High Speed Rail in Taiwan

Dr. S.K. Jason Chang
Professor, Dept of Civil Engineering
Director, Advanced Public Transport Research Center
National Taiwan University
skchang@ntu.edu.tw

Roundtable on
The Economics of Investment in High Speed Rail
New Delhi, India, December 18~19, 2013
Agenda

1. Development of Taiwan High Speed Rail
2. Operation of Taiwan High Speed Rail
3. Financial Sustainability
4. Governance Sustainability
5. Concluding Remarks
94% of Taiwan’s Population Live Along the West Corridor (20% of land)

Urbanization phenomenon/issue ~ But, at least, we identified a corridor which can support the HSR.
Travel Time Comparison among Modes

Taipei to Kaohsiung (345 km)

- **Secondary Highway** (8 – 10 hours)
- **Freeway** (5 – 6 hours)
- **Traditional Railway** (5 – 8 hours)

**Air** (50 min)

1. Check in 20 min in advance
2. Only 2 flights/week (after the HSR)

**High Speed Rail** (90 min)

* Without Considering Traffic Congestion
Taiwan High Speed Rail

Total length: 345 km
## Taiwan High Speed Rail Development

<table>
<thead>
<tr>
<th>Year</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974.4</td>
<td>The first high speed rail project conducted by Taiwan Railway Administration</td>
</tr>
<tr>
<td>1987.4.2</td>
<td>Feasibility study of HSR conducted by Ministry of Transportation and Communications, as part of integrated public transportation systems with metro in urban areas</td>
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<tr>
<td>1990.3.15</td>
<td>Confirmation of the feasible plans and a preliminary route is recommended based on alternatives analysis</td>
</tr>
<tr>
<td>1990.4.12</td>
<td>The preliminary plan is approved by the Central Government</td>
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<tr>
<td>1991.10.1</td>
<td>Revised plan was proposed and evaluated due to the National Plan on development of new towns and industrial parks</td>
</tr>
<tr>
<td>1992.6.25</td>
<td>Approval of the revised plan</td>
</tr>
<tr>
<td>1993.7</td>
<td>PPP Approach is requested by the Congress with a minimum 40% of investment from private sector</td>
</tr>
<tr>
<td>1996.10.29</td>
<td>Call for Proposal of the BOT Project announced by MOTC</td>
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<tr>
<td>1997.9.25</td>
<td>Taiwan High Speed Rail Consortium obtained the concession</td>
</tr>
<tr>
<td>1998.7.23</td>
<td>Signing ceremony of the BOT Project (MOTC and THSRC)</td>
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</tbody>
</table>
Construction

- Total 345KM
- Tunnel provided by Government
- Total Budget: US$16B~17B

Embankment 9.4% (31km)
Tunnel 14.2% (47km)
Elevated Bridge 76.4% (252km)
MOSTLY Elevated!~
Demand Forecasting

Source: THSRC, 2002.05
Taipei Station
Banciao Station
HSR Taoyuan Station
HSR Hsinchu Station
HSR Taichung Station
HSR Chiayi Station
HSR Tainan Station
Zuoying Station
Operation Speed 300 KPH

Taipei – Taichung  45 min
Taipei – Zuoying  90 min
Taiwan HSR Operation (1/3)
Operation Plan - Stopping Pattern

<table>
<thead>
<tr>
<th>Stop Pattern</th>
<th>Taipei</th>
<th>Bain-Chiao</th>
<th>Tao-Yuan</th>
<th>Xin-Ju</th>
<th>Miao-Li</th>
<th>Tai-Jung</th>
<th>Zhang-Hwa</th>
<th>Yun-Ling</th>
<th>Chia-Yi</th>
<th>Tai-Nan</th>
<th>Zuo-Ying</th>
<th>Travel Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Zuo-Ying</td>
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<td>65</td>
</tr>
</tbody>
</table>

Tentative Daily Frequency

2007 : 60
2013 : 100
2033 : 120
<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Total Train Service</td>
<td>300,487</td>
</tr>
<tr>
<td>No. of Passengers</td>
<td>241,190,908</td>
</tr>
<tr>
<td>Passenger-km</td>
<td>48.85 billion</td>
</tr>
<tr>
<td>Loading Factor</td>
<td>56.00 %</td>
</tr>
</tbody>
</table>

