COMMUTING FLOW PATTERNS IN LMA: TOWARDS AN EFFECTIVE CONTRIBUTION TO SUSTAINABLE DEVELOPMENT?

Ana Louro
Nuno Marques da Costa
CEG-IGOT-ULisboa

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1th UPE Lusophone Symposium
The main objectives of this paper:

1) To understand the evolution of commuting flow pattern in LMA, and;

2) Related it with the polycentrism perspective as the preferential spatial model for Sustainable Development in a multi-level scale.

Structure:

Introduction: objectives & methodologies

1. Polycentrism as path to Sustainable Development

2. Evolution of commuting flow patterns in LMA towards SD

2.1 LMA brief characterization
2.2 Main trends of commuting in LMA
2.3. One Fact Stands Out: Distance To Lisbon City Center

3. Demand vs Supply of public transport – The case of Bus in LMA

4. Final considerations
INTRODUCTION: OBJECTIVES & METHODOLOGY

SPECIFIC OBJECTIVES:

a) having LMA as case study, to understand the evolution of commuting flow patterns between 1981 – 2011, considering the Origin-Destination matrix, travel time and travel mode;

c) in the context of public transport system in LMA, to briefly analyze the bus system, in order to understand the mismatch between the existent service and their use.

METHODOLOGY:

a) collect and organize statistical data – population and commuting flows (Census, 1981 - 2011); employment (Ministry of Economy, 2003-2013);

b) collect and organize the database of public transport system in LMA (the case of bus, 2015);

c) use of a GIS, to represent spatial evolution of commuting flow patterns and the bus network coverage.
European policy orientations promote **polycentrism** as key concept to territorial cohesion and **sustainable development**.


The objectives of **polycentric development** are clearly defined in the Portuguese spatial planning instruments, namely in PNPOT (2007) and in the Regional Spatial Planning Strategies, reinforcing the Sustainable Development Strategy at national, regional and local levels.

**In Portuguese Metropolitan areas:**
» Functional Urban Areas have not enlarge from 2001 to 2011 (despite the urban sprawl), but reinforced the relations between the Metropolitan municipalities.

(Costa & Costa, 2013)
1 POLYCENTRISM AS A PATH TO SUSTAINABLE DEVELOPMENT

» Complementarity of functions and employment
» Existence of an integrated infrastructure and public transport system

FUA
• **Principles:** integrated planning and management of infrastructures and services
• **Goal:** contribute for a more sustainable territorial model – strategic perspective; promoting connection through a high quality public transport network

Local – Ex. Sustainable Communities
• **Principles:** self-sufficiency, proximity, governance
• **Goal:** promotion of non-motorized travel modes or public transport modes; easy access to employment, public facilities, sports and leisure, etc.
1 POLICENTRISM AS A PATH TO SUSTAINABLE DEVELOPMENT

**Polycentrism** has two complementary aspects:

1st) morphology - distribution of urban areas (number of cities, hierarchy, distribution);

2nd) relations between urban areas - networks of flows and cooperation (generally related to proximity, though networks can also be independent of distance).

(ESPON, 3, 2005).

In this sense, the variables “employment” and “travels” are fundamental to measure polycentrism, allowing the identification of centers and sub-centers.

(Giuliano e Small, 1991; McDonald e Prather, 1991)

**Commuting travel** could be used to analyze the functional dimension of polycentrism as it reflects the interaction among municipalities or regions. In this case, commuting travel was considered as a functional aspect as it **represents the organization of housing and labor/scholar dimensions**.

(Nunes, Mota & Campos, 2011, 8)
2. EVOLUTION OF COMMUTING FLOW PATTERNS IN LMA (1981-2011)
2.1 LMA brief characterization

18 municipalities separated by Tagus River

increased population of 13.7% (Census 1981 - 2011)
(from 2,482,276 inhabitants in 1981 to 2,821,699 inhabitants in 2011)
2.1 LMA brief characterization

- Influence of geographical dispersion of residential and labor functions
2.2 Main trends of commuting in LMA

**Destination of commuting trips**

- 1981: 1,200 thousand
- 1991: 1,500 thousand
- 2001: 1,800 thousand
- 2011: 2,000 thousand

- In other municipality: 1981 - 500 thousand, 1991 - 600 thousand, 2001 - 700 thousand, 2011 - 800 thousand

No data about “within residence parish” for 1981

**Transport mode**

- Walk or none: 1981 - 10%, 1991 - 20%, 2001 - 30%, 2011 - 40%
- Other: 1981 - 0%, 1991 - 10%, 2001 - 20%, 2011 - 30%
- Company or school transport: 1981 - 0%, 1991 - 5%, 2001 - 10%, 2011 - 15%
- Bus or metro: 1981 - 0%, 1991 - 10%, 2001 - 20%, 2011 - 30%

