THE FUTURE OF BUS RAPID TRANSIT (BRT) IN MALAYSIA

OVERVIEW OF BUS RAPID TRANSIT (BRT) CONFERENCE 2019

Volvo Buses (Malaysia) was proud to host the very first Bus Rapid Transit (BRT) Conference in Putrajaya, Malaysia on 19th November 2019, together with Technology Depository Agency (TDA) and Prasarana. Supported by the Malaysian Government, The Swedish Embassy and Business Sweden - the intention was to bring together key stakeholders from across Malaysia to build a shared vision in making Bus Rapid Transit (BRT) a success in Malaysia.

EXECUTIVE SUMMARY

Volvo Buses together with Technology Depository Agency (TDA) and Prasarana Malaysia Berhad, hosted the first Bus Rapid Transit (BRT) Conference – An Industrial Collaboration Programme (ICP) by Volvo Buses on 19th November 2019 at the Le Meridien Hotel, Putrajaya. The BRT conference was supported by the Malaysian Government, the Swedish Embassy and Business Sweden. The main objective of the BRT conference was to gather major stakeholders all over Malaysia to share the vision of making Bus Rapid Transit a reality in Malaysia. The BRT Conference is part of the ICP programme which stemmed from the procurement of 90 Volvo B8L Euro 6 Double Deck Buses for Rapid Bus for the use in Klang Valley. The programme was initiated by Technology Depository Agency Berhad (TDA), to create a platform for best practice sharing on BRT system to be used as a reference for future BRT development in Malaysia.

TDA is a government agency under the jurisdiction of the Ministry of Finance, Malaysia. Its functions are to carry out planning, evaluating, managing, monitoring, analysing and recording the implementation of the Industrial Collaboration Programme (ICP) in Malaysia. ICP is an initiative by the Government of Malaysia to ensure procurement spent by the Malaysian government which will be compensated to the country in the form of technology transfer, human capital development as well as enhancement of local companies' involvement in the global supply chain.

The conference commenced with Mr. Akash Passey's (Senior Vice President of Business Region International, Volvo Bus Corporation) welcoming speech. This was followed by speeches from the Ambassador of Sweden to Malaysia H.E Dag Juhlin-Dannfelt (Embassy of Sweden) and YB Tuan Loke Siew Fook (Former Transport Minister of the Government of Malaysia) who addressed the future of public transport in Malaysia. The conference was attended by more than 270 participants from various private as well as government agencies, industries and media outlets.

The conference drew on the experience of BRT specialists, blending global insights with local experience. The aim was to identify and address key considerations in regard to BRT implementation including planning, tendering, designing, constructing, operating and maintaining. The audience were informed of key topics such as the international overview of the BRT concept and its suitability to prospering cities, existing business models using examples from across the globe, information on choosing the right technology, design, construction and operation, the value of public transport and implementation of land value capture and the latest developments in regard to BRT systems in Malaysia.

The programme also included a panel discussion on 'The Future of Bus Rapid Transit in Malaysia'. Moderated by Sridhar Chari, a former public transport journalist from India, who now works in public relations for Volvo Buses. The panel discussion aimed to share, discuss and debate views, experiences, and ideas on future BRT systems in Malaysia. The panel also pondered about the various choices of green technology - Euro 6 engine, hybrid, hydrogen and electric powered vehicles in future, all featured in the discussions.

The former CEO of TDA, Dato' Zailani Safari delivered the closing remarks that summarised the conference outcomes and highlighted the importance of ICP as an effective tool in leveraging the national economic growth and hope that the BRT Conference will be the platform for speakers and industry experts to inspire the participants with new and creative ideas, and initiate effective collaboration between the Government and industry players in building a relationship with mutual benefits.

From the discussion and knowledge shared by the speakers and panellists, it can be inferred that BRT has the potential to serve as the new public transport systems for progressing and emerging cities. It is able to alleviate traffic congestions and preserve the environment with cleaner air. Sunway Township is the first city in Malaysia to introduce BRT service to the public, with segregated BRT transit ways, intelligent transportation system (ITS) applications and state-of-the-art stations. The BRT service was found to be efficient, effective, reliable and convenient to the passengers. However, in order to ensure the return on investment (ROI) of BRT systems and to encourage more people to use public transport, it is important to have an attractive fare that is affordable to all levels of society. If BRT systems were to be expanded to other cities in Malaysia, a more comprehensive study on the market requirement needs to be conducted and comparison has to be made with other services in order to achieve a profitable and successful operation. Besides, selection of vehicle for the BRT systems also plays the role in minimising the investment, infrastructure, operational and maintenance costs. Last but not least, the BRT systems technologies can be readily transferred to the locals and the foreign suppliers must support the development of local human capital talents and skills. If Malaysia intends to make public transportation a mainstream choice of mobility, it is imperative to choose the right system, adopt the best practices but at the same time be ready with mitigation solutions should any issues arise.

INTRODUCTION

Through the Industrial collaboration Programme (ICP), Volvo Buses in collaboration with Technology Depository Agency (TDA) and Prasarana Malaysia Berhad organised the Bus Rapid Transit (BRT) Conference on 19th November 2019, at Le Meridien Hotel, Putrajaya.

The BRT also known as a busway and transit way, is a bus-based public transport system designed to improve capacity and reliability relative to a conventional bus system.

The objective of this BRT Conference 2019 is to identify and address the real challenges in designing, planning, tendering and managing construction, operation, maintenance as well as implementing BRT to various transport and logistics stakeholders.

The outcome of the conference will be used as input for other potential ICP Projects to ensure the continuity of the project apart from having a knowledge sharing or an exposure session to the stakeholders on the concept of BRT System.

"A developed society is not where the poor drive cars, but where the rich go by public transport"

- Enrique Peñalosa, Mayor of Bogotá, 1998-2001

ITINERARY OF BUS RAPID TRANSIT (BRT) CONFERENCE

Bus Rapid Transit (BRT) Conference co-organised by Technology Depository (TDA), Prasarana and Volvo Buses on 19 November 2019 (Tuesday) at Le-Meridien Hotel, IOI Resort City, Putrajaya, Selangor, Malaysia.

The itinerary of the BRT Conference was scheduled as below:

Time	Activity	Speaker
08.00 am	Registration	
08.45 am	Commencement of Conference	
09.00 am	Welcome Speech	Mr Akash Passey, Senior Vice President, Volvo Bus Corporation
09.10 am	Opening Remarks	YB Dato' Mohamed Hazlan Mohamad Hussain, Former President Group of CEO, Prasarana
09.20 am	Speech by Swedish Ambassador to Malaysia	H.E Mr Dag Juhlin-Dannfelt, Embassy of Sweden
09.30 am	Speech by Former Transport Minister, Ministry of Transport, Malaysia	YB Tuan Loke Siew Fook, Goverment of Malaysia
09.50 am	**Break**	
10.15 am	Keynote Speech ***'Potential of BRT as a Mass Transit Option in Southeast Asia'***	Ms Xiaomei Duan, Chief Engineer, Guangzhou Municipal Engineering Design and Research Institute, China
10.45 am	Keynote Speech ***'Practical Experience from Transjakarta'***	Mr Yoga Adiwinarto, Director of Engineering and Facility PT. Transportasi Jakarta (Transjakarta), Indonesia
11.15 am	Keynote Speech ***'The Value of Public Transport and Implementation of Land Value Capture'***	Ms Sue Chan, Head of UITP Asia Pacific, Hong Kong
11.45 am	Keynote Speech ***'The BRT Business Model'***	Mr Frits Olyslager, Public Transport/Institutional Specialist, Australia
12.15 pm	Lunch	
01.30 pm	Keynote Speech ***'Humanising BRT Sunway Experience'***	Mr Muhammad Yazurin Sallij Muhammad Yasin, CEO Rapid Bus
02.00 pm	Keynote Speech ***'Volvo Buses Technology and Solutions'***	Mr Stefan Widlund, City Mobility Director, Volvo Bus Corporation

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Time	Activity	Speaker
02.30pm	Group Panel Discussion on ***'Future Bus Rapid Transit Systems in Malaysia'***	
	Moderator	Mr Sridhar Chari, Manager of Public Affairs and Media affairs, Volvo Bus Corporation
	Representative from Volvo Bus Corporation	Jan Vandooren, Former Director BRT Region International, Volvo Bus Corporation
	Representative from Rapid Bus Sdn Bhd	Muhammad Yazurin Sallij Muhammad Yasin, CEO Rapid Bus, Malaysia
	Representative from Guangzhou Municipal Engineering Design and Research Institute	Xiaomei Duan, Chief Engineer, Guangzhou Municipal Engineering Design and Research Institute, China
	Representative from The Land Public Transport Agency (APAD)	Mr Ahmad Radhi Maarof, Deputy Director General (Development) of APAD, Malaysia
	Representative from Transportasi Jakarta (Transjakarta)	Mr Yoga Adiwinarto, Director of Engineering and Facility at PT. Transportasi Jakarta (Transjakarta), Indonesia
4.00 pm	Questions & Answers Session	
4.30 pm	Closing Remarks	YBhg. Dato' Zailani Safari, Former CEO of TDA Berhad
4.45 pm	Presentation Ceremony	
5.00 pm	Close of Conference	
5.00 pm	Networking Function	
6.00 pm	The End	

BRT CONFERENCE PARTICIPATING ORGANISATIONS

Participating Organisations

Government Agencies

Ministry of Finance (MOF)
Ministry of Transport (MOT)
Ministry of International Trade and Industry (MITI)
Technology Depository Agency Berhad (TDA)
Ministry of Youth and Sports (MOYS)
Malaysian Investment Development Authority (MIDA)
Embassy of Sweden
Prasarana Malaysia Berhad
Mass Rapid Transit Corporation Sdn Bhd (MRTC)
Road Transport Department Malaysia (JPJ)
Land Public Transport Agency (APAD)
Road Safety Department Malaysia (JKJR)
Malaysian Institute of Road Safety Research (MIROS)
Department of Standards Malaysia (JSM)
SIRIM Berhad (SIRIM)
Malaysia Automotive Robotics and IoT Institute (MARII)
Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC)
Malaysian Green Technology Corporation (MGTC)
Ahli Majlis Mesyuarat Kerajaan (AMMK) Johor
Perbadanan Pengangkutan Awam Johor (PAJ)
Iskandar Regional Development Authority (IRDA)
Land Transport and Logistics Division Ministry of Transport, Sarawak
Sarawak Economic Development Corporation (SEDC)
Green Technology For The Development of Low Carbon Cities (GTALCC)

Municipals

Putrajaya Corporation (PPj)
Kota Kinabalu City Hall (DBKK)
Kuala Lumpur City Hall (DBKL)
Kuching South City Council (MBKS)
Melaka Historic City Council (MBMB)

Academic Institutions

Universiti Malaysia Pahang (UMP)
Institut Latihan Perindustrian (ILP) Jitra
Malaysia Institute of Transport (MITRANS)
Universiti Kuala Lumpur (UniKL)
Institut Kemahiran Tinggi Belia Negara Dusun Tua (IKTBNDT)

Corporations

Udenna Group
Business Sweden
HSS Integrated Sdn Bhd (HSSI)
Handal Indah Sdn Bhd
Disitu Holdings Sdn Bhd
Tower Transit
Perak Transit Bhd
Airport Coach Sdn Bhd
Siang Yun Transportation Sdn Bhd
Truckquip Sdn Bhd
Avis Malaysia
Pioneer Coach Builders Sdn Bhd
Warisan Holdings
Gemilang Coachworks Sdn Bhd

BUS RAPID TRANSIT CONFERENCE SUMMARY

An Industrial Collaboration Programme by Volvo Buses

Le Méridien Putrajaya, 19 November 2019

The Future of Bus Rapid Transit in Malaysia conference brought together experts from industries, government agencies, and academic community. Solutions must be developed based on a deep understanding of the country and city contexts backed by local knowledge and experience both on the government and industry partner side fostering strong participation from all involved. It is very important for stakeholders to choose partners who display this understanding of the local context and understanding of the aspirations of stakeholders.

In terms of technology, electromobility is certainly going to replace traditional fuels such as diesel. However, the experts who presented at the conference suggested that currently, all electric fleets can work well for small stand-alone projects (e.g. Petaling Jaya's Sunway Line) or for small parts of larger projects. Outside the very specific context of China, proven low emission technologies provide the best combination of environmental performance, value for money and ease of deployment. Furthermore, these proven technologies offer compatibility with existing systems, work force skills and supply chains (e.g. availability of spare parts). A key theme of the conference was a recognition that the best decision for most cities would be to introduce BRT using proven technological systems and then upgrade to technologies such as electromobility or guidance systems once it comes time to renew the fleet in future years at which point in time, electromobility will be a more mature technology.

SUMMARY OF SESSIONS

Welcome Speech from Mr Akash Passey, Senior Vice President of Volvo Bus Corporation

Mr. Akash Passey welcomed all the delegates to the very first Bus Rapid Transit Conference in Malaysia. The main objective of this conference was to share the vision of making Rapid Bus Transit system a reality in Malaysia.

The expected outcome of the conference is to assist Malaysia in building smart, sustainable and attractive Bus Rapid Transit (BRT) systems based on the input and experiences shared by the invited speakers.

Volvo Buses has immense experience with BRT, and was the first to invent and deliver the high-capacity BRT system in Curitiba, Brazil in 1975. Volvo Buses has been actively involved in expanding BRT systems all over the world, and encouraging discussions and views to promote better solutions. By having an efficient Bus Rapid Transit (BRT) system, it will be an ideal solution for future cities that want to ease road congestion problem, reduce pollution and finally improve the quality of life of its population. BRT systems are able to reduce 50 per cent travel time and ensure safety due to fewer cars on the road.

Volvo Buses has about 5,000 Volvo buses operating in BRT systems in 32 cities from 15 countries, transporting an average of 12 million passengers per day. Based on Volvo Buses experience, BRT was proven to be the most flexible, scalable and cost-efficient transport infrastructure. Volvo Buses also looks forward to seeing more BRT developments in Malaysia.

Thus, shared insights by the guest speakers and discussions among the panellists regarding the benefits of BRT systems will provide invaluable knowledge about BRT to all the conference participants with the hope of making sustainable mobility a reality in Malaysia.

“At Volvo Buses, we are driven by a passion to improve everyday life for people. Making a difference, pioneering sustainable transport solutions ensuring millions of people reach their travel destination every day”

- Akash Passey, Senior Vice President of Volvo Bus Corporation

Opening remarks from Dato' Mohamed Hazlan Mohamed Hussain, Former President and Group CEO, Prasarana Malaysia Berhad

Dato' Mohamed Hazlan shared the success story of the Sunway BRT line, which is Malaysia's first elevated BRT network of a 5.4km-long route, with 7 stations including one with 'Park n Ride' facilities and a depot. It has been operating since 2015 between Subang Jaya and Sunway Township, serviced by 15 electric buses, with a frequency of 4 minutes for weekdays during peak hours and 8 minutes for weekdays during non-peak hours.

BRT was introduced to further enhance connectivity of existing public transport services, as well as to relieve traffic congestion in Bandar Sunway and Subang Jaya. Costing a total of RM634 million for construction, it may have appeared to be on the high end of the cost spectrum for BRT systems, but it greatly reduced the risk of road accidents and traffic congestions, thus making the investment a real success. Dato' Mohamed Hazlan acknowledged that there are opportunities to be leveraged on, and Malaysia is dedicated to making BRT one of the main future sustainable transport solutions.

"BRT was introduced to further enhance connectivity of existing public transport services, as well as to relieve traffic congestion"

- Dato' Mohamed Hazlan Mohamed Hussain, Former President and Group CEO, Prasarana Malaysia Berhad

Speech by H.E. Mr Dag Juhlin-Dannfelt, Ambassador of Sweden to Malaysia, Embassy of Sweden

The ambassador explained the commitment of Swedish companies to ensure safety, quality and environmental care and emphasised the importance of sustainable transport modes to address climate change. The Ambassador noted the strong relationship between Sweden and Malaysia since 1958 with both being free trade focused open economies. Malaysia is committed to United Nations (UN) for sustainable development goals which will set the scene for an open, competitive, sustainable and healthy economy.

Sustainable development is a hallmark of Swedish industry and Sweden is proud of Volvo's contribution to both environmental sustainability and safety. The Ambassador noted that Volvo is introducing the first ever Euro 6 compliant double decker buses in Malaysia and Volvo is collaborating with Malaysia on numerous road safety initiatives. The Ambassador concluded his speech by providing insights into the successful collaboration between Sweden and Malaysia in promoting sustainable development highlighting the importance of combating environmental care and safety for Malaysians.

"His Excellency noted that Volvo is introducing the first Euro 6 compliant double decker buses in Malaysia and collaborating with Malaysia on numerous road safety initiatives"

- H.E. Mr. Dag Juhlin-Dannfelt, Ambassador of Sweden to Malaysia

Speech by YB Tuan Loke Siew Fook, Former Transport Minister, Government of Malaysia

The Minister started his speech by highlighting the importance of the transport sector in building the economy of the country. The transport sector has grown at over 5 per cent per annum for the last 15 years and accounts for 3.5 per cent of Malaysia's gross domestic product (GDP). The National Transport Policy (2019-2030) was developed to improve the transport sector in enhancing the economic growth and social benefits, including accessibility and reduced environmental impact. The Industry Collaboration Programme (ICP) is viewed as a long term instrumental process in identifying capacity gaps and developing partnership between all stakeholders.

Having good infrastructure and reliable buses alone are not sufficient for Malaysia to build a world-class transport system. Malaysia needs to acquire knowledge transfer and there is a need to train bus captains, staff and regulators and it is important for workers to have passion as well as pride to serve the public with integrity. Government must empower workers to keep this up and drive development of work force to make sure that the benefits of the infrastructure are captured. The Minister also spoke about the challenge of encouraging the use of public transport and the Government's effort to do so through a number of initiatives. The investments spent on developing infrastructure will only be effective if there is an increase in the use of public transport.

According to YB Loke, the ridership of the Sunway BRT has increased by 30 per cent when Prasarana reduced 20 per cent of the fare in 2018 in response to public feedbacks. Public transport users are price sensitive and the fare must be made attractive to encourage people to use public transport. Thus, the Government has introduced incentives such as the My100 pass with unlimited usage for all public transport rides (rail and road) in Klang Valley and more than 100,000 people benefit from this programme. This subsidy scheme is instrumental to encourage the ridership of public transport by extending the scheme across Malaysia. Besides offering attractive fare and subsidy, the public transport system must have the elements of being reliable, efficient and safe in order to increase the ridership further.

Federal Government is working closely with State Governments, such as Johor and Sarawak to expand the BRT systems since there are large population in these cities. The Minister concluded his speech by discussing how the ICP can assist in national economic development via collaborations with various agencies and stakeholders.

"The key success factor in cultivating public transport usage is to ensure affordability of the services, including offering subsidised fares as a way of encouraging public transport ridership"

- YB Tuan Loke Siew Fook, Former Transport Minister, Malaysia

Keynote Speech: ‘Potential of BRT as a Mass Transit Option in Southeast Asia’
Ms Xiaomei Duan,
Chief Engineer, Guangzhou Municipal Engineering Design and Research Institute

Ms Duan discussed the best practices for the development of BRT projects in China and pointed out some of the lessons learnt for cities in South East Asia with BRT projects and related urban transport planning initiatives. She discussed the importance of having a vision for the broader city before starting construction of a new BRT system and matching the vision with detailed and comprehensive development and planning. Focus was also placed on the importance of planning the improvement of urban design alongside the development of the transport infrastructure.

It was recognised that these time frames reflect the situation in China where construction is able to move much more rapidly than in most other jurisdictions. Ms Duan spoke about the need for commitment to transport, infrastructure and construction planning around the BRT network, particularly the need to ensure that street space is dedicated to the BRT service.

She also brought in an international perspective and discussed some of the success stories both within and outside of China. The cities discussed included Guangzhou, with a relatively new network that is already achieving very high ridership, Cali in Colombia, with its extensive network of services and Brisbane in Australia, with a network that is achieving very high levels of usage in a city with relatively low public transport need.

The discussion included the issue of the BRT operation services with separate or integrated trunk and feeder routes too. The key question here is whether to construct a system that is ‘closed’ with BRT vehicles only operating along the length of the corridor or to utilise an ‘open’ (also known as direct) system with buses serving routes outside the BRT system before joining the BRT corridor to continue the service. Brisbane in Australia, Yichang in China and the current proposals in Malaysia are open systems which provide a single seat journey to users and allow the benefits of the BRT network to spread more widely across a city. Conversely, higher capacity or high floor buses can be used on a closed system and may be easier to operate as they are better segregated from the rest of the traffic.

Ms Duan provided the insight that the decision between an open and closed system comes down to the proportion of boarding and alighting expected to occur on the BRT corridor versus off the BRT corridor. Where there are more trips starting or finishing off the corridor, a ‘direct’ service will be better as it minimises the need of transfers. If most of the trips run between origins and destinations on the BRT corridor then the operational benefits suggest a ‘closed’ system with feeder bus passengers transferring from BRT stations to the main route.

Other benefits of BRT were also illustrated in the city of Guangzhou. It has the world’s highest BRT bus flows, with one bus every 10 seconds into the city, in the morning during rush hour. The system features a range of innovative and transformational features, and it is the first high-capacity BRT system worldwide to operate ‘direct service’ routes. Guangzhou’s BRT has no terminals and no interchanges, and uses predominantly regular 12 metre buses. This new operational model has a profound impact on BRT worldwide, as most cities now opt for ‘direct service’ rather than ‘trunk-feeder’ BRT operations. It is the first BRT system in China with more than one bus operator and the first with private sector operators. It is also the first BRT system worldwide with a bike sharing system planned and implemented at the same time along the corridor.

BRT in Guangzhou, China

Karl Fjellstrom, itdp-China.org

There are several different significant local benefits to City of Guangzhou residents, especially those who travel on this corridor:

1. Travel times on the corridor have improved for motorists and bus riders along the corridor by 20 per cent and 29 per cent respectively.
2. Quality of bus service has improved dramatically with the implementation of real time bus information in new stations.
3. There are thirty per cent higher bus speeds, resulting in an average time saving of 6.63 minutes per BRT trip, or 88,000 passenger-hours per day, or more than 30 million passenger-hours saved each year.
4. There is a reduction by half for out-of-pocket bus trip costs for passengers, from 4.9 RMB (December 2009) to 2.6 RMB (August 2010).
5. There is a 15 per cent decrease in bus waiting time along the BRT corridor.
6. There is a 50 per cent increase in cycling along the BRT corridor in locations with the highest demand.

