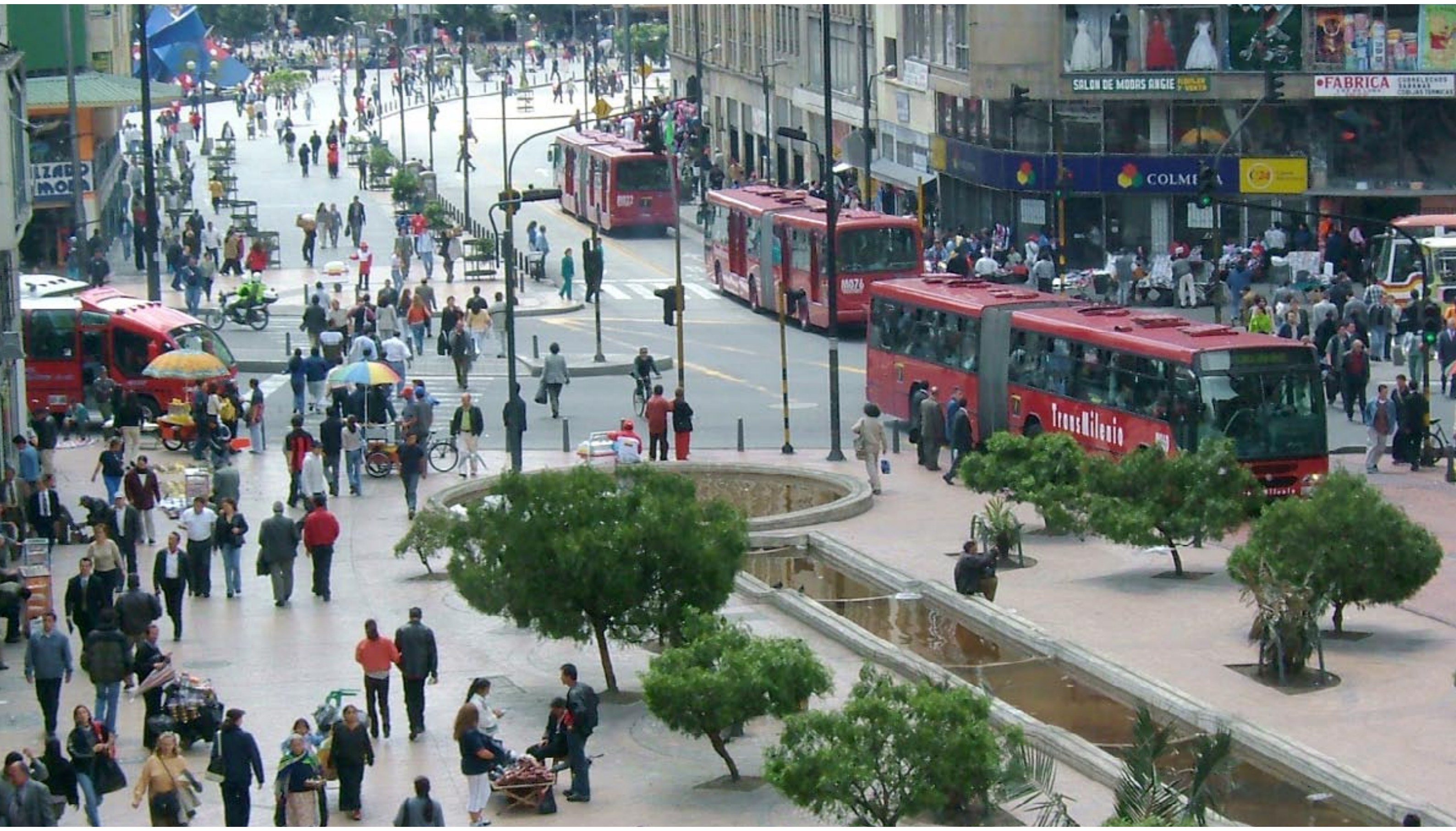

Bus Rapid Transit
Planning Guide

June 2007

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Preface

"We wander for distraction, but we travel for fulfillment."

