

## **A Historic Review on Consequences of Critical Events Leading Revolution in Mass Rapid Transit in Bangkok**

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**Abstract:** Since 1960s, Bangkok had taken a road-base transport development strategy under growing economy, and accordingly had been falling down into a vicious circle led to the hell of hyper congestion until 1990s. However, the Thai Government and the Bangkok Metropolitan Government turned their strategies to rail transit-based and reached a plan for year 2020 of 464 km long rail transit system accounted for 82% of whole national infrastructure investment. This research aims to make clear the mechanisms of this extraordinary historical turn, which can be useful for Bangkok's future transport and other developing mega-cities, taking the following steps: to mainstream the consequences of critical events of transport development in Bangkok and to investigate the mechanisms how each project was realized or failed

*Keywords:* Mass Rapid Transit Development, Transportation History, Bangkok

### **1. INTRODUCTION**

Since 1782, when Bangkok has been established, King Rama I moved the city from west to east side of Chao Phraya River. Canals were dug for protecting the city and communication; therefore, people living along canals and river bank and boat transport was the important mode of the locals. That is why Bangkok was once named "the Venice of the East".

Bangkok waited for almost 100 years until the first western-styled road, Charoen Krung road, was contracted in 1861. Five years later at End of King Rama IV's reign, there were 5 roads with total length of 20 km and people started to move to reside along new routes. This can be seen as the starting mark of city development along the road.

For rail development, the first Railway, from Bangkok to Nakorn Ratchasima province in North-eastern of Thailand, started its construction in 1891. In 1896, Partial operation was started from Bangkok to Ayutthaya, north of Bangkok, total length of 71 km and fully operation to Nakorn Ratchasima with total length of 265 km begins in 1900. In 1910, end of King Rama V's reign, total length of railway in Thailand was up to 932 km, and 50 routes of road with total length of 70 km. Moreover, Electric Tram and Car started to be introduced in early 1900's but no more canals constructed inside the city area.

Since 1960, government policy had been focused on road infrastructures development. The plan for Greater Bangkok in B.E.2533 (1990) or The Litchfield Plan (1960) recommended Bangkok to depend on cars, develop road infrastructures, ring roads, and expressways followed the American style (Litchfield et al., 1960). The 1<sup>st</sup> National Economic and Social Development Plan (1961-1966) recommended building more highways to connect provinces and with the neighboring countries (Hayashi and Wasuntarasook, 2013). Therefore, The Greater Bangkok Plan, The First Revision of the plan for Metropolitan Area (1971) was

established as a plan for promoting road-base transport, building new bridges, and expressways (DPCT, 1973). Thus, thanks to the rapid growth in economic, population increasing and the government policies supporting motorization development, the main transportation was changed from water transport to land transport.

Since 1971, Thai government with assistances from Germany's group of consultants conducted a study of transportation in BKK and proposed a plan of building highway and train for mass transit, collecting fee for road usage as a usage restriction scheme and planning new city plan. It was recommended to develop the first phase of mass transit by elevated bus system and convert that to the heavy rail later.

In the early 1990s, there were 3 entities who proposed to build Mass Transit in Bangkok, namely State Railway of Thailand (SRT), Bangkok Metropolitan Administration (BMA) and Expressway and Rapid Transit Authority (ETA) (which later Metropolitan Rapid Transit Authority, MRTA, take responsible over Mass Rapid Transit in Bangkok Metropolitan Region (BMR) after separation from ETA) However, from those three proposals, only the BTS Skytrain (BMA initiated) survived after several hindrances which will later explain in the next chapter.

Nowadays, there are 4 lines of the mass rapid transit that have been operated in BMR, BTS skytrain 2 lines which are Silom line and Sukhumvit line started operate in 1999 transfer at Siam station. MRT blue line or subway started operating in 2004 which has interchanges with BTS at Asoke/Sukhumvit station and Saladaeng/Silom station. Suvarnabhumi Airport Rail Link started operating in 2010, which can transfer to BTS at Phaya Thai station. Total length of Mass Transit in BMR is 80 km. There is also an operation of 16.5 km of Bus Rapid Transit (BRT) by BMA itself. Moreover, there are 6 under construction projects of the mass transit which are purple line, light and dark red line, light green line, and dark green line with the length of 100 km.

Though BMR has faced many erratic events in the transport development history, it Bangkok seems to move toward the right direction of development by using mass rapid transit. As a consequence, there are many good and bad experiences regarding planning and operating the transport system such as the delay, resistances, and financial problems before the day that mass rapid system boom. The objectives of this research are to make clear the mechanisms of the extraordinary history, which can be useful for future transport of Bangkok and other developing mega-cities, taking the following steps: (a) to mainstream the consequences of events of Transport development in Bangkok and (b) to investigate the background mechanisms how each project was realized or failed. This paper will consist of Methodology, Detail in Mass Transit Development Projects in Bangkok, and the conclusion.

