

The Study of Mass Rapid Transit System: A Case Study of Singapore Mass Rapid Transit (SMRT)

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Abstract

The main objective of this paper is to study the transportation facility of Singapore and how it was developed in different construction phases. Also, some point taken into consideration as construction management point of view and structural point of view. Also, how a systematic perspective can enhance a city development and infrastructure as a whole. The current scenario of transport facility is also mentioned. Transport within Singapore is land based. Many small islands within the country are connected by road or rail. The major mode of transportation is rail which runs through major neighbourhoods. The Mass Rapid Transit system is a rail network that is the backbone of Singapore's public transport system. Singapore offers a highly integrated and sophisticated transport system that appears to achieve its purpose of providing an affordable, sustainable, and well organised mass transport system.

Keywords: Transportation service, Mass rapid transit system, Urban Infrastructure, Singapore,

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I. INTRODUCTION

As any island nation, Singapore is country where land is limited and premium. The government acknowledged early on that the mass transit system would help the country traffic flow and enhance the economy. The transport infrastructure is built, operated and managed by solely government.

Singapore has one of the best and affordable mass rapid transit system in the world. Singapore has highest public passenger satisfaction rate in the world. As growing population, Singapore government is increasing reliability of the mass public transport system. The Mass Rapid Transit, which was opened in 1987 was a heavy rail metro system that serves as the major spine of Singapore's public transport system. As of January 2020, it was noted that the train network a length of 203 km (126.14 mi) and 122 stations. The main planning authority of the Mass Rapid Transit, plans to provide a broader rail transport system by expanding the existing rail system to a total of 360 km (223.69 mi) by the year 2030, with eight households from the ten households will be living within a 10-minute walking distance of an MRT station.

II. THE SINGAPORE MRT DEVELOPMENT

2.1. The Dispute and Demand

The idea for construction of rapid transit line in the country was introduced in 1967. It was a part of urban rehabilitation and development plan which for designed for a long-term plan for better future physical development of the country. The problem of island nation with land limitation for road network was acknowledged for future transport demand. It was predicted that no of car owner will increase with economic growth and building more road was not an option due to land limitation.

As of 1970s, they already recognized to retain the private car ownership as the large-scale road network was not a suitable scheme. For restriction of private car ownership, it was necessary to build a good sustainable public transport. Surface tunnel transport was considered as an option. It needed a good management system for better working performance transport.

2.2. The MRT Debate

The question was to provide road network base bus transport or high-tech train-based mass transport or mixture of both. For this in 1970s, a team of professional officers and consultants from government was made for study as Singapore mass transit study. The study indicated that rail-based transport will provide superior result compare to bus-based transport. The world bank was not in the favour of rail-based transport and requested for further investigation.

Different opinions were made in form of debate and research were presented in time period of ten years. The study came to a conclusion that an all-bus system would be inadequate as it would have to compete for road space which would be a greater problem in future. The problem would be solved by building a well-planned and developed rail system.

2.3. The Beginning of construction

The permission to build the largest public work project in Singapore was given in 1982. MRT was intended to much more than just a transport investment, it was developed in keeping mind the foreign investors, added value to adjoining real estate and promoting economic and social activity. The majority of the was work was intended to finished before 1993. In this project 67 km long track with 42 stations within which 26 would be elevated 1 would be at grade and 15 would be at underground level. It was suggested the construction work will be done in different phases for years to take advantage of low-cost construction. This contributed to lowest per kilometre of MRT system per unit cost in worldwide.

III. THE MULTI STAGES DEVELOPMENT

3.1. The First Phase (North-South & East-West Line)

The initial phase was to construct North-South and East-West lines. The North-South line was priority because it was passing through Central Business District (CBD) and orchard road which is the heart of commercial activity in Singapore. It became up and running in 1987. The project was mostly kept above the ground with less than 30% underground which was passing through Central Business District (CBD) to minimize the construction cost because underground construction requires tunnelling which is costly.

The phase one constructed two year before the dead line. This indicated the success in construction. The construction was done in US dollar bases which eliminated the currency exchange fluctuation. The under ground work was done with utmost safety to eliminate the hazardous work in Central Business District (CBD). The project was completed below the budget.

In 1987, the MRT first line started operating. It was functioning well from the start and had positive review and impact on people in Singapore. It created economic growth, land use planning and people moving to less developed housing near transit lines. This enhanced the property value near the transit lines. With this positive review the construction of phase two began in 1996.