– Hilaire Belloc, writer, 1870–1953

The ability to access jobs, education, and public services is a fundamental part of human development. An efficient and cost-effective public transport system essentially connects people to daily life. For many cities, though, effective public transport has been forgone, leaving mobility needs exclusively in the hands of private vehicles and uncoordinated paratransit operators. These cities have been largely unprepared for the consequences, including severe traffic congestion, air and noise pollution, accidents, and the loss of a sense of community. A high-quality public transport system remains an indispensable element in creating a city where people and community come first.

Bus Rapid Transit (BRT) is increasingly recognised as amongst the most effective solutions to providing high-quality transit services on a cost-effective basis to urban areas, both in the developed and developing world. The growing popularity of BRT as a viable solution to urban mobility underscores the success of initial efforts in cities such as Curitiba, Bogotá, and Brisbane. By allowing cities to provide a functional network of public transport corridors, BRT permits even low-income cities to develop a high-quality mass transit system that serves the public's daily travel needs.

However, BRT is not just about transporting people. Rather, BRT represents one element of a package of measures that can transform cities into more liveable spaces. Integration of BRT with non-motorised transport, progressive land-use policies, and car-restriction measures forms part of a sustainable package that can underpin a healthy and effective urban environment. In this sense, BRT represents one pillar in efforts to better urban quality of life for all segments of society, and especially in providing greater equity across an entire population.

The Bus Rapid Transit Planning Guide has been the culmination of over five years of efforts to document and improve the state of the art in cost-effective public transport solutions for cities. This current document is the third edition of the Planning Guide. The production of new versions in a short span of time is indicative of the pace by which the BRT concept is growing and evolving. The first two versions of the Planning Guide were developed by Lloyd Wright and published through the Sustainable Urban Transport Project (SUTP) of the German Technical Cooperation (GTZ). This new edition has been expanded to include inputs from a wide range of professionals with direct experience in implementing actual systems. Further, as new projects have been implemented, the base of knowledge on issues such as route design, information technology, fare collection options, and BRT vehicles has expanded significantly.

This Planning Guide first provides an overview of the BRT concept, including its definition and historical development. The Planning Guide then proceeds to give a step-by-step description of the BRT planning process. The

Planning Guide encompasses six major components in BRT planning: I. Project preparation; II. Operational design; III. Physical design; IV. Integration; V. Business plan; and VI. Evaluation and implementation. In total, there are 20 different chapters covering a comprehensive set of planning issues including communications, demand analysis, operational planning, customer service, infrastructure, modal integration, vehicle and fare collection technology, institutional structures, costing, financing, marketing, evaluation, contracting, and construction planning. Finally, this publication also lists a range of information sources that can assist a city's BRT planning efforts.

The BRT Planning Guide is intended as a guidance document for a range of parties involved in delivering public transport services to urban areas. Municipal planning professionals and planning consultants will particularly benefit from the step-by-step documentation of the BRT development process. However, non-governmental organisations and civic organisations involved in transport, environment, and community development will likewise find this information of use in realising their objectives. Additionally, other stakeholders, including business groups, regional and national governmental agencies, and international development organisations are also key partners who will benefit from knowledge on the BRT option.

The BRT Planning Guide was originally developed principally for officials in developing-nation cities, and most of the expertise presented here has been developed in the cities of developing nations. Given that the most successful applications of BRT to date have been from cities such as Bogotá, Curitiba, and Guayaquil, developed nations have much to learn from the developing world. Further, as energy security and the spectre of climate change have become topics of increasing global concern, providing effective public transport should be a fundamental objective for all cities, regardless of a nation's economic designation.