## **2. METHODOLOGY**

This paper chronologically examines the events of transport development in Bangkok. Mainly, information is gathered from annual reports of the Mass Rapid Transit Authority of Thailand (MRTA), and local news wires. From those secondary data, the paper can obtain how each event related to the mass rapid transits was unfolded. Moreover, for gathering some critical and insight information, authors conducted interviews on key persons who had been involved in decision making in transport policy of Bangkok in the last 20 years; for example, former deputy permanent secretary of Ministry of Transport, Action chief operating office of SRT Electrified train Co., Ltd., executive vice president of Bangkok Metro Public Company Limited (BMCL), etc. The paper utilized that information to draw a list of political and policy event related to the transport projects as to define an entire perspective of transport system

development in Bangkok. Furthermore, the paper descriptively analyzed the history of transport development to extract a figure of casual relations between political and policy events and identify essential individual events and the linkages in between. Ultimately, the paper will show a possibility to apply this casual figure for future transport policies of Bangkok and the other mega-cities.

### **3. MASS TRANSIT DEVELOPMENT PROJECT**

Since 1971, Thai government with assistances by Germany's group of consultants conducted a study about transportation in BKK and proposed a plan to build highway and train mass transit, road pricing as usage restriction scheme and plan city planning. It was recommended to develop the first phase of mass transit by elevated bus system and convert that to the heavy rail later. (Kocks, 1975)

Expressway and Rapid Transit Authority (ETA), has been established in 1972, was in charge of both expressway and mass transit because of the recommendation from a study for Bangkok transport by Germany in 1971-1975. But they focus on expanding expressway (Hayashi and Wasuntarasook, 2013).

As Bangkok motorization has progressed since 1980's, operations of trains in SRT have been disturbed by cars occupying level crossings due to continued queues at the nearby road intersections. Therefore, the government was very keen to solve the problem by constructing level separated rail transit systems either elevated or underground, for which they called tenders for public-private partnership project. Then many projects of BOT (Build-Operate-Transfer) that have been proposed since 1980s, including the following projects:

- 1) Hopewell project (SRT)
- 2) BTS or skytrain (BMA)
- 3) MRTA Project
- 4) SRT Airport Link project

In this section, successful and unsuccessful stories of these projects will be described to clarify the consequences of critical events occurred.

#### **3.1 Hopewell Project**

During the year 1980s, SRT faced a problem with their train operation because they couldn't increase railway service because of the bad traffic at the road-rail crossing points. Therefore, in the year 1983 to 1984, SRT asked for assistance from the Japanese government to send expert to conduct a feasibility study to increase railway service and solve the traffic congestion at level crossings. Outcome of the Japanese study suggested that construction of Elevated track was most suitable remedy, which 3 routes in total of 13 km were recommended: Hua Lamphong – Bang Sue (5.5 km), Yommaraj – Makkasan (3 km), and Makkasan – River/Harbor (4.5 km). The suggested project would remove level crossings at 14 locations in BKK, and suggested that 30 km of conventional railroad around Hua Lamphong area in the Bangkok perimeter could be improved.

Finally, SRT proposed a 3 billion Baht mega transport project to the government on 25 August 1987. Ministry of Communication (Former name of the current Ministry of Transport) assigned SRT to prepare construction of the project by inviting investment from private sectors. The first bidder invitation was on 18 April 1989 with a condition that investor would be granted only the rights to land plots beneath the railway, but there was no proposal

submitted. Second invitation, adding the rights to manage the land along the entire route still end with no proposal submitted by the deadline of 20 September 1989. A month later, 16 October 1989, Ministry of Communication invited anyone who was interested in construction of both railway and elevated roadway, with a condition that the winner would be granted the concession to operate a community train and toll way on routes owned by SRT total 23 km. Winner would also have other benefits including the rights to commercially manage an area of 247.5 rai (396,000 m<sup>2</sup>) for 30 years. This announcement attracted four organizations to acquire the bidding form but Hopewell Company from Hong Kong was the only applicant who submitted the proposal by the deadline of 15 January 1990. The proposal was accepted for negotiation on 23 March 1990.

On 9 November 1990, a concession agreement between Ministry of Communication, SRT, and Hopewell (Thailand) Company Limited was signed, and became effective on 6 December 1990, which could be marked as the starting date of the Hopewell project. The concession would have last 30 years with 8 years of construction, which designing, investment, and operation were the responsibilities of Hopewell Company. Condition of agreements were the company must invest, design, operate and maintain the elevated system while the company can collect toll fees, community rail fare, rent and revenues from the systems. The company also retains the rights to procure benefit from SRT's lands along the entire routes and rights to develop land areas of approximately 633 rai (1 km<sup>2</sup>), in additional to the concessional routes. Hopewell must also provide ground level roads alongside the system alignment. The Project was consisted of 2 main routes and 1 branch route with total length of 60 km.