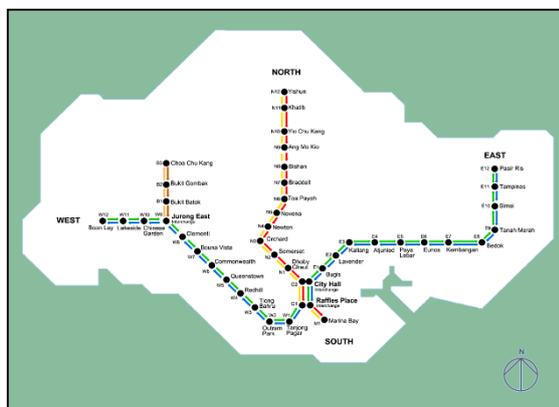


Figure 1. First phase

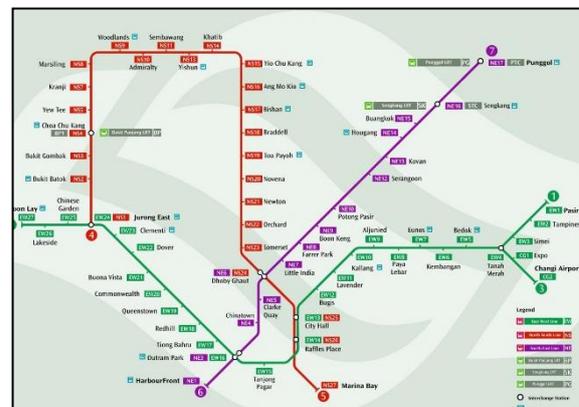


Figure 2. Second phase

3.2. The Second Phase (North-East Line)

The success of first phase gave the government more commitment to do second phase of construction. It was a expansion to North-South line but the problem was that it was mostly underground the construction cost would be higher but seeing the positive response from the first that the work for second phase begun in 1996. It was built knowing the hazardous risk and higher economic cost. It completed the construction in 2002.

3.3. The Third Phase (Circle Line)

The Circle line a spider web type orbit network connecting radial lines. The construction started in 1999. The goal was to join all previously build MRT lines to link into a circle-based line. It fully opened in 2017 linking all radial lines making it longest underground driverless MRT line in Singapore.

3.4. The Forth Phase (East Cost Line)

It is a medium capacity transit line which is still undergoing construction work. The first stage line was opened in January 2020. The work is still ongoing and it is estimated to complete in 2027.

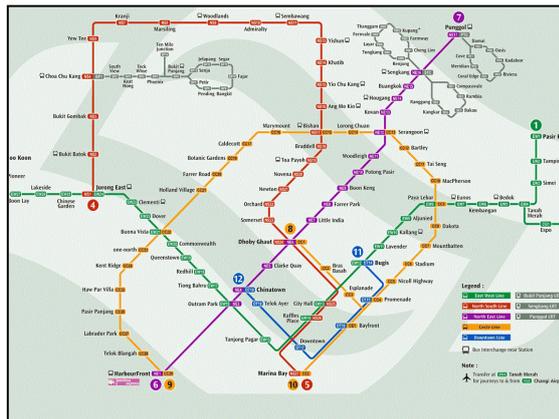


Figure 3. Third phase

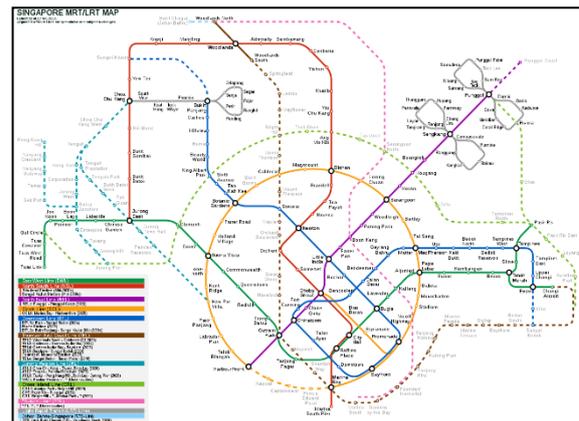


Figure 4. Forth phase

IV. LESSONS FOR CONSTRUCTION MANAGEMENT

4.1. GROWING DEVELOPMENT

In 1983, the MRT Corporation (MRTC) was set up to be the developer and future operator of the proposed rail systems. MRTC team was built quickly with the supports of expert consultants recruited from Hong Kong and United Kingdom. At the peak construction, there were more than 300 engineers were working under MRTC project. According to Land Transport Authority (LTA), these engineers were expensive but very professional, and also hard to manage. However, these engineers were experienced and strong-minded, with many of them from Hong Kong rapid transit project, and who were trained to expressing themselves freely, and getting their own proper way. (LTA 2004)

