A TOOL FOR THE ASSESSMENT OF URBAN-MOBILITY SCENARIOS IN CLIMATE CHANGE MITIGATION: AN APPLICATION TO THE GRANADA’S LRT PROJECT

Miguel Lorenzo Navarro Ligero
Luis Miguel Valenzuela Montes
Problem statement: dimensions of climate change

• New guiding concepts: energy efficiency, resilience, adaptation capacities...


• Strategic and systemic approaches: policy alignments, stabilization/destabilization, transitions…

• Long-term scope and uncertainty:
  – What will be relevant?
  – Will solutions be effective?
  – Will effective solutions endure?
Problem statement: barriers of mobility planning

- Two levels of in policy making *(strategic and operational)* + Two main policy components
- Gaps between levels:
  - Information
  - Thinking paradigms, approaches and methods
  - Feedback/continuity
  - Decision-making contexts (uncertainties)
Problem statement: scenarios as planning tool

- Scenarios: *internally coherent and plausible futures.*
  
  *Plausible:* “appearing worthy of belief” ≡ relevant to policy making

- Properties and dimensions considered:
  
  - **Diversity** Incremental vs. Exploratory
  - **Transition** Trend-based vs. Trend-breaking
  - **Consistency** Conservative vs. ‘Edge-scenarios’
  - **Performance** Structure-relevant vs. Decision-relevant

- Nature of scenarios:
  
  - Structured elements (variables, states, parameters – quantitative, qualitative –, indicators...)
  - Unstructured elements (ideas, themes, storylines, developments...)

- Use of scenarios:
  
  - Reactive vs. Proactive
  - Forecasting vs. Backcasting
  - Planning inputs vs. Planning products
Research objectives: a tool for mobility planning (MITIGA)

• Decision-making tool prototype for assessing strategic options, under a set of plausible futures (scenarios)

• Features:
  – Strategic options (policy packaging)
  – Assist scenario making through scenario-structure generation (morphological analysis)
  – Assessment framework embedded in scenario-making

• Underlying principles:
  – Focus on ‘right processes’ rather than ‘right answers’
  – Flexibility and modularity
  – Simplicity and transparency
  – Exploratory capacity and interactivity
Methodology: MITIGA framework & scenario-planning phases

**Unstructured process**

1. Policy content, context and barriers/opportunities analysis

2. Identification of representative policy components and scenario-structure elements: variables (driving forces) and states (trends)

3. Future conditions and uncertainties, in relation to policy components (policy alignments); formulation of hypothesis about key interactions (‘how do certain policy arrangements align with future conditions?’)

4. Formalisation of interaction rules between trends and policy instances

**Structured process (MITIGA-tool elements)**

5. Exploring alternative policy-combinations for developing strategies

6. Identification of alternative strategic options and criteria

7. Set scenario boundaries: base-scenario definition, trend relevance (inertia, weak/strong signals of change...) and relationships between variables (compatibility, conditionality, mutual stabilization/destabilization...)

8. Scenario generation (morphological analysis), scenario metrics (performance, transition depth and consistency) ans screening

9. Scenario outlines and elaboration of themes, arguments and developments (narratives, storylines, future visions, etc.)

10. Definition of performance indicators (targets), and state indicators (alert thresholds, signposts, etc.)
Methodology: policy analysis (policy components)
Methodology: policy analysis (policy components)

Information sources
LRT implementation-cases review

A Tool for the Assessment of Urban-Mobility Scenarios in Climate Change Mitigation: an Application to the Granada’s LRT Project
Methodology: policy analysis (*driving forces and trends*)

- Identification of *driving forces and trends* (*LRT example*)