**Travel time (one trip)**

- Less than 16 min: 1991 - 20%, 2001 - 20%, 2011 - 20%
- 16 - 30 min: 1991 - 40%, 2001 - 40%, 2011 - 40%
- 31 - 60 min: 1991 - 20%, 2001 - 20%, 2011 - 20%
- > 60 min: 1991 - 10%, 2001 - 10%, 2011 - 10%

**Duration of travel – LMA (2011)**

- Average: 26.37 min
- Using individual transport: 22.09 min
- Using collective transport: 42.48 min

2.2 Main trends of commuting in LMA

- enlargement of urban functional areas
- Intensity increase of inter-municipal relations.
2.3. ONE FACT STANDS OUT: Distance to Lisbon City Center

Role of Lisbon Municipality in LMA

» Portuguese capital
» central position within LMA
» 3,3% of LMA surface;
» 19,4% of resident population
» 21,8% of dwellings

<table>
<thead>
<tr>
<th></th>
<th>LMA</th>
<th>Lisbon Municip.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density</td>
<td>940</td>
<td>6.448</td>
</tr>
<tr>
<td>(nº/km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling Density</td>
<td>496</td>
<td>3.814</td>
</tr>
<tr>
<td>(nº/km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average population age (years)</td>
<td>41,19</td>
<td>44,44</td>
</tr>
<tr>
<td>Average building age</td>
<td>37,19</td>
<td>61,97</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Source: Census 2011, INE
2.3 Distance to Lisbon City Center – Commuting ring patterns

**Destination of commuting flows**

1991

- 1: Lisbon
- 2: Ring 1
- 3: Ring 2
- 4: Ring 3
- 5: Ring 4
- 6: Ring 5

2011

- 1: Lisbon
- 2: Ring 1
- 3: Ring 2
- 4: Ring 3
- 5: Ring 4
- 6: Ring 5

**Travel time of commuting flows**

1991

- Less than 15 min
- 16 to 30 min
- 31 to 60 min

2011

- Less than 15 min
- 16 to 30 min
- 31 to 60 min

Reorganization/Concentration of the employment location; & Relative inflexibility of residential location.
2.3 Distance To Lisbon City Center

Travel mode of commuting flows

1991

2011

Lx city center » » » Fringe of LMA

This modal split reflects the individual option of Trading “space” for “time”

Synthesis

<table>
<thead>
<tr>
<th>Rings</th>
<th>O/D</th>
<th>Travel time</th>
<th>Travel mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Majority of inter-parish commuting</td>
<td>Convergence among rings profile between 1991 and 2011 (Specially ring 3)</td>
<td>Modal transfer: loss of Bus and walking specially in the central rings</td>
</tr>
<tr>
<td>2nd</td>
<td>Considerable inter-municipal commuting (especially ring 3)</td>
<td>Majority of commuting until 30 minutes</td>
<td>Great increasing of car use, specially the greater the distance to Lisbon</td>
</tr>
<tr>
<td>3rd</td>
<td>Balanced partition between intra-parish and inter-municipality commuting</td>
<td>Reduction of % of commuting during more than 60 minutes</td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5th</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6th</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. DEMAND VS SUPPLY OF TRANSIT SYSTEM
The case of BUS in LMA
3 Demand vs Supply of Transit system
The case of BUS

Decreasing of bus users for labor commuting... and increase of car use

... explained by bus system characteristics or personal option?
# 3 Demand vs Supply of Transit system

## The case of BUS

### BUS stops, 2015

<table>
<thead>
<tr>
<th>Munic</th>
<th>Nº stops</th>
<th>Stop dens. (stops/km²)</th>
<th>Stops per 10.000 inhab.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascais</td>
<td>992</td>
<td>10,2</td>
<td>48,0</td>
</tr>
<tr>
<td>Lisboa</td>
<td>2295</td>
<td>27,0</td>
<td>41,9</td>
</tr>
<tr>
<td>Loures</td>
<td>1045</td>
<td>6,2</td>
<td>51,0</td>
</tr>
<tr>
<td>Mafra</td>
<td>940</td>
<td>3,2</td>
<td>122,6</td>
</tr>
<tr>
<td>Oeiras</td>
<td>897</td>
<td>19,5</td>
<td>52,1</td>
</tr>
<tr>
<td>Sintra</td>
<td>2316</td>
<td>7,3</td>
<td>61,3</td>
</tr>
<tr>
<td>VF Xira</td>
<td>943</td>
<td>3,0</td>
<td>68,9</td>
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<tr>
<td>Amadora</td>
<td>617</td>
<td>25,9</td>
<td>35,2</td>
</tr>
<tr>
<td>Odívelas</td>
<td>540</td>
<td>20,5</td>
<td>37,4</td>
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<tr>
<td>Alcochete</td>
<td>122</td>
<td>1,0</td>
<td>69,4</td>
</tr>
<tr>
<td>Almada</td>
<td>666</td>
<td>9,5</td>
<td>38,3</td>
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<tr>
<td>Barreiro</td>
<td>117</td>
<td>3,2</td>
<td>14,9</td>
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<tr>
<td>Moita</td>
<td>219</td>
<td>4,0</td>
<td>33,2</td>
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<td>Montijo</td>
<td>449</td>
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<td>87,7</td>
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<tr>
<td>Palmela</td>
<td>548</td>
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<td>Seixal</td>
<td>669</td>
<td>7,0</td>
<td>42,3</td>
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<tr>
<td>Sesimbra</td>
<td>470</td>
<td>2,4</td>
<td>94,9</td>
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<tr>
<td>Setúbal</td>
<td>713</td>
<td>3,1</td>
<td>58,8</td>
</tr>
<tr>
<td>AML</td>
<td>14558</td>
<td>4,8</td>
<td>51,6</td>
</tr>
</tbody>
</table>