Yichang was the second city in Asia after Guangzhou to achieve the gold standard BRT award. It has a 23.9 kilometre network covering 37 stations, 6 footbridges, and 3 pedestrian tunnels. The BRT corridor also features urban design and Transit Oriented Development (TOD) features including improved conditions for cyclists and pedestrians, parking management improvements, landscaping and urban design features especially in station areas, and bike-sharing system supported by a network of greenways.

Alongside the development of the BRT system, came the investment in improved parking and an improved urban realm.

Yichang is an example of BRT on a relatively narrow road (35 metres wide) but still allows one lane of road space on each side of the BRT. One commitment required for this project was the removal of 2,000 car parking spots as one of the prerequisites to start the project. The effectiveness of the project is demonstrated through the development of new high-rise apartments alongside the BRT network and the reduction of car usage along the corridor from 40 per cent of trips to 30 per cent.

Ms Duan also shared the feasibility studies which have been carried out by Far East Mobility, such as Yangon Urban Transport Project, Bandung BRT, Metro Manila BRT, and future Iskandar Malaysia BRT. Based on her experience in BRT projects, she pointed out some tips on the lessons learned as stated below:

01 Start essentially with strong BRT concept design and BRT preliminary design.

02 Ensure that BRT design incorporates Non-motorised Transport (NMT) and other Transit Oriented Development (TOD) because it would be difficult to retrofit in future.

03 Optimise the early operations.

04 Plan and design for higher capacity BRT even it is not required in the short term.

05 Note that BRT can be a mass transit.

06 Plan BRT station access carefully because it has a major impact on BRT performance.

"Decision between an open and closed system comes down to the proportion of boarding and alighting expected to occur on the BRT corridor versus off the BRT corridor"

-Ms Xiaomei Duan, Chief Engineer, Guangzhou Municipal Engineering Design and Research Institute

Keynote Speech: ‘Practical Experience from Transjakarta’
Mr Yoga Adiwinarto,
Director of Engineering and Facility at PT. Transportasi Jakarta (Transjakarta)

Transjakarta has one of the largest BRT fleets in the world and has grown from a purely trunk route system in 2004 to a fully integrated network in 2019. Transjakarta, a provincially-owned corporation, has the world’s longest BRT system (251.2 km). The system is considered the first mode of public transport in Jakarta. The buses run in allocated lanes and the tickets are subsidised by the regional government. Currently, it has about 3,900 buses and serves an average of 956,000 passengers on a daily basis, as per 2019 record.

As of 2019, Transjakarta has about 240 stations and is connected to 13 primary BRT corridors with 212 routes. About 78% of the total population of “Special Capital City Region (DKI)” is served by Transjakarta within 500 metre radius.

Currently, Transjakarta operates a number of various branded services:

i. Bus Rapid Transit (371 units)
Used to serve customers from residential areas outside Jakarta into BRT Transjakarta system.

ii. Metrotrans (300 units)
Used to serve non-corridor routes and modified the bus floor to accommodate customers with special needs.

iii. Minitrans (308 units)
Used by carrier of Transjakarta and can operate inside or outside BRT corridor.

iv. Royaltrans (100 units)
Used to serve customers from residential areas outside Jakarta, into BRT Transjakarta system equipped with TV, USB ports and declining seat.

v. Mikrotrans
Used to serve customers from settlement areas.

As for contracting, Transjakarta operates by itself around 30 per cent of its bus fleet, and the remaining is operated by other companies and co-operatives under a service contract. The service contracting could be challenging as it requires close negotiations with other companies, co-operatives and co-operative members (who own the fleet). Therefore, human capital cum capacity development of co-operative members has become a priority for Transjakarta .

Another challenge for Transjakarta is to create effective integration with other public transport operators. The industry has traditionally placed more emphasis on competition rather than on co-operation between different operators as well as developers of new transport infrastructure and has negatively viewed new projects as replacing existing public transport options.

The new approach under the Transjakarta model is to expand the overall network with the setup and it was not easy in the beginning to bring operators into the new network. This change of mindset, and business model were addressed through legislation. Transjakarta continuously takes the lead to promote the new ethos.

As one of the ongoing processes, Transjakarta is currently focusing on upgrading its bus fleet with the ambition of improving environmental sustainability and building the brand image of public transport in general. The next goal for Transjakarta is to have a full electrification fleet by 2030 including all vehicles from micro buses to BRT systems. The plan was to start with 100 electric vehicles in 2020, which is expected to grow to 12,882 by 2030. In order to achieve this goal, all procurement will be electric buses with effect from 2022 with the minimum diesel buses to procure in 2021.

“On the different business model of having contracts by various operators, whereby close negotiations, human capital and capacity development of cooperative members become increasingly important to succeed”

-Mr Yoga Adiwinarto, Director of Engineering and Facility at PT. Transportasi Jakarta (Transjakarta)

Keynote Speech: 'The Value of Public Transport and Implementation of Value Capture'
Ms Sue Chan,
Head of Asia Pacific, International Association of Public Transport (UITP)

The International Association of Public Transport (UITP) is a non-profit organisation (NGO) for public transport authorities and operators, policy decision-makers, scientific institutes and the public transport supply and service industry. UITP takes the role of facilitating the exchange of ideas, the discovery of solutions and the forging of mutually beneficial business partnerships. UITP has diverse membership which represents an international network of 1,800 member companies located in more than 100 countries and covers all modes of public transport.

UITP has recently launched a brief policy on Land Value Capture (LVC). A land embedded with new public transport infrastructure becomes more accessible and more desirable; thus, the land value increases. The increase in land value is also determined by the amount of public works and government development projects carried out in the area alongside the corridor. As land and property prices increase with the delivery of transport infrastructures and services, UITP will has the idea of getting land users to contribute to the funding of the system.

LVC is more than just a funding method; it is about creating a governance framework that integrates transport and land use, so that developments can be undertaken jointly for an optimised urban environment. There are two mechanisms to capture the land value and they can be categorised into two methods:

i. Project Based mechanisms
ii. Tax or Fee-based Mechanisms

Each mechanism reacts differently in terms of efficiency, equity, sustainability and feasibility. The selection of suitable method will be determined by the nature of the project, ownership of the land and the social and political context of where the LVC has been implemented. For greenfield projects, it is easier to employ LVC compared to land with ownership because the authorities have to convince individual land owners to accept a readjustment of their land.

Furthermore, it is not practical to allocate land value to transport accessibility as transport investments and the emergence of land value do not occur simultaneously. These hindrances may lead to disputes involving the integration of land and transport developments within a single approach as a requirement for an effective LVC implementation.

Ms Chan illustrates the case of Hong Kong where public transport makes a profit. In Hong Kong, fares are not seen as an ideal source of commercial revenue and the farebox revenue alone could not generate sufficient commercial returns to fund the development of transportation. Instead, railway finance comes from property development and rental property. As a result, station commercial space contributes two thirds of commercial income. The Hong Kong government gives land development rights to MTR who pays a land premium and this method allows the transport operator to make a profit.

Four principles to implement land value capture were provided.

Principle 1: Fostering Public Acceptability

Stakeholders' engagement is crucial since LVC depends on stakeholders' commitment to pay tax or fee to further fund the transport infrastructure and services. This principle recognises that when a mechanism imposes a fee, it is likely to encounter public opposition. It is necessary to provide evidence of the value of public transport, while acknowledging the access that transport provides as in the case of Istanbul where an attempt was made to construct a mass transit system within a context of limited budget.

The central government did not make any financial contribution; nevertheless, a few projects attracted international loans. A decision was made to sell the Great Metropolitan Municipality owned land and capture the land value to fund the rail infrastructures further. Hence, it is imperative to provide proof of the value of public transport as well as admit that transport facilitates the integration of subsequent benefits at the societal and institutional level.

Principle 2: Valuing access

Public transport increases access by providing the public with the ability to reach a broader range of opportunities including employment, education, shopping and health. This principle states that moving away from valuing just time (mobility) to a model that adopts an accessibility perspective will help stakeholders and communities to develop a common language and set of priorities.

This principle also identifies that access to opportunities is randomly spread and that it is reasonable for areas that are provided with greater opportunities to help fund those opportunities. This principle also utilises an accessibility approach which comprises visualisation tools and techniques capable of picturing the access benefits of transport and conveying very clear information to support the decision-making process and engaging with land users.

Tokyo practises this principle by using a land readjustment mechanism that convinces landowners to pool their land together to sell a part of it to fund the public transport project.

Principle 3: Managing land and transport jointly

As providing access becomes the ultimate objective of transport infrastructure and delivery of services, public transport authorities (PTAs) must plan them accordingly, optimising the value for land users. Transit Oriented Development (TOD) constitutes a good practice. The idea to mobilise development around stations in order to drive growth is a positive step towards the implementation of LVC. This principle recognises that the greatest increase in land value occurs when land development and transport developments have integrated planning and management.

Metrolinx in Canada's Toronto and Hamilton area provides a good example where the objectives of the land use plans and transport plans were aligned at all levels of government.

Principle 4: Design consistent transport policies

Consistent policies and measures for the transport sector helps to legitimise land value capture and manage expectations of land users. Cities that regulate car use enhance the competitiveness of more sustainable alternatives including public and active transport modes.

Stockholm, is a good example providing a positive context for LVC implementation. The Cordon Road Pricing subsequently reduced traffic significantly, which resulted in increased accessibility, as well as an enhanced urban environment ultimately benefiting real estate within the Cordon. The improvement in public transport ridership that ensued was actually supported by a small extension of services made simultaneously with the introduction of the road pricing scheme. Hence, LVC is commended for attaining the best form of transport integration.

"Land Value Capture (LVC) is about creating a governance framework that integrates transport and land use, so that developments can be undertaken jointly for an optimised urban environment"

-Ms Sue Chan, Head of UITP Asia Pacific

Keynote Speech: 'The BRT Business Model'
Mr Frits Olyslager,
Public Transport/Institutional Specialist, Australia

New technologies have benefited buses considerably in terms of fare collection, bus location systems and passenger information systems; however, many cities still face challenges:

- Over promising the benefits of BRT in one city based on success stories in other cities which may have very different projects and circumstances

- Following BRT standards that assume ideal circumstances in other cities, rather than designing the best solution for the local context by cooperating with outside partners with strong international experience

Whilst there are many different types of BRT services around the world, all successful BRTs have some common features:

- Designing services that fulfil the needs of the city and integrated land use

- Integrating BRT into the overall transport and development strategies of the city which involves engaging with various stakeholders

- Establishing strong and capable institutional structures

Mr Olyslager's presentation reinforced the themes that had been introduced in the earlier presentations and strongly emphasised the need for governments to maintain or increase the strength of their institutions and regulatory structures to ensure BRT is successful. Governments as the key stakeholders need to draw on local innovation and local understanding of the policy and institutional context. Governments also have a key role in ensuring that there is a sound business model and again this is context specific with a tension existing between lower fares to help improve access for the less wealthy and higher fares as a way to support financial sustainability.

Some lessons for successful implementation were also shared, such as improving the capacity of the existing transport operators and improving the existing network service to encourage the shift to public transport and to help ease the introduction of new transport modes and operators. Mr Olyslager saw this as a bigger priority than determining the appropriate contracting model as successful contracting requires strong institutional capacity. A commercially minded approach by operators who are customer focused and working to build customers and manage costs is another success factor. Operators bearing some of the risks helps this and it is possible to have commercially minded operators even where governments subsidise services.

Mr Olyslager also presented another example of a source of revenue for funding transport investment. Laos has introduced a paid parking system with the revenue hypothecated as subsidies for public transport. This encourages people to switch to public transport as a travel demand management measure but also acts as a source of funding for public transport.

Finally, the triangulation of ridership, efficiency and fare level for financial sustainability were discussed. BRT is a good product that can be very popular amongst the travelling public; it is also an efficient mode compared to other forms of public transport. However, it is necessary to trade-off the level of service and the level of fares to ensure financial sustainability. Agreement on how to trade off service levels and fare levels to achieve financial sustainability can be difficult to achieve unless there is an agreement amongst key stakeholders and this means finding consensus on the objectives at the start of the project.

Laos road traffic in front of presidential palace

Mongkon N. Thongsai, https://www.bigstockphoto.com/.

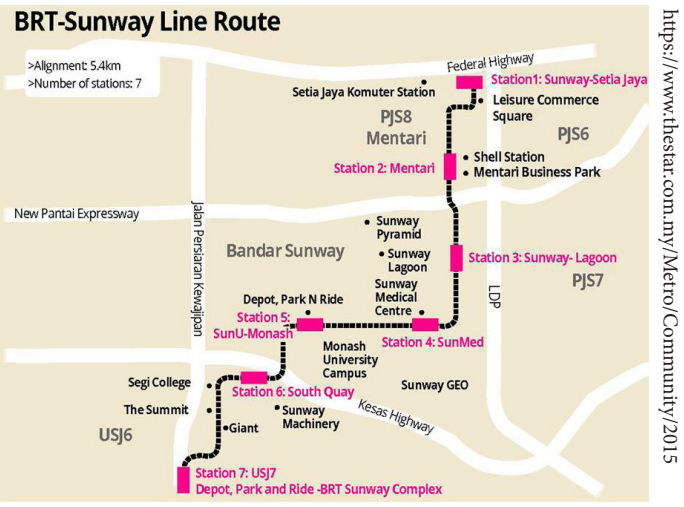
“The Governments need to maintain or increase the strength of their institutions and regulatory structures to ensure BRT is successful”

- Mr Frits Olyslager, Public Transport/Institutional Specialist, Australia

Keynote Speech: 'Humanising BRT Sunway Experience'
Mr Muhammad Yazurin Sallij Muhammad Yasin, CEO Rapid Bus Sdn Bhd

Mr Yaszurin brought in the operator's perspective and discussed Rapid Bus and lessons learnt from operating the BRT Sunway. Rapid Bus has a vision to provide connectivity and mobility for all with a mission to increase use of public transportation through reliable, affordable, capable, integrated and vibrant services on a sustainable basis. The importance of improving the institutional capabilities and resourcefulness of the Malaysian transport sector was emphasised by the conference speakers as it provides the sustainable basis for the development of new transport infrastructure.

Bandar Sunway serves a population of 418,000 in the Petaling Jaya district with 90 per cent of the area being residential zones. The BRT Sunway line was built as an elevated corridor to avoid the horrendous congestion during peak hours which would otherwise create uncomfortable and frustrating journey experiences. This also allowed the line to be built within an existing developed area. As most of the area was already developed, additional development was not given as much emphasis in this project. The route itself is 5.4 kilometres with 7 stations served by 15 electric buses charting an average weekday ridership of 14,000 passengers. It was opened in 2015 as a public-private partnership between Prasarana Malaysia Berhad and Sunway Berhad.



https://www.thestar.com.my/Metro/Community/2015

The BRT Sunway line connects two railway lines with residential, educational, commercial, healthcare and hotel units located along the line. The setup of the line in a large urban area means that the BRT plays a different role compared to other BRT systems worldwide that serve as a transit backbone in dense urban areas.

The BRT Sunway line is a centrepiece of an urban development programme:

1. BRT is fast, reliable, convenient, affordable and distinct from regular bus services.

2. It is an integrated package of facilities, systems and transport options designed to suit local conditions and constraints.

BRT Sunway recognises that new populations are more prone to change and the large student population in the Sunway area provides a constant opportunity to win new riders. They have found that a generic campaign or promotion to all students is not as effective as campaigns targeted to new students during enrolment or new student intake and the growth in patronage is greatest around the time of new student intakes each year. They have also experienced the limitations of park and ride facilities. In fact, it is best to invest in last mile connectivity to help riders to reach their final destinations without motor vehicles.

Development opportunities were limited by the extent of existing developments, but BRT has led to the creation of an activity centre along the BRT line. When the project first opened, patronage for the Sunway line was mainly during peak hours. Now with the creation of intermediate destinations, there is a noticeable increase in off peak hour patronage and a significant ‘Lunch hour rush’. This emphasises the impact of value co-creation and urban development. Important evidence was presented on price elasticity and the need to consider pricing strategies.

Originally fares were fixed high with the idea that this was a price inelastic market (i.e. higher fares would not discourage ridership). However, the operators decided to experiment with several trials of free travel months. For instance, free weekend travel found almost 12,000 passengers per weekend hour. Another trial of half price fares around the opening of the new metro rail station achieved a very encouraging response.

Assessment of the evidence led to a 20 per cent fare decrease in December 2018 and the introduction of the new My100 monthly pass since January 2019. This has led to an overall 40 per cent ridership growth as compared with the corresponding ones from a year earlier starting from March 2019 and the change in the marketing emphasis for the project. The communication message now emphasises on the travel time savings by BRT rather than positioning BRT as a ‘premium’ product.

Mr Yazurin ended his presentation by discussing the importance of understanding the customers’ needs, creating efficient multimodal connections, and creating destinations along the route to balance peak and off-peak demand along with the need to account for price elasticities in setting fares.

“The setup of Sunway BRT line in a large urban area means that the BRT plays a different role compared to other BRT systems worldwide that serve as a transit backbone in dense urban areas”

-Mr Muhammad Yazurin Sallij Muhammad Yasin, CEO Rapid Bus Sdn Bhd

Keynote Speech: 'Volvo Buses Technology and Solutions'
Mr Stefan Widlund,
City Mobility Director, Volvo Bus Corporation

Mr Widlund discussed the urban challenges of air pollution, congestion, noise, urbanisation, energy use, climate change and road safety. These issues are important globally and particularly important for Malaysia which has over 70 per cent urbanisation.

BRT offers a distinctive image with high capacity buses, dedicated lanes, prepaid ticketing, the provision of stations or enhanced stops and telematics fleet management system. Mr Widlund shared Volvo Buses' global experience in developing BRT systems for the last 45 years.

BRT was first introduced in Mexico City in 2005, and now BRT is the best ranked transport mode in Mexico City which has about 0.9 million passengers per day and covers more than 105 km network. The BRT system in Mexico City has been successful in increasing public transport modal share, and reducing emission and noise pollution levels.

Mr Widlund also shared the maturity of the development of electric buses. Electric buses account for 17 per cent of buses globally but 99 per cent of the electric buses are in China.

The electrification of bus fleets in most cities faced significant challenges:

01 Limited range

Electrical vehicles (EVs) need to have a minimum electricity level to travel. As such, the travelled distance and time of EVs are relatively limited hence, EVs require frequent charging which has to be performed at a specific charging station.

02 Initial cost

Vehicle price has been identified as one of the main barriers because the price of EV is 2-3 times higher than diesel vehicles, but their maintenance are actually cheaper since no engine needs to be maintained. TCO includes manufactured price and also the cost for maintenance, operation, energy distribution, infrastructure, emission, insurance and end of life. On vehicle price, all electric buses are more expensive than the diesel-engine buses.

03 Grid requirements

Electrification systems utilising pure electric buses may potentially impact peak hour electricity demands, and considerations for off-peak charging need to be considered seriously if the system will run on grid electricity.

04 Battery evolution

Battery performance is impacted by a variety of factors including topography, climate and temperature, weight of the bus, energy capacity of the batteries. The price of batteries per kilowatt hour (a measure of battery capacity) is reducing but the need for more battery capacity per vehicle means that cost of electric buses is not falling in the same quantum.

05 Cost and ownership of charging infrastructure

The cost and ownership of charging infrastructure can be a challenge if charging is to take place on public roads. Locating charging station in depots solves this problem but creates a need for large electricity grid capacity at the site of depot and may require investment in grid.

06 Involvement of several stakeholders

To have an efficient BRT system operated using electric buses, it involved several stakeholders' commitments, and huge investments in infrastructure.

Taking into account of the above reasons, operators and governments need to recognise that specifying an all-electric fleet may add an extra layer of complexity to new projects and may have implications for the financial feasibility of the project.

Volvo strongly supports the development of electromobility but there will be a transition period to realise this fully. Meanwhile, there are very good alternative solutions to fully electric buses. For instance, hybrid buses allow instant deployment so there is no need for a new infrastructure. Hybrid buses can operate up to one kilometre on full electric mode at the speed up to 50 kilometres per hour so they provide zero emissions in sensitive areas. e.g. around bus stops, historical or environmentally sensitive areas. Also, there are many different types of alternative fuels but the Euro 6 standard provides the closest environment benefits to all electric vehicles but at a much lower cost particularly the hybrid buses.

Mr Widlund concluded by stating that whilst electric propulsion is the future, for large scale BRT deployment, proven technologies are recommended. Diesel/Biodiesel powered vehicles have advantages over gas powered vehicles and electric buses can be used in smaller projects or for smaller parts of a bigger project. Hybrid offers a significant reduction of fuel, carbon dioxide (CO_2) and other pollutants compared to gas and diesel buses.

"Volvo strongly supports the development of electromobility but there will be a transition period to realise this fully, hence, one of the alternative solutions is the introduction of the Euro 6 fuel which provides the closest environment benefits to all electric vehicles but at a much lower cost particularly the hybrid buses"

-Mr Stefan Widlund, City Mobility Director, Volvo Bus Corporation

Group Panel Discussion: "Future Bus Rapid Transit in Malaysia"

The group panel discussion was moderated by Mr Sridhar Chari from Public affairs and strategic communication of Volvo Buses South Asia, on the future of BRT in Malaysia. The panellists were :

i. Muhammad Yazurin Sallij Muhammad Yasin, CEO Rapid Bus Sdn Bhd, Malaysia

ii. Xiaomei Duan, Chief Engineer, Guangzhou Municipal Engineering Design and Research Institute, China

iii. Ahmad Radhi Maarof, Deputy Director General (Development) of Land Public Transport Agency (APAD), Malaysia

iv. Jan Vandooren, Former Director Urban Mobility, Volvo Bus Corporation, Belgium

v. Frits Olyslagers, Public Transport/ Institutional Specialist, Australia

The panellists shared, discussed and debated on their views, experiences and ideas regarding the future BRT systems in Malaysia. They also discussed the various choices of technology, such as clean Euro 6 diesel, hybrid technologies and electrification.

During the discussion, Mr. Muhammad Yazurin Sallij shared his concerns about the criticism received from the public regarding bus fare, which affected ridership. Rapid Bus always strive to maintain a low bus fare even though the operating and maintenance costs for full electric buses and dedicated routes are higher.