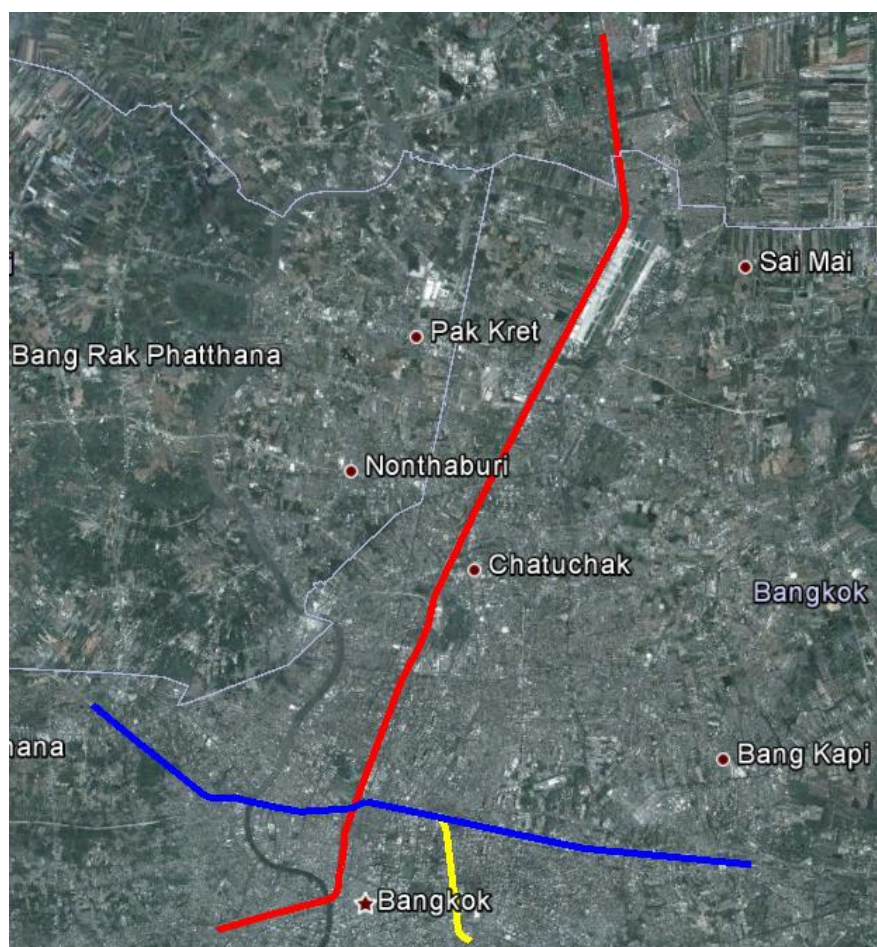


Figure 1. Hopewell project route

Figure 1 shows the Hopewell project 3 routes, which are Main route 1 (red line) is about 34.2 km. long, starting from Ponimit station via Wongwian Yai, crossing Chao Phaya River, passing Hua Lamphong station, Samsen station, Bang Sue station, Don Mueang station, and terminate at Khlong Rangsit station. Main route 2 (blue line) is about 22.6 km. long, start from Taling Chan station, via Thonburi station crossing Chao Phaya River passing Yommarat station, Makkasan station and terminate at Hua Mak station and branch route (yellow line) is 3.3 km. long, starting from Makkasan station to Menam station and Krung Thep Harbor. There is no elevated roadway on this route.

SRT obtained 300 million Baht benefit from payment on the day contract was signed (6 November 1990), the first payment of 300 million Baht on the day contract took effect (6 December 1990), the second payment of 300 million Baht on 6 November 1992, annual payment of 50 million Baht higher than the previous year until the 15<sup>th</sup> payment (15 December 2005). The payment after the 15<sup>th</sup> year would constantly be the minimum 1000 million Bath but during the year 9<sup>th</sup> – 23<sup>rd</sup> SRT would either receive the higher amount of flat payment indicated for each year or the payment calculated from 3% of annual profit of the project. Payments 24<sup>th</sup> – 38<sup>th</sup> would be 2404 million Baht each per year or 30% of annual net profit of the company, whichever amount is higher. SRT would also have got the new Central Bang Sue Station building and several new constructions which the company would provide in compensation for the demolition of the current residence and hospitals. (Chatkeo, 1992)

Delays of Hopewell project was caused by both Thailand's government agencies and Hopewell company itself. Firstly, the delay occurred on the process of approving the construction drawings just after the concession contract was become effective (December 1990). The company had submitted to SRT its first draft of the project master plan which was fast-track design, construction started even though the design had not finished. However, the submitted plan neglected many aspects such as proper survey of the project areas; therefore, SRT asked the company to revise the plan and resubmit again. That was caused a delay with the construction as the SRT ordered the company to halt every activity within the concession areas because of the plan was unapproved. Later on, on 9 October 1992, Hopewell Company submitted the plan once again and hoped to start the construction within 60 days after approval. However, SRT still urged the company to revise the plan many times. Finally, after 28 months from the resubmitting date, in February 1995, the construction plan was approved.

SRT also caused delay to the project construction with its inability to hand over the construction area to the Hopewell Company. According to the plan, the first stage of hand over should start within March 1992 but practically it had delayed to September 1993. This was because there were problems with expropriation and land acquiring. During that time, lands along the SRT railroad were filled with many squatters along the construction areas, which SRT could not force them to evict abruptly. There was also a conflict with Don Mueang Tollway which has operated a toll way along the same line as the Hopewell project.

The experts indicated that there were more problems. According to Wilbur Smith Association (1991), Hopewell east-west lines could not proceed to the west from Yommarat without violating structural height restriction or sound engineering principles while the north-south lines could not proceed to the south and cross the Chao Phraya River without causing extreme property or environmental damage or both. Moreover, a study of SPURT (1991) stated that the new expressway would bring 40,000 vehicles an hour altogether into the inner city area. The arterial roads and expressways together would grossly overload the ordinary road because these roads are already overloaded and there are no plans to expand them. Expressways need a corresponding expansion of the supporting networks and car parks. In the case of the inner area, it would require expensive expenditure and efforts. The result would also adversely affect the landscape and environmental of the area (TDRI, 1993).

