ACCESSIBILITY INSTRUMENTS FOR PLANNING PRACTICE

Lecture 3. Cecília Silva
Program

• Accessibility in Planning
• Accessibility Instruments
• What Accessibility Instruments offer (TU1002)?
• What Planning Practice looks for?
• Some examples from TU1002
Accessibility in Planning

• What is Accessibility?
• Paradigm sift from Mobility to Accessibility Planning
• The European Context
### What is Accessibility?

#### Intrastructure-based

**Transports Indicators**
- ‘system enabling mobility’
  - Highway length;
  - Highway capacity;
  - Congestion levels;
  - Average speed of a specific road;
  - Frequency of PT service per route;
  - Average waiting time to access PT;
  - Width of sidewalks
  - etc.

#### Person-based (or location based for accessibility)

**Mobility Indicators**
- ‘ease of movement’
  - Number of trips
  - Travel distance
  - Travel frequency
  - Average travel speed per person
  - Travel time
  - Transport mode
  - etc.

**Accessibility Indicators**
- ‘ease of reach of desired activities’
  - Number of activities/population/employment accessible by car
  - Area accessible by walking
  - Different levels of accessibility by travel distance
  - etc.

### Real mobility

### Potential mobility

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• no universally used definition can be found in the literature
  – ‘Accessibility … is a slippery notion … one of those common terms that everyone uses until faced with the problem of defining and measuring it’. Gould (1969, p.64)
  – the definition of the concept of accessibility depends on the objective for which it is intended (Geurs & Eck, 2001).
    • Accessibility is the extent to which the land use and transport system enables individuals to reach different types of opportunities (Silva, 2008)
Paradigm Shift: Mobility ► Accessibility (1)

- Need for a paradigm shift
  - mobility planning ► accessibility planning

- Nowadays we travel for longer distances and more frequently
- However,
  - more mobility ≠ more accessibility
    - Car-based urban mobility
    - Expansion of cities / separation of function
    - More (regional/metropolitan) choices – wider areas accessible by car
      - Public transport losses competitiveness in comparison to the car
      - Less local choices
Paradigm Shift: Mobility ➤ Accessibility (2)

### Planning for mobility
- Mobility
- Ease of movement
- ... planning system that favours increasing mobility
- Infrastructure-centred planning or performance-centred planning

### Planning for accessibility
- Accessibility
- Ease of movement versus the ease of reach of desired opportunities
- ... re-centres transport planning on the connection of people and activities instead of on the transport system and enables the integration of land use and transport planning
- Person-centred planning

#### Paradigm shift results in:
- Shift of focus from the means (infrastructure and its performance) to the ends (fulfilment of people’s expectations)
Accessibility in the European Context

• Review of EU directives:
  – Accessibility concerns have recently entered EU directives at the principle level
  – At the operational level, accessibility almost always limited to reduction of barriers of the mobility impaired or PT coverage

• Review of National contexts:
  – Survey involving 16 different countries (Hull and Silva, 2012)
    • 3 have national directives requiring accessibility planning
    • 5 have national recommendations to use accessibility planning (not required)
    • 8 it is neither required nor advised
Accessibility Instruments

• The concept
• The components
• Type of Accessibility measures
Accessibility Instruments

Accessibility Instruments:
- Accessibility measures made operational for planning practice
  - Follow a certain accessibility concept
  - Have a specific planning goal
  - Analyse and represent accessibility conditions (in maps or values/indicators)

The development of accessibility instruments involves several choices which could be grouped into:
- components used;
- type of accessibility measure used; and,
- additional operational detail for the accessibility measure.

All of these choices are interdependent and mutually influencing, combining themselves into the final definition of the operational accessibility measure.
Components used

Components

- Transport
  - Character quality, performance of transport system

- Land Use
  - Magnitude, quality and character of activities

- Temporal
  - Availability of opportunities by time of day and daily distribution / ability to participate in opportunities

- Individual
  - Needs, abilities and opportunities depending on individual characteristics

Legend:
- Choice type (1st to 4th level)
- Choice option (1st, 2nd level)
- Details
Type of Accessibility measure (1)
CHOICES

Details

Consideres

- Potential measure
  - Distance decay
- Inverse balancing factor
  - Competition effects (of origin or destination)
  - Personal preferences (or of groups based on lifecycle or lifestyle)
  - Different trip purposes (disaggregated vs. only one trip purpose or all aggregated)
  - Different transport modes (only one transport mode or all aggregated/integrated choosing fastest/cheapest)
  - Different times of day (or days of week)

Does not consider

- Contour measure

Types / Detail (2)
Type of Accessibility measure (3)

Simplicity; Understandability; Communicability; Operationability; Availability of data

Area wide accessibility measure
Distance decay
Account for competition
Higher disaggregation

Distance measure
Contour measure
Potential measure
Inverse balancing factor
Derived from time-space geography

Activity-based measures

Utility-based measure

Utility theory
Higher disaggregation

Data requirements: Complexity – theoretical soundness; Difficulty of communicating / understanding.
What Accessibility Instruments offer (TU1002)?