Today, the number of expatriates with the Land Transport Authority, LTA (incorporated MRTC) working on rapid rail systems has decreased to around thirty. There is growing maturity in building rapid rail systems in Singapore gained from almost 40 years of developmental experience with best track record.

4.2. OPTIMUM APPLICATION & INCREASE IN CAPABILITY

Japan is said to have best technology in construction work and Singapore MRTC fully utilized their work into it. Singapore adopted Japanese construing policies and method in building the MRT. The management was also done is a way that all engineers working under the project were fully utilized and had a stage where they can present their point of view to the higher authority without hesitation.

Japanese constructors tend to have muscle-oriented power on the other hand Singapore constructors have management skills. With combination of both of these Singapore MRT had best optimum application of the resources for betterment of the project. These finally increased the capability that can outperform any construction work that had that time.

4.3. PROJECT RISK MANAGEMENT

With a project this big it tends to have risks involved. The issue was with software development for controlling and signalling. Difficulty in establishing timelines with succession was at stake. The software developed in France for signalling is used. The system this big tends stick with its traditional method to avoid risk. MRTC commands that if you not take risk you will never have a new system. So, it was developed by open mined engineers. He overseas technology was used with predelivery test to ensure the project efficiency.

V. A STRUCTURAL VIEWPOINT REFLECTION

Mass Rapid Transit (MRT) system is major infrastructural development project. Which affect day to day activity of people. This type of system goes under various divergence and convergence development with pre project feasibility study and different planning phases. The pre-project definitions and planning is heart of any project. Pre-project divert into strategic points, conceptual evaluation and former engineering on the other hand planning divert into final commitment and approval of project.

A soft system methodology is used to conduct systematic enquiry to develop a model in context to real world need and situations. It ensures that the completed project is both technically and feasibly usable. Upon approval, the project implementation starts and it aims to achieve the rapid conveyance result. This phase ensures discipline and control in engineering practice. For any infrastructural development user's as people who are going to use the product economic and social needs are considered. This kind of MRT project follows multi-phase development accordance to usage.

This kind of project implementation takes high demand to complete systematic approach is highly required to complete the given work with its objectives and scopes. This kind of work takes hard discipline and end goal seeking capability. The required feedback from the user is also essential for the work done. The work done in budget is acquired by systematic spending on essentials and proper work methodology.

VI. CURRENT SCENARIO OF MRT

The MRT system relies on its two main lines, the North South and East West lines, until the opening of the North East line in 2003. The plans for these old lines and the new currently under construction lines were formulated long before, the Land Transport Authority's publication of a paper titled "A World Class Land Transport System" in 1996 to motivate the government's intentions to greatly expand the system. It called for the expansion of the 67 kilometres of track in 1995 to 360 in 2030. It was expected that daily passenger in 2030 would grow to 6.0 million from the 1.4 million passengers at that time.

New lines and extensions are mostly announced as part of the Land Transport Master Plan, which is announced every five years and outlines the government's intentions for the future of the transport network in Singapore. The latest plan, the Land Transport Master Plan 2040, was announced on 25 May 2019, and provides for line extensions to the Downtown and Thomson-East Coast lines, a new MRT line under study, and 2 new stations on the North South line.

VII. CONCLUSION

For feasible economic development of a country, country must invest frequently in infrastructure construction. The infrastructure development is one time investment. Country planners should take a well-ordered view of infrastructural development capable of continues growth, and in need for renewal. Possibility and necessities should be made for future expansion in step with economic progress. Singapore has over five decades of experience and achievements in intensive infrastructure construction. Some of these knowledges and teachings learned are worldwide and some are relatively exclusive in Singapore's context. In the national development, the construction industry as a whole has made important contributions as lively contributor in infrastructure development. The local construction industry should continue to learn from the world class best performs and to influence on international talents and resources.

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