BRT alone will not solve all the myriad of social, environmental, and economic challenges facing our various urban centres across the globe. However, BRT has shown to be an effective catalyst to help transform cities into more liveable and human-friendly environments. The appeal of BRT is the ability to deliver a high-quality mass transit system within the budgets of most municipalities, even in low-income cities. BRT has proven that the barrier to effective public transport is not cost or high technology. Planning and implementing a good BRT system is not easy. This guide aims to make the task a little easier. The principal ingredient, however, is not technical skill: It is the political will to make it happen.

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Acknowledgements

The development of this Bus Rapid Transit Planning Guide has benefited from the experiences of cities and professionals from around the world. In many respects, BRT owes its existence to the creativity and determination of Jaime Lerner, the former mayor of Curitiba (Brazil) and the former governor of the state of Paraná. Curitiba marked a vital first step in understanding a customer-based view of public transport provision. Former Mayor Lerner and his municipal team used a great deal of creativity in developing a "surface metro" system that was the forerunner of BRT.

Subsequently, the leadership of former Bogotá Mayor Enrique Peñalosa resulted in the development of the Bogotá TransMilenio system in the late 1990s. The Bogotá system proved the applicability of BRT in even the largest and most complicated urban settings. Further, former Mayor Peñalosa has gone on to be a worldwide ambassador of sustainable urban transport. Together, the stories of Curitiba and Bogotá are now the basis for more and more cities engaged in urban transformation led by BRT and a package of other sustainable transport measures.

It is no coincidence that many of the persons involved with this BRT Planning Guide have played a central role in planning and implementing BRT systems around the world. The experience of planners from Brazil, Colombia, and elsewhere has helped to dramatically improve the quality of this third edition of the BRT Planning Guide.

This guide has drawn most heavily on the team that designed Bogotá's TransMilenio system. The consulting firm Akiris, especially Juan Carlos Diaz, have helped to draft the sections of the Planning Guide on project preparation, communications, and technology. Under the guidance of Luis (Pilo) Willumsen, staff from Steer Davies Gleave contributed inputs to the demand analysis and operations sections. Jarko Vlasak formerly helped lead the team that developed the business and institutional structure for TransMilenio, and he has provided inputs on these topics to the Planning Guide. Angélica Castro, the current Managing Director of TransMilenio SA, and other members of Bogotá's public BRT company, TransMilenio SA, also provided many highly useful ideas and inputs. Further, the former director of TransMilenio, Edgar Enrique Sandoval, has applied his experience to provide a wide spectrum of suggestions to the Planning Guide. Likewise, Dario Hidalgo, formerly the Deputy Director of TransMilenio and now with the firm of Booz Allen Hamilton, has assisted with an array of inputs, including insights into initial project development.

Pedro Szasz, a world leading transport engineer who played a key role in helping TransMilenio reach its current unrivalled capacity and speed, contributed greatly to the sections on operational and design issues. Likewise, the inputs and ongoing interactions from Brazilian consultants such as Wagner Colombini (Logit Enghenaria), Paulo Custodio, and Arthur Szasz have provided invaluable insights to this Planning Guide.

César Arias, who played a key role in developing the Quito BRT system and is now doing the same in the city of Guayaquil, has provided inputs from BRT development in these cities. Likewise, Hidalgo Nuñez and Cecilia Rodriguez of Quito's Department of Transport have provided much assistance in documenting Quito's experiences.

For Asia, valuable lessons emerged from our partnership with the Guangzhou Municipal Technology Development Corporation under the Guangzhou Construction Commission, and from the Energy Foundation's Beijing Office. Special recognition should also be extended to Lin Wei and the entire team from the city of Kunming who developed China's first BRT project. Additionally, the inputs of Dr. Jason Chang and Kangming Xu have helped to document early experiences in China and Taiwan. In India, Dr. Dinesh Mohan and Dr. Geetam Tiwari of the Indian Institute of Technology in Delhi are at the forefront of efforts there, and many elements of this guide result from the richness of their inputs. With particular attention to the integration of pedestrian access and small vendors into the station environment, Dr. Tiwari has provided insights for this Planning Guide. Recognition must also be extended to DKI Jakarta and the valuable lessons learned during the development of the TransJakarta BRT system.

