Insights on Walkability and Walking in Lisbon with the IAAPE Method

Filipe Moura
Instituto Superior Técnico

Follow this and additional works at: https://pdxscholar.library.pdx.edu/trec_seminar

Part of the Transportation Commons, and the Urban Studies Commons

Let us know how access to this document benefits you.

Recommended Citation
https://pdxscholar.library.pdx.edu/trec_seminar/143

This Book is brought to you for free and open access. It has been accepted for inclusion in TREC Friday Seminar Series by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: pdxscholar@pdx.edu.
AKNOWLEDGEMENTS

• Paulo Cambra (PhD Student at IST)
  paulo.cambra@tecnico.ulisboa.pt

• Alexandre Bacelar Gonçalves (Assistant Professor at IST)
  alexandre.goncalves@tecnico.ulisboa.pt
1. Lisbon in a nutshell
2. Why studying walking and walkability?
3. IAAPE method
4. The importance of pedestrian networks
5. Some case studies
6. How to validate walkability assessment models?
7. Questions remain regarding IAAPE
8. Technology can help: WALKBOT project
1. LISBON IN A NUTSHELL
Lisbon Metropolitan Area
Portugal

AML
18 municipalities
Total Area = 3 015 km² (1164mi²)
Total Population = 2,82x10⁶ Inhab.
Pop. Density ~ 940 Inhab./km² (2 400 Inhab./mi²)
24 parishes
Total Area = 100 km² (38.61 mi²)
Total Population = 504 x10³ Inhab.
Pop. Density = 5 040 Inhab./km²
(= 13 053 Inhab./mi²)
# LISBON VS. PORTLAND (and metro areas)

<table>
<thead>
<tr>
<th></th>
<th>LISBON</th>
<th></th>
<th>PORTLAND</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>City</td>
<td>Area</td>
<td>City</td>
<td>Area</td>
</tr>
<tr>
<td>Area (km²)</td>
<td>100</td>
<td>3 015</td>
<td>376</td>
<td>17 310</td>
</tr>
<tr>
<td>Population (10³ inhab)</td>
<td>504</td>
<td>2 817</td>
<td>640</td>
<td>2 425</td>
</tr>
<tr>
<td>Density (inhab/km²)</td>
<td>5 040</td>
<td>940</td>
<td>1 702</td>
<td>140</td>
</tr>
<tr>
<td>Ageing index (P65+/P19-)</td>
<td>137,9</td>
<td>89,4</td>
<td>54,5</td>
<td>47,8</td>
</tr>
<tr>
<td>Car/Transit/Walk/Bike (%)</td>
<td>48/34/17/0,1</td>
<td>55/28/15/0,2</td>
<td>78/4,4/10,4/2,9</td>
<td></td>
</tr>
<tr>
<td>Motorization rate (car/household)</td>
<td>1,4</td>
<td>1,8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Av. Ann. Precipitation - inch (mm)</td>
<td>27 (691)</td>
<td>36 (915)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max/Min Temperature - °F (°C)</td>
<td>73 (23) / 52 (11)</td>
<td>63 (17,3) / 46 (7,6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. WHY STUDYING WALKING AND WALKABILITY?
WHY STUDYING WALKING AND WALKABILITY
WHY STUDYING WALKING AND WALKABILITY

We may postulate that:

- Perceptions are context specific (local)
- Perceptions vary from person to person
- Perceptions of a person may vary according to the trip motive

3. IAAPE — INDICATORS OF ACCESSIBILITY AND ATTRACTIONNESS OF PEDESTRIAN ENVIRONMENTS
THE IAAPE METHOD

• Objectives
  Set of indicators to measure walkability in urban context
  Detailed digital pedestrian network
  Operational tool to support urban planning

• Why is it different from the others?
  Context-Specific (local)
  Participatory method to capture context-specific perceptions
  Micro-scale analysis based on the detailed pedestrian network
  Considers different population segments and different trip motivations
  Validation
**THE IAAPE METHOD: STRUCTURED BY 7 C’S**

<table>
<thead>
<tr>
<th>5 C’s</th>
<th>2 C’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONNECTIVITY</td>
<td>Do I have access to a formal pedestrian network?</td>
</tr>
<tr>
<td>CONVENIENCE</td>
<td>Does the network suit me? Is it functional?</td>
</tr>
<tr>
<td>COMFORT</td>
<td>Do I have a nice experience?</td>
</tr>
<tr>
<td>CONVIVIALITY</td>
<td>Does it attract other people?</td>
</tr>
<tr>
<td>CONSPICUOUSNESS</td>
<td>Is the built environment legible? Do I get the guidance I need?</td>
</tr>
<tr>
<td>COEXISTENCE</td>
<td>Do other modes disturb me? Put me into danger?</td>
</tr>
<tr>
<td>COMMITMENT</td>
<td>Do community and decision-makers commit to improving walkability?</td>
</tr>
</tbody>
</table>

