Analysis On Night-time Public Transportation Access In Seoul: How Do People Travel At Night In Seoul Using Taxies?

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Introduction

- Seoul is one of the mega cities in the world
  - Area: 605.21km²/ Pop: 9,770,638(2019)
- Despite its socio-economic, and demographic power, its night-time public transport system is not as much supportive as they are in the other mega cities.
- What about the night-time public transportation system in other mega cities like London, NYC, Melbourne and Tokyo?
- Does the night-bus (Owl Bus) introduced in Sept. 2013 provide enough service?
- Currently, discussion on expanding subway operation hour and introducing another type of night-bus
Literature Review

- No single consensus regarding walking distance to public transit

Table 1. Literature review on walking distance to bus stop

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>City, Area</th>
<th>Pop (Year)</th>
<th>Walking distance to public transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burke &amp; Brown 2007</td>
<td>Brisbane, Australia 15,826km²</td>
<td>2,408,223 (2016)</td>
<td>600m (median), 1.3km (85th percentile)</td>
</tr>
<tr>
<td>Daniels &amp; Mulley 2013</td>
<td>Sydney, Australia 12,368km²</td>
<td>5,230,330 (2018)</td>
<td>400m and 800m</td>
</tr>
<tr>
<td>TCQSM 2013</td>
<td>Washington D.C. 177km²</td>
<td>702,445 (2018)</td>
<td>maximum 700m</td>
</tr>
<tr>
<td>Borowska-Stefańska, Wiśniewski 2016</td>
<td>Łódź, Poland 293.2km²</td>
<td>687,702 (2018)</td>
<td>500m</td>
</tr>
</tbody>
</table>

Figure 1. Walking distance to bus stop (TCQSM, 2013: 4-48)
Methodology

- Mapping public transportation stops in operation between 0am – 5am:
  
<table>
<thead>
<tr>
<th>Operation hour</th>
<th>Weekday</th>
<th>Weekend</th>
<th>Mapping info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subway</td>
<td>5am - next day 1am</td>
<td>5am - midnight</td>
<td>Operation hour</td>
</tr>
<tr>
<td>Bus</td>
<td>Early 4am – over midnight</td>
<td></td>
<td>Passenger</td>
</tr>
<tr>
<td>Night bus</td>
<td>Early 23pm – around next day 4am</td>
<td></td>
<td>Passenger</td>
</tr>
<tr>
<td>Community bus</td>
<td>Early 5am – around midnight</td>
<td></td>
<td>Passenger</td>
</tr>
</tbody>
</table>

- Building public transit access buffer for 0-400m, 400-800m and beyond 800m, respectively

- Analysing night-time taxi ridership at 150m road links in each buffer: by hour, by weekday/weekend

- Identify the night-time missing links by measuring daily taxi ridership in beyond 800m buffer
Data

Table 2. Dataset

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Period</th>
<th>Data</th>
<th>Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Administrative area boundary</td>
<td>2016.12.31</td>
<td>Administrative area boundary</td>
<td>Statistics Korea</td>
</tr>
<tr>
<td>2</td>
<td>TaxiMatch Link dataset</td>
<td>2016.9-2017.8</td>
<td>link ID, day of week, time of day, weather, destination, on-board trips, off-board trips, empty trips</td>
<td>Seoul City Government</td>
</tr>
<tr>
<td>3</td>
<td>Bus ridership data</td>
<td>2017.8</td>
<td>location of bus stops, hourly ridership at bus stops</td>
<td>Seoul City Government</td>
</tr>
<tr>
<td>4</td>
<td>Statistics on Public Transport Use</td>
<td>2017</td>
<td>location of subway stations(shp.)</td>
<td>Seoul City Government – Big Data Campus</td>
</tr>
</tbody>
</table>

* Mapping the standard node link ID

<table>
<thead>
<tr>
<th>T_Link_ID</th>
<th>Day</th>
<th>Time</th>
<th>Weather</th>
<th>Dest(?)</th>
<th>CntOn</th>
<th>CntOff</th>
<th>CntEmp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link ID</td>
<td>Day of week</td>
<td>Time of day</td>
<td>Weather</td>
<td>Destina tion</td>
<td>On-board trips</td>
<td>Off-board trips</td>
<td>Empty trips</td>
</tr>
</tbody>
</table>

Primary Key

T_Link_ID, Day, Time, Weather, Dest(?)

Example

110011.0 1 1 1114, 312, 0.0
110011.0 1 1 1113, 324, 3.0
110011.0 1 1 1113, 312, 3.0
110011.0 1 1 112, 312, 3.0
Results

1) Spatial areas covered by public transit service in Seoul during night-time
- Buffer with high accessibility (0-400m) comes narrower and buffer with low accessibility (beyond 800m) comes wider during 2-3am.

2) Travel demands underserved within 400-800m buffer and beyond 800m buffer
- Buffers after 400m have noticeably high demands on taxi at 1am on weekdays (35.0%)
- On weekdays, buffers farther than 400m shows noticeably high demands on taxi at 3am (46.3%).
Results

3) Taxi links in medium/low accessibility buffers with high taxi ridership

- In the 400-800m buffer, taxi links with more than 20 taxi ridership per hour are identified. Total 10 links are identified on weekdays—only at 1am, and total 25 links are identified on weekends between 2-4am.

- In the beyond 800m buffer, 14 and 15 taxi links with high ridership are identified for weekday and weekend, respectively.
  - Mostly during 2-3am
  - Places: hip areas like Itaewon, Bangidong food alley; university town around Hongik university and Korea university; or inter-city transport facilities like Express Bus Terminal

- Low ridership taxi links are amount to about 21000, scattered all around the city.
Conclusion

- Firstly, 2-3am shows the worst coverage of public transport service. Almost 45% of Seoul city is left under the low accessibility buffer which is farther than 800m from public transit stations.

- Secondly, taxi ridership ratio in buffers farther than 400m from public transit stations is turned out to be the most at 1am on weekday and 3am on weekend.

- Lastly, more than 21000 taxi links are used per day regardless of day of week.

- Taxi links used by more than 20 times of boarding are hip places like Itaewon, Bangidong Food Alley, university town around Hongik university and Korea university or inter-city transport facilities like Express Bus Terminal.

- Given the ridership scale of the taxi links, different policy measures—such as expanding night bus routes, carpooling, shared bikes, etc.—could be designed
Reference


- *TCQSM Chapter 3*, Appendix A, p. 3-9.