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Insights on Walkability and Walking in Lisbon with the IAAPE Method

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INSIGHTS ON WALKABILITY AND WALKING IN LISBON WITH THE IAAPE METHOD

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AKNOWLEDGMENTS

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OUTLINE

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 $= 100 \text{ km}^2 \ (38,61 \text{ mi}^2)$
Total Population $= 504 \times 10^3 \text{ Inhab.}$
Pop. Density $= 5040 \text{ Inhab./km}^2$
$\quad \quad = 13053 \text{ Inhab./mi}^2$
# 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>3015</td>
<td>376</td>
<td>17310</td>
</tr>
<tr>
<td>Population (10³ inhab)</td>
<td>504</td>
<td>2817</td>
<td>640</td>
<td>2425</td>
</tr>
<tr>
<td>Density (inhab/km²)</td>
<td>5040</td>
<td>940</td>
<td>1702</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></td>
<td>1,8</td>
<td></td>
</tr>
<tr>
<td>Av. Ann. Precipitation - inch (mm)</td>
<td>27 (691)</td>
<td></td>
<td>36 (915)</td>
<td></td>
</tr>
<tr>
<td>Max/Min Temperature - ºF (ºC)</td>
<td>73 (23) / 52 (11)</td>
<td></td>
<td>63 (17,3) / 46 (7,6)</td>
<td></td>
</tr>
</tbody>
</table>
2. WHY STUDYING WALKING AND WALKABILITY?
WHY STUDYING WALKING AND WALKABILITY

[Diagram showing the benefits of walking, including social, environmental, and economic aspects, and their impacts on physical activity, mental health, obesity, overweight, safety, social interaction, inclusion, inequalities, air quality, and noise.]
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 ATTRACTIVENESS 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

**CONNECTIVITY**
- Do I have access to a formal pedestrian network?

**CONVENIENCE**
- Does the network suit me? Is it functional?

**COMFORT**
- Do I have a nice experience?

**CONVIVIALITY**
- Does it attract other people?

**CONSPICUOUSNESS**
- Is the built environment legible? Do I get the guidance I need?

**COEXISTENCE**
- Do other modes disturb me? Put me into danger?

**COMMITMENT**
- Do community and decision-makers commit to improving walkability?

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

**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>80</td>
</tr>
<tr>
<td>F</td>
<td>130</td>
</tr>
<tr>
<td>G</td>
<td>4</td>
</tr>
</tbody>
</table>

Walk score = 42

AGGREGATE 7 Cs according to SCORES
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
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

- Commitment
- Coexistence
- Conspicuousness
- Conviviality
- Comfort
- Convenience
- Connectivity

Leisure vs. Utilitarian
RESULTS: WEIGHTS BY PEDESTRIAN GROUP

Trip motive: Utilitarian

- Commitment
- Coexistence
- Conspicuousness
- Conviviality
- Comfort
- Convenience
- Connectivity

Legend:
- Children
- Impaired
- Seniors
- 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?
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

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

Realistic Spatial coverage

100

5 minute buffer

50

Centerline Network
Pedestrian Network

Detailed Pedestrian Network -> waiting times

Robust Pedestrian Network -> walkability attributes

30
5. CASE STUDIES
TWO ELEMENTARY SCHOOLS IN ARROIOS

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

- Less than 60% of the standard circular buffer area
TWO ELEMENTARY SCHOOLS IN ARROIOES

Measuring walkability indicates QUALITY of walking:

School A

Legend
Walk Score
Child Transportation
- 0 - 20.0
- 20.1 - 40.0
- 40.1 - 60.0
- 60.1 - 80.0
- 80.1 - 100.0

Length of Pedestrian Network by LOS (%)

<table>
<thead>
<tr>
<th>LOS</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20%</td>
<td>1%</td>
<td>38%</td>
<td>54%</td>
<td>8%</td>
<td>0%</td>
</tr>
</tbody>
</table>

School B

Legend
Walk Score
Child Transportation
- 0 - 20.0
- 20.1 - 40.0
- 40.1 - 60.0
- 60.1 - 80.0
- 80.1 - 100.0

Length of Pedestrian Network by LOS (%)

<table>
<thead>
<tr>
<th>LOS</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20%</td>
<td>8%</td>
<td>65%</td>
<td>24%</td>
<td>2%</td>
<td>0%</td>
</tr>
</tbody>
</table>
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

Calculation of Walkability Scores (Pedestrian x Motive)

Validation

Street Surveys and Countings

Data collection

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 => 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 = aprox. 10,000 counts
OUTLIERS CAN BE OUR FRIENDS!

---

**Walk & Walkability**

**IAAPE method**

**Ped. networks**

**Case studies**

**Validation**

**1.Lisbon in a nutshell**

**50**

**Pedestrian flows**

**Walkability Scores**

\[ R^2 = 0.4019 \]
MORE PEDESTRIANS => MORE WALKABILITY

- Significant pedestrian flow, with unsatisfying quality
- Improving walking conditions shifts these outliers to the right of the graph

Quality below expectations
Network is inconsistency

- 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.
PIE LEVELS AND WALKING SHARE

TREC Friday Seminar Series. 135. https://pdxscholar.library.pdx.edu/trec_seminar/135
STREETS SURVEYS: PERCEPTIONS MATCH WALKABILITY

1. Lisbon in a nutshell

1. Walk & Walkability

1. IAAPE method

1. Ped. networks

Case studies

Validation

1. Questions

WALKBOT project

---

<table>
<thead>
<tr>
<th>Adults</th>
<th>Perceived Walkability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Measured Walkability</td>
<td>High (WS &gt; 60)</td>
<td>163</td>
</tr>
<tr>
<td></td>
<td>Low (WS &lt; 40)</td>
<td>7</td>
</tr>
<tr>
<td>Total valid answers</td>
<td></td>
<td>207</td>
</tr>
<tr>
<td>Total Match = (163 + 4)/(207 + 210) = 40.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seniors</th>
<th>Perceived Walkability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Measured Walkability</td>
<td>High (WS &gt; 60)</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Low (WS &lt; 40)</td>
<td>3</td>
</tr>
<tr>
<td>Total valid answers</td>
<td></td>
<td>82</td>
</tr>
<tr>
<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 pedestrian flow vs. walkability score with a critical threshold and value function.](image-url)
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.
Detailed mapping:
- Sidewalks
- Pedestrian crossings

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

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

WALKBOT: SEMI-AUTOMATIC DATA COLLECTION

WALKBOT project
Thales Innovation Challenge – 1st Ed.
Research team - IST:
Civil Eng. (CERiS)
Paulo Cambra
Filipe Moura
Alexandre Gonçalves
Robots (ISR)
Miguel Costa
Manuel Marques
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.

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?

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