5 C’s originally (Methorst et al, 2010)

2 C’s additionally

---

THE IAAPE METHOD

IAAPE’S PARTICIPATORY EVALUATION PROCESS

**STRUCTURING/SCORING**
(Define and weight keypoints/indicators)

- CONNECTIVITY
- CONVENIENCE
- COMFORT
- CONVIVIALITY
- CONSPICUOUSNESS
- COEXISTENCE
- COMMITMENT

**DATA COLLECTION**
(Measure)

- KEYPOINT A: 130
- KEYPOINT B: 0.07416
- KEYPOINT C: 80%
- KEYPOINT D: 80
- KEYPOINT E: 130
- KEYPOINT F: 4
- KEYPOINT G: 20

**VALUE FUNCTION**

<table>
<thead>
<tr>
<th>Keypoint</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>130</td>
</tr>
<tr>
<td>B</td>
<td>0.07416</td>
</tr>
<tr>
<td>C</td>
<td>80%</td>
</tr>
<tr>
<td>D</td>
<td>80</td>
</tr>
<tr>
<td>E</td>
<td>130</td>
</tr>
<tr>
<td>F</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>20</td>
</tr>
</tbody>
</table>

**AGGREGATE 7 Cs according to SCORES**

- 50
- 30
- 80
- 40
- 80
- 10
- 20

Walk score = 42
STRUCTURING “KEY POINTS”/INDICATORS FOR EACH DIMENSION

1) Distribution “play roles”

2) Selection of “Key points”/indicators

Final selection: 17 Key points/Indicators For 7 C’s
SCORING: WEIGHTING WITH “DELPHI” METHOD

1) Group “play role” in round tables  2) Answer the moderator questions

Which of the two settings do you think is more walkable, A or B?

The group answer had to be consensual (discuss until consensus)

Clearly A! or We couldn’t reach consensus => skip
"SCORING" RESULTS: WEIGHTS BY TRIP MOTIVE

Pedestrian group: Adults
RESULTS: WEIGHTS BY PEDESTRIAN GROUP

Trip motive: Utilitarian

![Bar chart showing weights by pedestrian group for various factors including Commitment, Coexistence, Conspicuousness, Conviviality, Comfort, Convenience, and Connectivity. The chart compares weights for Children, Impaired, Seniors, and Adults.]
4. THE IMPORTANCE OF PEDESTRIAN NETWORKS
Walking distance is widely used in urban and transportation planning and analysis.

Where do we actually get in 5 minutes walking?

How appropriate are the conditions to walk?

Elementary school, 1km / 15 mins walking

Sports playground, 1km to 2km / 15 to 30 mins walking

High School, 2km / 30 mins walking

Portuguese Standards for location of public facilities
DETAILED PEDESTRIAN NETWORKS

Network Analysis

- Standard 5 minute buffer (radius 300m)
- Street network centrelines
- Pedestrian Network (sidewalk + crossings)

5 locations in distinct urban settings in Lisbon
DETAILED PEDESTRIAN NETWORKS

Realistic Spatial coverage

Considering different quality standards for walking - seniors; children; impaired mobility -

100

5 minute buffer

50 Centreline Network

Pedestrian Network

30 Detailed Pedestrian Network

-> waiting times

0 Robust Pedestrian Network

-> walkability attributes
5. CASE STUDIES
TWO ELEMENTARY SCHOOLS IN ARROIOS

Setting a 300m radius => PEDSHED (1min/s)

- Less than 60% of the standard circular buffer area
Measuring walkability indicates QUALITY of walking:

### Case studies

<table>
<thead>
<tr>
<th>Length of Pedestrian Network by LOS (%)</th>
<th>Walk Score (Children, Transportation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>(0, 20%)</td>
<td>(20, 40%)</td>
</tr>
</tbody>
</table>

**School A**
- E: 1%
- D: 38%
- C: 54%
- B: 8%
- A: 0%

**School B**
- E: 8%
- D: 65%
- C: 24%
- B: 2%
- A: 0%
AVENIDAS NOVAS: 3 DIFFERENT POPULATION SEGMENTS

- Distinct pedestrians -> Distinct Quality Needs
- Different factors are valued differently
- Same urban space, different Walkability Scores
6. VALIDATION OF IAAPE
WHAT TO VALIDATE IN THE MODEL?

Sources and types of uncertainty

- Uncertainty of data collection/input
- Methodological uncertainty
- Calibration uncertainty
- Model/function specification uncertainty

Focus Group Sessions

Case study characterisation → Structuring → Scoring → Data collection

Calculation of Walkability Scores (Pedestrian x Motive)

Validation → Street Surveys and Countings

Assembling into GIS
HOW TO VALIDATE THE MODEL?

