Investigating the Influence Range of Southern Taiwan Science Parks Using ETC Data

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Through this study, we used ETC data to be more persuasive.
PURPOSE
Explore the influence range of passenger cars in inter-city of the Southern Science Park.

RESEARCH FRAMEWORK

MOTIVATION & PURPOSE

LITERATURE REVIEW

Big Data

Influence Range

Freeway and Urban planning

Electronic toll collection system (ETC)

DATA ANALYSIS

Impact Range

RESULT

Visualization

Build the Database

CONCLUSION & SUGGESTIONS
Freeway and Urban planning

- **Tools**
  
  Defining the influenced populated area of the Freeway using Geographic Information Systems (GIS) method

- **Space Units**
  
  **Borough**, in the 15 km around the interchanges, where population changes significantly.

- **Space Factors**
  
  15-minute interchange within the range of the study, the highway construction for the **regional population** and **industrial development** in space and time are affected, with the different size of the impact domain.

This study linked between urban planning and ETC.
Electronic toll collection system (ETC)

- **Dynamic Traffic Flow**
  Established a dynamic estimated traffic flow matrix.

- **The Relationship of Traffic Volume**
  Like Volume and the speed, the traffic behavior, time and speed.


Zhao, N. etc. (2014); Weng, J. etc. (2014)

This study will use the ETC data which are complete and correct in origin-destination pairs.
Influence Range

Mainly focus on the traffic influence caused by a construction project, including road capacity, road grade and saturation flow.

Scope of research area: radius of 500 meters

This study will focus on a wider range of areas such as cross-county area of traffic.

Definition of Influence Range

<table>
<thead>
<tr>
<th>Influence Range</th>
<th>Extent of the interchanges affected by a certain construction.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traffic flow of each influenced interchange.</td>
</tr>
</tbody>
</table>
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Research Method

- **Statistical Analysis**
  narrative statistical operations
  Tool: EXCEL

- **Visualization**
  Tool: GIS

- **Data Resource**
  "Transport Database" of Taiwan Area Freeway Bureau, MOTC, with the original data (M06) of the travel trips from 2013
  — daily and hourly vehicles, time and numbers of interchanges, driving distance

- **Using Data**
  January, 2015 and 2016

<table>
<thead>
<tr>
<th>車種</th>
<th>起點時間</th>
<th>起點交流道編號</th>
<th>途點時間</th>
<th>途點交流道編號</th>
<th>里程長度</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>2015/1/1 02:41 05F0438N</td>
<td>2015/1/1 02:50 05F0399N</td>
<td>16.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2015/1/1 02:17 03F0188S</td>
<td>2015/1/1 02:25 03F0142S</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2015/1/1 02:57 03F0337S</td>
<td>2015/1/1 03:00 03F0394S</td>
<td>11.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2015/1/1 02:27 01F3525N</td>
<td>2015/1/1 02:44 01F3227N</td>
<td>36.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2015/1/1 02:30 03F0447S</td>
<td>2015/1/1 02:30 03F0447S</td>
<td>7.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2015/1/1 02:46 01F3339S</td>
<td>2015/1/1 02:14 01F3667S</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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**Southern Taiwan Science Parks**

<table>
<thead>
<tr>
<th>Science Park \ Items</th>
<th>Tainan S. Park</th>
<th>Kaohsiung S. Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (ha)</td>
<td>1,043</td>
<td>570</td>
</tr>
<tr>
<td>Annual production value (100 million NTD)</td>
<td>122</td>
<td>64</td>
</tr>
<tr>
<td>Number of manufacturers (household)</td>
<td>6,647</td>
<td>505</td>
</tr>
<tr>
<td>Employment (people)</td>
<td>69,040</td>
<td>8,493</td>
</tr>
</tbody>
</table>

(Source: Southern Science Park, 2015 Official Website)

http://www.stsp.gov.tw/web/WEB/Jsp/Page/cindex.jsp?frontTarget=DEFAULT&thisRootID=37
Research Framework