In Africa, the city of Dar es Salaam has embarked upon a path to prove that a high-quality public transport system is possible even in cities with limited financial resources. The rise of the Dar es Salaam BRT system may well spur on similar efforts across the African continent. Interactions with Raymond Mblinyi and Asteria Mlambo of the Dar es Salaam Project Management Unit, along with the team from Logit Engenharia provided invaluable guidance on issues appropriate to working in the African context.

The Planning Guide has benefited not only from leading developing-nation experiences but also from the growing level of interest in BRT in Australia, Western Europe, Japan, and North America. A similar compendium of experiences developed under the United States Transit Cooperative Research Program (TCRP) has been a rich source of world-wide experiences in BRT. Sam Zimmerman, now with the World Bank, and Herbert Levinson, an independent transport consultant, have been leading these efforts and have helped to provide insightful contributions to this Planning Guide.

Heather Allen and the entire team at the International Union of Public Transport Operators (UITP) have helped to share the experiences of their membership in order to strengthen this Guidebook. François Rambaud of French Research Centre on Transport and Urbanism (CERTU) has also been most helpful in noting BRT developments in France, as has been Werner Kutil of Veolia Transport. Appreciation is also extended to Dave Wetzel, the Vice Chair of Transport for London (TfL), who has contributed greatly to innovative financing strategies such as the concept of a Land Benefit Levy (LBL).

Additionally, efforts to raise awareness of the BRT option have been furthered by several US-based organisations, including the US Federal Transit Administration (USFTA), the American Public Transport Association (APTA), and WestStart-CALSTART. The team of Dennis Hinebaugh, Georges Darido, and Alasdair Cain at the National BRT Institute at the University of South Florida have been quite gracious in providing data and images for this Planning Guide. Also, Bill Vincent of Breakthrough Technologies has been an inspirational lead for BRT in the US and elsewhere, and has helped to develop one of the most effective videos on BRT to date. Kate Blumberg of the International Council on Clean Transportation (ICCT) contributed many insights on air quality and fuel technology for this Planning Guide. At the city level, the efforts of officials in Brisbane, Nagoya, Ottawa, and Rouen have also made a significant difference in furthering the BRT concept.

Several international transport professionals are working to ensure that concepts like BRT are integrated within the local context. Michael King of Nelson/Nygaard Consultants is the principal author of the Planning Guide's section outlining the integration of BRT with pedestrian access. Todd Litman of the Victoria Transport Planning Institute (VTPI) gave major contributions to the sections on BRT integration with land use planning and BRT within a framework of transit-oriented development (TOD). The VTPI remains a valuable resource within the sustainable transport movement. Also, through co-operation with Nancy Kete, Lee Schipper, and the entire team at the Embarq programme of the World Resources Institute (WRI), and the Center for Sustainable Transport in Mexico City, valuable insights have been gained.

Several international organisations are now at the forefront of making BRT a mainstream option for cities worldwide. The World Bank and the Global Environment Facility (GEF) have teamed up to support BRT initiatives in a range of cities, including Hanoi, Lima, Mexico City, and Santiago. Gerhard Menckhoff, a World Bank consultant, has been particularly instrumental in this process, and he has made substantial contributions to many elements of this Planning Guide. Likewise, Peter Midgley, a former World Bank transport specialist, who has been a pioneer in forming the BRT concept, also provided assistance to this Planning Guide. Other World Bank staff who are closely involved in making BRT projects a reality include Mauricio Cuéllar, Pierre Graftieaux, and Shomik Mehndiratta. Further, Cornie Huzienga and his team at the Clean Air Initiative for Asian Cities (CAI-Asia) are working to improve air quality of Asian cities through the promotion of measures such as BRT. Efforts in Asia are also assisted through the Environmentally-Sustainable Transport (EST) programme of Kazunobu Onogawa, Choudhury Mohanty, and others at the United Nations Centre for Regional Development (UNCRD).