It has been highlighted that in order to have a successful BRT operation, the fare must be affordable, and the operations must be efficient and cost-effective. It does not necessarily adopt a high technology that may incur high maintenance costs. However, BRT service must be appealing to the passengers and is able to give the highest return on investments.

Electrification may be beneficial in the long run and good for the environment; however, it has setbacks when it comes to maintenance and uptime. Battery powered electric buses have limitations in terms of driving range. There is a , compromise between passenger load and battery capacity and it incurs higher procurement costs. The reduced infrastructure for the overhead lines is partially offset by the cost of the infrastructure to recharge the batteries.

Thus, another alternative is the usage of hybrid or clean diesel fuels for the BRT system. The implementation of Euro 6 into the market will encourage the vehicle manufacturers to introduce the latest bus engine technology which can help to reduce emission.

Panellists also advised to go for average sized corridor route and run the trial before investing in the BRT system. One of the question raised by the audience was "What would happen should BRT system '*fail*' in Malaysia?". According to the panellists, planning is most crucial and if it does not operate efficiently then it would be running at a loss. Panellists also unanimously advised that wastages such as loss in investment and abandoned infrastructure should be avoided, and disciplined governance of the system was necessary to ensure ultimate success.

Based on the panellists' experience, one of the biggest challenges faced by countries trying to adopt the BRT system was that they planned for everything except rider occupancy. Firstly, it should build the interest and attract the passengers to utilise the system to ensure the system has sufficient ridership to operate successfully.

Closing Remarks
Dato' Zailani Safari,
Former CEO of Technology Depository Agency (TDA)

Dato' Zailani Safari, the former CEO of TDA summarised and highlighted the importance of ICP to develop and strengthen Malaysia's economy through procuring technology and knowledge that are both foreign and unavailable locally.

This means that there is still a need to develop an understanding of BRT's potential amongst key stakeholders and the need to ensure that BRT offers value for money for the public. Dato' Safari concluded by stating the need to consider BRT as a whole eco-system, including vehicles and fuel across the entire life cycle.

There is also a need for BRT to support other government initiatives. For instance, BRT could find ways to support the palm oil industry through the adoption of biodiesel, with the aim to achieve sustainability for both the environment and the economy in long term.

Group photo with all the keynote speakers

BRT CONFERENCE SPEAKERS' AND PANELISTS' PROFILE

Mr Akash Passey,
Senior Vice President of Volvo Bus Corporation

Akash Passey presently serves as Senior Vice President of Volvo Bus Corporation. As a member of the Volvo Bus Executive Management, he is responsible for business performance in the International Region covering Asia Pacific, Africa/Middle East, China, the Commonwealth of Independent States (CIS) countries and India. He considers it the greatest privilege to work with and present transportation solutions to talented as well as innovative people across the globe. In his previous roles, Akash has served as Board member of Sunwin Buses, China and the Managing Director & CEO of Volvo buses in South Asia, which included all markets in the South Asian Association for Regional Cooperation (SAARC) region. He had the honour in 2001 to start and establish Volvo Bus as a ticket brand in India. Akash has over 25 years of experience in the Truck and Buses Industry. Akash currently serves as Senior Executive Advisor to the Swedish India Business Council (SIBC), Stockholm.

Dato' Mohamed Hazlan Mohamed Hussain,
Former President and Group Chief Executive Officer Prasarana Malaysia Berhad

Dato' Mohamed Hazlan Mohamed Hussain was appointed as President & Group Chief Executive Officer of Prasarana Malaysia Berhad on 3rd September, 2018. Previously, he served as Group Director of Organisational Support at DRB-HICOM Berhad and has a vast experience and expertise in trust management and audit. A graduate of the Imperial College of Science and Technology, University of London in Civil Engineering, Dato' Mohamed Hazlan served as Group Director of Services & Education DRB-HICOM Berhad until 20th January, 2016. He served as Group Director for Transport Planning and Commercial Division at Prasarana until 2012 too. Between January and November 2011, he served as its Chief Operating Officer of Bus Division and Group Director of Bus Division.

H.E Mr. Dag Juhlin-Dannfelt,
Ambassador Sweden to Malaysia, Embassy of Sweden

His Excellency Dag Juhlin-Dannfelt has a background in law and began his career as a Junior Judge at the County Court of Strömstad, Sweden. He joined the foreign service in 1990, working with European affairs until 1994. From 1994 to 2005, he worked at the Swedish Embassies in Teheran, Tel Aviv and Islamabad (covering Pakistan and Afghanistan). From 2005 to 2011, he worked at the Ministry of Foreign Affairs in Stockholm, holding the positions of Coordinator for Development Cooperation and Human Rights for Middle East (2005-2006), Head of the Gulf Section (2006-2008) and then Deputy Head of the Middle East and North Africa Department (2008-2011). From September 2011 to August 2016, Dag was Ambassador of Sweden to the Kingdom of Saudi Arabia, and Non-resident Ambassador to the Sultanate of Oman, State of Kuwait and Republic of Yemen. Since 1st September 2016, Dag was appointed as the Ambassador of Sweden to Malaysia, having presented Letter of Credence on 2nd December 2016.

Ms Xiaomei Duan,
Chief Engineer, Guangzhou Municipal Engineering Design and Research Institute, China

Ms Duan graduated from Shanghai's Tongji University with a Masters in Traffic Engineering. She is currently Chief Engineer of the Guangzhou Municipal Engineering Design and Research Institute, Guangzhou's largest engineering institute. She also serves as the Chief Technical Officer of Far East Mobility. Xiaomei has worked on numerous urban transportation projects in many cities in China and the Asia Pacific region. Known to have arguably the most experience in the planning, design and implementation of successful BRT projects than any other engineer in China, Xiaomei has also worked on sustainable urban transportation projects in Vientiane (ADB), Kuala Lumpur (SPAD), Johor Bahru (IRDA), Metro Manila (ADB), Medan (ADB), Jakarta (ITDP), and Ulaanbaatar (ADB). She is part of the expert team in the ongoing GIZ funded project to plan BRT early studies in Bandung, Semarang, Pekanbaru and Batam (2019). For the last 15 years, she has been in charge of the planning and design of several famous BRT projects and Green transportation projects in China including Guangzhou, Lanzhou, and Yichang BRT. She is now a nationally accredited Senior Engineer and has worked as a consultant for Asian Development Bank.

Mr Yoga Adiwinarto,
Director of Engineering and Facility at PT. Transportasi Jakarta (Transjakarta), Indonesia

Yoga Adiwinarto is Transjakarta's Technical and Facility Director, managing the fleet and infrastructure of the largest BRT system in the world. Before being appointed as director in Transjakarta in mid-2019, Yoga served as ITDP South East Asia Director, where he spent more than a decade working on numerous sustainable transport projects in cities in Asia, mainly focusing on Bus Rapid Transit, public transport operation and non-motorised transport improvement. During his professional career, Yoga has worked in different countries including; England, Indonesia, Timor Leste, Laos, Pakistan, Malaysia, Azerbaijan, Thailand and Fiji. His role saw him assist city governments, donors and development agencies to implement and improve public transport, walking and cycling conditions in the city. He also has spoken in many conferences and seminars on transportation in Indonesia and abroad, as well as led technical workshops and training on sustainable transport issues. Yoga holds a Bachelor Degree in Civil Engineering from Institute Technology Bandung, Indonesia, and a Master's Degree in transport planning from Leeds University, UK. Yoga is a member of Indonesia Transport Society, and currently serves as the Deputy chairman of its Jakarta chapter.

Ms Sue Chan,
Head of UITP Asia Pacific, Hong Kong

Sue Chan is the Head of UITP Asia Pacific since July 2015. She has been working in the traffic and transportation field for nearly 20 years, specialised in transport planning, strategy and policy. She was the director for several transport and engineering consulting firms leading their Hong Kong and China offices. Throughout her career, she has developed good connection with major transportation operators, transportation related government authorities, international institutions (e.g. ADB and World Bank) and universities in Asia, particularly in Hong Kong and China. She holds a Master of Arts Degree in Transport Policy and Planning from the University of Hong Kong and a Bachelor Degree in Economics from Macquarie University in Sydney, Australia. She is also a Chartered Member of the Chartered Institute of Logistics & Transport (CMILT). At UITP, Sue leads the development of the association in the Asia-Pacific region in the advocacy of public transport and sustainable development. She is responsible for coordinating and developing UITP work plan in the region. As the Head of UITP Asia-Pacific, Sue supervises projects within the region and manages all the administrative day-to-day activities of the office. She represents UITP in Asia-Pacific and contributes to global UITP activities.

Mr Frits Olyslager,
Public Transport/Institutional Specialist, Australia

Frits Olyslager is a bus systems development specialist with over 40 years' experience and 25 years in international development projects, involving institutional and organisational reform of urban transport, planning and implementation of bus networks and BRT systems, operational modelling and developing business plans. With broad and practical experience in planning and managing bus operations, Frits also develops business models using a commercially oriented business approach to public transport with the aim for financial sustainability. He also conducts detailed planning of bus networks, business and operations, capacity-building and training. Frits has extensive experience in developing countries of South Asia, East Asia and Africa and has held the position of World Bank funded Transport Advisor to the Dhaka Transport Coordination Authority (DTCA) in Dhaka Bangladesh (2012-15) as well as Team Leader for the DTCA Capacity building project (AFD 2018). Presently, Frits is Team Leader for the Transaction Technical Assistant (TRTA) capacity-building project in Vientiane, Laos (SUTP & BRT implementation) and holds positions in two projects in Phnom Penh Cambodia, being for a Sustainable Urban Transport Project (SUTP) and development of the urban bus network. Frits is also a consultant to the World Bank reviewing 20 years of BRT implementation of bank-funded projects.

Mr Muhammad Yazurin Sallij Muhammad Yasin,
CEO Rapid Bus Sdn Bhd, Malaysia

Muhammad Yazurin Sallij Muhammad Yasin is a corporate executive with over 18 years' of experience in the field of transportation services – mainly in urban public transport (Bus/BRT) and expressways. Currently, he is the Chief Executive Officer of Rapid Bus Sdn Bhd, the subsidiary of Prasarana Malaysia Berhad that is responsible for operating city buses in Klang Valley and Selangor, Penang, Kuantan in Pahang; and Kamunting as well as Manjong in Perak. The bus services include the full-fledged electric bus services in Bandar Sunway, Selangor, which is Malaysia's first Bus Rapid Transit project and the first bus services on a fully elevated track.

A graduate from the University of New South Wales, Australia armed with a degree in Bachelor of Commerce, majoring in Accounting & Commerce, Yazurin has ventured into various roles which have witnessed him mastering in fields of Operational Management, Strategic Planning and Business Development.

Mr Stefan Widlund,
Director of City Mobility, Volvo Bus Corporation, Sweden

Stefan is the Director of City Mobility for Volvo Bus Corporation, based at Volvo Buses' Headquarters in Gothenburg, Sweden. In his current role, Stefan is supporting regions and cities in progressing towards sustainable bus traffic. With a key focus on implementing the right technology into the right operation, Stefan is an expert at analysing routes, assisting with project planning and recommending appropriate Volvo product solutions.

Prior to joining Volvo, Stefan spent 23 years working at Ericsson in various roles that gave him the opportunity to gain extensive work experience in Asia and Europe. Stefan has lived and worked in Asia for over 5 years, including Malaysia. Stefan has a Master of Science and Industrial Engineering degree from Chalmers University of Technology in Sweden.

Mr Sridhar Chari,
Manager of Public Affairs and Media Relations Volvo Buses South Asia, India

Sridhar is responsible for Public Affairs and Media Affairs at Volvo Buses Region -South Asia. He has a Master's Degree in Business Management.

Prior to joining Volvo Buses in 2014, he worked as an automotive journalist for almost 15 years. Apart from writing for some of India's leading publications, he also co-founded a trade magazine 'Commercial Vehicle', of which he was Editor for close to 10 years.

His eclectic work journey has led him to engage with prominent people and destinations across the world, where he has enjoyed reporting as well as organising and hosting events. He enjoys facilitating lively and result-oriented discussions, especially around his favourite subject – public transport – through its various manifestations, technology, policy and, ultimately, people.

Ahmad Radhi Maarof,
Deputy Director General (Development) of APAD, Malaysia

Ahmad Radhi Maarof is the Acting Deputy Director-General (Development) of Land Public Transport Agency Malaysia (APAD). His main responsibilities include the development of policies, strategic plans and database in respect to land public transport that include preparation of national and regional master plans, formulation of fare mechanism, public transport database integration and keeping abreast with the latest market intelligence and trends. Previously he was Head of Policy, Planning and Research Division at Malaysia's Land Public Transport Commission (SPAD). He was responsible for overseeing public transport projects under the Commission, that work to create a reputable and reliable service within Greater Kuala Lumpur, where the end goal is to increase the modal share of public transportation to 40 per cent of all commutes by 2030. He was also overseeing several technology projects including Performance Monitoring Hub System and First Last Mile Mobility initiatives with the objective to improve passenger experience when taking public transportation. Radhi received his bachelor's degree in urban planning from RMIT University Australia. Having 19 years of urban planning and transportation experience strengthened by professional exposure on policy development, strategic planning and community engagement, Radhi's area of interest includes transit technology, mobility, bus network planning and master planning.

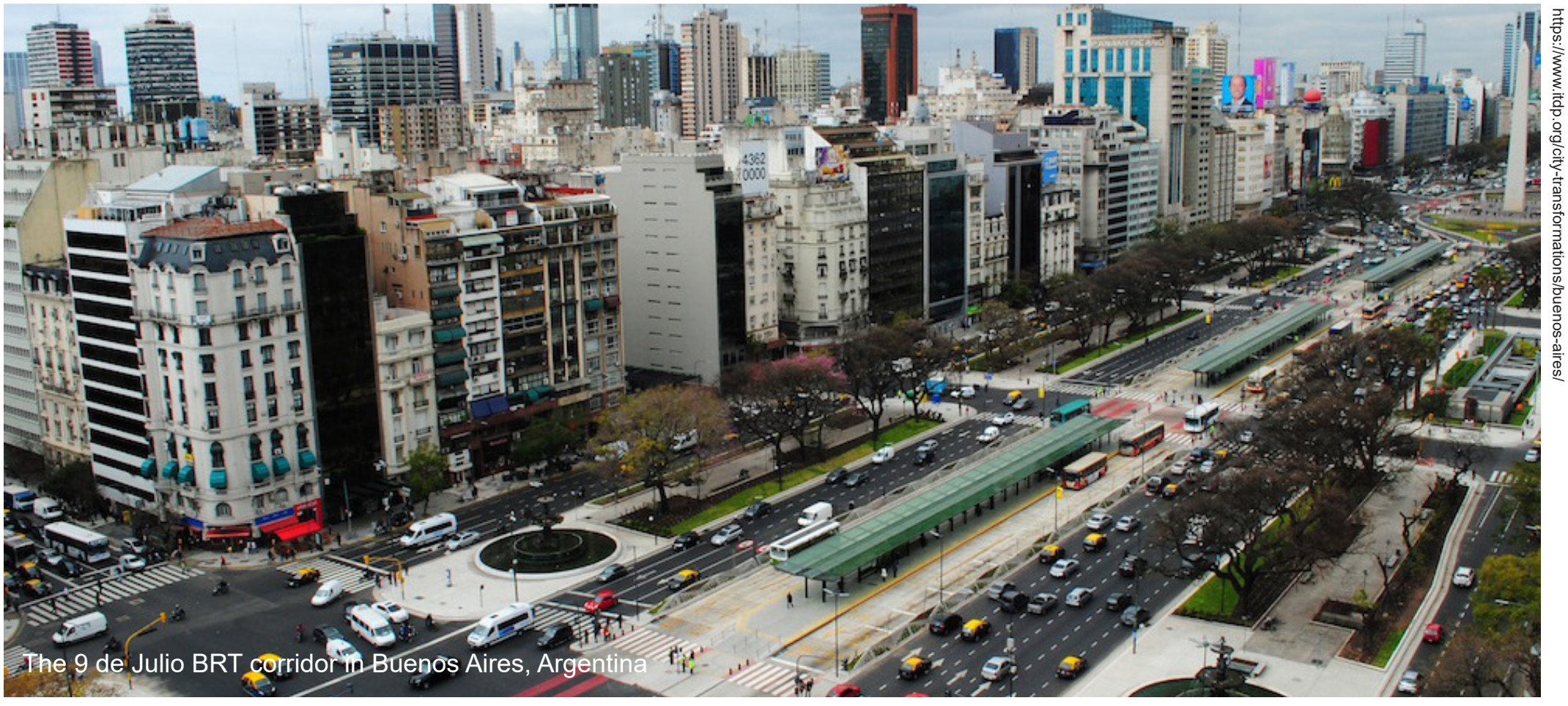
Jan Vandooren,
Former Director Urban Mobility, Volvo Bus Corporation, Belgium

Jan has 37 years of experience in the global bus business environment. He started his career with the Belgian bus builder Jonckheere (now part of VDL Group) as Export Manager and left the company in the function of Global Sales & Marketing Director.

He joined Volvo Bus Corporation in 1997 and spent most of that time overseas in 3 different continents with assignments such as (founding) President of Volvo Bus Morocco and Vice-President for Volvo Bus MEAC (Middle East, Africa and CIS). For the last few years, Jan has been responsible for the development of Urban Transportation Systems. This concerns a new function whereby Volvo Bus wants to focus on the rapid booming Bus Transport development in our regions with the emerging markets in a more pro-active way towards the multiple stakeholders such as multilateral banks, MOT, local authorities & PTA's and consultants. Jan is a Belgian citizen and a graduate of Leuven University (Dipl-Ing and MBA).

Dato’ Zailani Safari,
Former Chief Executive Officer, Technology Depository Agency (TDA)

Dato Zailani Safari is the former Chief Executive Officer of Technology Depository Agency (TDA), the Industrial Collaboration Programme (ICP) monitoring authority in Malaysia, established under the purview of the Ministry of Finance Malaysia. With over 14 years of experience in the area of countertrade and offsets in Malaysia, Dato Zailani was instrumental in the development of the latest ICP policy and framework published by the Government of Malaysia in 2014. The success of implementing ICP in Malaysia under his stewardship has set an example to the global offset and countertrade community and further to this, Malaysia hosted the first Global Offset & Countertrade Association Asia Pacific Conference 2017 (GOCA APAC 2017) was held in March 2017 in Kuala Lumpur. TDA also hosted the Knowledge Sharing Session (KSS) for Government Offset Leaders since 2017 – the 1st KSS (in Kuala Lumpur), the 2nd KSS (in Florida) and 3rd KSS (in Paris). Dato Zailani has chaired and presented at various prestigious, high level government meetings and conferences in the offset/ICP industry



The 9 de Julio BRT corridor in Buenos Aires, Argentina

https://www.itdp.org/city-transformations/buenos-aires/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VILLA SOLDATI
RETIRO
RETIRO
x BRASIL
SUBE
AGRALE
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4284
Claus
RADIOTAXI

“STANDARDS AND CHARACTERISTICS”

Bus Rapid Transit (BRT) is a bus-based public transport system that adapts to the standard rail transit system into bus lines through the use of dedicated lanes, bus-priority intersections, and pre-boarding ticket purchasing at bus stations to improve reliability and efficiency.

The Standard was conceived by the Institute for Transportation and Development Policy (ITDP) in 2012 to ensure that BRT corridors worldwide meet a minimum quality standard and deliver consistent social, economic, and environmental benefits. The BRT standard highlights the basic requirements and identifies several critical design elements that must be present for a corridor to qualify as BRT. For each element, a best practice is identified, along with benchmarks for partial achievement of the feature. Each element is evaluated based on a wide range of metrics where high quality BRT corridors are awarded as bronze, silver, or gold rankings. The five essential elements of a BRT corridor are as follows:

TransJakarta in Jakarta, Indonesia

1. Dedicated Right-of-Way

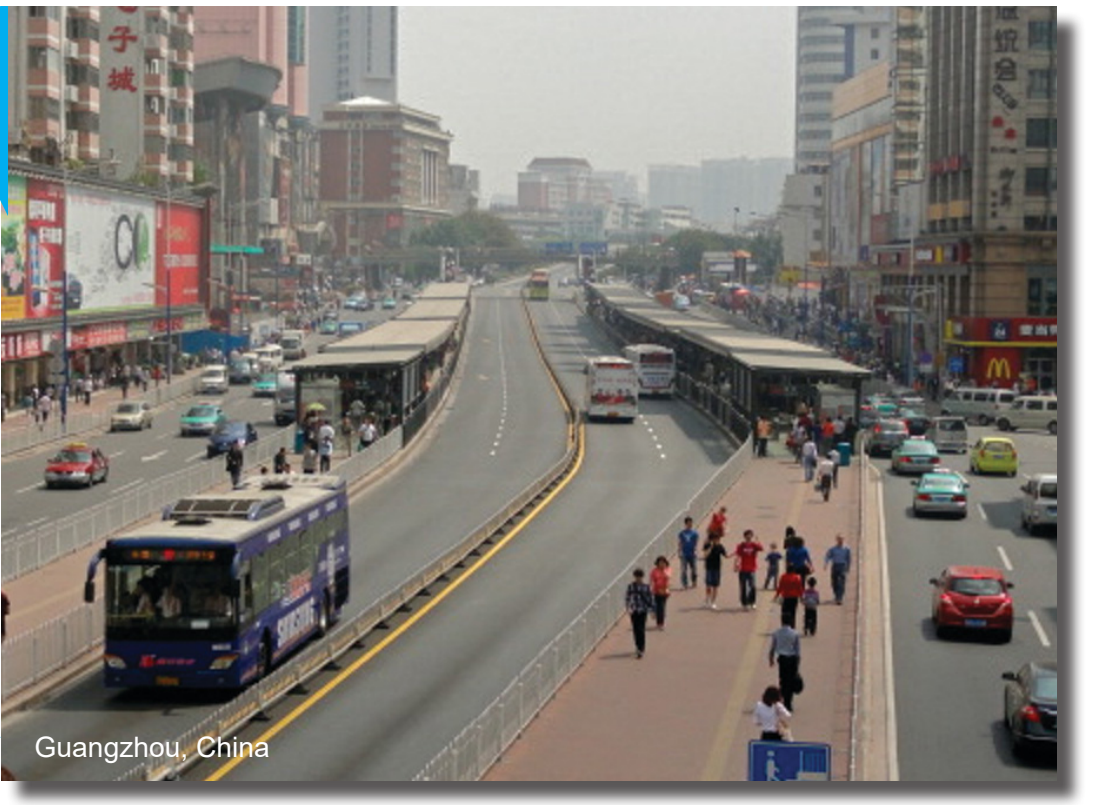
Bus-only lanes make for faster travel and ensure that buses are never delayed due to mixed traffic congestion.