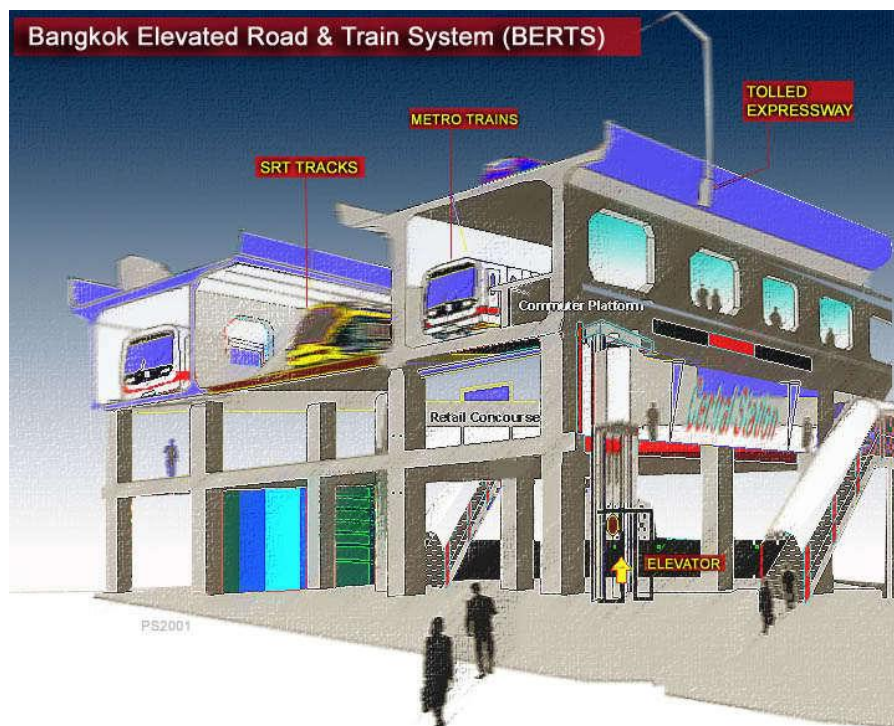


Figure 2. The gigantic structure of Hopewell project  
(Source: [www.bangkok-today.com](http://www.bangkok-today.com))

### 3.2 Bangkok Transit System (BTS) Skytrain

In 1990, traffic congestion in Bangkok has already become one of the main problems of the city. Therefore, Major General Chamlong Srimuang, who was a governor of Bangkok, announced to the public that BMA would accept any bid to build from scratch the mass rapid systems from private companies. Mr.Keeree Kanjanapas of the Tanayong Public Company Limited bid in and won the BTS project (named Tanayong Project at that time). The project aim at easing the current traffic crisis as well as providing extended public transport services in the central business district (CBD) of Bangkok. This project is the only survivor from three projects planned in the early 1990 (Hayashi and Wasuntarasook, 2013).

According to the initial plan with expected total cost of 20 Billion Baht, Bangkok Mass Transit System Public Company Limited (BTSC) would construct and operate the elevated skytrain system comprising 2 routes – Victory Monument and Sukhumvit Road. Expected total time for commencement of the preparation step to the start of services was about 4.5 years. Construction was planned to start in the mid-1993 and first phase of its operation should have been ready and be able to provide public services on the entire victory monument route and a part of sukhumvit route (pathumwan to sukhumvit 39) in the mid-1996. By end of 1996 full range of services should have been available (Arbhabhirama, 1992). The construction did not require any land acquisition (on rights of way) because it mainly built on the road median. The concession contract, which last for 30 years, should start since the first day of services.

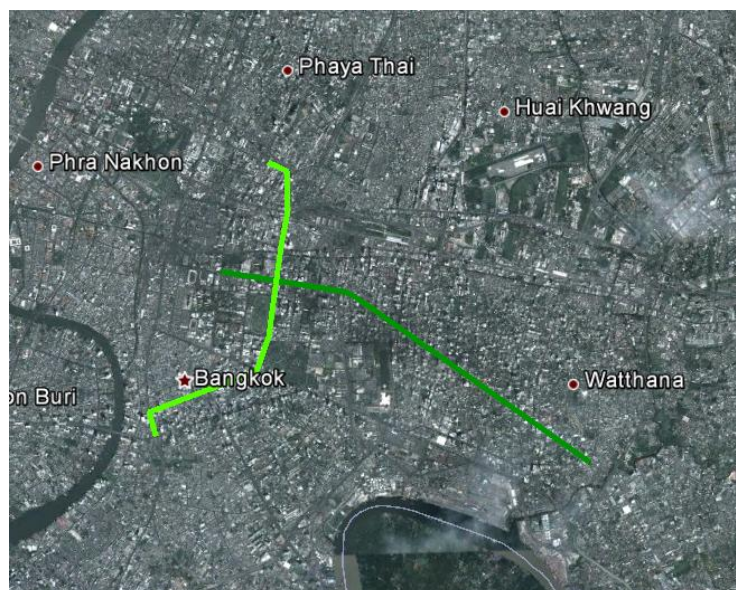


Figure 3. Initial of BTS Skytrain project route

However, Ridley (1992), who conducted several studies on transport problems in Bangkok, recommended the core Mass Transit Network for three projects – 2 lines of Tanayong and 1 line of MRTA. BMA and BTSC agreed to the suggestion which led to changes of routing as Route 1: victory monument – Sukhumvit road and Route 2: National stadium to Silom road. The operation was started on 5 December 1999, 2 lines, Silom line and Sukhumvit line, which was 3 years behind the initial plan. Now the project is currently operating on build-operate-transfer (BOT) scheme, developed on BMA land and operated and funded by BTSC.

