Risk Management Strategy for Infrastructure Public-Private Partnership Projects

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Brown Bag Seminar, 26 April 2006
Outline

- **Background:** Private-Private Partnership in Taiwan
- **Case:** Taiwan High Speed Rail
- **Initiative:** Risk Management Strategy for Infrastructure Public-Private Partnership Projects
Part I: Background
Private-Private Partnership in Taiwan
PPP - Definition

“A Public-private partnership is a contractual agreement between a public agency (federal, state or local) and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility.”

- National Council for Public-Private Partnerships
PPP - Spectrum

Source: Savas, E.S. [2000].
PPP – Worldwide Trend

**Survey of PricewaterhouseCoopers**

- In 2004~2005, 206 PPP deals, totaled €42 billion

- Outside Europe: €21 billion in 54 deals
  - Australia, Canada, Japan, Mexico, US
  - China, Hong Kong, Singapore, Middle Eastern countries

- Europe: €21 billion in 152 deals
  - UK, Spain, Portugal, German, France
  - Italy, Ireland, Netherlands, Greece, Denmark, Finland
PPP in Taiwan – Location

Area: 36,000 km²
Population: 23 million
Climate: 24.7 °C Avg. in May

Taiwan

Taipei ★
PPP in Taiwan - History

1887: 300km railway concession proposed by local government

1994: Statute for Encouragement of Private Participation in Major Transportation Projects

1995: Regulation of Open Electricity Industry

1996: Plan for Public & Private Participation in Incinerator Projects

2000: Law for Promotion of Private Participation in Infrastructure Projects
PPP in Taiwan – PPIP Law

- **Underlying principles**
  - General Application
  - Maximization of private participation
  - Maximum government prudence

- **Models of Private Participation**
  - BOT, BTO, BOO, ROT, OT

- **Procedures of Application**
  - Government planned projects
  - Unsolicited Proposal
PPP in Taiwan – Application

Government-Planned Projects
PPP in Taiwan - Organizations

Coordination Committee for the Promotion of Private Participation in Infrastructure Projects, Executive Yuan

Coordination Task force

County (City) government authority-in-charge promotion committees

Central government authority-in-charge promotion committees

Authority-in-charge of each project
Implementing agencies of individual projects

Authority-in-charge of each project
Implementing agencies of individual projects
PPP in Taiwan – Incentives

- Land acquisition
- Capital raising
- Tax incentives for major infrastructure projects
- Ancillary enterprise
- Deregulation of foreign capital participation
PPP in Taiwan – Statistics

Amount of Private Investment

- **2002**: 0.22 billion USD (49 projects)
- **2003**: 1.86 billion USD (36 projects)
- **2004**: 3.88 billion USD (82 projects)
- **2005**: 1.84 billion USD (152 projects)

Amount increased 8.6-fold in 2003 and 2.1-fold in 2004.
## PPP in Taiwan – Statistics

<table>
<thead>
<tr>
<th>Private Participation</th>
<th>Investment Volume (Unit: million US$)</th>
<th>No. of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOT</td>
<td>5,742.5</td>
<td>34</td>
</tr>
<tr>
<td>BTO</td>
<td>3.1</td>
<td>1</td>
</tr>
<tr>
<td>ROT</td>
<td>145.5</td>
<td>61</td>
</tr>
<tr>
<td>OT</td>
<td>120.6</td>
<td>93</td>
</tr>
<tr>
<td>BOO</td>
<td>906.3</td>
<td>10</td>
</tr>
<tr>
<td>BOT + OT</td>
<td>92.5</td>
<td>1</td>
</tr>
<tr>
<td>BOT + ROT</td>
<td>35.9</td>
<td>4</td>
</tr>
<tr>
<td>OT + ROT</td>
<td>3.8</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,050.2</strong></td>
<td><strong>192</strong></td>
</tr>
</tbody>
</table>