This most recent version of the Planning Guide would not have become a reality without the vision and support of several key organisations. The Hewlett Foundation stands out as one of the principal catalyst organisations making BRT possible in countries such as Brazil, China, and Mexico. Much appreciation must be extended to Joseph Ryan and Hal Harvey of the Hewlett Foundation for their belief in BRT as a sustainable option for developing-nation cities. Likewise, Sheila Aggarwal-Kahn and Lew Fulton of the United Nations Environment Programme (UNEP) worked with the Secretariat of the Global Environment Facility (GEF) to also make both a substantive and a financial contribution to this document's publication. Additionally, Manfred Breithaupt and the Sustainable Urban Transport Project (SUTP) of GTZ have played a pivotal in supporting the development of the first two versions of this Planning Guide. Likewise, GTZ has also given support to this third edition as well as continues to support BRT knowledge dissemination through workshops and training courses.

Finally, much has been learned by turning the ideas of BRT into on-the-ground realities. Most of the valuable lessons presented here resulted from the persistence and patience of key people often in often difficult situations. Several key staff members at the Institute for Transportation & Development Policy (ITDP) have been at the forefront of bringing direct technical assistance to developing cities pursuing sustainable transport options. From ITDP's team, Oscar Diaz played a critical role in collecting information about TransMilenio; likewise, John Ernst's work in Jakarta, Eric Ferreira's work in Brazil, Karl Fjellstrom's work in China and Tanzania, and Aimee Gauthier's work in Dakar and South Africa, was the basis for many of the insights shared here. A special thanks is also extended to Klaus Neumann who provided the design and formatting of this document.

In total, the Bus Rapid Transit Planning Guide is the sum of some of the most experienced minds that are striving to improve public transport conditions worldwide. The contents of this Planning Guide give the reader a revealing look at the promise and latest accomplishments of Bus Rapid Transit systems.

Acronyms

AEI	Access Exchange International
AIJ	Activities Implemented Jointly
APTA	American Public Transport Association
AfDB	African Development Bank
ALS	Area Licensing Scheme
ADB	Asian Development Bank
AGV	Automatic Guided Vehicle
AVL	Automatic Vehicle Location
BNDES	Banco Nacional de Desenvolvimento Econômico e Social (Brazilian National Development Bank)
BOT	Build-Operate-Transfer
BRT	Bus Rapid Transit
CH_4	Methane
CIDA	Canadian International Development Agency
CO	Carbon monoxide
CO_2	Carbon dioxide
CFD	Car-free day
CBD	Central business district
COE	Certificate of entitlement
CER	Certified Emission Reduction
CAI	Clean Air Initiative
CDM	Clean Development Mechanism
CNG	Compressed Natural Gas
COP	Conference of the Parties
DANIDA	Danish International Development Agency
dB	Decibel
DLT	Development Land Tax
DFID	UK Department for International Development
ERP	Electronic Road Pricing
EIA	Environmental Impact Assessment
EST	Environmentally-Sustainable Transport
EU	European Union
EOI	Expression of Interest
GEF	Global Environmental Facility
GST	Goods and services tax
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) (German Technical Cooperation)
HCBS	High-Capacity Bus System
HOV	High-occupancy vehicle
IADB	Inter-American Development Bank
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IEA	International Energy Agency
ICT	Information and communications technologies
IFC	International Finance Corporation
IPCC	Inter-governmental Panel on Climate Change
ITDP	Institute for Transportation & Development Policy
ITS	Intelligent Transportation Systems
JBIC	Japanese Bank for International Co-operation
JICA	Japanese International Co-operation Agency
JI	Joint Implementation
JIT	Just-in-time
KfW	Kreditanstalt für Wiederaufbau (German Bank for Reconstruction)
kph	Kilometres per hour
LVT	Land-value taxation
LOS	Level of service
LPG	Liquid Petroleum Gas
LRT	Light Rail Transit
LBL	Location Benefit Levy
MRT	Mass Rapid Transit
NBRTI	National Bus Rapid Transit Institute
NOx	Nitrogen oxides
N_2O	Nitrous oxide
NGO	Non-governmental organisation
NMT	Non-motorised transport
OMV	Open market value
O-D	Origin-Destination
OECD	Organisation for Economic Co-operation and Development
O_3	Ozone
PM	Particulate matter
PCU	Passenger car units
pphpd	Passengers per hour per direction
PC	Personal computer
PDA	Personal digital assistant
PRT	Personal Rapid Transit
PV	Photovoltaic
PPQ	Por el País que Queremos (For the Country that We Want)
PPP	Public-private partnership
PSA	Public service announcement
PT	Public transport
PTTF	Pune Traffic & Transportation Forum