- Pedestrian counts
  Higher pedestrian flows => Higher walkability scores

- Street surveys
  Pedestrians’ perceptions match walkability scores

- Home-based surveys
  Respondents’ route choices match routes with higher walkability scores

- Other models
  Consistency with other tools
MORE PEDESTRIANS =&gt; MORE WALKABILITY

- 2,600 audited street segments
- Sample of 60 street segments used for validation
- 60 streets x 6 days (5 weekdays + 1 Saturday) x 5 time periods x 6 counts per period = approx. 10,000 counts
OUTLIERS CAN BE OUR FRIENDS!

Walkability Scores vs Pedestrian flows scatter plot with regression line and R² = 0.4019.
MORE PEDESTRIANS $\Rightarrow$ MORE WALKABILITY

- Significant pedestrian flow, with unsatisfying quality
- Improving walking conditions shifts these outliers to the right of the graph
MORE PEDESTRIANS => MORE WALKABILITY

- Network is inconsistency + Scarce integration in the system
- Improving connectivity within the network could raise pedestrian flow, shifting these outliers up in the graph
- If no action taken, conditions may degrade, walkability decreases and outliers would shift left
MORE PEDESTRIANS => MORE WALKABILITY

• It is not a matter of pursuing a better model fit.
• It is a matter of aiming to a more coherent pedestrian network.
TREC Friday Seminar Series. 135. https://pdxscholar.library.pdx.edu/trec_seminar/135
## Streets Surveys: Perceptions Match Walkability

<table>
<thead>
<tr>
<th>Adults</th>
<th>Perceived Walkability</th>
<th>Measured Walkability</th>
<th>Seniors</th>
<th>Perceived Walkability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td></td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>163</td>
<td>122</td>
<td></td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>79%</td>
<td>58%</td>
<td></td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>(WS &gt; 60)</td>
<td></td>
<td></td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>4</td>
<td></td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>(WS &lt; 40)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3%</td>
<td>2%</td>
<td></td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Total valid answers</td>
<td></td>
<td></td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>207</td>
<td>210</td>
<td></td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Total Match = (163 + 4)/(207 + 210) = 40.0%</td>
<td>Total Match = (57 + 4)/(82 + 84) = 36.7%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Good** match for high measured/perceived walkability pairs
- **Poor** match for low measured/perceived walkability pairs
- **Problem?**
  - IAAPE measures everything single street
  - Respondent don't know every (worst) street segments

7. QUESTIONS REMAIN?
7. QUESTIONS REMAIN?

Does “more pedestrians” mean ALWAYS “more walkable”?

- Do current Walkability Assessment models capture this effect? For IAAPE?
  E.g., too much conviviality => lower score after some level?

![Graph showing the relationship between walkability score and pedestrian flow.]

![Graph showing the relationship between measure of conviviality and critical threshold.]

Pedestrian flow vs. Walkability Score

Critical threshold (?capacity?)

Value Function
7. QUESTIONS REMAIN?

- How to avoid all sources of uncertainty?
- How much “walkable” is enough, when planning?
  Benchmarking => how to define benchmarks?
- Can we use walkability scores to predict demand?
  Can walkability scores be a measure of impedance?
  What about “cumulative impedance” over a route?
7. TECHNOLOGY CAN HELP: WALKBOT PROJECT
PROBLEMS AND CHALLENGES

• **Big amount of data collection**
  Pedestrian network configuration, network quality, network accessibility.
  The common way of doing it is manually, with visual scanning and street audits.

• **Automatic or semi-automatic pedestrian network scanners?**
  Allow for wider and faster data collection
  Potentially more objective and more reliable.
WALKBOT: SEMI-AUTOMATIC DATA COLLECTION

* Sensor Box *
- Imagery recognition
- Scan laser 3D
- GPS + IMU
- Urban vehicle (mono-wheeler, 2 wheeler, cart, Segway, etc.)

Detailed mapping:
- Sidewalks
- Pedestrian crossings

Walkability indicators:
- Sidewalk width
- Slope
- Obstacles
- Steps
- Risk of slipping (granularity)
- Pavement quality (irregularities, wholes)

Mapping (digitizing pedestrian network) + Walkability indicators
FIRST TESTS AND RESULTS

**Effective width:**
- Automatic detection up to 5m distance,
- Error +/- 5cm (2 in.)

**Risk of slipping:**
- Automatic detection of irregularities, wholes, bumps.

[Images of road, sidewalk, and bump with annotations: Video recognition - interpretation]
WALKBOT: HOW IT “SHOULD” WORK IN THE END
WALKBOT: PUTTING IT INTO PRACTICE

- Crowd sourcing
- Involving agents that walk (circulate) regularly in the built environment
- Automated vehicle?
QUESTIONS?

Filipe Moura
Fulbright Visiting Scholar at PSU
Associate Professor in Transportation Systems at IST - CERIS
fmoura@tecnico.ulisboa.pt