Source: Public Construction Commission [2005]
# PPP in Taiwan – Statistics

<table>
<thead>
<tr>
<th>Facilities</th>
<th>Investment Volume (Unit: million US$)</th>
<th>No. of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural &amp; Education</td>
<td>198.0</td>
<td>49</td>
</tr>
<tr>
<td>Transportation &amp; Common Conduit</td>
<td>4,154.4</td>
<td>25</td>
</tr>
<tr>
<td>Sewerage, Water Supply &amp; Conservancy</td>
<td>386.3</td>
<td>4</td>
</tr>
<tr>
<td>Social &amp; Labor Welfare</td>
<td>83.0</td>
<td>15</td>
</tr>
<tr>
<td>Industrial, Commercial &amp; Hi-tech</td>
<td>1,022.3</td>
<td>7</td>
</tr>
<tr>
<td>Agricultural</td>
<td>75.1</td>
<td>12</td>
</tr>
<tr>
<td>Sanitation &amp; Medical</td>
<td>197.0</td>
<td>64</td>
</tr>
<tr>
<td>Tourism</td>
<td>934.1</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,050.2</strong></td>
<td><strong>192</strong></td>
</tr>
</tbody>
</table>

Source: Public Construction Commission [2005]
Part II: Case
Taiwan High Speed Rail
Specifications

● **Alignment**
  - 345 km, Taipei ~ Kaohsiung
  - 12 stations, 5 maintenance bases

● **Structure types**
  - Viaducts & bridges – 207km
  - Tunnel/ cut & cover – 56km
  - Embankments/ cuttings – 81km

● **Track**
  - 2 tracks
  - Standard gauge (1,435mm)
Specifications

- **Core system**
  - TGV + SKS hybrid system

- **Design speed**
  - 350 km/hr

- **Operating features**
  - 250~300 km/hr operation speed
  - 4-min service interval in peak hour
  - 18-hr operation every day
  - 80-min travel time for direct train
  - 989 seats per train
Model of Private Participation

10 Years
Government
Planning

35 Years
Taiwan High Speed Rail Corporation
Build
Operate

Government
Transfer

19
Scope of Work

THSR

Government’s Work

- Land Acquisition & Handing Over
- Improvement of Access Highway to Stations
- Civil Works between Nankang & Panchiao Stations (i.e. Central Taipei)
- Supervision and Administration of THSR project
- Expropriation of Station Special Districts by Zones
- Miscellaneous Works

THSRC’s Work

- Planning, Design & Construction of THSR (except Nankang~Panchiao)
- Operation & Maintenance of THSR
- Land Use & Development of Station Special Districts

Estimation by the Government

US$ 3.3 billion

US$ 16 billion

US$ 12.7 billion
Scope of Works

- Preliminary
  - D/B, fixed price, lump-sum
- Core System
  - D/M/B/I, fixed price, lump-sum
- Stations
  - D/B/B, fixed price, lump-sum
- Depots
  - D/B/B, fixed price, lump-sum
- Trackwork
  - D/B, fixed price, lump-sum
- Civil Works
  - D/B, fixed price, lump-sum
## Chronology

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990/07</td>
<td>Provisional Office of the High Speed Rail was established.</td>
</tr>
<tr>
<td>1992/06</td>
<td>The alignment of THSR was permitted by the Executive Yuan.</td>
</tr>
<tr>
<td>1995/01</td>
<td>The Legislative Yuan passed the THSR plan, requiring the part of</td>
</tr>
<tr>
<td></td>
<td>private investment in THSR must exceed 40%.</td>
</tr>
<tr>
<td>1996/10</td>
<td>Announcement to invite private participation.</td>
</tr>
<tr>
<td>1997/09</td>
<td>Taiwan High Speed Rail Consortium was selected as the best applicant</td>
</tr>
<tr>
<td></td>
<td>by the Selection Committee.</td>
</tr>
<tr>
<td>1998/05</td>
<td>Taiwan High Speed Rail Corp, Ltd. (THSRC) was officially registered</td>
</tr>
<tr>
<td></td>
<td>with the capital volume of US$1.56billion.</td>
</tr>
<tr>
<td>1998/07</td>
<td>THSRC was awarded the concession agreement by MOTC.</td>
</tr>
<tr>
<td>1998/09</td>
<td>Chiao Tung Bank (CTB), Bank of Taiwan (BoT), and International</td>
</tr>
<tr>
<td></td>
<td>Commercial Bank of China (ICBC) formed the finance syndicate for</td>
</tr>
<tr>
<td></td>
<td>THSRC.</td>
</tr>
<tr>
<td>1999/08</td>
<td>THSRC signed the Tripartite Contract with MOTC and CTB, representing</td>
</tr>
<tr>
<td></td>
<td>the Bank Consortium, comprised of 25 banks.</td>
</tr>
<tr>
<td>2000/01</td>
<td>Design contracts of all Stations were awarded.</td>
</tr>
</tbody>
</table>
## Chronology