- Coverage on Geographical Scale
- Coverage on Planning Goals
- Coverage on transport modes
- Coverage on trip purpose
- Usefulness (developers perception)?
TU1002 – Collecting Accessibility Instruments

1st report being finished as we speak (Hull and Silva, 2012)
- Literature review on accessibility instruments and measure
- Literature review on Accessibility instruments in planning practice
- Collection of Accessibility Instruments produced across Europe
- 24 Accessibility Instruments reviewed
- 22 Instruments present short reports in Chapter 3
- 23 Instruments were compared through a Survey in Chapter 4
  - Context
  - Planning Goals
  - Characteristics of the Instrument
  - End users and how they use the tool (developers perception)

Summary Sheets of Accessibility Instruments in the Action
• Categorizing questions (Survey) / What Accessibility Instruments offer:
  – What is the geographical scale?
  – What is the planning goal?
  – What are the transport modes you want to consider?
  – What are the trip purposes you want to consider?

• We are building a web-based repository with easy browsing and searching of accessibility instruments that may in the future help to make the bridge between developers and practitioners
  – Online dissemination tool
  – Categorizing tolls and facilitating search
What is the geographical scale?

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What is the planning goal?
What are the transport modes you want to consider?

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</tr>
</tbody>
</table>
## Ratings by developers

### Gestão da Mobilidade Urbana

<table>
<thead>
<tr>
<th>Theme</th>
<th>Question</th>
<th>Min.</th>
<th>Max</th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality, accuracy and speed of the instrument</strong></td>
<td>Quality of data</td>
<td>3</td>
<td>7</td>
<td>5.6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Quality of calculations</td>
<td>3</td>
<td>7</td>
<td>5.6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Accuracy of the model</td>
<td>3</td>
<td>7</td>
<td>5.2</td>
<td>5</td>
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<tr>
<td></td>
<td>Speed of the tool</td>
<td>1</td>
<td>7</td>
<td>3.9</td>
<td>4</td>
</tr>
<tr>
<td><strong>Knowledge and Skill levels required by practitioners</strong></td>
<td>Modelling and computational skills</td>
<td>1</td>
<td>7</td>
<td>4.5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Spatial awareness skills</td>
<td>2</td>
<td>7</td>
<td>4.6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Understanding policy context</td>
<td>1</td>
<td>6</td>
<td>3.7</td>
<td>4</td>
</tr>
<tr>
<td><strong>Ease of Using Accessibility Instruments</strong></td>
<td>Ease of collecting data</td>
<td>2</td>
<td>7</td>
<td>4.2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Ease to play</td>
<td>1</td>
<td>7</td>
<td>3.8</td>
<td>3</td>
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<td></td>
<td>Transparency</td>
<td>3</td>
<td>7</td>
<td>5.4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Flexibility</td>
<td>3</td>
<td>7</td>
<td>5.4</td>
<td>6</td>
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<tr>
<td></td>
<td>Understandable output</td>
<td>4</td>
<td>7</td>
<td>5.3</td>
<td>5</td>
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<tr>
<td></td>
<td>Visual representation</td>
<td>2</td>
<td>7</td>
<td>5.5</td>
<td>6</td>
</tr>
</tbody>
</table>

Note: all ratings go from 1 (worst performance) to 7 (best performance)
What Planning Practice looks for?

- The implementation gap
- Feedback from research
- The COST Action TU1002
The implementation gap

Research has produced numerous Accessibility-based Planning Support Instruments in the last decades

However, these are scarcely used in practice

Why?

