Traffic Demand Risk: The case of Bangkok’s Skytrain (BTS)

by Mathieu Verougstraete and Isabelle Enders (March 2014)

The following case study will examine the issue of traffic demand risk and will shed light on how the problem of inaccurate ridership forecasts can impact a PPP project by using the example of the Bangkok SkyTrain.

TRAFFIC DEMAND RISK

Even though literature is rich about theory and practice of traffic forecasting, little attention has been paid to the predicted accuracy of traffic forecasting models and the consequences of occurring errors.

Empirical studies suggest however that traffic forecasts in the transport sector are characterized by large errors and considerable optimism bias. This statement goes in line with the review conducted on PPP projects financed by the European Investment Bank which states that major issues in road projects occurred because of traffic performance has been overestimated. Findings disclose that 1/2 of toll road projects failed to meet their early-year forecasts; often by some margin (errors of 50% - 70%).

This pattern of forecasting error and systematic optimism-bias is even more marked in the case of toll roads as illustrated in figure 1, which compares two samples of international transport projects.

Commonly reported drivers for these inaccuracies include the complexity of the project, the underestimation of the severity and duration of ramp-up, the overestimation of the value of time and the dependence on macro-economic projections.

Recognizing the potential risk caused by inaccurate forecasts for the viability of PPP projects, the rest of the paper will examine the case of the Bangkok BTS project to see how this issue has impacted the project and what solutions have been found.

BANGKOK BTS: CASE SUMMARY

Bangkok covers about 606 square miles and is densely populated. By 1990 it was renowned for its chronic traffic congestion, and over the subsequent decade vehicle ownership more than doubled. Heavy traffic volume which is caused by bus, car and motorbike journeys was making Bangkok one of the worst cities in the world in terms of congestion and air pollution caused by vehicles.

With support of developing partners several studies have been conducted which recommended to establish a rail transit system in Bangkok to help develop the outer areas and to help mitigate the congestion problems in Bangkok’s city centre. However, the cost of the system - estimated at over US$1 billion – was more than the government was able to fund on its own.

The government decided then to develop a 30-year Build-Operate-Transfer (BOT) scheme for the elevated rail transit system.
Financing Package

The total cost of the BTS was estimated at THB 55.5 bn ($1.4 bn), financing came from both equity and debt funding.

The debt to equity ratio was determined at 2:1. Equity was raised in cash and through shareholder loans. Debt for the project came from two development banks - the International Finance Corporation (IFC) and the Kreditanstalt für Wiederaufbau (KfW) as well as from Thai banks.5

The three main banks (KfW, IFC and Siam Commercial bank) involved agreed upon three principles in structuring the project finances:

- A major portion of the loans to come from local banks to safeguard the project from political interferences and reduce foreign exchange risk;

- The construction consortium to share the risks of the initial operations to ensure completion on time and high quality;

- The financing package, including support loans, to be adapted to the expected cash flow to allow for weakness during the start-up period

Partnership Structure

The initial partnership structure of the PPP is illustrated in Figure 2.

On the one hand, the overall public partner was the Bangkok Metropolitan Administration (BMA), which is the local government of the city. Several agencies of BMA have been involved in this PPP.

On the other hand the private partner was the Bangkok Transit System Corporation (BTSC), which was formed in 1992 to implement the project. The BTSC was permitted to retain all revenue deriving from the system operation for 30 years.6

Infrastructure

The SkyTrain system entered into service in 1999. The original network comprises 23.5km of elevated trackwork and 23 stations built on a single column support structure, which runs through the heart of Bangkok's commercial, business and tourist districts.

Tariff

Skytrain ticket fares were priced below the cost of a taxi (for a single person), but above the cost of other public transportation services like buses. The lack of fare integration between modes had a negative impact on BTSC's ridership.

Under the terms of the concession contract,
BTSC required BMA’s approval before adjusting system fares (formula based on inflation, interest rates, power tariffs, devaluation of Baht and any major new investment requested by BMA).

The system’s current fare structure is zone based with options for monthly passes. Student discounts are also available.⁷

**Risk and reward allocation**

In 1992, the BOT agreement between the BMA and the BTSC was signed. The concession contract had a fixed price, a specified delivery date, and performance standards. The contract also required the main private sector partner to maintain at least a 51% stake in BTSC.

The private partner BTSC was responsible for 100% of design, financing, construction and operation and further has to ensure adequate levels of safety in operations and security.