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<tr>
<th>Year</th>
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</tr>
</thead>
<tbody>
<tr>
<td>2000/01</td>
<td>Design contracts of all Stations were awarded.</td>
</tr>
<tr>
<td>2000/02</td>
<td>The Contract of Syndicate Loan totaled US$10.1 billion was signed between THSRC and 25 banks, represented by the CTB.</td>
</tr>
<tr>
<td>2000/04</td>
<td>Design/build contracts of all civil works were awarded.</td>
</tr>
<tr>
<td>2000/12</td>
<td>THSRC signed core system supply and installation contracts valued at US$3 billion with the Taiwan Shinkansen Corp. and the Taiwan Shinkansen International Engineering Corp.</td>
</tr>
<tr>
<td>2003/03</td>
<td>Contract of automated booking and tolling system was awarded.</td>
</tr>
<tr>
<td>2003/07</td>
<td>T240 Rail Installation Ceremony, symbolized the commencement of track work.</td>
</tr>
<tr>
<td>2004/01</td>
<td>The production of THSRC 700T trains by Kawasaki was finished.</td>
</tr>
<tr>
<td>2004/05</td>
<td>Construction works alone the route completed.</td>
</tr>
<tr>
<td>2005/01</td>
<td>700T Test Run Inauguration started in Tainan.</td>
</tr>
<tr>
<td>2005/09</td>
<td>THSRC announced the revision of Target Operation Date from 2005/10/31 to 2006/10/31.</td>
</tr>
<tr>
<td>2005/10</td>
<td>700T Test Run reached top speed of 315km/hr.</td>
</tr>
</tbody>
</table>
Shareholders of THSRC

- **A/E/C, Transportation & Materials**
  - Continental Engineering Corp.
  - EVA Airways Corp.
  - Tung Ho Steel Enterprise Corp.

- **Finance**
  - Taipei-Fubon Commercial Bank
  - Shinkong Insurance Co., Ltd.

- **Electronics & Communication**
  - Pacific Electric Wire & Cable Co., Ltd.
  - TECO Electric & Machinery Co., Ltd.
  - Walsin Lihwa Co, Ltd.

- **Government & Relevant Organizations**
  - Executive Yuan Development Fund
  - Taiwan Sugar Corp.
  - China Aviation Development Foundation
  - CTCI Foundation

- **Institutional & Individual Investors**
International Teamwork

**THSRC**
- 1500 engineers & technical staff
- 1/3 of above are foreigners from 26 countries

**Contractors**
- Civil works – 12 subprojects
  - Taiwan, Japan, Korea, Hong Kong, Thailand, Italy, Germany, Netherlands, France
- Stations – 8 subprojects
  - Taiwan, Japan
- Depots – 4 subprojects
  - Taiwan, Japan
- Electric & Mechanical – 2 subprojects
  - Taiwan, Japan, France
## List of Contractors – Civil Works