One of cause of delay of the BTS project was the changes in construction place for depot and workshop. At first, the project planned to use Lumpini Public Park as the depot but it faced many oppositions from the public. The publics quoted words from the late King Rama VII who gave this area to the people as a public park and appealed that the area should be used for the good of all people. That was why the depot was forced to move to the northern bus terminal area, which obliged the processes of re-planning and moving to took almost 1 year.

Another cause of delay was from disapprovals of the locals. Before and during the construction of BTS, there were many resistances from the public such as Mater Dei School who had a concern that BTS rider could peek into their all-female school and cause a problem from bad traffic during construction. An influenced public figure was also against the project because of her concern about environment and scenery impact. According to the interviewed experts, the problems arose because people did not have the image how BTS would be in reality. The statement is supported by the fact that, during the construction period, BTS urged the surrounding buildings to make a connection passage with the station for free of charge but nobody cooperated. In contrast, after BTS succeeded, building a connection passage was not free anymore, though there were many buildings which wanted to build one. During that time, people still believed in road and development along the road. Wherever the road went, property price around there would grow. As they did not believe that such benefit would happen with the skytrain, they had not concerned about mass rapid transit.

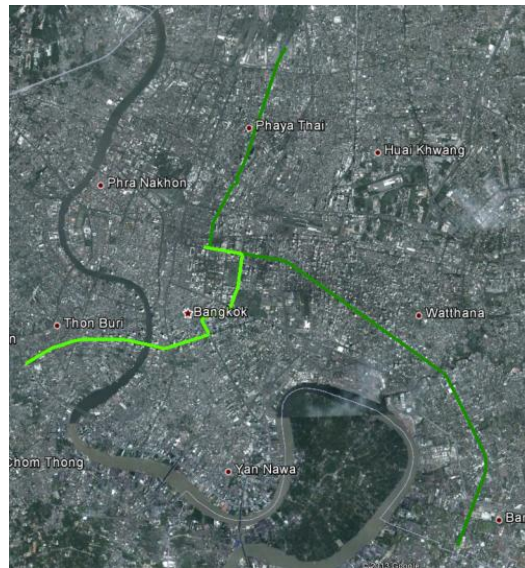


Figure 4. BTS Skytrain project route

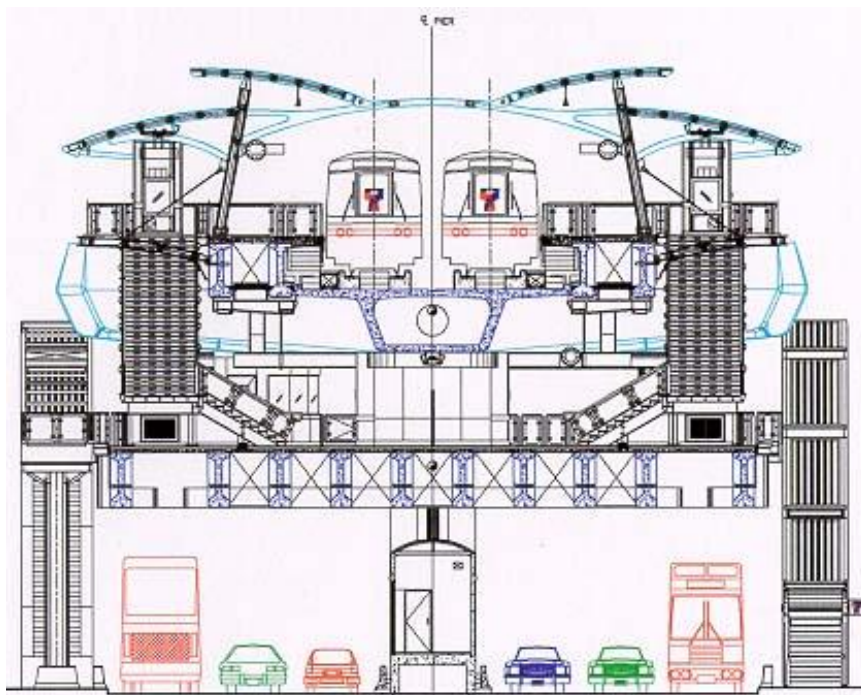


Figure 5. BTS skytrain station cross section  
(Source: 2bangkok.com)





Figure 6. BTS skytrain

Experts believed that the most important factor for the success of BTS was that the project did not need to own land as they developed the project on the land owned by BMA. BTS used the road medians for the pier of elevated super structure for tracks. However, they stated that lacking in land rights was also a down side as the project could not generate profit from the land and forced to rely on the fare only. They also added that the station of BTS was too small comparing with the demand and the access bridges to the road side pedestrian walks were limited. In some areas, there was no light under the station because it is too close to the surrounding buildings. All of these gave Bangkok citizens somewhat bad impressions on the elevated mass Rapid transit (Hayashi and Wasuntarasook, 2013).