QIC	Quality incentive contract
RATP	Régie Autonome des Transports Parisiens (Paris Regional Public Transport Agency)
RF	Registration fee
SMS	Short message service
SOx	Sulphur oxides
Sida	Swedish International Development Agency
SUMA	Sustainable Urban Mobility in Asia
SUTP	Sustainable Urban Transport Project
TOR	Terms of Reference
TDM	Transportation Demand Management
TOD	Transit-Oriented Development
TfL	Transport for London
TRB	Transportation Research Board
TVR	Transport sur Voie Reservée (Transport on Reserved Lane)
UITP	International Association of Public Transport
UNCRD	United Nations Centre for Regional Development
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US AID	United States Agency for International Development
US EPA	United States Environmental Protection Agency
US FHWA	United States Federal Highway Administration
US FTA	United States Federal Transit Administration
US NCHRP	United States National Cooperative Highway Research Program
US TCRP	United States Transit Cooperative Research Program
UCL	University College London
VTPI	Victoria Transport Policy Institute
VOCs	Volatile organic componds
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

Contents

Executive Summary

Public transport is a critical means by which citizens can effectively access goods and services across the expanse of today's cities. Bus Rapid Transit (BRT) has been found to be one of the most cost-effective mechanisms for cities to rapidly develop a public transport system that can achieve a full network as well as deliver a rapid and high-quality service. While still in its early years of application, the BRT concept offers the potential to revolutionise the manner of urban transport.

Bus Rapid Transit (BRT) is *a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service.* BRT essentially emulates the performance and amenity characteristics of a modern rail-based transit system but at a fraction of the cost. A BRT system will typically cost 4 to 20 times less than a tram or light rail transit (LRT) system and 10 to 100 times less than a metro system.

To date, "full BRT" systems encompassing almost all high-quality service features have been developed in Bogotá (Colombia) and Curitiba (Brazil). Other leading developing-nation systems include Guayaquil (Ecuador), Jakarta (Indonesia), and Pereira (Colombia). In the developed world, high-quality systems have been implemented in Brisbane (Australia), Ottawa (Canada), and Rouen (France). In total, approximately 40 cities on six continents have implemented "BRT" systems, and an even greater amount of systems are either in planning or construction. The elements that constitute the BRT concept include high-quality infrastructure, efficient operations, effective and transparent business and institutional arrangements, sophisticated technology, and excellence in marketing and customer service.

The Bus Rapid Transit Planning Guide details the steps within the six major planning areas for delivering a successful BRT system. These planning areas include: 1. Project preparation; 2. Operational design; 3. Physical design; 4. Integration; 5. Business plan; and 6. Evaluation and implementation.

Fig. 1
Bogotá TransMilenio BRT system.
Photo courtesy of TransMilenio SA

1. Project preparation

Project initiation

A new public transport system does not create itself. Somewhere, some how, someone must act as the catalyst to set out a dramatic new vision for a city's public transport system. This catalyst for change may be a political official, a non-governmental organisation, or simply a concerned citizen. Ultimately, though, ***political leadership*** must take upon the task of turning a vision into a realisable project. The most successful BRT systems to date have been initiated and led by charismatic political leaders, such as former Mayors Jaime Lerner of Curitiba and Enrique Peñalosa of Bogotá.