- Dichotomy between supply and demand
  - Planning practitioners are generally unaware of and inexperienced in the use of PSI
  - Developers have little awareness of the demand requirements

- PSI suffer from a ‘rigour-relevance dilemma’
  - Pursuit for scientific rigour in order to contain ever-growing complexity enabled by technological developments
  - Result: Black-box effect
Evidence from Research (1)

• Planning practitioners perceive PSI as being:
  – Technology oriented
    • pursuing technology development instead of problem solving
  – Too abstract
  – Too generic
  – Too complex
  – Too inflexible
  – Narrowly fixed on strict rationalities
  – And thus, inadaptable to changing planning needs

• In practice, most PSI used in are tailor made
Evidence from research (2)

- **Argument by developers:**
  - useful for information storage and retrieval,
  - simple information visualization,
    - non-analytical uses are given higher value

- **What happened in many cases was**
  
  **increasing complexity of planning**
  
  **technological developments** (especially in computer sciences)

  **complex PSS**

  ‘black-box effect’
Evidence from Research (3)

Main Problems

Figure 3: Potential bottlenecks for LUTR instruments and their perceived importance (percentage of respondents who consider it a big problem).

Source: te Brømmelstroet (2010) Equip the warrior instead of manning the equipment, JTLU 3(1), 25–41
Evidence from Research (4)

- Valued characteristics

Figure 5: Importance of characteristics for LUT PSS in supporting the generation of LUT strategies (percentage of respondents that see each characteristic as important).

Source: te Brömmelstroet (2010) Equip the warrior instead of manning the equipment, JTLU 3(1), 25–41
• Future steps:
  – Test collected Accessibility Instruments in European wide workshops with local practitioners, solving local planning problem
  – More than 20 local workshops
  – One common workshop methodology

• Expected Outcomes/Impacts:
  – Assessment of usefulness of accessibility instruments in planning practice by practitioners
  – Recommendations for development of more useful Accessibility Instruments
  – Contribute to bridging the implementation gap
Some examples from TU1002

- JAD
- SAL
- HIMMELI
- GraBAM
• JAD – Joint-Accessibility Design
  – Authors: Thomas Straatemeier (tstraatemeier@goudappel.nl) (NL)

• Concept:
  – Conceptual measure
  – Developing accessibility measures with practitioners and not for them

• Concept tested through local workshops:
  – Evidences on benefits of using accessibility
    • Accessibility as a way of relating transport and land use policies, and societal issues
  – Evidences on benefits of developing accessibility measures with practitioners
    • Practitioners are more engaged with measures which they were actively involved in developing (making decision on what and how to measure), being fully aware of their abilities and limitations
• **SAL – Structural Accessibility Layer**
  
  − Authors: Cecília Silva ([ccsilva@fe.up.pt](mailto:ccsilva@fe.up.pt)) (PT)

• **Concept:**
  
  − is a geographical representation of comparative accessibility levels by types of transport modes to different types of opportunities generating travel (Silva, 2008)
• Operational detail:
  – Geographical scale: supra-municipal, municipal, neighborhood
  – Goal: urban planning, transport planning
  – Decision support task: passive decision support tool
  – Activity-measure type: contour measure
  – Transport modes considered: Car, PT, walking, cycling
  – Trip purposes considered: all (disaggregate)
• Accessibility measure:
  - Diversity of Activities by transport mode (DivAct: NMDivAct, PTDivAct; CARDivAct))

\[
DivAct = \frac{\sum_y (Act_y \times f_y)}{\sum_y f_y}
\]

fy – ponderation factor regarding frequency of use

| \(0\) | None of the activities is accessible |
| \(\ldots\) | |
| \(1\) | Accessibility to all the considered activities |
Accessibility measure:

- Accessibility Clusters
  - 7 clusters grouping areas offering high accessibility by the same transport mode(s)
  - THUS, offering favourable conditions for the use of these transport modes
• Local choices required for the definition of the case-specific SAL:
  – the study region;
  – the spatial disaggregation level;
  – the disaggregation of activities;
  – the potential frequency of use of activities - $f_y$;
  – the cut-off criteria and values;
  – the concept/value of high accessibility;
  – and, the complementary information for policy design.
• Walking Accessibility
• Accessibility clusters
• **Usefulness:**
  
  – provide important information on availability and service level and quality of each transport mode across the territory
  
  – provides information on spatial inequalities with regard to land use and transport opportunities
    
    • Useful for the development of public service standards for public transport
    
    • Useful for the classification of the hierarchy of urban centralities
    
    • Useful for the definition of priorities for mixed development strategies
  
  – categorizes relative competitiveness of different transport modes and thereby identifies areas where inhabitants do not have competitive alternative to the car
HIMMELI (1)

Gestão da Mobilidade Urbana

- HIMMELI– Heuristic three-level Instrument combining urban Morphology, Mobility, service Environments and Locational Information
  - Author: Sanna Iltanen (sanna.iltanen@tut.fi) (FI)