### 3.3 Mass Rapid Transit (MRT) Blue Line (Subway)

The project for constructing a subway system was initiated following the Germany study in 1978 – 81. In 1986, Expressway and Rapid Transit Authority (ETA) invited the private sector to invest. Lavalin, a Canadian civil engineering and construction firm, won bidding in 1990. Contract signing ceremony was held in 7 February 1992 but the contract was terminated on 7 July 1992, just 5 months after signing. According to MRTA annual report (MRTA, 1993), the problem behind contract termination was Bombeadier Co./UTDC, who took over Lavalin after the project initialized, did not confirm their participation in the project. Bombeadier Company only wanted to sell its equipments for the subway system but did not want to take part in the construction. However, confirming their participation was a condition required by

the contract and Lavalin Group failed to find a new partner within the frame time of 22 June 1992. After the deadline and negotiations were extended, Bombardier confirmed their participation but only if the government agreed their terms. Bombardier and Lavalin group proposed the new conditions that (a) Thai Government had to guarantee 800 million Canadian Dollars soft loan from the Canadian government, and (b) Bombardier group wanted Thai government to compensate if the project failed halfway through. Nonetheless, the cabinet didn't agree those terms and the contract was terminated.

Initially the Lavalin project was decided by ETA with 3 lines of 60 km. The project was later reviewed since the initial cost was very high. It was then decided that the project should be implemented in phase and the distance of the first phase was reduced to 34 km. The route of project to be developed by Lavalin might partially overlap with others due to lack of coordination among parties involved (Attajarusit, 1992).

Figure 7 shows proposed three routes of the scrapped Lavalin project. The red line is Rama line (Phra Khanong to the marshalling yard of SRT at Bang Sue). The yellow line is Sathon line (Wongwian Yai in Thonburi to Lat Phrao). And the blue line is Memorial line (Dao Khanong in Thonburi and Makkasan).

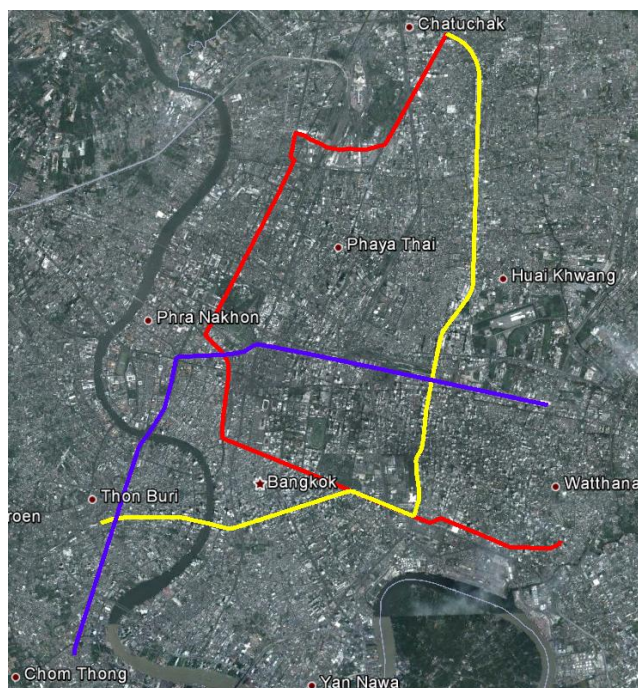


Figure 7. Lavalin project route

During the cabinet of Anand Panyarachun, after Lavalin project failed, government decided to build Mass Rapid Transit System in the Greater Bangkok Area by itself. On 28 July 1992, Metropolitan Rapid Transit Authority (MRTA) was established, under the control of the Office of the Prime Minister, to take responsibilities of mass rapid transit systems in BMR. In December 1992, it hired an engineering consulting firm for preparing tender document of the initial system project, which was a 20 km route entitled Bang Sue - Queen Sirikit National Convention Center – Hua Lamphong, comprising elevated structure of 19.4 km and underground structure 0.6 km with 20 elevated stations and an underground station. According to the above mentioned plan, the construction would start by the end of year 1994 and operation in 1998 (MRTA, 1993).

Originally the government asked private companies to invest in the whole project and

Bangkok Land Company won the bid. However, after accidents and resistances occurring from BTS skytrain construction, government amended the plan to become all-undergrounded project. Project delays were caused by the cabinet's request to make the elevated section in the original plan into underground in CBD. Bangkok Land, the concessionaire, agreed to change the 11.3 km long section from Asoke to Hua Lamphong to underground, but MRTA, a responsible body for construction on behalf of the government, had to pay an additional cost of 16,500 million baht. The cabinet didn't agree despite many rounds of negotiation with Bangkok Land, and finally canceled the contract with Bangkok Land.

Finally, construction of an all-undergrounded system started in 1997. The project was 80% funded by MRTA which covers infrastructure cost for tunnels, tracks, stations, depots and workshops, etc. and 20% was funded by private sector including services, maintenances and operations. After 7 years of construction, the subway system began its operation in 2004.