Data Cleaning

Visualizing the influence range and establish database

Analyzing the difference between weekday, weekend and holidays

Discussion and Conclusion

Study Object

Time: weekday commuting time
AM7:00-9:00
(MOTC: weekday means Tue to Thur)

Vehicle Type: Small passenger cars

MOTC: Ministry Of Transportation And Communications
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**RESULTS**

- **Tainan Science Park**
  - 1. Tainan Interchange: 1,000 PCE
  - Yongkang, Guanmiao, Dawan, Madou: about 400 to 800 vehicles
  - Influence range of Tainan Science Park Hsinchu to Pingtung: about 9 counties
  - The greatest volume is Tainan urban areas, while Kaohsiung’s volume of distribution is more averaged.

![Map showing Tainan Science Park and its influence range](image)
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**RESULTS**

- **Weekday**: about 8,000 PCE
- **New Year Holiday**: about 3,000 PCE
- **Weekends**: about 4,000 PCE

- Compared to commuting time after work
- It becomes mature, changing little between 2015 and 2016

<table>
<thead>
<tr>
<th>Tainan</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>employees</td>
<td>72,634</td>
<td>71,313</td>
</tr>
<tr>
<td>↓1,300</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By Date

By Weekday
Kaohsiung Science Park

1. Rende System Interchange and Luzhu Interchange, with a volume about 500 to 550 PCE

2. Southern urban area and the Nanzi area, with 250 to 300 PCE each.

Influence range of Kaohsiung Park Taichung to Pingtung about 7 counties

Most of commuting trips are from Tainan City and Kaohsiung City, each of them is nearly 50%
Kaohsiung Science Park

- **Weekday**: about 2,500 PCU
- **New Year Holiday**: about 1,000 PCU
- **Saturday**: about 1,500 PCU
- **Sunday**: about 1,000 to 1,300 PCU

- between 30% and 40% employees commuting by small passenger cars

<table>
<thead>
<tr>
<th>Kaohsiung</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>employees</td>
<td>6,601</td>
<td>8,092</td>
</tr>
</tbody>
</table>

↑1,500
Comparative analysis

- **Difference**
  - Nearly six times the number of employees, but only about four times of passenger cars, because of better residential properties and transportation like free shuttle bus and train stations around Tainan Park.
  - On Friday passenger cars from Tainan Park were even more than morning, seems that some employees stay around Tainan Park on weekdays and return home on weekends.

- **Same**
  - Every Friday will be early to get off work, other than weekdays, Monday to Thursday are between about 17:00 to 20:00.
LIMITATION

■ Space
Include Highway No.1 No.3 No.5, not include the province road, county road or general road.

■ Human Factors
Some vehicles don’t have the ETC identification stickers so that we can’t know their origin and destination.
The use rate of ETC and the number of users over the years are different. It may cause research errors when they are compared.
CONCLUSION

Influence Range of Southern Science Park

Both Tainan and Kaohsiung science parks had the greatest volume from old Tainan City, but Tainan park had farther influence range than Kaohsiung park although it’s not a decreasing form.

Influence range may depend on employees, surrounding environment and development time of science parks.
CONCLUSION

- Provide a reference for Taiwanese construction sites in the future.
- More persuasive through the real data and establish a set of ETC data analysis process.
- Build a database of influence range of important constructions and visualize them as the basis for long-term observation.

SUGGESTION

- Add buses and trucks of the situation and complete the influence range of other science parks with comparative analysis.
- Add other kinds of construction such as tourist spot and transport, recreation areas, airports and ports to improve the influence range of the database.
- Data Limitation
  In the future it may use VD data for comparison.
  The VD data provided by MOTC include the traffic flow from east to west freeway and provincial road, but it does not include the direction.
ACKNOWLEDGMENT

We would like to thank Taiwan Area Freeway Bureau, MOTC R.O.C. and Institute of Transportation, MOTC R.O.C. for providing relevant information.