Taiwan HSR Operation (2/3) 2007.01.05~2013.10.31
Taiwan HSR Operation (3/3) 2007.01.05~2013.10.31

Service Reliability 99.94%
Service Punctuality 99.36% (delay < 5min)
Average Delay Time 0.25 min
No. of Operation Accident 0
Growth of Passenger Volume

- **Daily Vol. (Max)**
- **Weekend Vol. (Ave.)**
- **Daily Vol. (Ave.)**
- **Weekday Vol. (Ave.)**

**2007/1/5 通車營運**

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<tr>
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<tbody>
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<td>2007</td>
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<td>2010</td>
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<tr>
<td>2011</td>
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**Important Dates**
- 10/12 雙十假期
- 2/16 春節
- 2/5 春節

**Passenger Volume Growth**
- **Daily Volume**: 20,000 to 200,000
- **Weekday Volume (Ave.)**: 60,000 to 140,000
- **Weekend Volume (Ave.)**: 80,000 to 160,000
- **Daily Volume (Max)**: 190,596

**Key Points**
- Growth in passenger volume from 2007 to 2011
- Significant increase in volume during holidays
- Smooth increase in daily and weekday volumes

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Growth of Daily Frequency

Weekend

Weekday

Trains/Day

Copyright © 2009 Taiwan High Speed Rail Corporation.
Vehicle: 700T
Intercity Travel Demand
Along Taiwan’s Western Corridor

Modal Split

Unit: million passenger trip/year

<table>
<thead>
<tr>
<th>Year</th>
<th>HSR</th>
<th>Airline</th>
<th>Bus</th>
<th>Railway</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>61%</td>
<td>36%</td>
<td>3%</td>
<td>2%</td>
<td>180</td>
</tr>
<tr>
<td>2007</td>
<td>57%</td>
<td>33%</td>
<td>8%</td>
<td>2%</td>
<td>189</td>
</tr>
<tr>
<td>2011</td>
<td>52%</td>
<td>30%</td>
<td>18%</td>
<td></td>
<td>225</td>
</tr>
</tbody>
</table>

Intercity Travels

(2007)

- Private Car: 78%
- Public Transport: 22%

(2011)

- Private Car: 70%
- Public Transport: 30%

Source: "THI Consultants, Inc", 2008 & THSRC
Market Share of Intercity Travel Demand

Based on Study on 2003.05

Note: Only for Trips from Taipei
Sustainable Mobility: Energy Consumption and CO2 Emission

Energy Consumption

<table>
<thead>
<tr>
<th>Mode</th>
<th>Energy Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSR</td>
<td>100%</td>
</tr>
<tr>
<td>Railway</td>
<td>103%</td>
</tr>
<tr>
<td>Bus</td>
<td>287%</td>
</tr>
<tr>
<td>Private Car</td>
<td>471%</td>
</tr>
<tr>
<td>Airplane</td>
<td>805%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode</th>
<th>CO2 Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSR</td>
<td>100%</td>
</tr>
<tr>
<td>Railway</td>
<td>101%</td>
</tr>
<tr>
<td>Bus</td>
<td>262%</td>
</tr>
<tr>
<td>Private Car</td>
<td>397%</td>
</tr>
<tr>
<td>Airplane</td>
<td>697%</td>
</tr>
</tbody>
</table>

- HSR: 8.7ml/passenger-kilometer
- Railway: 9ml/passenger-kilometer
- Bus: 25ml/passenger-kilometer
- Private Car: 41ml/passenger-kilometer
- Airplane: 70ml/passenger-kilometer
- CO2 Emission:
  - HSR: 26.7g/passenger-kilometer
  - Railway: 27g/passenger-kilometer
  - Bus: 70g/passenger-kilometer
  - Private Car: 106g/passenger-kilometer
  - Airplane: 186g/passenger-kilometer
Socio-Economic Impact of THSR (2007.01.05~2009.05.31)

Energy Saving
(Compare to Private Car)
420 Thousand Kilo-Liters oil equivalent or US$295 Million