"BRT is a bus-based rapid transit system that can achieve high capacity and speed at relatively low cost by combining segregated bus lanes that are typically median aligned, off-board fare collection, level boarding, bus priority at intersections, and other quality-of-service elements (such as information technology and strong branding)."

-BRT Standard, 2015

2. Busway Alignment

Centre of roadway or bus-only corridor keeps buses away from the busy curb side where cars are parked, temporarily stopped, or turned.



3. Off-board Fare Collection

The off-board fare collection facility enables the passengers to settle fares at the station, and eliminates the delay caused by passengers waiting to pay on board.

https://www.arlnow.com/2016/01/27/premium-bus-service-planned-for-columbia-pike-dedicated-lanes-to-be-studied/

BRT intersections at Michigan and Foster, and at Grand River and Northwind

4. Intersection Treatments

Prohibiting turns for traffic across the bus lane reduces delays. Prohibiting such turns is the most important measure for moving buses through intersections which are more important even than signal priority.

Cedar Avenue, America

5. Platform-level Boarding

The station should allow level boarding by matching the height of the platform with the height of the bus floor for quick and easy boarding. This also makes wheelchair bound travellers, disabled passengers as well as strollers and carts fully accessible with minimal delays.

Brisbane Australia

Marechal Floriano BRT station, Linha Verde (Green Line), Curitiba, Brazil

OVERVIEW OF BRT SYSTEMS AROUND THE WORLD

BRT aims to introduce the speed and capacity of typical metro systems without high capital and minimal infrastructure requirements. First introduced in Curitiba, Brazil in 1974, the BRT transport system is rapidly being adopted by developing cities with complex urban layout around the world. The proper implementation of BRT service provides affordable, reliable, and fast transport service to the local population.

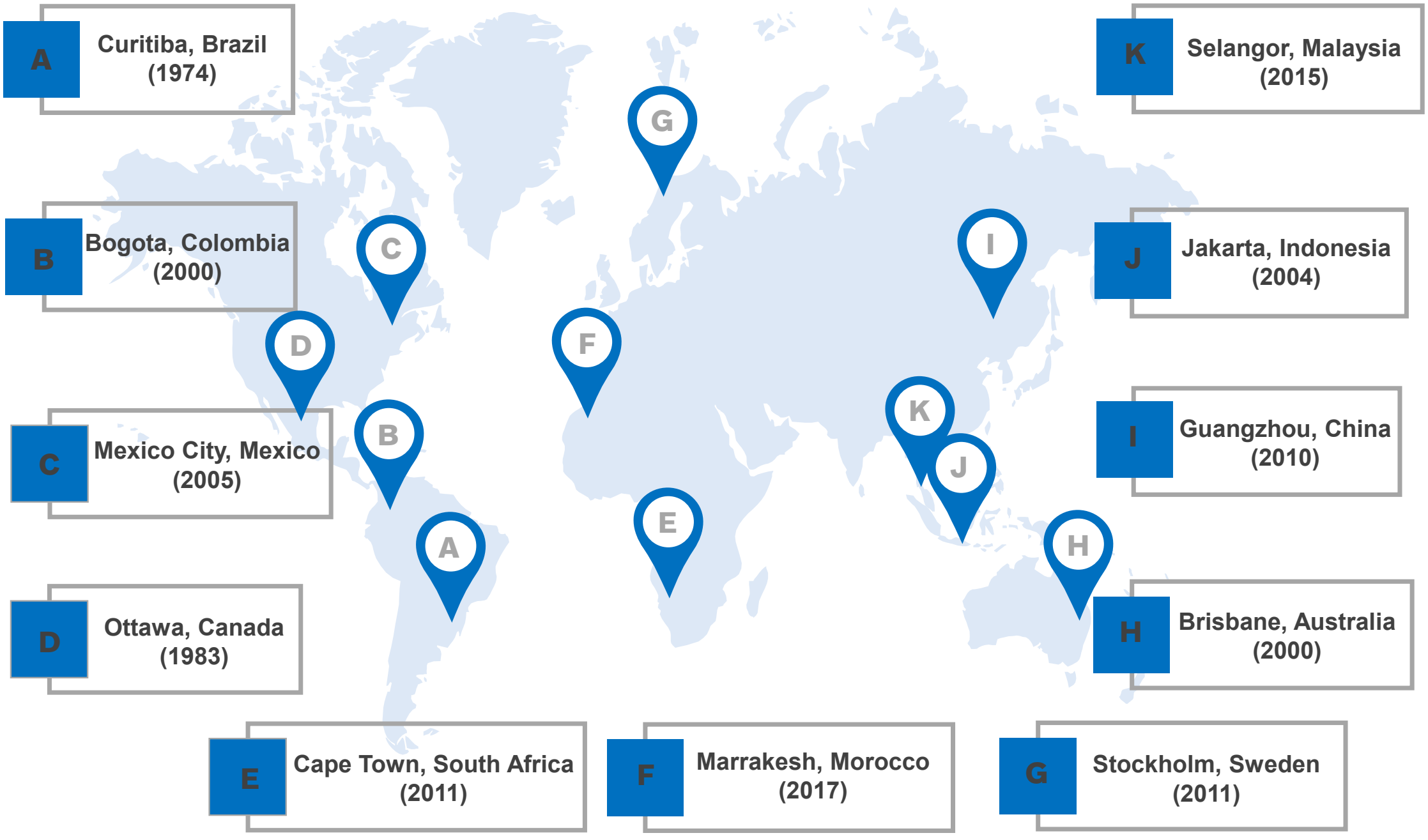
The global BRT data is an avenue for the public to access information about the bus priority systems in 176 cities throughout the world. The platform compiles data from various sources such as researchers, transit agencies, municipalities and non-governmental organisations (NGOs). The global BRT data is important to enhance knowledge about these systems to help decision makers, journalists and organisations dealing with urban mobility. It also eases relevant searches. This information is necessary to address the increased demand in urban mobility and encourage current movement of people using high quality bus systems in cities that provide cheaper solutions for the viable urban transport.

Prior to 1990, BRT was operated in 18 cities. As of today, there are about 176 cities in the world that run BRT services and serve more than 34 million passengers daily with 5,308 km total route length.

Global Bus Rapid Transit (BRT) data [Source: https://brtdata.org]

Regions	Passengers per Day	Number of Countries	Number of Cities	Length (km)
Africa	491,578 (1.44%)	3	5 (2.89%)	131 (2.52%)
Asia	9,561,593 (28.12%)	12	45 (25.56%)	1,647 (31.02%)
Europe	1,613,580 (4.74%)	10	44 (25.00%)	875 (16.48%)
Latin America	20,909,541 (61.49%)	13	56 (31.81%)	1,863 (35.09%)
Northern America	988,683 (2.9%)	2	21 (11.93%)	683 (12.86%)
Oceania	436,200 (1.28%)	3	5 (2.84%)	109 (2.05%)

OVERVIEW OF BRT SYSTEMS IN THE WORLD



Curitiba, Brazil

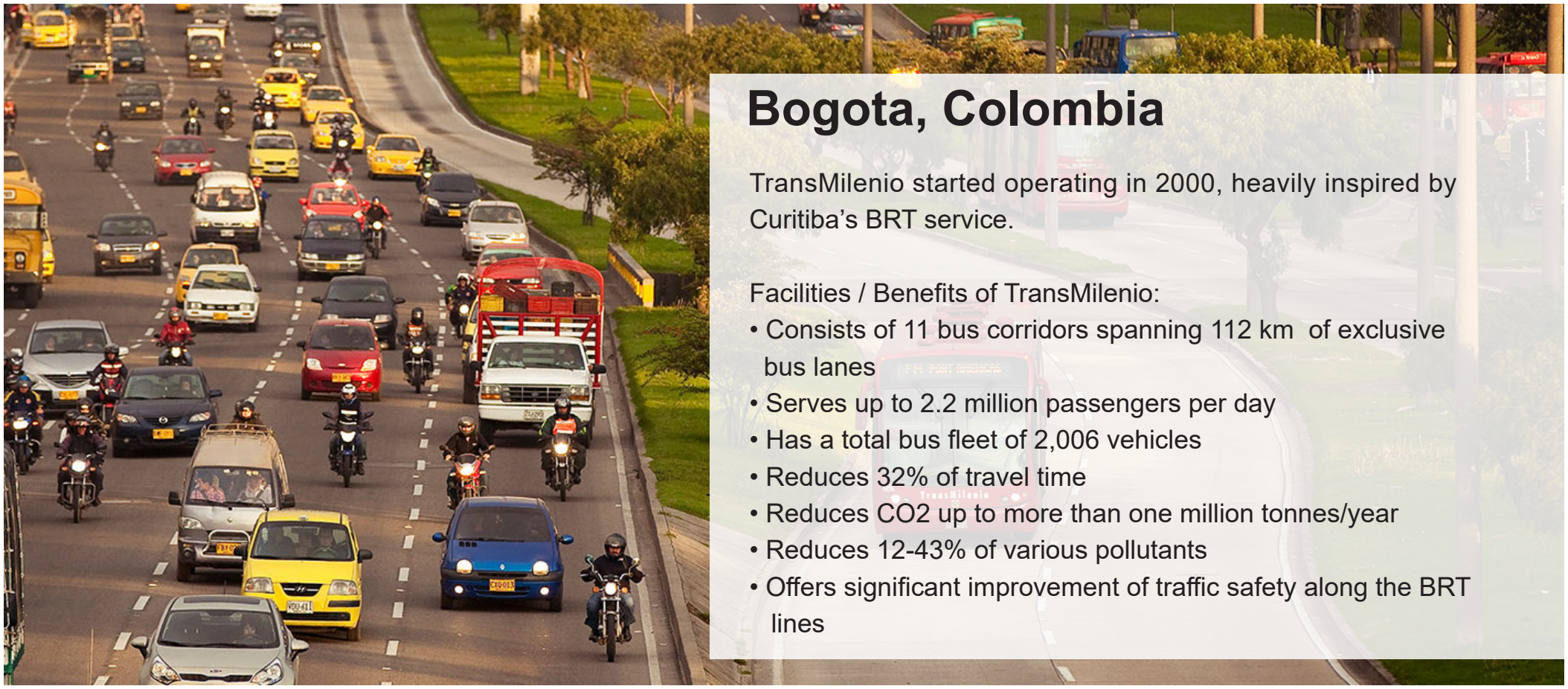
The Rede Integrada de Transporte (RIT), Portuguese for Integrated Transport Network, was implemented in 1974 in Curitiba, Brazil and is widely considered as the first successfully implemented integrated BRT system in the world, thus acting as a model for BRT development for other cities.

Facilities / Benefits of RIT:

- Has a network spanning 81km of exclusive bus lanes
- Serves more than 700,000 passengers per day
- Consists of 186 articulated buses operating in 7 BRT corridors
- Has closed “tube” stations and terminals to allow level boarding

Region: Latin America

BRT systems were initially introduced in Curitiba, Brazil and currently South America has the highest number of cities that are using BRT systems in the world, serving approximately 61% of passengers (about more than 20 million passengers per day).



Bogota, Colombia

TransMilenio started operating in 2000, heavily inspired by Curitiba's BRT service.

Facilities / Benefits of TransMilenio:

- Consists of 11 bus corridors spanning 112 km of exclusive bus lanes
- Serves up to 2.2 million passengers per day
- Has a total bus fleet of 2,006 vehicles
- Reduces 32% of travel time
- Reduces CO2 up to more than one million tonnes/year
- Reduces 12-43% of various pollutants
- Offers significant improvement of traffic safety along the BRT lines

Mexico City, Mexico

Metrobús started its operation in Mexico City since 2005.

Facilities / Benefits of Metrobús:

- Comprises a network spanning 140 km on 7 corridors
- Has a total bus fleet of 647 vehicles
- Serves more than 1.24 million passengers per day
- Reduces 120,000 tonnes of CO2 per year
- Reduces travel time up to 50%
- Reduces accidents up to 30% along BRT lines

Region: Northern America

Ottawa, Canada

Transitway BRT network is operated by OC Transpo, Ottawa, the system of which was introduced in 1983 as a solution to increase the speed of city bound service.

Facilities / Benefits of OC Transpo:

- Comprises a network of 58 km on 5 bus priority corridors
- Serves up to 220,000 passengers per day
- Has a total bus fleet of 936 vehicles

Region: Africa

Cape Town, South Africa

MyCiti operates as part of Integrated Public transportation strategy of the City of Cape Town Municipality since 2011.

Facilities / Benefits of MyCiti:

- Comprises a network of 30 km on 2 bus priority corridors
- Serves up to 66,178 passengers per day
- Has a total bus fleet of 310 vehicles

Marrakesh, Morocco

BRT Marrakesh was introduced in 2017 which also includes partial trolleybus service.

Facilities / Benefits of BRT Marrakesh:
- Comprises a network of 8 km on a singlbus line
- Has a total bus fleet of 15 electric buses

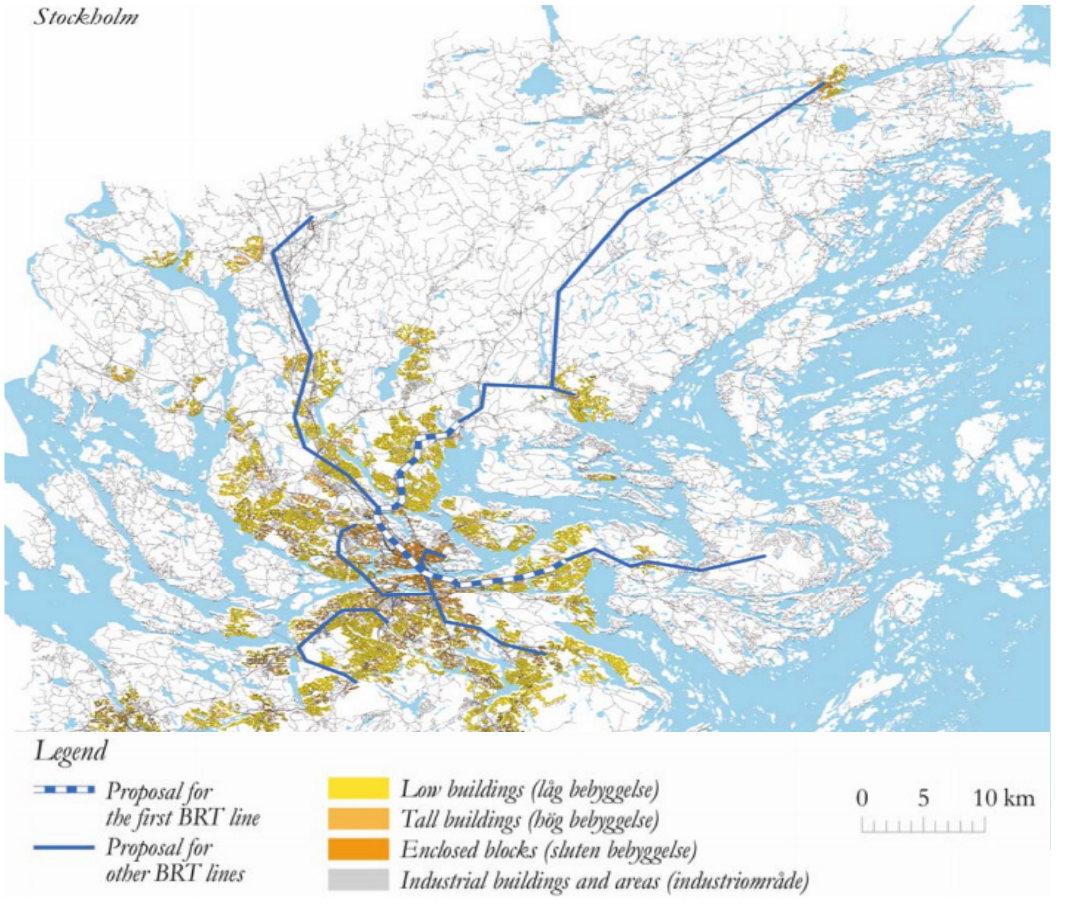
Region: Europe

Stockholm, Sweden

Operating under Stockholm (Bus with High Level of Service) BHLS, the Trunk Network for Buses commenced in1998.

Facilities / Benefits of Stockholm BHLS:

- Comprises a network of 30 km on a single bus priority line
- Serves up to 57,000 passengers per day

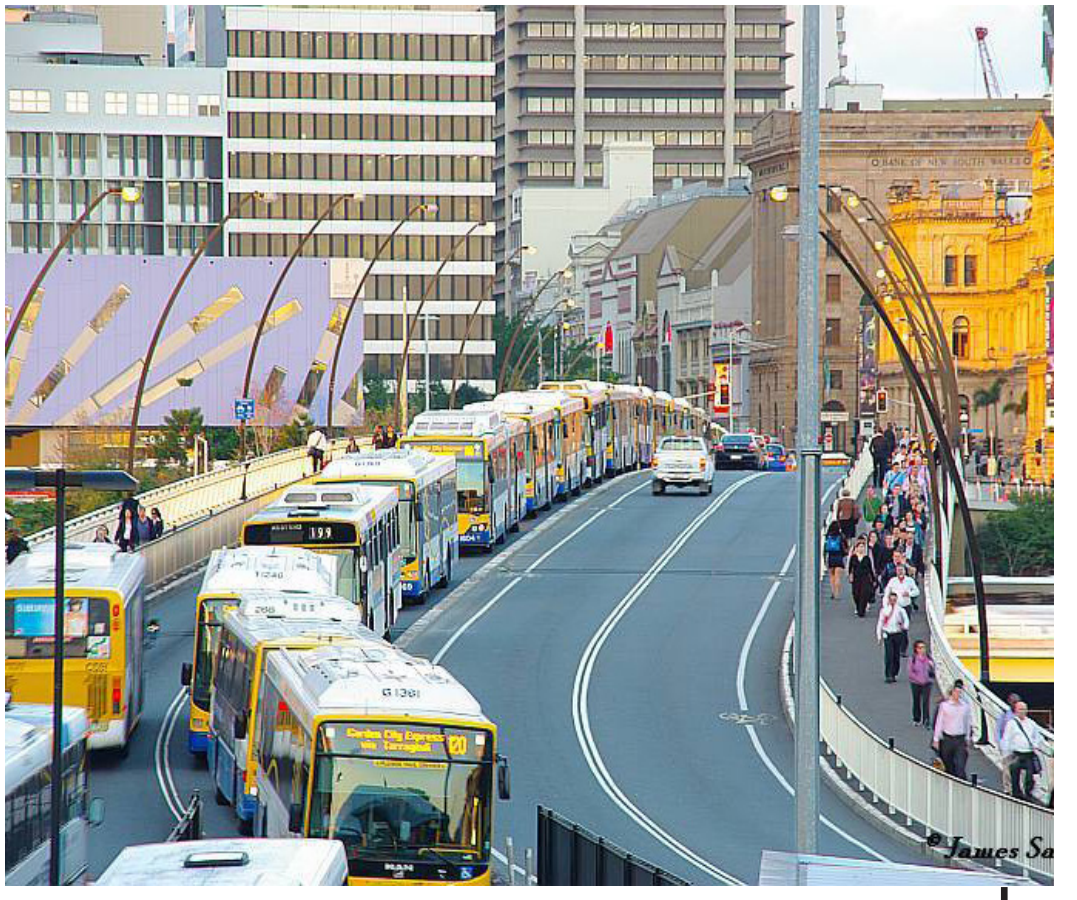


Region: Oceania
Brisbane, Australia

Brisbane Busways has been operating in cooperation with Queensland Rail City Network which was introduced since 2000.

Facilities / Benefits of Brisbane Busways:

- Comprises a network of 28 km operating 3 priority bus lines
- Serves up to 356,800 passengers per day
- Has a total bus fleet of 475 vehicles
- Reduces travel time up to 70%
- Has underground stations contributing to nearly 4 km of tunnels



Region: Asia

Guangzhou, China

Guangzhou Bus Rapid Transit (GBRT) started operating in the city of Guangzhou since 2010.

Facilities / Benefits of GBRT:

- Consists of a network of 22 km on a single bus priority lane
- Serves up to 850,000 passengers per day
- Has a total bus fleet of 989 vehicles
- Contains the world’s longest BRT station around 260 meters including bridges

Jakarta, Indonesia

The first BRT system in Southeast Asia, operating under the name of TransJakarta. It is the first operational BRT, introduced in 2004.

