INTERMODALITY HUBS
Including new emerging modes

Fatemeh Torabi
TU Delft University
PhD student
Fatemeh Torabi
PhD student intermodal hubs
F.TorabiKachousangi@TUDelft.nl

Prof.dr.ir. Serge Hoogendoorn
s.p.hoogendoorn@tudelft.nl

Dr. Niels van Oort
N.vanOort@TUDelft.nl
Competition challenge: Theme 6; Mobility, Accessibility & Door-to-Door Solutions
Overview

• Introduction
• Research Question
• Methodology
  • Case Study (Delft-zuid Train Station)
  • Stated preference survey
• Conclusion
"Society is changing, and our transport systems need to innovate to keep pace"
PhD Research Question

With arrival of the new modes, what design guidelines should be implemented (or considered) in order to increase accessibility of passengers to access/egress zone of intermodal hubs?
The Netherlands…

Area: 41,850 km²
Population: 17,135,198

2019: 17,135,198
2039: 17,740,096
Modal split in The Netherlands

The Netherlands has a wish for change…

(Ton, 2019)
Upcoming modes in the Netherlands
Intermodal hub
Access-egress zone

Seamless mobility in intermodal hubs
Methodology
Case study

Delft;
• Population: 106,816
• A top tourist destination
• The capital in terms of innovation and technology

TU Delft;
• Ranked in the top 20 best engineering University in the World
• Highest ranked University in NL
• 8 Faculties
• 22,000 students + 2,100 staff
Case study

- 5000 passengers/working days
- 35% TU Delft staff
- Poor public transportation
Weather is **rainy** and you have a **luggage max 10kg**.

<table>
<thead>
<tr>
<th>Scenario E3</th>
<th>Bike sharing</th>
<th>E- Step sharing</th>
<th>E- Scooter sharing</th>
<th>Individual AV</th>
<th>Collective AV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time</td>
<td>6 min</td>
<td>3 min</td>
<td>3 min</td>
<td>6 min</td>
<td>11 min</td>
</tr>
<tr>
<td>Cost</td>
<td>1.5 euro</td>
<td>1 euro</td>
<td>1.5 euro</td>
<td>5 euro</td>
<td>2.5 euro</td>
</tr>
<tr>
<td>Availability</td>
<td>80%</td>
<td>70%</td>
<td>90%</td>
<td>90%</td>
<td>100%</td>
</tr>
</tbody>
</table>

1) What is your choice?
Results

User characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>44%</td>
<td>Male: 54%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female: 20-39 years old</td>
</tr>
<tr>
<td></td>
<td>82%</td>
<td>Age</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td>Income &lt; 29,999 euro</td>
</tr>
<tr>
<td>Origin/destination</td>
<td>54%</td>
<td>TU Delft</td>
</tr>
<tr>
<td>Education Level</td>
<td>84%</td>
<td></td>
</tr>
<tr>
<td>Trip Purpose</td>
<td>38%</td>
<td>31%</td>
</tr>
</tbody>
</table>

ACCESS MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike</td>
<td>51%</td>
</tr>
<tr>
<td>Car</td>
<td>33%</td>
</tr>
<tr>
<td>Others</td>
<td>4%</td>
</tr>
</tbody>
</table>

EGRESS MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike</td>
<td>34%</td>
</tr>
<tr>
<td>Car</td>
<td>50%</td>
</tr>
<tr>
<td>Others</td>
<td>6%</td>
</tr>
<tr>
<td>Public transport</td>
<td>4%</td>
</tr>
</tbody>
</table>
Results

MNL (Multinominal Logit)
All Significant

$\beta(\text{attributes})$

ASC (alternative specific constant)
Results

Importance of “Weather” and “Luggage” on passengers preference

\[ U = \beta_C x_C(\text{mode}) + \beta_T x_T(\text{mode}) + \beta_A x_A(\text{mode}) + \beta_{C(\text{context})} x_C(\text{mode}) + \beta_{T(\text{context})} x_T(\text{mode}) + \beta_{A(\text{context})} x_A(\text{mode}) + \text{ASC} \]
Conclusion
• Importance of intermodal hubs in future
• Netherlands has potential for increasing sustainability!
• Many individuals use a limited set of modes
• “Travel time” is the most important attribute
• “Weather” and “luggage” have key role on modal split
• New modes are not interesting in Sunny weather (walking preferred)
• “Shared bike” and “Avs” are preferred
• “Shared e-scooter” least preferred
Thank you for your kind attention