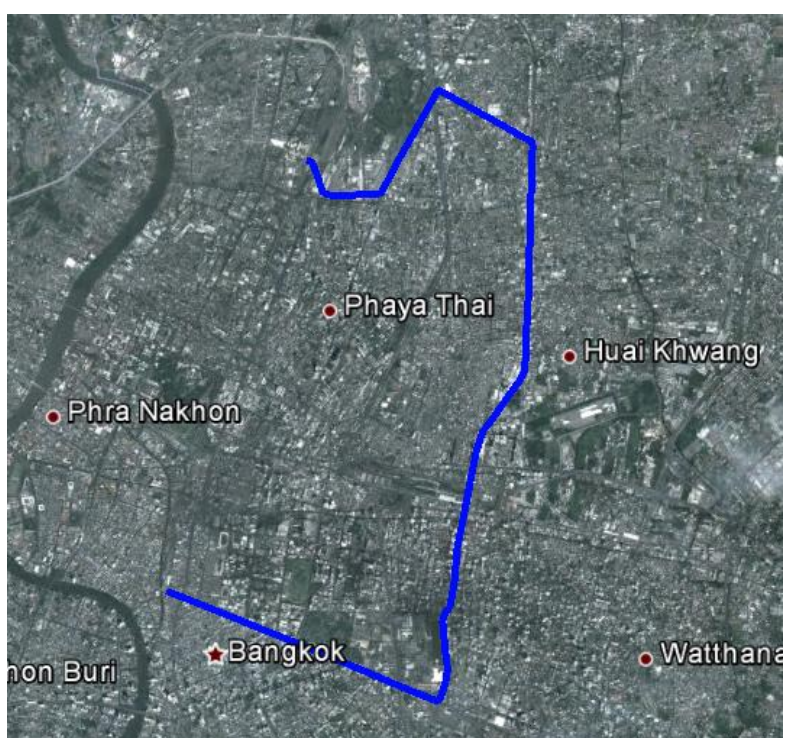


Figure 8. MRT Subway route

According to the experts, when the civil works nearly finished, MRTA had to wait for one year before negotiation result with Bangkok Metro Public Company Limited (BMCL), who is the operator of the system, was approved by the government. When the civil works finished, the system had to wait for the completion of rolling stocks for another 1.5 year. These are problems because the delay in bureaucracy system because the project is owned by the government. Finally, operation started in 2004, for 21 km. from Bang Sue station to Hua Lamphong Station. About 30 percent of the alignment of the Lavalin project becomes the current MRTA blue line which is the result of the study from a consultant firm.

Delays also occurred from the MTRA side. After the project planned, it delayed 3-4 years because the government initially decided the project as all private investment. After the bid from the private sector, MRTA made some negotiation with them but finally suggested the government not to sign on any contract with the bidder because MTRA was afraid that the project would become the second Hopewell project. This is why finally the government built

all the infrastructure of the MRTA blue line project by itself with loans from JBIC (Hayashi and Wasuntarasook, 2013).

### 3.4 Suvarnabhumi Airport Rail Link (SARL)

In 1991, an expert in transport engineering in Thailand studied the possibility of high speed rail operation in Bangkok. From the study, very high speed rail like Japanese's Shinkansen might to be suitable for Thailand but 160 km/h trains to major destinations such as Suvarnabhumi airport, Pattaya, and Rayong was viable. At that time, JICA study (1995) also proposed a suburban railways commuting city center to the new transport and residential development beyond. Subsequently, the same expert was appointed as a secretariat director for the prime minister on a national committee on Suvarnabhumi airport and was also a committee for airport construction and development since the planning phase. The airport construction plan indicated to build the airport link train together with the airport. Moreover, he suggested the government to invest every aspect by itself as he believed it was the key point of success of the project. Later on, six months after the committee decided to build the airport link train, the State Railway of Thailand (SRT) submitted a 25,907 million Baht railway construction plan and got the approval at 1st June 2004. However, because of inefficiency of the SRT, the project had been delayed for 2 years because of many problems (Hayashi and Wasuntarasook, 2013). Construction started in 2006 and the operation started in 23 August 2010 with length of 28.8 km (27 km elevated, 0.9 km at grade, and 0.9 km underground). Initially, the system had 2 lines, City Line stopping at all stations and the first Express Line stopping only at the city air terminal (Makkasan station) and Suvarnabhumi airport station. In May 2011, because of very few passengers using express line from Makkasan station, SRT decided to add the second express line from Phaya Thai station to the airport. This raises the number of passengers using the express line because riders can transfer to/from BTS at Phaya Thai station.