<table>
<thead>
<tr>
<th>Subproject No.</th>
<th>Start Mileage</th>
<th>Finish Mileage</th>
<th>Length (m)</th>
<th>Contractor</th>
<th>Award Date</th>
<th>Commencement Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>C210</td>
<td>16K+800</td>
<td>28K+080</td>
<td>11,280</td>
<td>Obayashi - Futsu JV</td>
<td>2000/1/10</td>
<td>2000/4/1</td>
</tr>
<tr>
<td>C215</td>
<td>28K+080</td>
<td>68K+540</td>
<td>40,460</td>
<td>Obayashi - Futsu JV</td>
<td>2000/1/10</td>
<td>2000/4/1</td>
</tr>
<tr>
<td>C220</td>
<td>68K+540</td>
<td>86K+320</td>
<td>17,780</td>
<td>Daiho Corporation</td>
<td>2000/3/1</td>
<td>2000/4/1</td>
</tr>
<tr>
<td>C230</td>
<td>86K+320</td>
<td>109K+760</td>
<td>23,440</td>
<td>Hyundai - Chung Lin - Zen Pacific JV</td>
<td>2000/4/1</td>
<td>2000/5/1</td>
</tr>
<tr>
<td>C240</td>
<td>109K+760</td>
<td>130K+600</td>
<td>20,840</td>
<td>Hyundai - Chung Lin JV</td>
<td>2000/4/1</td>
<td>2000/5/1</td>
</tr>
<tr>
<td>C250</td>
<td>130K+600</td>
<td>170K+400</td>
<td>39,800</td>
<td>Hochtief - Ballast Nedam - Pan Asia JV</td>
<td>2000/5/1</td>
<td>2000/5/1</td>
</tr>
<tr>
<td>C260</td>
<td>170K+400</td>
<td>207K+015</td>
<td>36,615</td>
<td>BB - CEC JV</td>
<td>2000/4/1</td>
<td>2000/4/1</td>
</tr>
<tr>
<td>C270</td>
<td>207K+015</td>
<td>249K+814</td>
<td>42,799</td>
<td>BB - CEC JV</td>
<td>2000/3/1</td>
<td>2000/4/1</td>
</tr>
<tr>
<td>C280</td>
<td>249K+814</td>
<td>284K+221</td>
<td>34,407</td>
<td>Samsung - Doosan - IE&amp;C JV</td>
<td>2000/2/1</td>
<td>2000/3/1</td>
</tr>
<tr>
<td>C291</td>
<td>284K+221</td>
<td>312K+734</td>
<td>28,513</td>
<td>Evergreen - Shimizu JV</td>
<td>2000/3/1</td>
<td>2000/4/1</td>
</tr>
<tr>
<td>C295</td>
<td>312K+734</td>
<td>340K+058</td>
<td>27,324</td>
<td>Evergreen - Italian Thai - PEWC JV</td>
<td>2000/3/1</td>
<td>2000/4/1</td>
</tr>
<tr>
<td>C296</td>
<td>340K+058</td>
<td>343K+120</td>
<td>3,062</td>
<td>Evergreen - Shimizu JV</td>
<td>2001/1/5</td>
<td>2001/1/5</td>
</tr>
</tbody>
</table>
## Progress

<table>
<thead>
<tr>
<th>Category</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>94.05% [Feb 2006]</td>
</tr>
<tr>
<td>Civil works</td>
<td>Completed 100%</td>
</tr>
<tr>
<td>Stations</td>
<td>Completed 98.71%</td>
</tr>
<tr>
<td>Trackwork</td>
<td>Completed 100%</td>
</tr>
<tr>
<td>Core system</td>
<td>Completed 79.05%</td>
</tr>
<tr>
<td>Depots</td>
<td>Completed 94.71%</td>
</tr>
</tbody>
</table>
Part III: Initiative
Risk Management Strategy for Infrastructure Public-Private Partnership Projects
Research Objective

To investigate the optimal risk allocation and risk management strategies for infrastructure PPP projects, by considering

- The interdependency of risk events and actions of project participants,
- Different types of PPP, and
- Different stages of infrastructure projects.
Risk Management

Risk Assessment Strategies

Risk Perception
- Public Perceptions
- Expert/Layperson Differences
- Risk Communication

Risk Assessment & Vulnerability Analysis

Modeling of Risks

Statistical Data Building Scenarios

Source: Kunreuther, H. [2004]
What is “Risk Interdependence”

“Risk faced by one person or firm depends on both its own security investments as well as on the actions of others.”