Whereas the Thai government provided the right-of-way and assisted in relocation of utilities along route during construction (according to the contract, BMA is responsible for paying the cost of utility diversion when the costs are above THB 500 million). BMA sustains however a limited regulatory role during operations phase.⁸

In accordance with the contract, the revenue stream for BTSC is based completely on fares; the government does not provide any funds to BTSC for operating the transit system. BTSC retains however all advertising revenue and revenues from right-of-ways. BTSC also had not to pay a licensing fee to BMA for the first ten years of the contract.

Given these provisions and projected ridership, it was estimated that BTSC would recover its costs within the first ten years with at least a 16% rate of return.

**RIDERSHIP FORECAST**

Even though the forecast predicted 600,000 riders per day for the opening of the system, the actual initial ridership was 150,000 (25% of forecast). By 2006 ridership increased to 380,000 riders per day, still significantly below predicted levels.⁹¹⁰

This inaccurate forecast (figure 3) has led to several major financial problems for the elevated transit system and the near collapse of the private company BTSC, which was created for the project.

Several reasons explain the lower-than-expected ridership. In the beginning the BTS only covered 23.5km along two routes in the center of Bangkok; many potential costumers would forego the Skytrain because it did not meet their needs. The missing integration with other public transport modes as well as the limited network not reaching into the surroundings of Bangkok led to low acceptance. Some other mass transit projects were also delayed/cancelled or not optimally interconnected with the BTS.¹¹

Furthermore, the more wealthy population use personal cars and the BTS fares are higher compared to other public transport modes like buses or government-subsidized ordinary trains. Another aspect not being considered during design was the accessibility of the Skytrain stations. The line had few direct ramps into malls and lacked escalators. Bit by bit, while escalators were installed and side bridges built, ridership increased.¹²

As a consequence, BTSC has faced financial difficulties since commencing operations. Operating performance suffered from the lower than projected ridership. Furthermore, the level of debt increased after the Thai baht depreciated in 1997, which resulted in a surge in interest expense.

BTSC defaulted on its principal payments in 2002 and started then discussions with creditors on debt restructuring plan.

As little progress were made, BTSC decided in 2006 to bring the issue to the Bankruptcy court and filed for business rehabilitation on 20 February 2006, which was approved on 31 January 2007. According to the plan, BTSC converted a large part of debt to equity

---

**Figure 3 : Actual Traffic vs. Forecast**

<table>
<thead>
<tr>
<th>Year</th>
<th>Initial Forecast</th>
<th>Estimation Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>100,000</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>200,000</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>300,000</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>400,000</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>500,000</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>600,000</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>700,000</td>
<td></td>
</tr>
</tbody>
</table>

---

Initial ridership was only 25% of forecast.
Due to financial difficulties, a large part of debt was converted into equity.

The leverage ratio dropped from 2.1 to less than 0.3:1 and large write-offs of both equity and debt were made. On 29 October 2008, BTSC was released from business rehabilitation and started to make its first profit.

In addition, ridership benefited in 2009 from the opening of a 2.2 km line extension (after several delays), which was funded by BMA itself.

A few years later, an infrastructure fund backed by revenues from the BTS SkyTrain, the BTS Rail Mass Transit Growth Infrastructure Fund (BTSGIF), has raised about US$ 2.13 bn in the biggest initial public offering (IPO) in Thailand’s history in April 2013. Proceeds from the IPO were used to buy from BTSC its rights to the future net farebox revenues for the remaining concession years (until 2039 / netfarebox revenues = farebox revenues - operating costs and capital expenditure).

In spite of this, BTSC remains the exclusive concessionaire, the exclusive operator as well as the largest economic stakeholder in revenues of the core network via its main shareholder BTS group, which also hold 1/3 of BTSGIF shares. BTSGIF hopes to finance new mass-transit projects in the future.

CONCLUSION AND OUTLOOK

Even though, the BTS project cannot be deemed fully successful because of all the financial difficulties, which have occurred due to inaccurate ridership forecasts leading to default and business rehabilitation, the SkyTrain helped ease traffic congestion in central Bangkok.

The project took just over 9 years from the initial conceptual phase to commercial operation. It can therefore be considered as delivered in a relatively short period of time. BTS is from the users, city residents and government’s viewpoint an excellent project. Its costs are modest (for a metro - close to the median of benchmarked systems) and its ridership is growing rapidly.

It has become the centre-piece of Bangkok’s future MRT (Metropolitan Rapid Transit) strategy and of the mega city’s future sustainable development. Due to the applied PPP scheme, the public investment has been relatively limited.

End Notes

3 Flyvbjerg, B., Holm, M., Buhl, S. (2005): How (in)accurate are demand forecasts in public works projects?