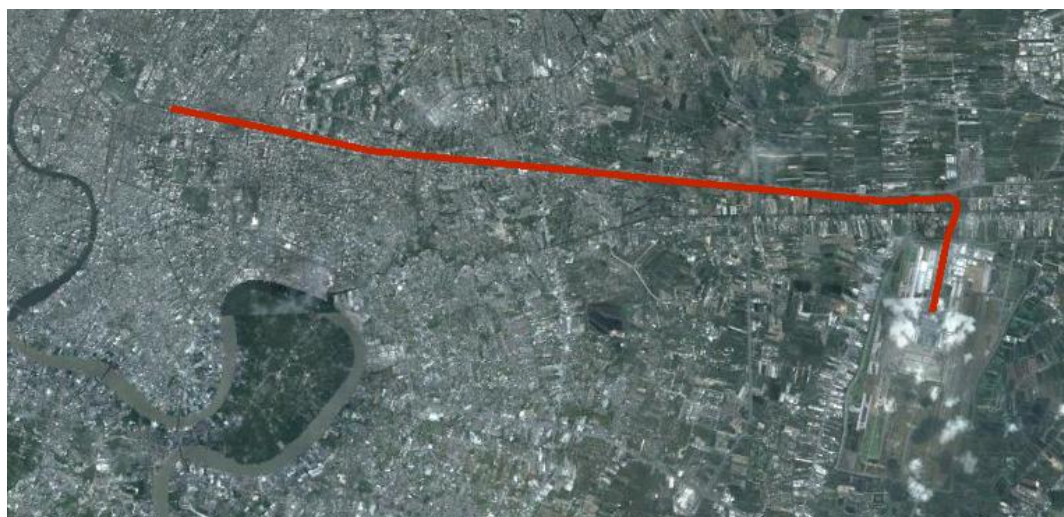


Figure 9. Suvarnabhumi Airport Rail Link route



Figure 10. Suvarnabhumi Airport Rail Link, city line

There are many causes of delay of the SARL project. Firstly, construction started 2 years later than the plan because SRT could not hand over some project areas to the contractors. There are many squatters and structures which could not be evicted or removed on time such as 300 inhabitants, old railroad infrastructures, housing of SRT workers, remaining elevation structures of Hopewell project, structures of National Housing Authority and many more. Secondly, there were many requests for amending the design of the project. This is because the project was constructed by “design and build” scheme, which means the construction can start even before the design of the whole project is finished. Thus, as every time the design was changed, it has to wait for some time for its approval. Thirdly, during the construction, the examiner found 0.05 mm hairline crack on the structures which led to inspection of all structures as a safety precautionary measure. Lastly, even though the system was ready to operate, planned test run on 30th April 2010 was forced to be postponed because of civil unrest happened at that time.

| Year      | Hopewell project   | BTS Skytrain  | MRTA project   |  |
|-----------|--|---|--|--|
| 1971 - 75 |  |   | Thailand's government with assistances by Germany's group of consultants conducted a study about transportation in BKK |  |
| 1972      |  |   | ETA had been established   |  |
| 1978 - 81 |  |   | Feasibility study  |  |
| 1983-84   | Feasibility study  |   | ↓  |  |
| 1986      | ↓  |   | Invitation for private investment with government holding 25%  |  |
| 1990      | SRT selected Hopewell (Thailand) Co., Ltd. for constructing elevated highway and rail line | BMA signed contracts with BTSC for building and operating BTS             | ↓  |  |
| 1992      | ↓  | ↓   | ETA selected Lavalin International Co., Ltd. for investing but the project finally failed / MRTA has been established  |  |
| 1993      | ↓  | Construction begins   | ↓  |  |
| 1994      | Pilling Constructing   | ↓   | ↓  |  |
|           | Cabinet requests part underground in CBD   |   |  |  |
| 1996      | ↓  | ↓   | ↓  |  |
| 1997      | SRT terminated contracts with Hopewell   | ↓   | Construction begins  |  |
| 1998      |  | ↓   | ↓  |  |
| 1999      |  | BTS begins its operation of two lines covering 23.5km                     | ↓  |  |
| 2000      |  | ↓   | MRTA signed contracts with BMCL for operating MRT  |  |
| 2004      |  | ↓   | MRT begins its operation of 20km   |  |
| 2006      |  | ↓   | ↓  | Construction begins                        |
| 2009      |  | BTS begins its operation of extension of Silom lines covering 2.2 km      | ↓  | ↓  |
| 2010      |  | ↓   | ↓  | SARL begins its operation covering 28.8 km |
| 2011      |  | BTS begins its operation of extension of Sukhumvit lines covering 5.25 km | MRTA started constructing the extension of MRT   |  |
| 2013      |  | BTS begins its operation of extension of Silom lines covering 1.5 km      | ↓  |  |

Figure 7. Timeline of mass transit development

#### 4. CONCLUSION

Thai government has changed the commuting system from water transport to land transport in 1960's and had emphasized plans of road-base transport infrastructures. This has shifted land use and travel behaviors to be road-oriented and then consequently converted Bangkok into a car dependency city and made its territory spread outwards.

In this study, we have made clear why Bangkok have been successful to turn the direction of transport from extremely road-based in till 1990's to the other extreme to investigating 82% of whole infrastructure investment in railways in the master plan towards 2020. During these processes, Bangkok has experiences the following difficulties until 1999:

- 1) Failures of mass rapid transit projects were caused by lacking of the real intention to mitigate the problems,
- 2) Complexity of bureaucracy system made government-funded project harder to be implemented,
- 3) Expropriation led to lateness and finally to an increase in cost of the project. These are the reasons why several projects failed.

In the BTS project, lacking of public understanding also caused some drawbacks to the project. During the construction, there were many oppositions from citizens who could not imagine how the transport situation would be improved when the project finished. Accidents in the construction works put pressure to other mass rapid transit plans to revise their location and even to change from skytrain to underground.

In turn, rail transit projects started to go ahead in 1999, with BTS skytrain project. This was made possible by the following factors:

- 1) Major General Chamlong Srimuang, Governor of BMA, announced his strong will to promote the skytrain system,
- 2) In 1990, Office of the Commission for the Management of Land Traffic (OCMLT) was established to combine all projects of rail and road. This office contributed much to investigate transport in an integrated manner,
- 3) JICA project report (1995) and JICA experts in railway studying in OCMTL have played essential roles to disseminate the concept and effects of railways to Thai officials in transport sector.

The authors hope this review study will be useful for planning the future transport plans in Bangkok and the other mega-cities in developing countries.

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