Analysis of the Travel Time of Various Transportation Systems in Urban Context

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Demand-Responsive Transportation (DRT)

- No fixed stops
- No fixed routes
- No timetable
Ridepooling: Bundling of Matching Requests
Research Question

Detour for picking up other passengers (pooling)

What’s the maximum detour for ride pooling that is accepted from passengers?

Research Approach

Detour due to stops along a bus line

Adapting the maximum reasonable detour of DRT to the detour time that is accepted when using conventional public transport.

Analysis of the Travel Time of Various Transportation Systems
Methodological Approach

Within our approach, the travel time of different means of transport in 13 German cities is analyzed using the Google Maps Routing application programming interface (API).

Classes of population of the cities under consideration:

<table>
<thead>
<tr>
<th>Number of inhabitants</th>
<th>Considered cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 2.5 Mio.</td>
<td>to unlimited</td>
</tr>
<tr>
<td></td>
<td>Berlin</td>
</tr>
<tr>
<td>1 Mio.</td>
<td>2.5 Mio.</td>
</tr>
<tr>
<td></td>
<td>Hamburg, Munich, Cologne</td>
</tr>
<tr>
<td>500,000</td>
<td>1 Mio.</td>
</tr>
<tr>
<td></td>
<td>Düsseldorf, Stuttgart, Dresden</td>
</tr>
<tr>
<td>250,000</td>
<td>500,000</td>
</tr>
<tr>
<td></td>
<td>Brunswick, Wuppertal, Bonn</td>
</tr>
<tr>
<td>100,000</td>
<td>250,000</td>
</tr>
<tr>
<td></td>
<td>Oldenburg, Potsdam, Freiburg</td>
</tr>
</tbody>
</table>
Example: Examination Area of the City of Hamburg
21 Reference Points

Selection of examination areas and the connection between start and destination:
- At least ten reference points per examination areas
- Distance between reference points from 1 to 3 km
- Reference points at important public transport stops
- Routes from any point to any other point
Summary of assumptions

Considered Means of Transport:
- Public Transport (PT)
- Motorized individual transport (MIT)
- Only Bus
- Bicycle

The route search for each traffic system is performed in the following way:
- Usage of Google Maps API to calculate the fastest route
- Single trip time, i.e. without arrival and departure times
- Reporting time: 19th September 2017 at 8 o'clock

The following parameters are used to evaluate the travel time:
- Travel time ratio (comparing means of transport)
- Air-line speed.
Averages of travel time ratio and air-line speed by city

<table>
<thead>
<tr>
<th>City</th>
<th>Oldenburg</th>
<th>Potsdam</th>
<th>Freiburg</th>
<th>Average</th>
<th>Brunswick</th>
<th>Bonn</th>
<th>Wuppertal</th>
<th>Average</th>
<th>Dresden</th>
<th>Düsseldorf</th>
<th>Stuttgart</th>
<th>Average</th>
<th>Cologne</th>
<th>Munich</th>
<th>Hamburg</th>
<th>Average</th>
<th>Berlin</th>
<th>All</th>
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<tbody>
<tr>
<td>Travel time ratio</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- PT/MIT</td>
<td>1.95</td>
<td>1.13</td>
<td>1.34</td>
<td>1.43</td>
<td>1.30</td>
<td>1.66</td>
<td>1.78</td>
<td>1.71</td>
<td>1.39</td>
<td>1.10</td>
<td>0.98</td>
<td>1.25</td>
<td>1.08</td>
<td>0.64</td>
<td>1.01</td>
<td>0.81</td>
<td>1.00</td>
<td>1.05</td>
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<tr>
<td>- Bus/MIT</td>
<td>1.93</td>
<td>1.32</td>
<td>1.37</td>
<td>1.83</td>
<td>1.36</td>
<td>2.33</td>
<td>2.07</td>
<td>1.96</td>
<td>1.34</td>
<td>1.50</td>
<td>1.19</td>
<td>1.37</td>
<td>0.82</td>
<td>1.23</td>
<td>1.39</td>
<td>1.31</td>
<td>1.44</td>
<td>1.54</td>
</tr>
<tr>
<td>- Bicycle/MIT</td>
<td>1.37</td>
<td>1.09</td>
<td>0.95</td>
<td>1.17</td>
<td>1.05</td>
<td>1.08</td>
<td>1.69</td>
<td>1.58</td>
<td>1.30</td>
<td>1.24</td>
<td>1.31</td>
<td>1.30</td>
<td>1.18</td>
<td>1.01</td>
<td>1.19</td>
<td>1.11</td>
<td>1.32</td>
<td>1.29</td>
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<td>Air-line speed</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>- MIT [km/h]</td>
<td>19</td>
<td>15</td>
<td>11</td>
<td>15</td>
<td>13</td>
<td>15</td>
<td>19</td>
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<td>12</td>
<td>16</td>
<td>12</td>
<td>11</td>
<td>14</td>
<td>12</td>
<td>17</td>
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</tr>
<tr>
<td>- PT [km/h]</td>
<td>10</td>
<td>12</td>
<td>9</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>15</td>
<td>14</td>
<td>13</td>
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<td>21</td>
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<td>17</td>
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<tr>
<td>- Bus [km/h]</td>
<td>11</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>12</td>
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<td>11</td>
<td>12</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>- Bicycle [km/h]</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>13</td>
<td>12</td>
<td>13</td>
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<td>13</td>
</tr>
<tr>
<td>Number of routes</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>135</td>
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<td>55</td>
<td>145</td>
<td>105</td>
<td>55</td>
<td>66</td>
<td>226</td>
<td>105</td>
<td>171</td>
<td>190</td>
<td>466</td>
<td>861</td>
<td>1,833</td>
</tr>
</tbody>
</table>

Number of inhabitants
100,000 to 250,000
250,000 to 500,000
500,000 to 1 Mio.
1 Mio. to 2.5 Mio.
From 2.5 Mio.
Average
Summary

- In cities with up to 1 million inhabitants, MIT usually has the highest air-line speeds.
- The air-line speed of the bicycle traffic is usually between the one of MIT and the one of public transport. In cities with more than 1 million inhabitants, the travel times of MIT and public transport are often similar and the bicycle somewhat slower.
- In the city center of Berlin the ratio is at 1.0, which means that passengers in Berlin are used to a public transport system that can compete with a journey by car. In the big cities Hamburg, and Cologne the results are similar. In Munich PT even enables a faster ride than MIT.
- Public transport is the fastest mode of transport in Stuttgart’s and Munich’s city center.
Conclusion
What is the Meaning of the Results for Research about DRT and Future Public Mobility?

- The travel time of public transport in the smallest considered cities of about 100,000 to 250,000 is at about 1.43 as high as the travel time when using MIT. The ratio within Oldenburg is the highest one identified in this study: 1.95 as high as the MIT travel time. A DRT that allows passengers to reach their destination quicker could be of great benefit.
- In big cities the ratio is at about 1.0. While establishing a DRT in big cities this fact should be taken into account: DRT will be only successful if travel times are short or when it is planned as an access mode to fast rail-based modes of transport that use an own infrastructure.
- It should be noted that the study can only give an approximation to the actual maximum reasonable DRT detour.
Thank you for your attention

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