Facilities / Benefits of Trans Jakarta:

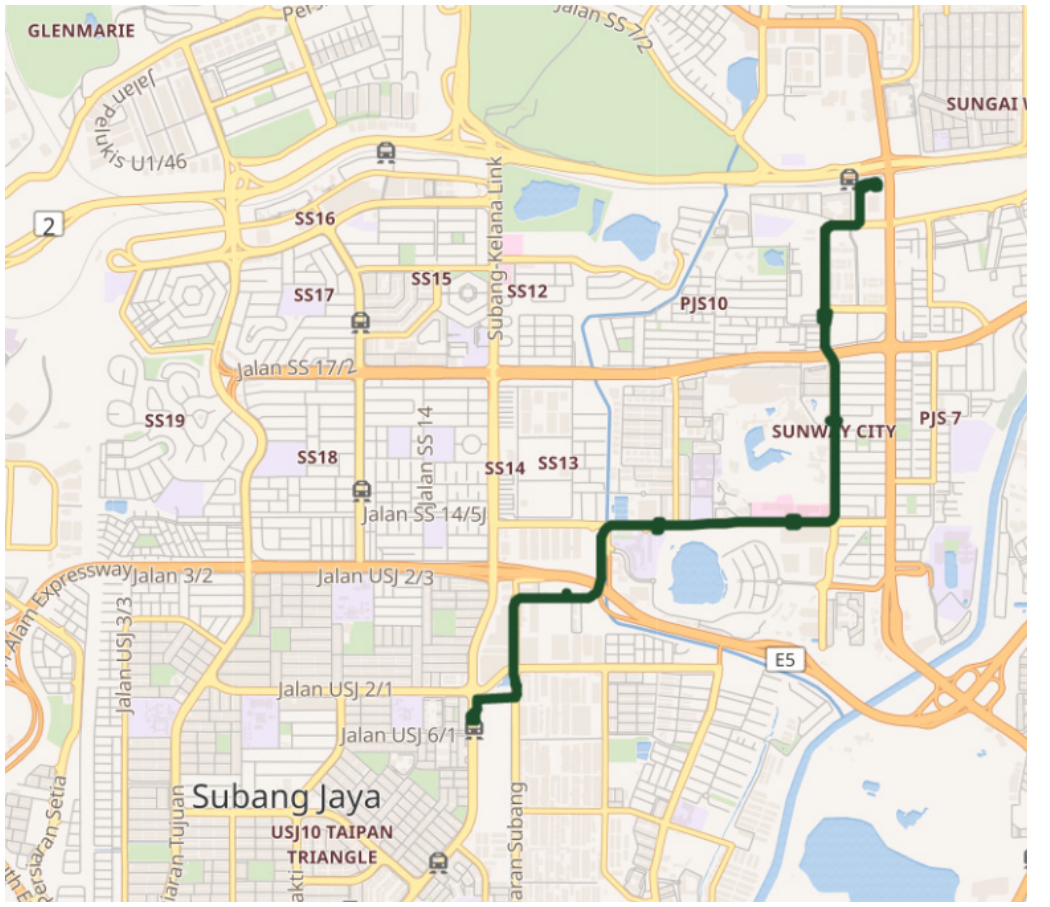
- Consists of a network of 206 km on 12 priority bus lines
- Serves up to 370,000 passengers per day
- Has a total bus fleet of 670 vehicles
- Offers passengers a fixed ridership cost, not bound by distance

Subang Jaya Selangor, Malaysia

Rapid Bus was introduced in 2015 to service the high- density areas of Sunway and Subang Jaya.

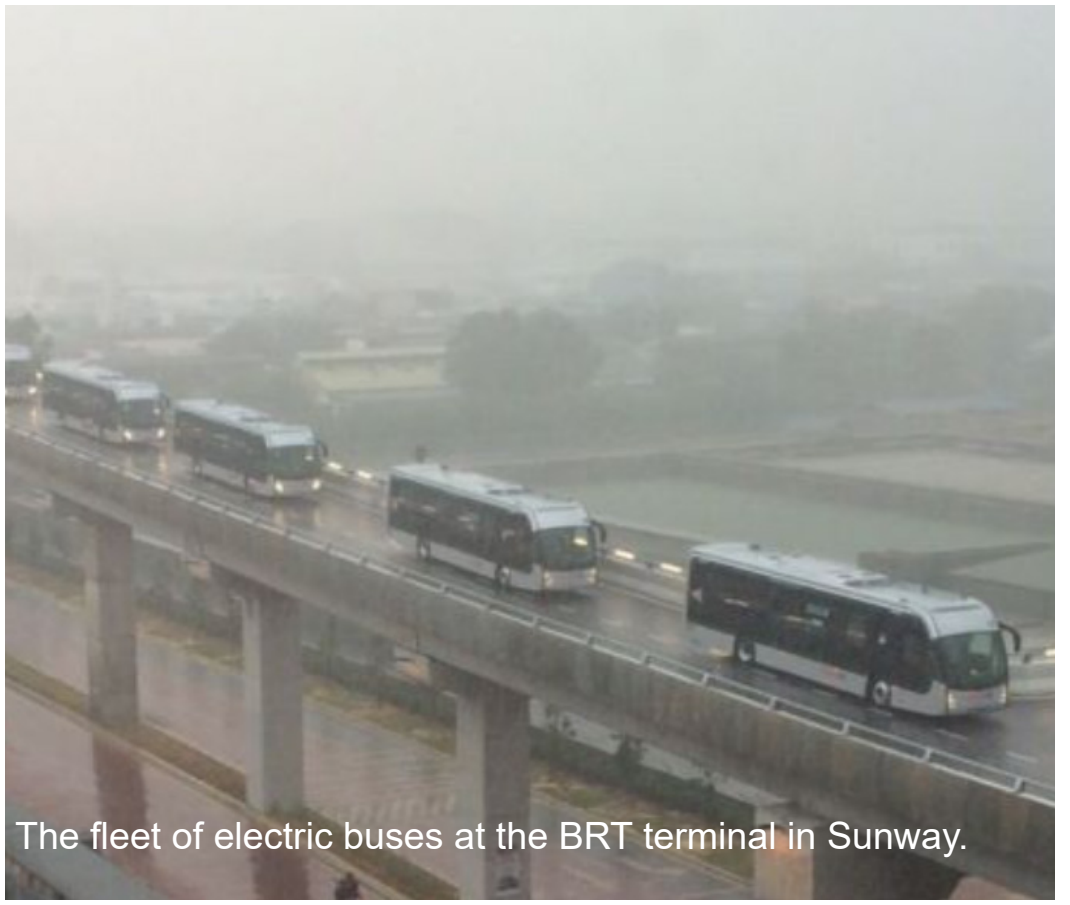
Facilities / Benefits of Rapid Bus operations:

- The BRT buses have exclusive right-of-way on an elevated guideway that is not shared with normal road traffic along its 5.4km route.
- It was awarded the bronze rating (BRT Standard score) from Institute for Transportation and Development Policy (ITDP).
- The system uses eco-friendly electric bus services on elevated tracks and connects major areas within the areas such as hospitals, commercial areas, shopping centres and universities.
- It is the first elevated BRT in Southeast Asia.
- It renders services to 500,000 residents in Subang Jaya.



BRT Park & Ride (SunU – Monash Station)

https://www.sunway.city/kualalumpur/parking-in-sunway-city-kl/



The fleet of electric buses at the BRT terminal in Sunway.

The BRT Sunway Line station


KUALA LUMPUR
Evening Forecast
27°
Cloudy
PowerScreen
AFFINBANK
VBL 8391

KEY ENABLERS FOR THE SUCCESS OF BRT

There are various challenges to implement a successful BRT system in a city and to ensure the system is fully taken advantage of by the local population, as well as financially sustainable. Therefore, several key factors were identified to drive the success of a BRT system.

1. QUALITY CONTROL

Ardilla (2008) stated that competition in the open market poses limitations for providing a competent bus based public transit service and may eventually leads to inflated fares, oversupply of buses, and low-quality service. This further results in poorly maintained buses, inconsistent bus arrival times, and fighting traffic space against pedestrian controlled vehicles. This can cause lower confidence on the reliability of a bus-based public transportation system from local community. By introducing a minimum standard for operations, BRT systems seek a remedy for these issues caused by the lack of quality control and management seen in independent bus operators.

The simple option of purchasing a boarding ticket at the station instead of doing it on the bus can increase the time efficiency of the operation , and lead to timely arrivals and departures. Utilising dedicated lanes also helps avoid risks of being hindered by traffic congestion and ensures buses adhere to their schedule more reliably. All these factors contribute to increase bus ridership satisfaction and improve the perception on bus-based public transportation thus increase public confidence in using BRT.

2. COVERAGE

At the end of the day, what passengers seek in a public transportation is accessibility of the stations and to their respective destinations. No matter how good a system is, people will seek alternative means of transportation in the absence of good transportation coverage, frequency and punctuality of the services. Matsumoto (2006) further elaborated that BRT's connectivity to other transportation modes is a crucial factor for the success of BRT, as BRT by itself cannot be expected to cover all the crucial areas in a city; hence, the effectiveness of BRT also depends on the presence of complementary transport options, such as integrated feeder services. This indicates that the success of a BRT system does not solely consist of the operations of the bus transportation lines but also through the cooperation with other forms of transportation services, forming a transportation network to solve the issues faced in the transportation sectors.

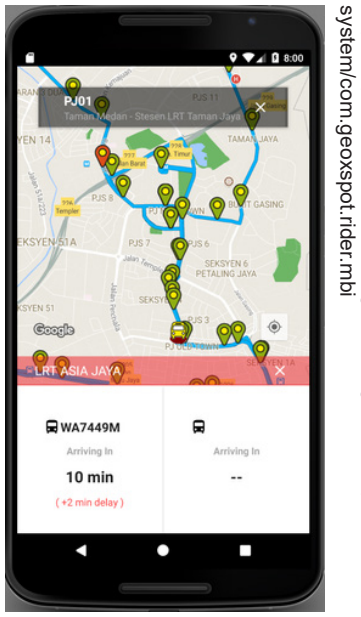
Volvobuses.com

3. IMPLEMENTATION OF INFORMATION TECHNOLOGY

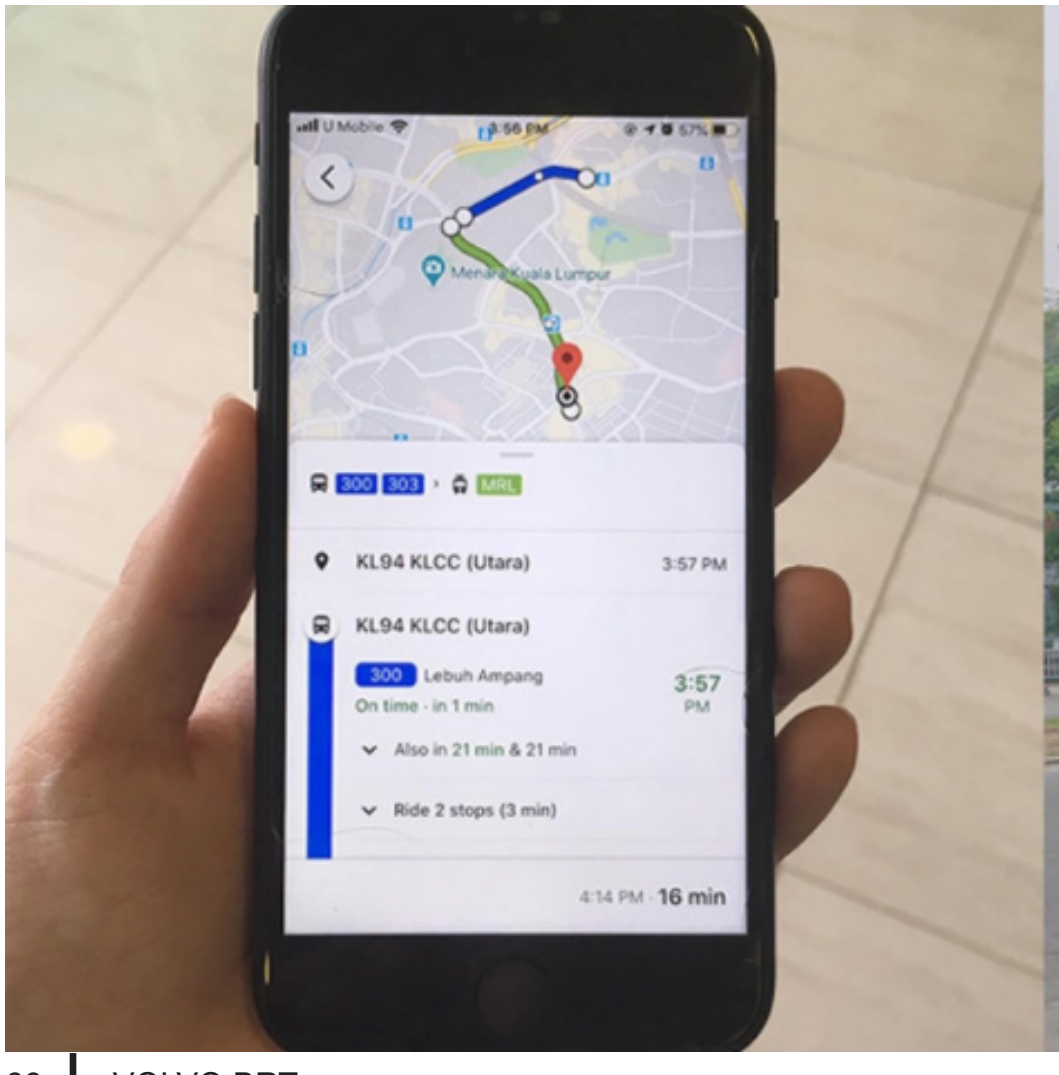
The development in information technology has increased the service efficiency across all industries, including the public transport service via the adoption of an Intelligent Transportation System (ITS). This comprises the use of Automatic Vehicle Location and Control (AVLC); reinforcement of the safety cum security of the whole system, control of traffic signal priorities, vehicle guidance and control, automated passenger counting, and fare collection.

This collection of information allows BRT to adapt its services to the needs of its passengers or respond to emergencies in a more effective and efficient manner. The sharing of information can also be utilised by passengers when accurate bus schedule and immediate access to details of the BRT services from a website or mobile application when readily made available.

SITS - Selangor Intelligent Transport System Apps displayed the information about the ETA and tracking.



https://apkfab.com/sits-selangor-intelligent-transport-system/com.geoxspot.rider.mbi



https://says.com/

4. PUBLIC PERCEPTION

Kepaptsoglou (2020) found that higher income people opt for Light Rapid Transit (LRT), while commuters and lower income people are more oriented towards using bus-based transport service. A potential explanation would lie on the impression of the two modes; while LRT is considered as a modern, advanced mode of travel by upper classes, lower income commuters are drawn to public bus transport services which operate at a lower cost. Coupled with the low reliability and availability of standard bus services, the BRT system will need to prove to the public that it operates differently and is capable of providing a transport service rivalling that of LRT at a more affordable cost. Hence, improvements with regard to reliability and comfort of bus services such as increasing service frequency, ensuring on-time performance, and enhancing travel comfort, can effectively increase bus ridership and bolster the bus market (Hu et al., 2015).

https://thecityfix.com/wp-content/uploads/2011/09/CityFix-Essay-09.jpg

The TransMilenio Bus Rapid Transit (BRT) system in Bogota, Columbia, provides the city with an efficient and safe mass transit system that encourages high ridership.


NO SMOKING
NO SWORDS

THE BENEFITS OF BUS RAPID TRANSIT (BRT) SYSTEMS

Bus Rapid Transit (BRT) systems are not simply bus lane, but complete corridors, with pre-payment, comfortable stations, pavements, landscaping and cleaner, high capacity buses running on time. Everything has been thought of to promote the well-being of passengers and drivers, along with ease of operation for managers and the orderly development of cities.

1. BENEFITS TO PASSENGERS AND SOCIETY

A. Reduced Travel Time for Customers

Passengers' main need is shorter commuting time. In most conventional bus systems, fares are charged on board the bus which means that boarding time will take longer. It is common to see stationary buses at stops with a line of passengers queueing to pay the fare and get on. This greatly increases idling time and overall travelling time, impacting the productivity of the entire system.

BRT also helps reduce the duration of journey through the use of exclusive, segregated lanes, level boarding between platforms and vehicles, advance payment, wide doors and high-capacity vehicles. All of these features minimise stopping time, thus maximising the speed of the system.

Signal priority at intersections, along the level crossings, are essential to ensure that the system achieves good commercial speeds. A longer distance between stops also promotes rapid travels. The commercial speed of a well-designed BRT should be greater than 25 km/h allowing stops for overtaking and making express services possible such that this commercial speed can reach up to 30 or 40 km/h. If the bus is able to travel at a permissible speed, then it can maintain its attractiveness in urban traffic. Thus, it will be recognised as a reliable means of transport which is fast, comfortable and safe.

THE 'LIGEIRÃO' BRT LINE
The deployment of the 'Ligeirâo' in Curitiba with its bi-articulated buses became possible once an overtaking lane had been created, allowing vehicles to run at different levels through intermediate stations. This express line reduced the number of stops from 16 to just 3, gaining commercial speed and having commuting times.

B. Improving Health and Wealth of the Population

The decrease in road vehicle traffic leads to the reduction of noise and air pollution besides reducing the number of accidents. This improved traffic conditions provide an immediate socioeconomic benefit for the city and its inhabitants. As a city grows and its population density increases, it will inevitably lead to a high traffic volume so providing an affordable and swift public transportation service can reduce traffic congestion without negatively impacting the productivity of the population.

Proper implementation of a BRT system will lead to further development of a city. With more people on the move, local businesses will prosper, and new enterprises will appear along the corridor. This will result in rising property values, more job opportunities and stronger local economy. Looking at the many cities where BRT has been implemented, there are also other long-term effects of the resolved traffic situation. Cleaner air means improved public health, and more direct effect is the reduction in the number of traffic accidents. Both circumstances reduce cost for health care and treatment. Well-designed BRT systems can operate without public subsidies. The fares collected in cities such as Bogotá, Guayaquil, Quito and Porto Alegre are able to cover all the operating costs. Avoiding public subsidies allows these government funds to be directed into education, health, sanitation and other needs of the population.

The use of public transport contributes to reducing traffic congestion, which is one of the major issues faced by developing and densely populated cities around the world. Around 40,000 people die every year in Brazil as a result of traffic accidents. In addition, motorised transport is responsible for 80% of air pollution in the major cities.

According to data from National Association of Public Transport (ANTP) Mobility Information System, pollution and traffic accidents in cities with over 60,000 inhabitants cost Brazil 10 billion USD per year. Public transport accounts for 20 per cent of this amount, while passenger vehicles are responsible for 80 per cent.

The Ligeirão bus, serving a high-demand corridor in the city Curitiba, was a new milestone in the history of public transport for the benefit of passengers. Ligeirão buses run on 100 per cent biofuel

C. Affordable Fare and Travel Comfort

The cost of BRT systems per passenger transported is competitive. One of the challenges of public transport is to provide society with affordable rates besides being financially sustainable to operate - which makes BRT a very favourable option. The value of passenger fares should cover operating costs without any government subsidies. Passengers are sensitive to fare prices and small differences in value. It is thus very favourable to opt for transport solutions with low operating costs.

BRT stations offer additional comfort unlike the traditional bus stops. BRT stations provide secured, enclosed stations that protect customers from the elements. Standardised stations design provides a level boarding experience, the design has taken into consideration on the accessibility for people with disabilities.

Attractive rate for:

- Apply for student
- Apply for OKU
- Apply for Senior Citizen

D. Convenience and Accessibility to Passenger Information

BRT normally provide information to passengers at various stages of their journey. In order to plan their trips, passengers should be able to access route and timetable information on the internet, via official website or mobile application. There should also be information displays at terminals providing customers with bus timetables and a network map. Information should also be visible to the passengers during their journey using a display panel inside the bus, so that they are always aware of their current location and are informed of upcoming stops by providing the estimated time of arrival. With the convenience and readily accessible information provided by BRT, it increases the confidence of commuters to rely on this transport mode which also provides good riding comfortability.

In Goiânia, since 2009, passengers have been able to obtain real-time city bus arrival forecasts via their mobile phones, the internet and displays located in terminals through the Traffic Management Solution from Volvo Bus Telematics.

Bus Rapid Transit (BRT) is transforming the way cities across the globe think about mobility. However, a successful BRT system needs well-designed stations in order to attract users and meet their needs.

2. BENEFITS TO THE CITIES

A. Fast implementation and Low Capital Requirements

BRT is an excellent high-quality transport for cities, with the advantage of requiring much lower development costs compared to other systems of the same capacity. This reduces the need for large investments that drain government funds, sacrificing other social priorities such as education, health, housing and security – among others. In addition, BRT improves the surrounding spaces and the city itself, with a direct impact on the satisfaction of society in relation to mobility needs.

In large and established cities, public transport systems need to be redesigned in as little of a time frame as possible unless the city is willing to risk long term economic disruption.

A BRT project can be planned and implemented within a single term . As a contrast, implementation of train systems has a longer process and the risk of over run on budget and time is higher. Although construction deadlines vary widely according to local circumstances, BRT deployment times are always shorter. BRT systems require 12-18 months of planning. The construction of the bus corridors may be accomplished from 12 to 24 months.

Thus, a BRT system can be completed within a period of 2 to 3.5 years. As an example, 70 per cent of the 42 km Bogotá's TransMilenio system had been planned and constructed during mayor Enrique Peñalosa's three-year term. While the learning curve for the BRT system continues to develop, the planning time frame is decreasing. The planning of the 16 km of the first phase of Beijing's BRT system only took five months.

TransMilenio System, Bogotá.

B. Expansion Capacity

Expansion capacity describes the ability of a system to adapt to the dynamic development of a city. More sophisticated systems require greater resources for expansion that are far above the investment capacity of most cities. Higher investments and costs require more passengers to sustain. In order to attract more passengers, a good system requires a network of routes that meet people's mobility needs.

BRT systems are much flexible to expand, both in terms of construction of new lines and adjusting characteristics of the system to the needs of passengers. With its smaller vehicle sizes, BRT adapts quickly to meet increased passenger demand, thus allows the public transport system to grow and evolve, keeping pace with the urban and demographic changes that occur naturally in cities.

BRT BENEFITS FOR CITIES

1. Revitalises public spaces and bring out the value of property.

2. Operational control Centre that monitors fleet via GPS.

3. Level boarding allows for accessibility, especially for people with disabilities.

4. Prepayment reduces boarding time and total commuting time.

5. High capacity vehicles accommodate an average of passengers 160 – 270 passengers.

6. Secure payment at boarding stations.

7. Intersection controlled by intelligent traffic lights improved speed.

8. One articulated bus can replace 100 cars.

9. Exclusive lanes reduce commuting time.

10. Accurate real-time information for users.

11. Modern vehicles with panoramic windows, interior lighting and comfortable seating.

12. Secure, enclosed stations protected from the elements.

Estação da Luz in São Paulo, São, Brasil. City that operates metropolitan trains

C. System Flexibility

Modern modelling and planning practices facilitate the adjustment of public transport projects to meet the evolving city's need. However user preferences can be difficult to determine with absolute certainty. The city's demographic will transform as social and economic conditions change. Therefore, it is always preferable to have a public transport system that can be adapted to suit the progress of the city.

The flexibility of BRT system can accommodate these changes with a modest level of investment in terms of time and money. Alterations to Bogotá's TransMilenio system were handled smoothly in the first week of the system's operation. In contrast, changes to rail system services and itineraries are less flexible. Once the engineering work carried out to lay the tracks and tunnels, the flexibility to make changes is quite limited. As such, rail systems require more in-depth and long-term planning. Once the planning is confirmed, , there is little room for alterations without incurring massive cost.

