth 2025:
-25000 - -10000
-10000 - -1000
-1000 - 1000
1000 - 10000
10000 - 25000
25000 - 50000

Scale 1:750000
land use results – land prices

Scenario A - 2025

Scenario B - 2025

Scenario C - 2025

Land prices growth 2025

-20000 - -5000
-5000 - 5000
5000 - 20000
20000 - 50000
50000 - 90000

TOD Zones
regional railway TER

Scale 1:750000
land use results – land consumption

CONSUMED LAND

urban mixed (ha)

detached land (ha)

residential land (ha)
transport results – modal share

Rush hour Simulation 7h – 9h
Home – Work
Home – Service

modal share

<table>
<thead>
<tr>
<th>Year</th>
<th>Car</th>
<th>Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>92%</td>
<td>8%</td>
</tr>
<tr>
<td>2025 A</td>
<td>89%</td>
<td>11%</td>
</tr>
<tr>
<td>2025 B</td>
<td>86%</td>
<td>14%</td>
</tr>
<tr>
<td>2025 C</td>
<td>84%</td>
<td>16%</td>
</tr>
</tbody>
</table>

train and bus trips

<table>
<thead>
<tr>
<th>Year</th>
<th>Train</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>10666</td>
<td></td>
</tr>
<tr>
<td>2025 A</td>
<td>19910</td>
<td></td>
</tr>
<tr>
<td>2025 B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025 C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
transport results – modal share

**evolution of car and PT number of trips**

- **LMCU**
  - CAR 2025 A: 7%, CAR 2025 B: 22%, CAR 2025 C: 151%
  - PT 2025 A: 7%, PT 2025 B: 95%, PT 2025 C: 113%

- **TOD**
  - CAR 2025 A: 34%, CAR 2025 B: 72%, CAR 2025 C: 136%
  - PT 2025 A: 33%, PT 2025 B: 46%, PT 2025 C: 49%

- **RURAL**
  - CAR 2025 A: 25%, CAR 2025 B: 46%, CAR 2025 C: 49%
  - PT 2025 A: 46%, PT 2025 B: 49%, PT 2025 C: 151%

- **CITIES**
  - CAR 2025 A: 64%, CAR 2025 B: 75%, CAR 2025 C: 75%
  - PT 2025 A: 75%, PT 2025 B: 81%, PT 2025 C: 81%

**evolution number of trips by trains**

- **LMCU**
  - 2025 A: 45%, 2025 B: 99%, 2025 C: 131%

- **TOD**
  - 2025 A: 81%, 2025 B: 131%, 2025 C: 245%

- **RURAL**
  - 2025 A: 120%, 2025 B: 47%, 2025 C: 44%

- **CITIES**
  - 2025 A: 57%, 2025 B: 75%

**Evolution number of trips by bus**

- **LMCU**
  - 2025 A: 31%, 2025 B: 97%, 2025 C: 161%

- **TOD**
  - 2025 A: 97%, 2025 B: 161%, 2025 C: 236%

- **RURAL**
  - 2025 A: 47%, 2025 B: 58%, 2025 C: 115%

- **CITIES**
  - 2025 A: 81%, 2025 B: 100%
transport results – TOD zones

modal share in TOD zones

TOD Armentieres  TOD Fretin  TOD Haubourdin  TOD Lesquin  TOD Seclin  TOD Comines  TOD Quesnoy-sur-Doule

TOD Orchies  TOD Armand Les Eaux  TOD Brébiere-Vitry-Corbehem  TOD Lillers-Choques  TOD Ostricourt  TOD Dunkerque  TOD Hénin Beaumont

TOD Bauvin-Sanghin  TOD Loos-Lievin-Bully  TOD Santes-Wavrin  TOD Phalempin-Libercourt  TOD Hautmont  TOD Aulnoye  TOD Denain-Somain-Bouchain

2009 CAR  2009 Transit  2025 A CAR  2025 A Transit  2025B CAR  2025B Transit  2025 C CAR  2025 C Transit
transport results – level of service

Base scenario 2009

2025 scenario C

□ A  Level A
□ B  Level B
□ C  Level C
□ D  Level D
□ E  Level E
□ F  Level F
□ G  Level G
□ H  Level H
transport results – level of service

Base scenario 2009

2025 C

Car became again more attractive than PT
conclusions

about results:

- show an increase of sprawl without specific contrasting policies
- TOD regional plan (scenario B and C) induces a limitation of sprawl and of car use
- TOD effects increase if associated with policies that discourage car use and improve transit performance (scenario C)
- land prices evolution confirms TOD capacity of value capture
- TOD effects are more evident in zones with a basic economic and productive dynamism with significant initial land and transport demand (rail corridors Lille – Douai; Lille – Lens - Bethune)

about modelling:

- complexity about the multi – scalar and regional approach (different densities and land uses for different territorial scales)
- complexity about modelling TOD
- Limits related to aggregated zoning (good for global analysis, less for punctual analysis)
- calibration and output analysis (need of time and of a multidisciplinary approach)
- Tranus confirms is consistence in multi - scalar and regional modelling
thanks a lot for your attention!

Contact: fausto.lofeudo@ifsttar.fr
Nord Pas de Calais Tranus model
Nord Pas de Calais Tranus model

mobil.TUM 2014
Sustainable Mobility in Metropolitan Regions
Munich, Germany - May 19-20, 2014