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Driving forces</th>
<th>Trend A</th>
<th>Trend B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>1. Economic ‘climate’</td>
<td>Growing</td>
<td>Recessive*</td>
</tr>
<tr>
<td></td>
<td>2. Spatial-planning tradition</td>
<td>Proactive</td>
<td>Reactive*</td>
</tr>
<tr>
<td>Governance</td>
<td>3. Transport-management context</td>
<td>Regulated</td>
<td>De-regulated*</td>
</tr>
<tr>
<td>Governance</td>
<td>4. Power/Autonomy of local planning authorities</td>
<td>High (decentralisation)*</td>
<td>Low (centralisation)</td>
</tr>
<tr>
<td>Governance</td>
<td>5. Coordination in planning functions</td>
<td>Low*</td>
<td>High</td>
</tr>
<tr>
<td>Political/spatial</td>
<td>6. Orientation of transport policy-making</td>
<td>Transit-oriented</td>
<td>Car-oriented*</td>
</tr>
<tr>
<td>Spatial-economic</td>
<td>7. Urban-centrality distribution</td>
<td>Centralisation</td>
<td>Decentralisation*</td>
</tr>
<tr>
<td>Spatial-economic</td>
<td>8. Regional economies/Metropolitan functional integration</td>
<td>‘City strongholds’</td>
<td>‘City clusters’*</td>
</tr>
<tr>
<td>Social-behavioural</td>
<td>9. Public-transport image</td>
<td>‘Low-class’*</td>
<td>‘High-class’</td>
</tr>
<tr>
<td>Social-behavioural</td>
<td>10. Car dependency</td>
<td>Car-dependent</td>
<td>Pro-car*</td>
</tr>
<tr>
<td>Social-behavioural</td>
<td>11. Urban life-styles and traditions</td>
<td>‘Urban vibrancy’*</td>
<td>Urban decadence</td>
</tr>
</tbody>
</table>

*Granada’s base-scenario*
Methodology: *policy alignment* assessment

- **Conformative policies** (*trend-adaptive*): they overcome barriers by adapting to the on-going trend mechanisms, and/or take advantage of them to achieve specific ends.

- **Transformative policies** (*trend-breaking*): opportunity-based policies, which remain latent or ‘locked-in’ in the on-going trend and only succeed in transition context (trend reversal), moulding to the conditions of certain end-scenarios.
Methodology: *interaction rules*

Information sources
LRT implementation-cases review

A Tool for the Assessment of Urban-Mobility Scenarios in Climate Change Mitigation: an Application to the Granada’s LRT Project
Methodology: *interaction rules*

**Interaction hypothesis**
“Low capacity from LRT-LU policies to capture additional travel when coordination is low, in a decentralised context”.

**Transformational alignment**

---

A Tool for the Assessment of Urban-Mobility Scenarios in Climate Change Mitigation: an Application to the Granada’s LRT Project
Methodology: *interaction rules*

**Goal**
Economical
- Strategic Objectives
  - Travel contention
  - Increasing PT efficiency
  - Increasing road transport efficiency
  - Improve walking conditions
  - Car restriction
  - Urban integration
  - PT integration
  - Car-PT integration
  - Use mixing
  - High density
  - Compact development
  - Commercial/Leisure
  - Residential
  - Consolidated development
  - New development
  - Low-density/Suburb

**Systems**
- PT system
- Transit project
- Interchange centres

**Information**
- LRT-TOD policies
- LRT implementation review

**Conformational alignment**
- City-region
- Regional hubs
- ‘city-clusters’
- Decentralisation

**Interaction hypothesis**
"LRT-LU policies promote use aggregation in new regional developments, when linked to greater transportation projects at the regional scale”.

**Low planning coordination**
- GOALS
  - Economic
  - Environmental
  - Social
- Sub-systems/features
  - Rail-based
  - Bus-based
  - Own right-of-way
- Access provision
  - Normative
  - Demand modulation
- Instrument logics
  - Spatial

A Tool for the Assessment of Urban-Mobility Scenarios in Climate Change Mitigation: an Application to the Granada’s LRT Project
Methodology: building the structure

- Information gathering
  - (case studies, theoretical models, simulations, experts opinion...)
- Policy analysis
  - (goals, objectives, logics, contexts, instruments, conditions...)
- Key interactions
  - (hypothesis, assumptions, decision dichotomies...)
- Strategic options generation
  - (strategies, visions, plans, projects...)
- Components hierarchy
  - c1, c2, c3, c4
- Strategic options
  - \{p1, p2, p3,...\}
- Strategy selection
- Scenario making
  - (projections, storylines, future visions, events, ‘bottlenecks’...)
- Scenario management
  - (target setting/adjustment, monitoring, benchmarking, alert thresholds...)