Bus stops in Curitiba , Paraná, Brazil . Marcopolo Torino Biarticulate bus with Volvo B10M Biarticulate.

D. Environmental Sustainability

BRT contributes to developing a healthy environment and improving the quality of urban life. Buses are operating with a higher average speed, reduces pollutants and CO_2 emissions, and supports the environmental sustainability in long-run.

According to a survey by the International Energy Agency, the growing number of cars on the streets in the 1991-2011 period increased the level of greenhouse gas emissions by 50%. BRT is one of the eight mobility principles defined by the Institute for Transportation and Development Policy (ITDP) to create more sustainable cities, generate fewer emissions and increase quality of life.

While every country is making commitment towards combating global warming, modern transportation systems are increasingly important to encourage the adoption of public transport; by reducing the use of cars, especially in the cities. They need to present low environmental impact solutions, eventually reaching zero emission in long-run.

Buses consume less fuel thus emitting fewer pollutants per passenger transported compared to private vehicles. BRT further capitalises on this advantage since the vehicles have a higher passenger capacity and faster commercial speeds. BRT systems are more energy efficient than rail systems, since underground train carriages and LRT are heavier than articulated and bi-articulated buses. In addition, the introduction of new technologies, such as hybrids and electric buses, further improves the system's energy efficiency capabilities. Such an example is the BRT Metrobús, in Mexico City, which opened its fourth bus line in 2012, reducing CO_2 emissions by an estimated 110,000 tonnes per year.

The C-40 Cities Climate Leadership Group, a collaborative network with 97 affiliated cities globally committed to addressing climate issues through the sharing of knowledge, has concluded that BRT systems represents the best cost benefit solution when comparing to the benefits of various transportation project investments in technical, political, financial, and operational terms.

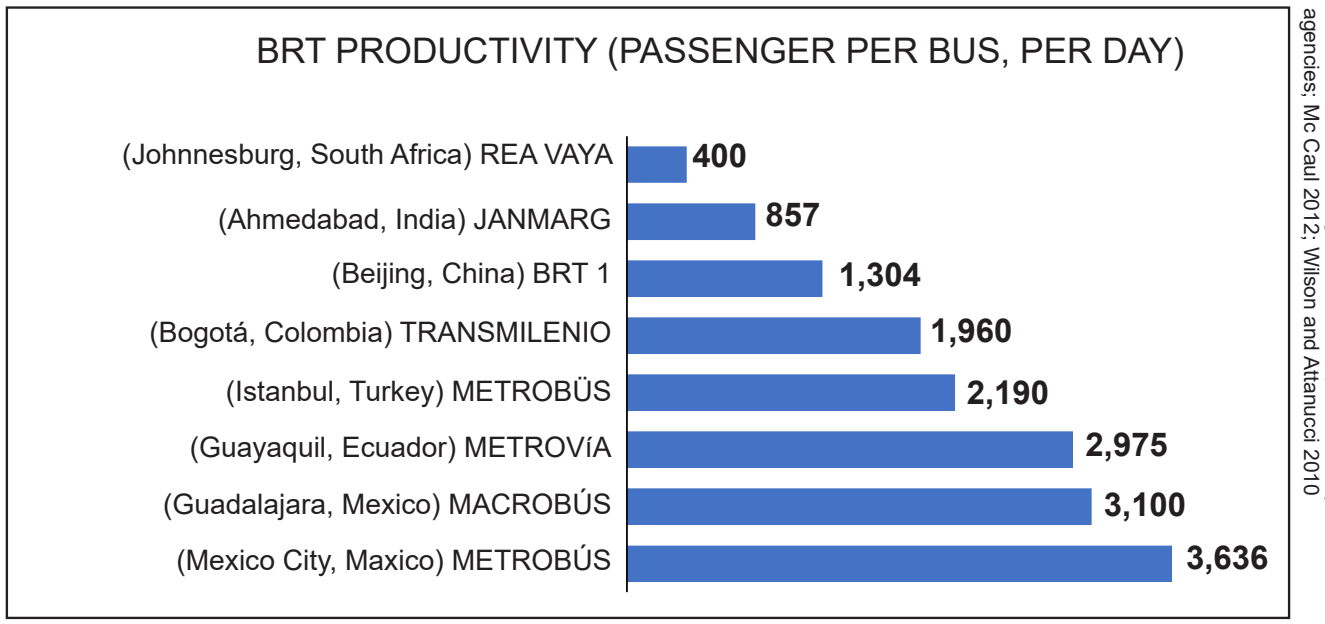
"About seven thousand people die every year in the metropolitan region of São Paulo because of pollution. The numbers are alarming. Pollution can lower life expectancy by up to 2.5 years. In 2030, more people worldwide will die due to pollution than from malaria"

- Dr Paulo Saldiva, Coordinator of the Air Pollution Laboratory, University of São Paulo

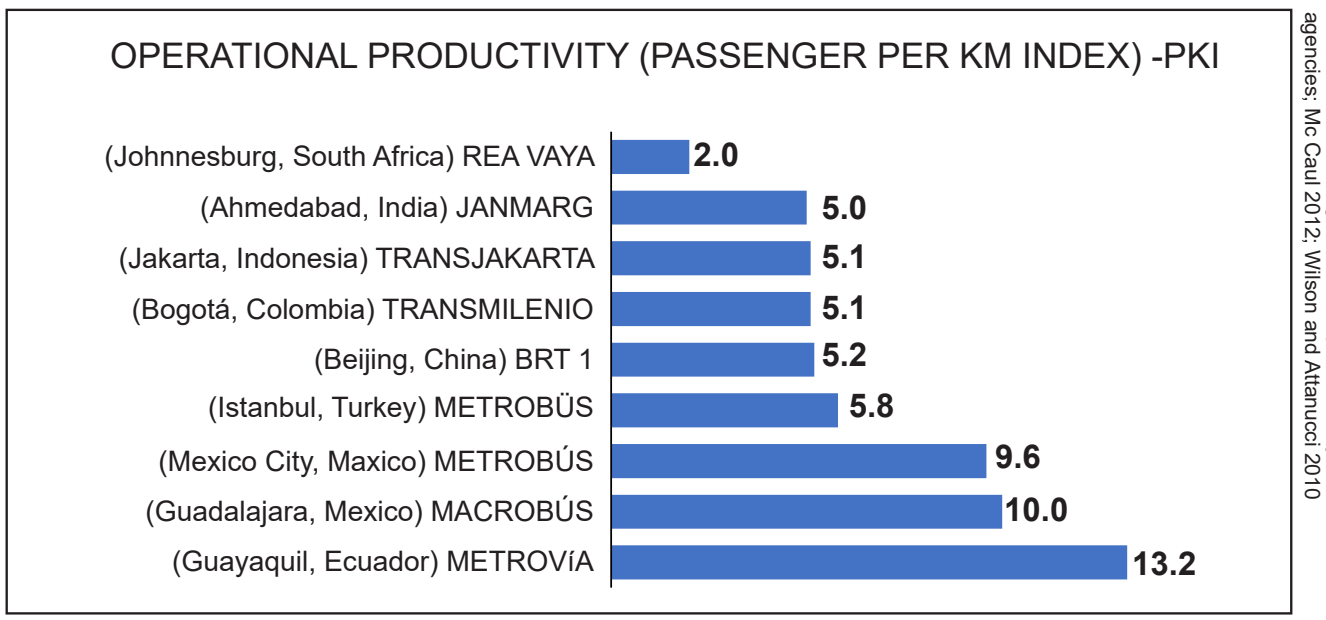
3. BENEFITS TO OPERATORS

A. Greater Productivity and Profitability

BRT's infrastructure and good operating conditions ensure that the operators have more control over the use of resources; therefore, guarantee greater security when it comes to estimating costs and revenues. This reduces the risks and uncertainties of an operation sharing the space with other vehicles in traffic. In addition, the regular circulation of buses ensures more accurate forecasts of fleet maintenance costs.



Source: BRTdata.org 2013; data published by transit agencies; Mc Caul 2012; Wilson and Attanucci 2010



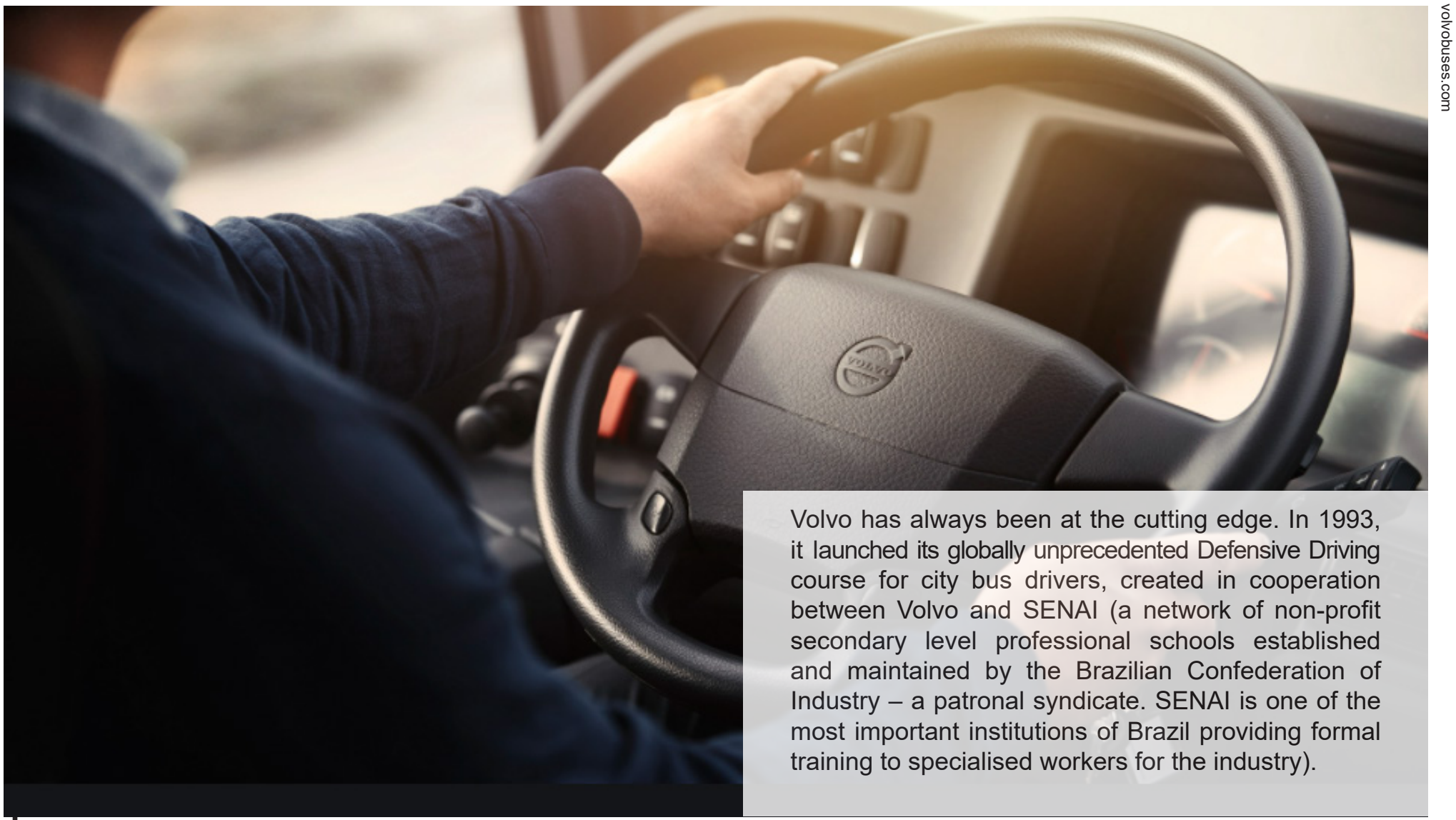
Source: BRT data.org 2013; data published by transit agencies; Mc Caul 2012; Wilson and Attanucci 2010

B. Quality at Work

The health of public transport drivers in urban areas is mainly impacted by the ergonomic conditions in the vehicle they drive, along with other physical, psychological and social concerns. BRT drivers operate modern vehicles that incorporate features which are designed to take care of drivers' health, for instance retractable steering wheels, automatic transmission and air suspension to stabilise the buses on the platforms.

The BRT bus engine is located at the back of the vehicle, which also eliminates the discomfort of working is in a noisy environment. This contributes to drivers' health and job satisfaction as well as the proper use of vehicles which reduces maintenance costs.

Ticket sale personnels do not work on BRT vehicle, but at the stations furnished with air-conditioning facility, thus giving comfort and safety to ensure the well- being of the BRT staff members at work.



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Volvo has always been at the cutting edge. In 1993, it launched its globally unprecedented Defensive Driving course for city bus drivers, created in cooperation between Volvo and SENAI (a network of non-profit secondary level professional schools established and maintained by the Brazilian Confederation of Industry – a patronal syndicate. SENAI is one of the most important institutions of Brazil providing formal training to specialised workers for the industry).

DIFFERENT PUBLIC TRANSPORT TECHNOLOGIES

BUS RAPID TRANSIT (BRT)

Roadway technology with high-capacity (usually articulated) buses operating above ground in segregated lanes, with priority at intersections. Low deployment cost (1 to 15 million USD). Flexible transportation capacity (10 to 50 thousand passengers per hour in each direction).

LIGHT RAIL VEHICLE (LRV)

Light rail technology using trains made up to 2 to 3 carriage. Operates on above ground tracks and requires electricity throughout the length of the line. Medium deployment cost (20 to 50 million USD). Low transportation capacity (10 to 15 thousand passengers per hour in each direction).

MONORAIL

Light rail technology operating on totally segregated overhead structures. Aerial stations for boarding and disembarking. High deployment cost (30 to 80 million USD). Average transportation capacity (10 to 30 thousand passengers per hour in each direction).

UNDERGROUND

Heavy rail technology using trains with a large number of carriages and operating on completely segregated lines running in tunnels and underground stations. Very high deployment cost (100 to 500 million USD). High transportation capacity (30 to 80 thousand passengers per hour in each direction).

METROPOLITAN TRAIN

Heavy rail technology operating above ground rails with physical separation. Generally, operates to transport passengers from the metropolitan area to the capital. High deployment cost. High transportation capacity (50 to 80 thousand passengers per hour in each direction).

BRT vs LRT

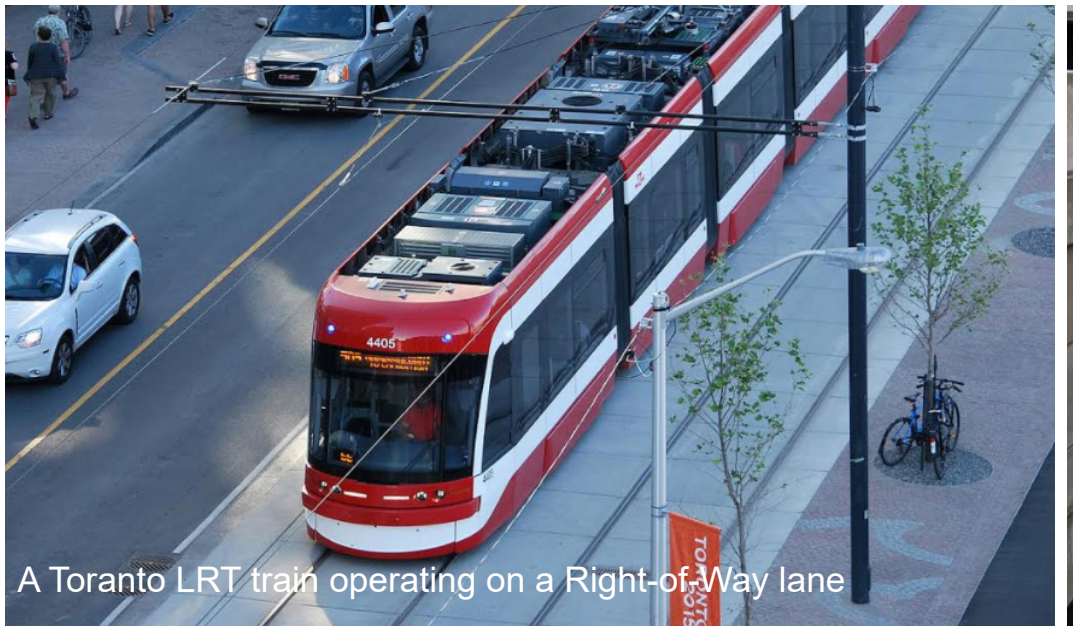
Light Rapid transit (LRT) systems are becoming increasingly attractive in the developing world as they improve transportation and mobility conditions in urban areas, reduce motorisation impacts and offer high quality, yet cost effective services to travellers.

The greatest advantage BRT has over other transport system is its cost effectiveness. Roadway technology with high-capacity (usually articulated) buses operating above ground in segregated lanes, with priority at intersections and operating at a higher speed than ordinary buses provides a relatively low-cost transportation. Rough estimation of deployment cost (1 to 15 million USD) along a flexible transportation capacity (10 to 50 thousand passengers per hour in each direction) makes BRT a viable public transport solution even for cities that do not have a large capital allocated for developing or improving a BRT system.

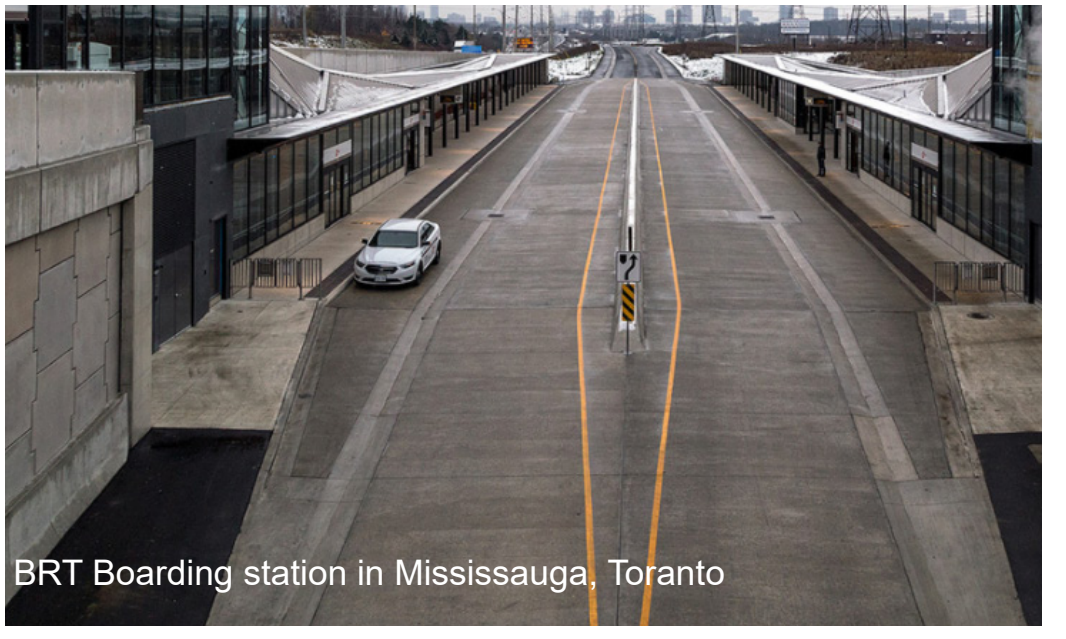
Comparison of the public transport systems parameters [Trubia et.al (2020)]

Type of Transit Mode	Capital Costs (Million US$/km)	Capacity (pphpd*)	Operating Speed (km/h)
Standard bus	-	3,180 -6,373	10-30
BRT	Up to 15	Up to 55,710	18-40+
LRT	13-40	Up to 30,760	18-40
Heavy Rail System	40-350	52,500-89,950	20-60

*Note: pphpd – Passenger per hour per direction



A Toranto LRT train operating on a Right-of-Way lane


BRT Boarding station in Mississauga, Toranto

LRT adopts light rail technology that uses rail tracks and electric powered trains consisting of 2 to 4 passenger carriage to transport passengers. LRT is capable of transporting a significant number of passengers with its space efficient carriage that is controlled remotely by a central system operator. The rail tracks is fully electric-powered whereby a power failure can potentially lead to the disruption for the whole line.

The use of powered rails requires the rail track to be fully segregated where dedicated infrastructure is constructed. All these operating conditions for an LRT system result in a highly efficient transportation option in an urban environment with its fast travel speed, high passenger capacity and high reliability but huge capital and time investment (30 to 80 million USD).

The flexibility of BRT enables the utilisation of existing buses and roads with minimal infrastructure investment and makes it a more affordable option. Investment can then be used on planning effective routes and improving existing roads which will benefit the whole traffic system. While BRT utilises dedicated lanes for its buses, it is not designed exclusively for bus use; BRT lines that operate alongside normal traffic can be used by emergency services, allowing better emergency response in the city. While there is no large investment commitment in laying down routes for BRT lines since it can be changed relatively easily, proper planning of routes is still very important since allocating a dedicated lane for BRT means less available road space will be used by other vehicles.

A Greater Cleveland Regional Transit Authority bus makes a stop on its bus rapid transit line, one of the highest rated in the Chicago, USA (Courtesy of Greater Cleveland Regional Transit Authority).

https://www.tampabay.com/

An LRT train leaving a boarding station in Toronto

https://skyrisecities.

BRT IS THE INTELLIGENT SOLUTION

TYPE OF SOLUTION	BUILD MORE WITH THE SAME INVESTMENT Mobility requires a transport network, one line is not enough!	FASTER DEPLOYMENT TIME Cities have to find mobility solutions that can be quickly implemented.	LOWER COST PER PASSENGER TRANSPORTED BRT helps make fares reasonable and does not require heavy subsidies.
BRT 	200 KM (1 BILLION USD)	2 YEARS	
LRT 	50 KM (1 BILLION USD)	5 YEARS	4X MORE
UNDERGROUND 	10 KM (1 BILLION USD)	10 YEARS	20 X MORE

COMPARING URBAN TRANSPORT MODES

10 KM JOURNEY

MODE		TIME TAKEN TO COMPLETE THE JOURNEY	AVERAGE SPEED	
BRT		20’	30km/h	
BUS		60’	10km/h	
CAR		40’	15km/h	

Intelligent Urban Mobility, Volvo 2020

ROAD SPACE REQUIRED TO TRANSPORT ONE THOUSAND PERSONS

BRT frees up urban road space

250

CARS (3.750m²)

12

REGULAR BUSES (3.750m²)

6

ARTICULATED BUSES (350m²)

4

BI-ARTICULATED BUS (310m²)

Intelligent Urban Mobility, Volvo 2020

ADVANCEMENT IN GREEN TECHNOLOGY

Development of green technology aims to improve the energy efficiency of vehicles and introduce the use of alternative fuel other than diesels for road transport that aims to reduce pollutants and improve the health of the urban population.