Interdependent Security (IDS) Problems
Examples of IDS Problems

- Airline security
- Fire protection
- Vaccinations
- Computer security
- Theft protection
- R&D investment
- Protection against bankruptcy
Classes of IDS Problems

- **Class 1: Partial Protection**
  - The more firms invest in preventive measures, the lower are the negative externalities in the system.

- **Class 2: Complete Protection**
  - If an individual invests in prevention it cannot be harmed by the actions of others nor can it harm others.

- **Class 3: Positive Externalities**
  - Investment by one individual creates positive externalities, substituting for the same investment by others & making it less attractive for others to follow suit.
Risk Interdependence

Interdependent actions

Interdependent outcomes
Research Procedure
## Risk Classification

<table>
<thead>
<tr>
<th>Complexity of output</th>
<th>Complexity of markets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>Defense facilities</td>
</tr>
<tr>
<td></td>
<td>Maintenance facilities</td>
</tr>
<tr>
<td></td>
<td>Public waste management</td>
</tr>
<tr>
<td></td>
<td>Computer facilities</td>
</tr>
<tr>
<td>Low</td>
<td>Power stations</td>
</tr>
<tr>
<td></td>
<td>Water supplies</td>
</tr>
<tr>
<td></td>
<td>Sewage treatment</td>
</tr>
<tr>
<td></td>
<td>Incinerators</td>
</tr>
<tr>
<td></td>
<td>Telecoms links</td>
</tr>
<tr>
<td></td>
<td>Imputed toll roads</td>
</tr>
</tbody>
</table>

*Source: Walker & Smith [1995]*
### Risk Classification

<table>
<thead>
<tr>
<th>Risks in BOT Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General (Country) Risks</strong></td>
</tr>
<tr>
<td><strong>Country Commercial Risks</strong></td>
</tr>
<tr>
<td><strong>Country Legal Risks</strong></td>
</tr>
<tr>
<td><strong>Development Risks</strong></td>
</tr>
<tr>
<td><strong>Construction/Completion Risks</strong></td>
</tr>
<tr>
<td><strong>Operating Risks</strong></td>
</tr>
</tbody>
</table>

#### Political Risks
- Political Support Risks
- Taxation Risks
- Expropriation/Nationalization Risks
- Forced Buy-out Risks
- Cancellation of Concession
- Import/export restrictions
- Failure to obtain or renew approvals

#### Country Commercial Risks
- Currency Inconvertibility Risks
- Foreign Exchange Risks
- Devaluation Risks
- Inflation Risks
- Interest Rate Risk

#### Country Legal Risks
- Changes in Laws and Regulations
- Law Enforcement Risk
- Delays in Calculating Compensation

#### Development Risks
- Bidding Risks
- Planning Delay Risks
- Approval Risks
- Transnational Risks

#### Construction/Completion Risks
- Delay Risk
- Cost overrun risk
- Re-performance risk
- Completion Risk
- Force Majeure Risk
- Loss or Damage to Work
- Liability Risk

#### Operating Risks
- Associated Infrastructure Risks
- Technical Risks
- Demand Risk (Volume and Price)
- Supply Risk (Volume and Price)
- Cost Escalation Risks
- Management Risks
- Force Majeure Risk
- Loss or Damage to Project Facilities
- Liability Risk

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Source: UNIDO[1996]
Research Strategy

- **From quantitative to qualitative**
- **From local to global**
  - Taiwan ⇒ Great Chinese Area ⇒
  - Transportation
    - Taiwan High Speed Rail, Kaohsiung Mass Rapid Transit, Taipei Port Container Terminal, Farglory Free Trade Zone, Taipei City Hall Transfer Station
- **From simple to complex**
  - N stages, N agents, factor model
Dapeng Bay Scenic Area ➔
(Biggest Tourism PPP in Taiwan)

↑ Landscape of
Taiwan High Speed Rail

Taipei 101 & Taipei City ➔
E-mail: pichu@stanford.edu

Looking forward to more and closer collaboration with you!