### BUS lines, 2015

Source: IMT, 2015, Own treatment
3 Demand vs Supply of Transit system

The case of BUS

Population density

Employment density

Class 1.1 Urban Fabric (COS 2007)
3 Demand vs Supply of Transit system
The case of BUS

LMA Bus coverage ...

250m from a bus stop

500m from a bus stop

800m from a bus stop
### 3 Demand vs Supply of Transit system
#### The case of BUS

<table>
<thead>
<tr>
<th>Municipalities</th>
<th>Covered Area (%)</th>
<th>Covered Population (%)</th>
<th>Class: 1.1 Urban Fabric (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance to a bus stop</td>
<td>Distance to a bus stop</td>
<td>Distance to a bus stop</td>
</tr>
<tr>
<td></td>
<td>250 m (+/-4 min)</td>
<td>500 m (+/-8 min)</td>
<td>800 m (+/-12 min)</td>
</tr>
<tr>
<td>Cascais</td>
<td>93,1</td>
<td>98,4</td>
<td>99,8</td>
</tr>
<tr>
<td>Lisboa</td>
<td>99,5</td>
<td>100,0</td>
<td>100,0</td>
</tr>
<tr>
<td>Loures</td>
<td>88,0</td>
<td>94,3</td>
<td>97,9</td>
</tr>
<tr>
<td>Mafra</td>
<td>86,2</td>
<td>94,7</td>
<td>97,8</td>
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<td>96,6</td>
<td>99,9</td>
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<td>Sintra</td>
<td>90,8</td>
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<td>Vila Franca de Xira</td>
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<td>100,0</td>
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<tr>
<td>Montijo</td>
<td>70,4</td>
<td>80,3</td>
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<tr>
<td>Palmela</td>
<td>75,4</td>
<td>85,1</td>
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</table>
3 Demand vs Supply of Public Collective Transport
The BUS service case

So... what are the main aspects to consider in the reading public transport vs private transport?

- Origin-Destination lines and interfaces
- Frequency of service
- Speed (and travel time)
- Cost (ticket cost, time, fuel, etc.)

(future analysis)
4 FINAL CONSIDERATIONS

Recent trends

Housing

Urban Sprawl

Employment

Deconcentrating New commercial and service areas

How the interaction between housing and employment affects the commuting mobility pattern?

Reinforce polycentrism

How public transport could supply the needs for commuting?

Commuting pattern

Public transport network

Ring pattern

Axial pattern

2011

2015
4 FINAL CONSIDERATIONS

Today mobility patterns are more complex than in the past:
- Much more trips not related to work;
- Different patterns according to age, income and household composition;
- ... and that was supported by car use.

»»» As result: increased pressure on road systems, congestion, high energy consumption, increasing of polluting emissions, among others » This puts into question the Sustainable Development principles at economic, environmental and social scopes.

To better decide we need to know and understand mobility needs in order to avoid mismatching of demand and supply.

» Justifying the relevance of regular mobility surveys, considering not only commuting but trips for diverse purposes (eg. leisure, sports, shopping, public services, etc.), allowing a multi-scalar reading (from local communities to metropolitan areas / functional urban areas).

And the solution is not only on the transport side (namely by car use). A better coherent urban planning policies will be needed.
COMMUTING FLOW PATTERNS IN LMA: TOWARDS AN EFFECTIVE CONTRIBUTION TO SUSTAINABLE DEVELOPMENT?

CITIES FOR US

engaging communities and citizens for sustainable development

Thanks for your attention!

Nuno Marques da Costa – nunocosta@campus.ul.pt
Ana Louro – analouro@campus.ul.pt
CEG-IGOT-ULisboa

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