Policy contents

Future conditions / uncertainties

Policy components

Alternatives \{a, b, c,...\}

Driving forces \{A, B\}

Trends \{A, B\}

Barriers/Opportunities

INTERACTION RULES (i)

\( i_{1} + i_{2} = \ldots + i_{n} = \text{something} + i_{n} = \text{something} \)

...then policy is

(CONSERVATIVE, TRANSFORMATIVE)

‘BASE-SCENARIO’

POLICY(p)

\( \sum_{p} \sum_{t} \text{weight}_{t} \)

CRITERIA

\{c1, c2\}

Scenario generation

Morphological analysis

Scenario metrics

‘END-SCENARIOS’

Policy performance

Scenario consistency

Criterion performance

Transition depth

Strategic op. performance

Scenario screening + selection

(focal efficiency)

Targets

Performance indicators

Evolution indicators / ‘Signposts’

A Tool for the Assessment of Urban-Mobility Scenarios in Climate Change Mitigation: an Application to the Granada’s LRT Project
Methodology: *criteria* for mitigating climate change

<table>
<thead>
<tr>
<th>Main strategy</th>
<th>Main approach (A-S-I)</th>
<th>Criterion</th>
<th>Instance(components) = {strategic objectives, mobility-patterns logics} (&lt;ns&gt;: not specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ‘Urban contention’</td>
<td>Avoid</td>
<td>Walkable city</td>
<td>{improve walking conditions, destination substitution}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Travel contention</td>
<td>{reduce travel need, destination substitution}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compact city</td>
<td>{generate activity/development, destinations substitution}</td>
</tr>
<tr>
<td></td>
<td>Shift</td>
<td>Modal shift (walk)</td>
<td>{improve walking conditions, car substitution}</td>
</tr>
<tr>
<td></td>
<td>VMT-reduction</td>
<td></td>
<td>{reduce travel need, car substitution}</td>
</tr>
<tr>
<td>2. ‘Transit shift and efficiency’</td>
<td>Improve</td>
<td>Modal shift (PT)</td>
<td>{increase PT-use, car substitution}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Effective PT</td>
<td>{increase PT use, &lt;ns&gt;}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Efficient PT</td>
<td>{increase PT efficiency, &lt;ns&gt;}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Efficient road-transport system</td>
<td>{increase transport efficiency, &lt;ns&gt;}</td>
</tr>
</tbody>
</table>
### Methodology: policies in Granada’s metropolitan area

<table>
<thead>
<tr>
<th>Strategic options (planning approaches)</th>
<th>Description</th>
<th>Policy instances examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Metropolitan spatial planning</strong></td>
<td>Mixing of general guidelines at metropolitan scale and directions for land-use, infrastructure and public transport system at specific strategic locations.</td>
<td>Commercial joint developments through local consortia (\text{land-use/transport, high density, joint development, public-private partnerships, new development, metropolitan, commercial, regional})</td>
</tr>
<tr>
<td><strong>2. Urban master-planning</strong></td>
<td>Dominance of normative planning instruments at local scale, with a high proportion of urban mobility and land use instruments in the city centre context.</td>
<td>Land reserves for metropolitan facilities and activities (\text{land-use/transport, high density OR use mixing*, normative OR location decisions*, planning/management OR official-sites relocation, new development, urban centre proximity OR metropolitan, office/industrial, regional})</td>
</tr>
<tr>
<td><strong>3. Metropolitan transportation governance</strong></td>
<td>Economic, managerial and collaboration instruments for the metropolitan transport system, including LRT.</td>
<td>Urban renewal in derelict areas of Granada city, near rail-station (\text{land-use/transport, urban renewal, normative, planning/management, derelict areas, urban centre proximity, regional hub, local})</td>
</tr>
<tr>
<td><strong>4. LRT project management</strong></td>
<td>Specific interventions and features of LRT project.</td>
<td>Coordination of metropolitan public-transport operators ('metropolitan consortium') (\text{PT system, PT integration, &lt;ns&gt;, public-private partnership, &lt;ns&gt;,&lt;ns&gt;,&lt;ns&gt;, regional})</td>
</tr>
</tbody>
</table>

\*<ns>: non specified
Methodology: building the structure

A Tool for the Assessment of Urban-Mobility Scenarios in Climate Change Mitigation: an Application to the Granada’s LRT Project
Results: ‘mapping’ scenarios

A Tool for the Assessment of Urban-Mobility Scenarios in Climate Change Mitigation: an Application to the Granada’s LRT Project
Conclusions:

- Does scenario-making end here?
  - MITIGA does not use scenarios, but give a structure to its generation
  - It assists planning, but does not bound planning (give more degrees of freedom, complement, interaction)
  - The “scaffolding” idea: interplay between structured and unstructured elements

- Orientation toward a collaborative-planning tool
  - Different user levels (technical to policy makers)
  - Different thematic customizable modules