Emission Reducing
(Compare to Private Car)
1.0 Million Tons CO2 or 70,000 hectares Forest Parks

Time Saving
90 Million Hours = US$480 Million

Economic Development and Competitiveness

Safety, Reliability & Comfort Services
Western Taiwan by Train

Photograph by Molly Loh, Reporter

Hop a high-speed (180 miles an hour) bullet train in Taipei to zip across western Taiwan's valleys, plains, and Central Mountain Range foothills. The Taiwan High Speed Rail western route winds through 46 tunnels and over 152 miles of elevated rail from Taipei south to Kaohsiung. The southernmost rail stop serves as the gateway to tropical Dapang Bay National Scenic Area, Kenting National Park, and Meinlan National Scenic Area, home to four indigenous groups—the Rukai, Paiwan, Bunun, and Tsou. A roundtrip western bullet train loop from Taipei and back is an easy day trip getting travelers back in time to sample crispy salt and spicy beef in Taipei's famous night markets. For station stops like Banciao, Taoyuan, Hsinchu, Taichung, Chiayi, and Tainan. From February 23 to March 11, at the nearby Sanyi Jiading hot spring, the Taitung Hot Spring Festival takes place. During each night of the festival, candle-lit paper lanterns illuminate the night skies of northern Taiwan's oldest city.
Taiwan Western Corridor – One-Day Living Circle

19th Century   1900~1950   1970s   21st Century

PORT

Railway + Highways

Freeway

High Speed Rail
Transfer Service Strategic Planning of Taiwan High Speed Rail

Planning Strategy and Guidelines
1. Internalization of Transfer and Feeder Facilities
2. Intermodal Station: Multiple Alternatives
3. Priority of Public Transport Modes
<table>
<thead>
<tr>
<th><strong>Build</strong></th>
<th><strong>Operate</strong></th>
<th><strong>Transfer</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government</strong></td>
<td>Obtain the Land</td>
<td>Design and Construction of Nangang-Banqiao Section</td>
</tr>
<tr>
<td></td>
<td>Project Management and Oversee</td>
<td></td>
</tr>
<tr>
<td><strong>THSRC</strong></td>
<td><strong>Operation Concession (35 Years) &amp; Construction</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Right for Affiliated Business (35 Years)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Land Development Right (50 Years): 500m Circle</strong></td>
<td>2 ~ 3 km → Central and Local government to develop</td>
</tr>
</tbody>
</table>

PPP Model – The BOT

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Financial Sustainability

- Investment (including: facilities constructed before the concession; Direct $ (gov. funds) → shareholder)

- Loan from State Banks (due to global economy downturn, no foreign bank involved)

- Re-negotiation of the Interest Rate (due to low ridership at beginning phase of HSR operation)

- Re-calculation of Depreciation (linear → performance-based)
Government vs. Private Investment

- Total Cost: 17 B (USD)

Taiwan Government’s Involvement (including: pre-HSR construction, direct funding as stakeholder)

Taiwan HSR Corporation Investment

- “Zero Investment” Promised by THSRC at the bidding phase
- At the end, THSRC DOES plan to buy out the gov. share after making profit.

Financial Independence
Governance Sustainability

- Create an Institutional Framework to make HSR happen
  - The HSR Bureau oversees the THSRC to ensure the quality (e.g., Reliability, Loading factor)
  - Law/Regulation enacted to encourage private sector’s investment

- Urban Planning and Land Development with help from Local Government
  - HSR Stations at remote area → for purpose of developing new town
  - Taipei and Kaohsiung Stations → Joint Development with TOD concept
Concluding Remarks

1. Governance and Financial Sustainability is crucial for Mega Infrastructure Project
2. Taiwan’s PPP Business Model → bring private sector’s investment, efficiency on construction, innovative operation and marketing, total budget is not booming, etc.
3. Profitability is expected; however, to clearly identify the external benefits of HSR is crucial for development.
4. Government Step-in → in some way, it solved some problems, however..
   ✓ Bureaucracy got introduced
   ✓ Still “institutional barriers” between local and central government
   → so, the new towns are not fully developed.
   → so, station development & TOD are not as expected.
Thank you ~

Q & A