- Concept:
  - HIMMELI is a model tool
  - Is focused on retailing
  - HIMMELI models how different accessibility factors influence spatial organization of retail units
  - Uses agent based modelling methodologies
    - households select their shopping destinations based on utility measures
    - The accessibility measure is used in the process of locating new retail units
Operational detail:

- Geographical scale: supra-municipal
- Goal: urban planning
- Decision support task: strategic planning
- Accessibility measure type: utility-based measure
- Transport modes considered: Car
- Trip purposes considered: shopping
Accessibility measure:

- Accessibility from a retail unit to every other retail unit
  \[ \text{Acc}_{R-R} = A_u = \frac{1}{n} \sum_{u=1}^{n} T_{uv} \] (average travel cost between all retail units starting at \( u \))
  where \( T_{uv} \) is travel cost from retail unit \( u \) to retail unit \( v \).

- Accessibility for a household in segment \( i \) to retail unit in segment \( j \)
  \[ \text{Acc}_{Hh-R} = A_{ij} = t_t T_{ij} \] (corrected travel cost; the higher the value the lower is accessibility)
  where \( t_t \) is coefficient depending on unit type and \( T_{ij} \) is travel cost from segment \( i \) to segment \( j \).

- The utility of a household in segment \( i \) for retail unit \( u \) in segment \( j \) is defined as
  \[ U_u = \frac{C_u R_u}{A_{ij}} \] (Utility is directly proportional to size and agglomeration of retail and inversely proportional to travel cost)
  where \( C_u \) controls the potential for spatial clustering of retail units and \( R_u \) controls for the potential effects of size of retail on choice.
• **Accessibility measure:**
  – The network accessibility measure for each segment $i$
    
    $\text{Acc}_{\text{Network}} = A_i = \frac{1}{n} \sum_{i=0}^{n} T_{ij} \quad (i, j \in R)$
    
    where the $T_{ij}$ is the travel cost from segment $i$ to segment $j$.
    
    This measure enable simulating the location of new retail units

• **Usefulness:**
  – knowledge on the relationship of retail dynamics and the structural properties of urban physical environment e.g. transportation networks
  
  – assessment of planning scenarios e.g. how new road alignments or new residential growth affects service locations
• GraBAM - GRAVITY-BASED Accessibility measures for INTEGRATED transport-land use PLANNING
  – Authors: Enrica Papa, Pierluigi Coppola (enpapa@unina.it) (IT)
• Concept:
  – It is a performance indicator of integrated land-use and transport planning
  – Measures the impacts and benefits on the land use induced by changes in the transportation system
Operational detail:

- Geographical scale: supra-municipal
- Goal: transport planning
- Decision support task: active decision support tool
- Activity-measure type: gravity-based measure
- Transport modes considered: Car, PT, walking
- Trip purposes considered: work, shopping
**Accessibility Measure:**

- **Active Accessibility (origin-based)**
  - Proxy of the ease of reaching the activities/opportunities located in different zones $j$ of the study area for a given purpose (e.g. workplace, shopping) moving from $i$:
    - $$A_{act,i} = \sum_j g(W_j)f(c_{ij})$$
    - Accessibility is function of the type of activity ‘$g$’ and of the generalized cost to reaching the destination where the activity is located ‘$f$’
    - Where $W_j$ is the activity/opportunity to reach in zone $j$, and $c_{ij}$ is the generalized cost of reaching zone $j$ from zone $i$.

- **Passive Accessibility (destination-based)**
  - Proxy of the opportunity of an activity located in a given zone $i$ to be reached from the potential “consumers” coming from all the other zones $j$ of the study area for a given purpose (e.g. the clients of a shop):
    - $$A_{pas,i} = \sum_j g(W_j)f(c_{ji})$$
    - Where $W_j$ are the potential “consumers” of the activity/opportunity to be reached in the zone $i$, and $c_{ji}$ is the generalized cost of reaching zone $i$ from zone $j$. 
• **Accessibility Measure:**
  - In summary, these measures represent accessibility of a given zone as a sum of the generalized travel costs between the origin or destination zone and all other zones of the study area \( f(c_{ij}) \), weighted by an attraction term representing \( g(W_j) \) either the opportunities to be reached in the other zones (in the case of the active accessibility) or the potential “consumers” of the opportunity located in the given zone (in the case of the passive accessibility).

• **Usefulness:**
  - can be used to measure the distribution of wider economic benefits of alternative transportation projects
Figure 3.22 An example of representation of active and passive accessibility in Campania Region (Nuzolo and Coppola, 2007)