ELECTRIC BUS TECHNOLOGY

Electric buses are efficient, quiet and environment friendly since they have a great prospective for short distance routes especially in the densely populated cities. Nevertheless, high investment costs as well as the driving distance (battery technology limitation) is the short-term constraint in promoting electromobility. The longer driving distance will require more battery packs, and this has to be compromised by the payload (passenger capacity). The battery of an electric city bus has a capacity which may vary from 60 to 548 kWh [Gao et al. (2017)] depending on travel distance, charging infrastructure, battery capacity and passenger load of the bus .

City driving involves short drive, frequent acceleration and braking. The energy saving of an electric bus is superior compared to that of a diesel bus since the battery can recharge during braking, thus reduce the energy consumption and pollutions on air and noises.

When operating in the city, it is crucial to minimise the load and weight of the bus to achieve optimal fuel consumption. By having a full aluminium bus body panel or other lightweight materials such as composite, will reduce the bus weight, allow for greater payload, and reduce wear to other components such as brakes, tyres and joints which will save the annual operation cost.

However, in an electric bus, the climate control can double or triple the energy consumption under high temperatures or in extreme cold weather, hence weakening the performance and the coverage range. Besides that, hilly slopes and terrains may also cause a challenge to the performance of electric buses. Another setback is the charging process involved. The time required to charge electric buses is longer compared to the time required for the diesel bus to refuel. Also, bus depots with larger number of electric buses require a new supply of energy that includes transformers and charging points. The power requirement of an electric bus is comparable to the energy consumed by 75 households. Hence, high local utility rates (especially during periods of peak demand) and proprietary charging systems impose impediments to adoption, whereas diesel or hybrid bus are relatively inexpensive to operate per kilometre.

A whole new range of possibilities for your city with Volvo 7900 Electric

A turn-key solution
Introducing the Volvo 7900 Electric means peace of mind. In order to maintain uptime and minimise operational and financial risk volvo offer it as a turn-key solution. The capacity you need at a specified cost per kilometre.

Manage sensitive zones
Many cities apply restrictions on city-centre traffic. Zones that impose limits on emissions, noise and speed are becoming more and more common. The Volvo 7900 Electric can meet such emission and noise limits by itself, and with the help of Volvo Bus Zone Management it can also handle speed limits.

Go across instead of around
Operating the Volvo 7900 Electric offers a whole new set of possibilities to make public transport attractive. New routes, silent traffic in sensitive areas and bus stops where people want them.

Efficient charging
Rapid and fully automatic charging at end stations keeps productivity up – and helps you keep your schedule. Opportunity charging is much more cost-efficient than overnight charging in the depot.

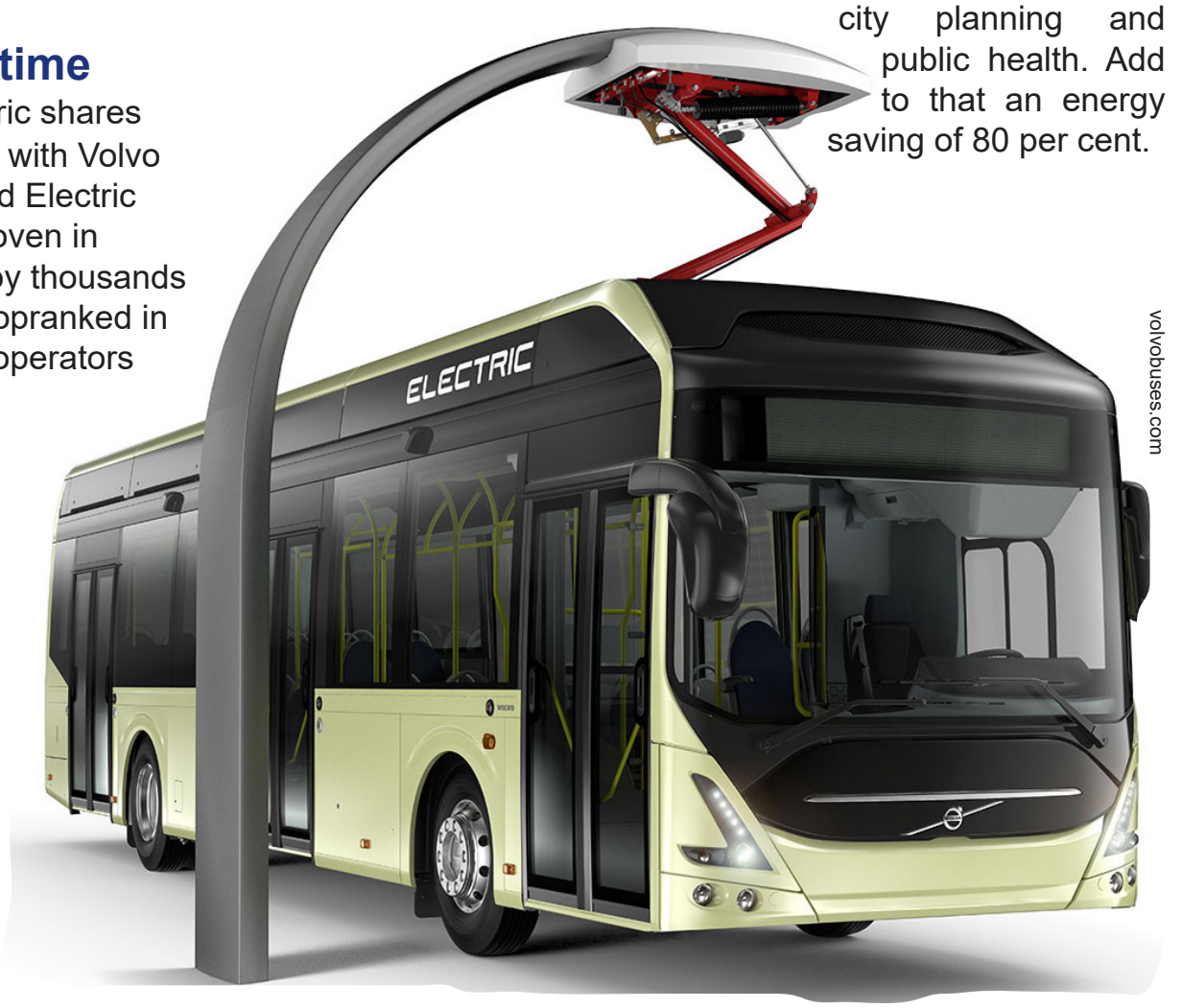
The driver in charge
Driving a Volvo 7900 Electric is smooth and straight-forward, just as with any other Volvo. Add to that one of the best driver environments available, with world-class ergonomics.

Silent comfort
The Volvo 7900 Electric offers an extremely silent and comfortable experience – for passengers on-board, those waiting at the bus stop and residents along the route.

True uptime
7900 Electric shares technology with Volvo Hybrids and Electric Hybrids proven in operation by thousands of buses, topranked in uptime by operators and PTAs throughout Europe.

The future is here and now
Electromobility is the way to sustainable transport solutions. Volvo can ensure you are safely guided through the technology change.

Environmental performance
The Volvo 7900 Electric is not only fossil-free. As opposed to ICE solutions it's also silent which is the next huge challenge for city planning and public health. Add to that an energy saving of 80 per cent.



volvobuses.com

HYBRID TECHNOLOGY

Hybrid buses operate in various forms. One of the most common forms of hybrid bus is the use of both internal combustion engine and battery powered electric motor. This gives the vehicle high energy efficiency since it switches between the two modes; the diesel mode is used to support high power driving conditions such as uphill, speeding while the electric-power drive is used in stop and go situation during dense traffic condition. A regenerative braking system is also used to further increase the efficiency of the stored energy in the battery. While hybrid does not completely remove exhaust emission of vehicles, the increase in fuel efficiency allows it to operate with less fuel consumption.

Another form of electric hybrid is plug-in hybrid in which the vehicle is fully powered by an electric motor, the battery of which is charged by plugging into the power grid. This allows more space dedicated to accommodate the larger and more expensive battery pack when compared to the internal combustion hybrid. However, it has the advantage of more energy efficient and completely emission free without having to account for the emission from electric generation of the power grid. Because plug-in hybrids operate fully on electric battery, they will require dedicated charging stations to charge the battery which may take a relatively longer time compared to a standard diesel refuelling.

VOLVO SELF-CHARGING ELECTRIC BUS

- Reduction in fuel consumption of up to 35%.
- Zero consumption during start-up.
- 50% less pollutants (NO_X and PM).
- Silent during start-up and stops.
- Energy efficiency for public transport.
- Greater transport capacity than the others.
- Transport capacity equal to the Standard bus, 100 passengers.
- Economically viable solution.

https://www.flickr.com/photos/express502/50240112101/

BIODIESEL

Other than improving the economic situation of a city by providing affordable transportation options and reducing traffic congestion, public transportation services also seek to address the rising concern of excessive carbon emission plaguing the world. The advancement of green technology leads to the use of biodiesel, made primarily from palm oil and other vegetable oils or animal fats which have the merits an alternative fuel options. As dependency on foreign oil escalates, use of any renewable energy source deserves further exploration. Biodiesel also provides a positive environmental impact as it has no real handling or infrastructure considerations and mixes well with diesel. In some circumstances it is less costly to operate than diesel fuel. Nevertheless, successful implementation of biodiesel requires agencies to improve their understanding of how the fuel differs from diesel and the preparations needed prior to deployment.

Biodiesel is produced by blending the animal fat or plant oil into diesel. When compared to pure diesel fuel, production and use of biodiesel produces 78.5 per cent less carbon dioxide (CO_2) emissions because crops such as oil palm and soybeans used to make biodiesel consume CO_2 as they grow. Since biodiesel has almost the same properties as normal diesel fuel, biodiesel blends are simple to use and require minimal modification to the vehicles.

Malaysia is the second largest palm oil producer in the world, and has the benefit of utilises the excess in palm oil supply in transport industry. The Biodiesel blend was increased from 7 per cent to 10 per cent in 2020; and to 20 per cent by 2021.

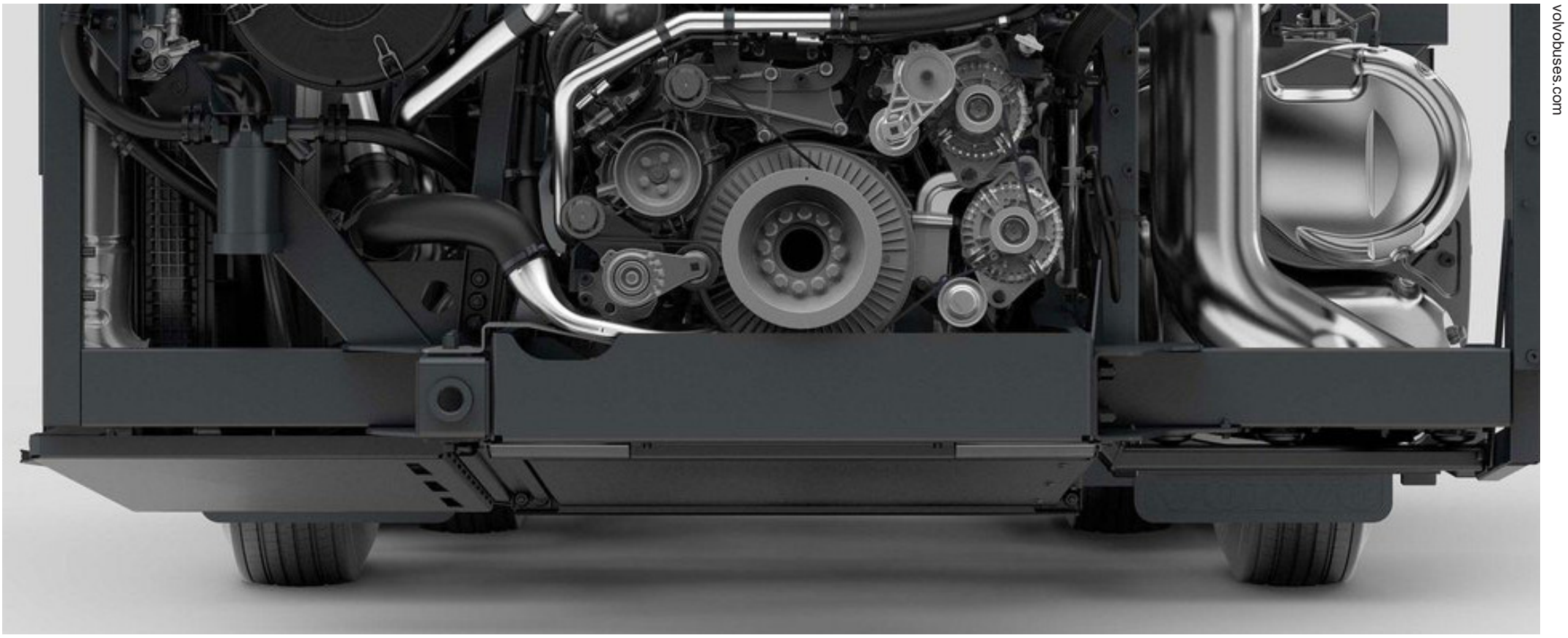
According to Rajaeifar (2019), biodiesel fuel results in less air pollution compared to diesel due to its higher oxygen content and lack of sulphur and aromatic compounds. More specifically, biodiesel combustion results in less particulate matter, carbon monoxide, and unburned hydrocarbon (UHC) emissions. In this regard, biodiesel could also be a promising alternative fuel source for urban buses.

EURO 6 ENGINE

Euro 6 was introduced in 2015 to further lower the harmful exhaust emission for new vehicles that is to be sold in the European market. Euro 6 standard is gaining relevancy with the introduction of ultra-low emission zones (ULEZ) and clean air zones (CAZ) in European cities where vehicles that do not comply with Euro 6 standard will face daily charges to operate on in those cities.

Diesel engines that comply with the Euro 6 standard will reduce harmful exhaust emission without losing the power output of a diesel engine which is an important factor for commercial vehicles. This ensures the vehicles a haul large number of their intended cargo or passengers while leaving less carbon footprint. Adoption of a vehicle with Euro 6 certification may reduce the level of air pollution in the city.

The reduction in emission will also lead to reduction in fuel consumption which will reduce overall operation cost. The higher fuel efficiency will also lead to the increase in engine resilience thereby reduce maintenance cost. Malaysia has its first Euro 6 double deck buses offered by Volvo in 2020. This marks the effort of the Malaysian government in committing to the reduction of carbon footprint towards a more sustainable environment.



HYDROGEN FUEL

Hydrogen fuel cell utilises the technology of fuel cells to power the on board electric motor wherein the fuel cells generate electricity by using compressed hydrogen gas and oxygen. This has resulted in hydrogen fuel cell vehicles to become zero - emission vehicles during operation as the by-product of the reaction is water and heat. One of the biggest advantages of hydrogen fuel cell is its energy efficiency in which smaller amount of hydrogen is able to produce more energy compared to other alternative fuels. This enables hydrogen to fuel vehicles with high energy requirements and operate longer and travel further than using fossil fuel. Align with this, the Volvo Group has announced its plans to engage in a 50/50 joint venture with Daimler Truck AG to develop and produce fuel cells for demanding applications.

Hydrogen is an abundant resource which comes mostly from the refinement of natural gas, methane, and coal. Hydrogen contributes to greenhouse gas emission. While there are environmental friendly alternatives to produce hydrogen gas through the electrolysis of water powered by wind and solar generators, the amount produced from these resources are smaller and require higher investment, making hydrogen fuel more expensive than fossil fuel.

Another challenge is the storage and transportation of hydrogen. Because hydrogen gas is very small and volatile, it must be transported in a fully sealed and pressurised container to ensure it does not leak and can transport safely. Unlike fossil fuel which can be transported in large amounts using pipes, hydrogen gas will drive up the cost.

Transportation now the largest sources of CO2 emission in the U.S. Hydrogen fuel is one of the alternatives emits water and heat

https://fuelcellsworks.com/


Citadines
MULTIMEDIA UNIVERSITY

THE FUTURE OF BRT IN MALAYSIA

BRT is seen as a financially savvy and intelligent approach in providing a significant upgrade in transit services, especially in Malaysia. It is efficient, costs less than a single rail mile and can connect people with a robust network and efficient service.

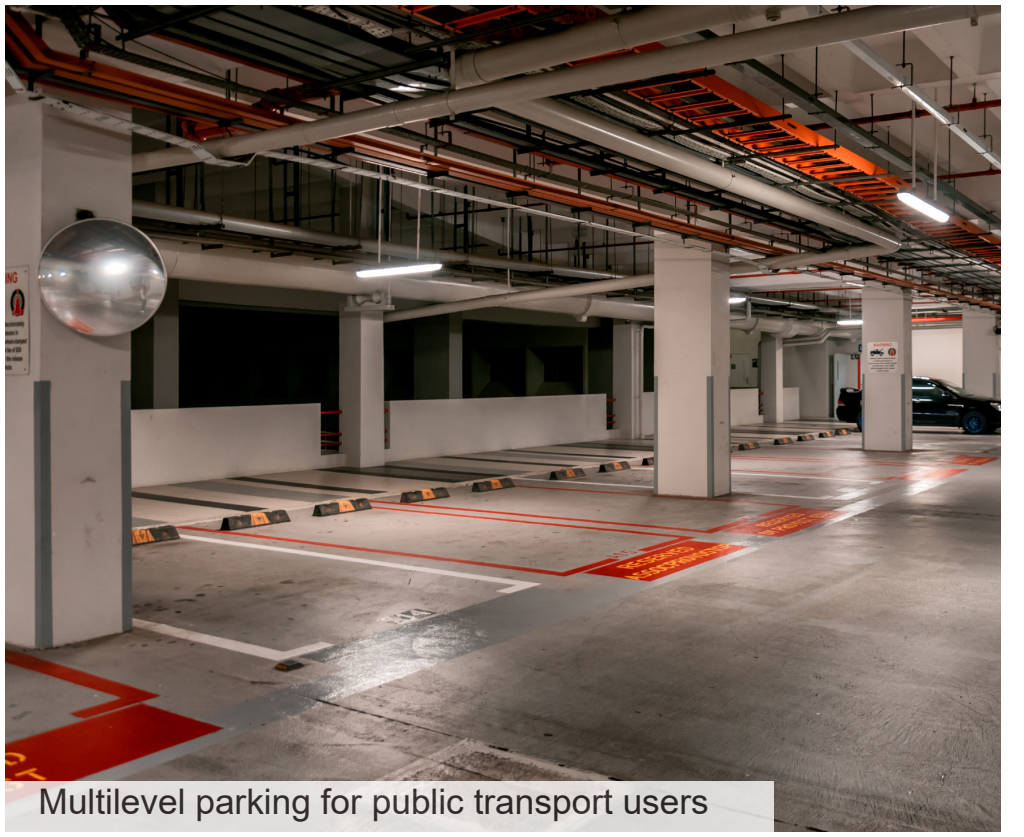
SUBANG JAYA, SELANGOR

The first BRT system implemented in Malaysia is the Sunway Line in Petaling Jaya, which started its operation in 2015 and was operated by Prasarana Malaysia Berhad's subsidiary, Rapid Bus. The Sunway Line provides an elevated bus transportation service from Setia Jaya to USJ 7, servicing a total of 7 elevated stations. Both ends of the line also act as exchange terminals with other public transport lines. The Setia Jaya terminal connect to Setia Jaya station for KTM Port Klang Line while USJ 7 terminal connect to USJ 7 station for LRT Kelana Jaya Line, allowing greater accessibility for pedestrians to more areas in the Klang Valley area.

https://www.sunwayconstruction.com.my/projects/bus-rapid-transit-brt-sunway-line/

The proposed BRT station and busway along Federal Highway at Asia Jaya

https://en.wikipedia.org/wiki/BRT_Federal_Line



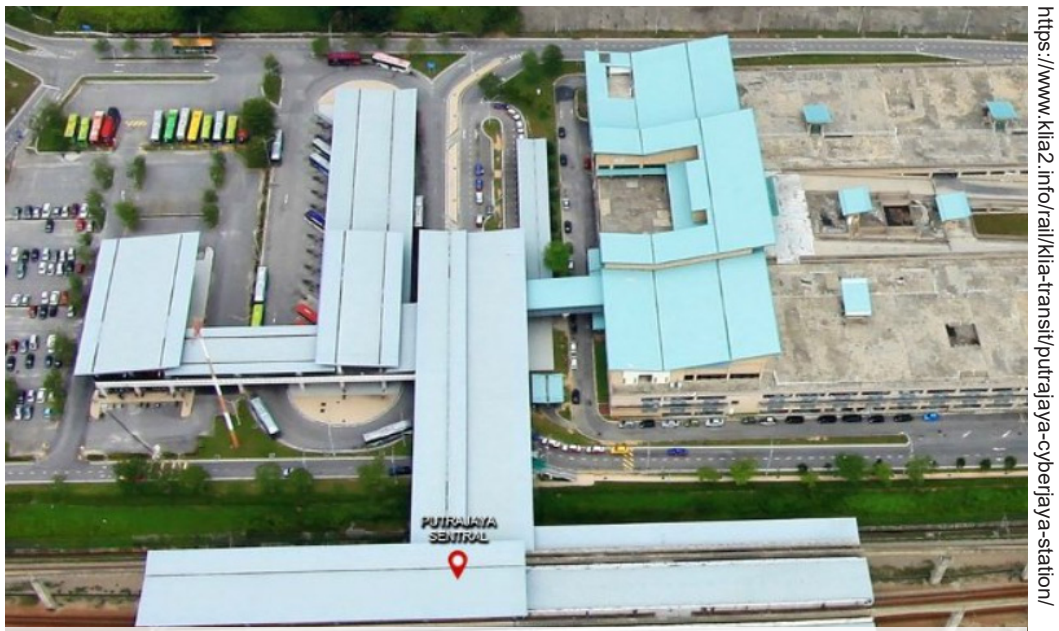
Multilevel parking for public transport users

CYBERJAYA, SELANGOR

Implementing a BRT system in Cyberjaya is the next logical step, given that Cyberjaya is repositioning itself as a more encompassing global tech hub in Malaysia where innovation is at the heart of the city's inhabitants. Cyberjaya features a single bus terminal, known as the Cyberjaya Transport Terminal for Cyberjaya's own Dedicated Transportation System, comprising bus routes connecting Cyberjaya to Putrajaya, Ampang, Gombak, Bandar Tasik Selatan, Bandar Utama, Kepong, Nilai Seremban, Shah Alam, and Klang. The station has a bus line connecting to Putrajaya Sentral, leading to a wider public transportation service coverage through access with the KLIA Transit, and the MRT line which is yet to be completed. Adapting the existing bus lines into a completed BRT system may increase the service quality without incurring much infrastructure cost.

Putrajaya & Cyberjaya ERL station

https://www.klia2.info/rail/klia-transit/putrajaya-cyberjaya-station/



Putrajaya & Cyberjaya ERL Station, the ERL station for KLIA Transit at Putrajaya / Cyberjaya area

https://www.klia2.info/rail/klia-transit/putrajaya-cyberjaya-station/

The electric buses introduced for Cyberjaya. The chargers are capable of charging the buses within 15 minutes. They are able to run up to 70km on a single charge

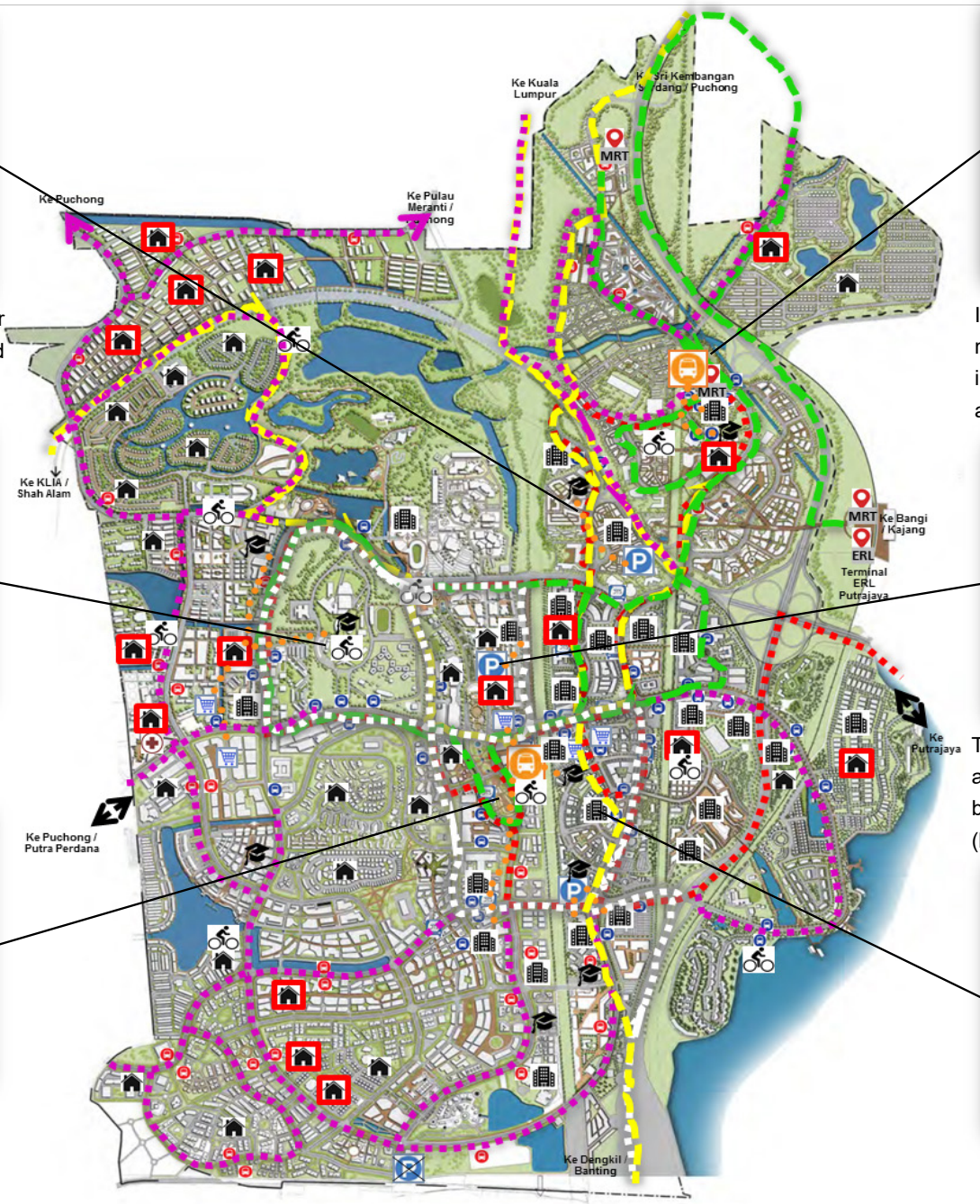
https://www.nst.com.my/cbt/2017/12/312983/deftech-manufacture-maintain-putrajaya-ev-bus

PUBLIC TRANSPORT PLAN AT CYBERJAYA

Pedestrian walkways are protected/ under trees, comfortable, and safe. Provided entertainment such as ads shows and music

The bicycle parking lot is systematic and secure

Bicycle lane and pedestrian lanes are safe. Routes are available next to bus routes.



Integrated Terminal which has facilities (parking, rest areas, restaurants, surau, wifi) and various intermediary services such as trains, buses, taxis and e-hailing, rental bikes (e-scooter)

The Park & Ride area is sufficient, systematic, and safe. Featuring facilities such as parking and bicycle rental (e-scooter), intermediary services (buses, taxis and e-hailing)

Showers are provided in public places and offices

Cyberjaya Transport Terminal
Institute Higher Education
Office Buildings
Residential
Residential (B40)
Hospital
Shopping Mall
Park & Ride
Propose Bicycles Rental Services
Existing Bus stop
Propose Bus Stop
Nadi Putra Routes
DTS Routes
MRT Feeder Bus Routes
Propose Bus Stop
Propose Bus Routes
Propose Pedestrian Walkway

JOHOR BAHRU, JOHOR

Another city planning to implement a BRT system is Iskandar, Johor Bahru to accommodate its population growth which is expected to reach 3 million by 2025. A BRT system was proposed and named as Iskandar Malaysia Bus Rapid Transit (IMBRT); it was originally conceptualised in 2009, seeking to merge Light Rail Transit (LRT) speed and reliability with the affordability of a conventional bus system. IMBRT was suggested to meet the transportation needs of the increasing population growth in the Iskandar Region. The system connects three main routes specifically Johor Bahru to industries and residential areas in Tebrau, universities and small and medium-sized enterprises in Skudai and new growth areas in Nusajaya. IMBRT system will use high capacity articulated bus running along dedicated bus lane with additional service through feeder buses.

First phase of IMBRT, the 51KM route will consist of 19 stations in Tebrau, 13 in Skudai and 7 in Iskandar Puteri

STATION AND TERMINAL FACILITIES

Retail outlet

Customer services centre

Low counter for wheel chair use

Staff at station to provide assistance

Tactile tiles

Ramp access

Ticket vending machine

Male and female surau

Male and female toilet

Disabled friendly toilets

Braille for lift button

Lifts and escalator

Komtar bus stop, one of the proposed BRT station to be upgraded and linked with Johor Bahru Sentral railway station

Stefan Fussan, Iskandar_Malaysia_Bus_Rapid_Transit#/media/File:Johor_Bahru_-_Train_station_0001

FIRST PHASE IMBRT

90%
Coverage of population of Iskandar Malaysia

51 KM
First Phase

9 Stations in Tebrau

13 Stations in Skudai

7 Stations in Iskandar Puteri

BUS TYPE (PROPOSED)


Articulated 18m (Trunk route)


8m bus (Feeder route)

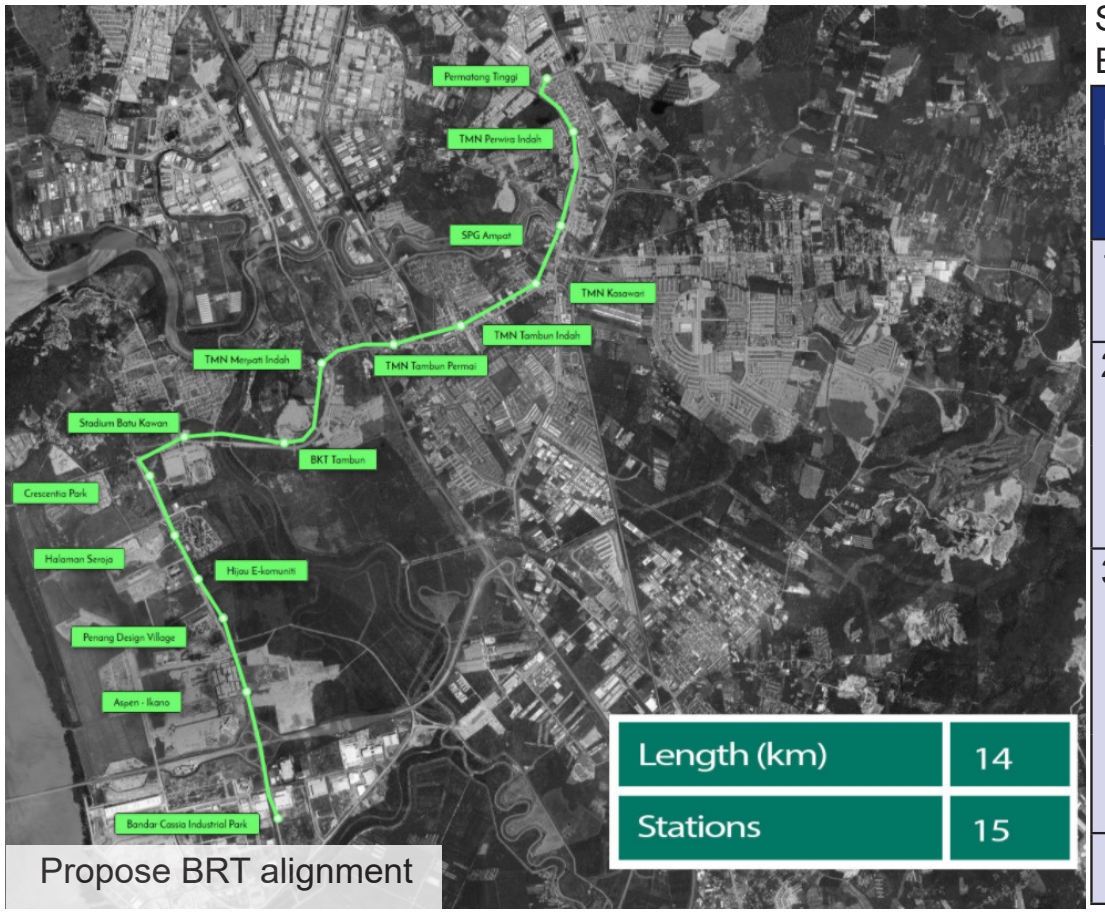

12m bus (Direct route)

https://twitter.com/imbrtofficial/status

PENANG

The other state that is planning to implement a BRT system is Penang where Penang government proposes the Penang Transport Master Plan (PTMP), an interconnected transportation network with a suitable long-term potential to raise the adoption of public transport in the province. The public transit plan is structured to operate in combination with the simultaneous improvements of the road and highway network and others to ensure holistic change and greater reliability for the public in travel experience. Therefore, BRT was proposed to reduce the traffic congestion in Penang area that will lead to the completion of the Penang Transport Master Plan by 2030.

The proposed three transit lines routes include Permatang Tinggi to Batu Kawan BRT, BRT extension northwards to Bukit Tengah/Seberang Jaya, and BRT extension southwards to Nibong Tebal. All the BRT lines are also inter-connected with other public transport systems, including LRT and KTMB Komuter line. Future extension of the bus lines is also taken into consideration when planning the routes. The prescribed frameworks in the planned public transport network systems are subject to continuous evolutions and changes, taking full advantage of the flexibility of a BRT system. This planning would help form foreseeable future transit-oriented developments (TODs) and act as a basis for ensuring the viability of future lines. As part of the framework or local plan process, it is also an integral step in balancing transportation with land use planning.



Propose BRT alignment

http://pgmasterplan.penang.gov.my/en/2019/07/bas-rapid-transit-brt/

Seberang Perai Transit Lines and Bus Rapid Transit (BRT) Extensions

No.	Seberang Perai – Proposed Lines	Length (km)	No. of Stations
1.	George Town (The Light) – Butterworth (Penang Sentral) – Sg Nyiur Line	18	8
2.	Raja Uda – Sg Nyiur – Bukit Mertajam – Permatang Tinggi Line	28	21
	• BRT extension northwards to Kepala Batas	13	10
3.	Permatang Tinggi–Batu Kawan BRT	14	15
	• BRT extension northwards to Bukit Tengah/Seberang Jaya	15	16
	• BRT extension southwards to Nibong Tebal	11	6
	Total	99	76

KUCHING, SARAWAK

The next city planning to implement a BRT system is Kuching, Sarawak. A BRT route under Blue Line Project has been proposed to connect Kuching Sentral to Kuching Waterfront. This project is taken under the Public Works Department (JKR) and Ministry of Transport Sarawak, and is expected to be implemented in the year March 2021. The aim of this project is to improve the overall public transportation system in Sarawak. This project will run with the cooperation of the ministry, JKR and Sarawak Multimedia Authority (SMA) to implement the proposed Integrated Smart Traffic Light System for Kuching City which includes installation of digital countdown traffic light system.

Furthermore, the advancement in hydrogen bus technology is seen as a potential green technology that can be used in the BRT lines in Sarawak. The ministry was working closely on the operation of hydrogen fuel cell buses with Sarawak Economic Development Corporation (SEDC) and on hydrogen production plant and hydrogen refuelling station with Sarawak Energy Berhad in collaboration with Linde EOX Sdn Bhd, a subsidiary of Linde Group, Germany.

The hydrogen fuel cell project under the State Applied Research and Development Initiative is in progress and the findings would help the State Government to plan and decide on how to move forward with the hydrogen fuel cell buses .

This initiative would also be a great reference for Malaysia to implement another green technology for BRT. The H2 Sarawak Hydrogen Bus is a free service to test out the new technology. It comes with the real-time location checking of the bus, and the timetable is integrated with Google Transit. Since 23rd of January 2020, the H2 Sarawak Hydrogen Bus launched the first Downtown Heritage Loop, transporting passengers from Riverside Majestic for a 14km loop around downtown Kuching.

The Downtown Heritage Loop bus at Riverside Majestic bus stop

https://railtravelstation.com/

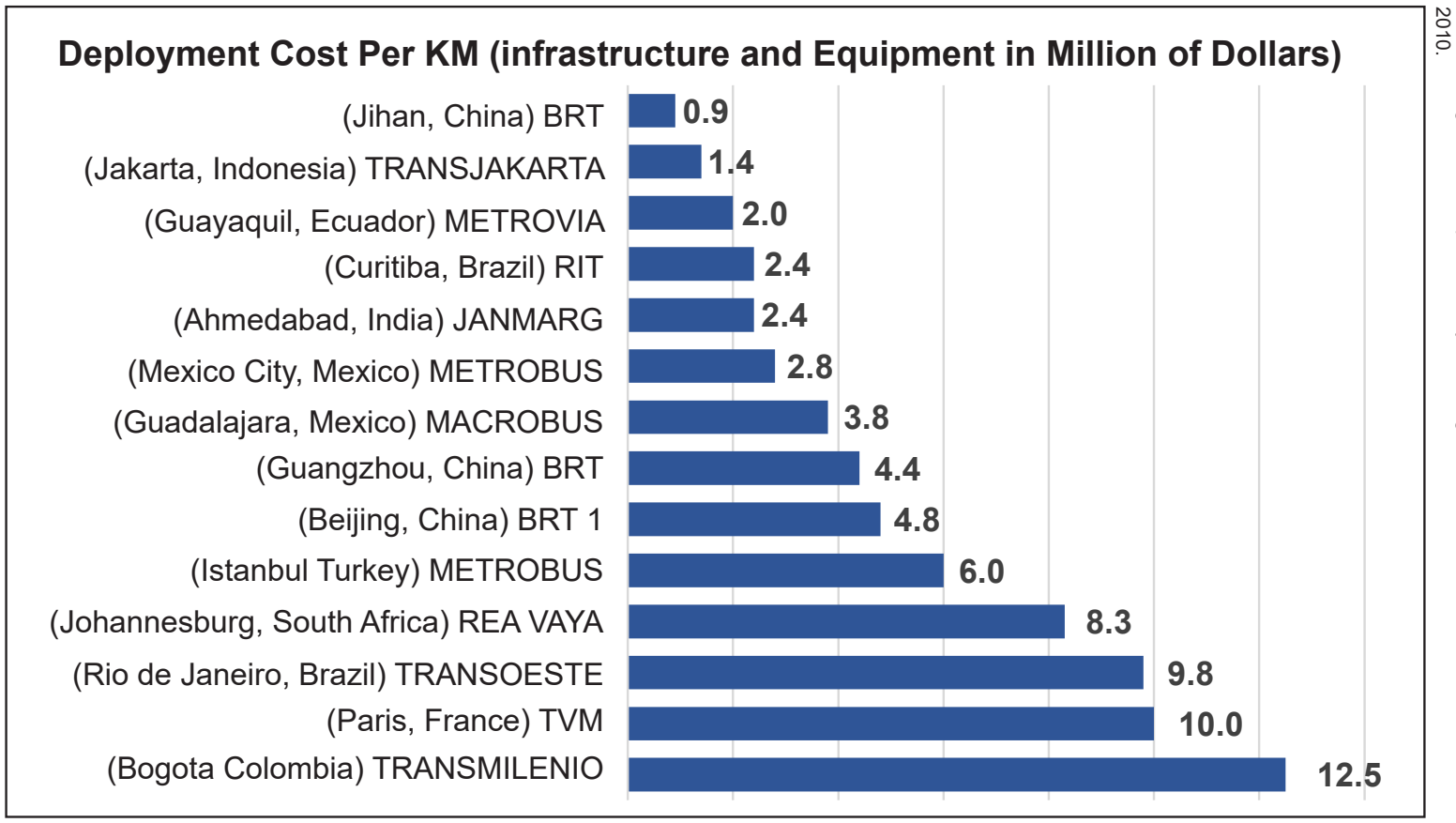
CONCLUSION

Malaysia is promoting the public transport as the people's choice of mobility. Currently, the modal share is between 20-25 per cent. Based on National Transport Policy, the national target is to reach a modal share of 40 per cent by 2030 for Greater Kuala Lumpur. During the Covid-19 pandemic when most companies are affected economically and downsizing, private vehicle purchase might not be a viable option for those affected by the economic situation. In Kuala Lumpur, transport expenses accounts for 10 per cent of household expenditure. It is a right time to promote the use of public transport, especially for the lower income group.

The BRT systems in emerging cities such as Klang Valley, Cyberjaya, Putrajaya, Penang, Johor Bahru and Kuching, will offer cheaper public transport options, since it costs a fraction of a conventional light rail transit, besides having operational flexibility that can be built quickly, incrementally, and economically. BRT systems have a proven global track records, and are able to alleviate traffic congestions, road accidents, environmental pollutions as well as parking issues.

Recognising the benefits of BRT systems to the society, economy, environment and operators, the Government is looking into the possibilities of expanding the BRT systems both within and outside of Klang Valley, as an integrated part of the city's development plan.

The success of sustainable and reliable BRT system is not only based on key features, such as segregated or prioritised right-of-way, state-of-the-art stations, off-board fare collections, multiple types of vehicles, safe, reliable and efficient service, but also a wider range of rapid transit elements, detailed planning of the network design, terminal space, catchment area, section of suitable vehicle, future development of the city and the intelligent technology.



BRTData.org 2013; data published by transit agencies; McCaul 2012; Wilson and Attanucci 2010.

RECOMMENDATIONS

BRT can be a good public transport mode for the cities that might not have the population to sustain a rail transit. BRT is easier to implement, and requires lower investment compared to rail transit. This benefits could be considered for major cities, such as Cyberjaya, Putrajaya, Johor Bahru, Penang and Kuching.

There are many technologies and operational features that can be utilised to improve the efficiency of the BRT systems. The Intelligent Transportation System (ITS) technology that can be integrated into the BRT systems as suggested by Kulyk and Hardy (2003) should be holistic. The features include signal timing to minimise any delay, Intelligent Vehicle Initiatives (IVI) for automated controls to avoid collision, electronic fare collection to reduce queueing time and increase passenger convenience, Vehicle Mechanical Monitoring and Maintenance Systems to reduce downtime and ensure reliable service, Passenger Information system to improve passenger satisfaction and other technology such as Silent Alarms and Surveillance Systems to enhance the security of the operations. All of the recommended ITS technologies have the potential to provide significant benefits for passengers and operators, and improve service performance.

From the operators' perspective, it is crucial to carry out extensive feasibility study and cost-benefit analysis when it comes to vehicle selection. The focus should not be just on the initial investment of the vehicle but also on the maintenance of the vehicle, reliability of the fleet, and aftermarket network and support over the life time of the vehicle.

There is no one-size-fits all solution in the BRT implementation. Instead of replicating a popular system of a particular city, factors such as roadway features, actual places of work, human populations, integrated networks and other special local characteristics must be considered at every developmental stage.

Besides technology, it is also important to address passengers' requirements and perceptions. Malaysia needs to change the stigma of public perception that public transport is meant for the low income group. There is a need to assure the public that BRT system is a modern and sophisticated mode of transport for all levels, with reliable services, frequent intervals which is safer, more environmental friendly and more sustainable (Azizan et. al, 2016).

BRT system can only be successful if the fares are reasonable. The ticket price for the BRT service must correlate with the affordability of the passengers. Therefore, it is important to evaluate the income level of the community before determining the ticket price to promote the usage of the service.

Government should also provide tax incentives for BRT operators, who choose to invest in zero or low emission vehicles and fare discounts for passengers using BRT systems to increase the ridership.

"There is no one-size-fits all solution in the BRT implementation. Instead of replicating a popular system of a particular city, factors such as roadway features, actual places of work, human populations, integrated networks and other special local characteristics must be considered at every developmental stage"

-Azizan et. al, 2016

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