Public transport technologies

BRT is not the only mass transit option available to a city. Metro rail, light rapid transit (LRT), monorail, suburban rail, and standard bus systems are all options that municipal leaders may consider. There is no one single right or wrong technology since much depends on the local circumstances. The factors affecting the technology choice include capital costs (infrastructure and land costs), operational costs, design and implementation considerations, performance, and economic, social and environmental impacts. The rise of BRT as an effective option relates mostly to its relatively ***low infrastructure costs*** and ability to ***operate without subsidies***. BRT's ability to be implemented within a short period (1-3 years after conception) also has proven to be a significant advantage. The flexible and scalable nature of BRT infrastructure also means that the systems can be cost-effectively adapted to a range of city conditions.

Project set-up

Once the decision has been made to develop a BRT system, forming a project team will be amongst the first activities. The project team will likely consist of both local government officials and outside consultants, and will involve a range of skilled positions, including administrators, financial specialists, engineers, designers, and marketing and communications professionals. In general, a BRT project can be planned within a period of ***12 to 18 months***. A BRT plan will generally cost in the range of ***US$1 million to US$3 million***, depending on the complexity and size of the city as well as the extent to which outside consultants are required. The financing of BRT planning activities can be gained through a variety of sources, including local and national transport budgets, international and regional development banks, and the Global Environment Facility (GEF).

Fig. 2
Quito Ecovía line.
Photo by Lloyd Wright

A BRT project will likely encompass a multi-phase process since it would be unrealistic to build a complete network in a single, brief period. The size of the initial phase will depend upon many factors, but generally a project's first phase should capture enough passengers to establish the new system on a sound financial basis. Generally it will encompass one to two major corridors for a total of 15 to 60 kilometres of exclusive busways as well as 40 to 120 kilometres of feeder services.

Demand analysis

A city's demand profile for daily trips provides the basis for designing the BRT system. Understanding the size of customer demand along the corridors and the geographical location of origins and destinations permits planners to closely match system characteristics to customer needs. The BRT Planning Guide presents two options for estimating customer demand: 1.) Quick ***assessment method***; 2.) Assessment with a ***full transportation model***. As its name suggests, the "quick assessment method" allows cities to roughly estimate demand in a relative short period of time and within a modest budget. In this case, basic traffic counts are combined with boarding and alighting surveys of existing public transport services. The likely demand for the new BRT system will be roughly equal to the existing public transport ridership along the corridor plus a percentage of new passengers from private vehicles (*e.g.,* perhaps a 10 percent shift from private vehicles, depending on local circumstances).

However, if a city already possesses the basis for documenting trips through a full transportation demand model, then such a model can provide a level of detail that will produce a more precise demand estimation. Using one of the recognised transport modelling software packages in conjunction with surveys, counts, and analysis will give greater certainty in the likely ridership but will also require more time and resources to complete.

Corridor selection

Corridors are generally chosen based on a range of factors, including ***customer demand***, network advantages, roadway characteristics, ease of implementation, costs, political considerations, and social equity. In a project's first phase, the chosen corridor(s) will likely serve popular origins and destinations in order to prove the technology as well as achieve financial sustainability from the outset. However, project developers may wish to avoid the densest and most difficult corridors in the first phase since the technical and political risks can be quite high.

A standard BRT lane requires approximately ***3.5 metres of width*** while stations are generally 2.5 metres to 5.0 metres wide. A standard busway with a single lane in each direction will require from 10 to 13 metres of road width. A system utilising express services and therefore passing lanes at stations may require 20 metres of road width just for BRT usage. While narrow roadway segments in historical centres and business districts can restrict BRT design, many solutions exist to overcome roadway limitations. Some of these solutions include use of median space, expanding roadway width, transit-only streets ("transit malls"), fixed guideways, grade separation, and operation in mixed traffic lanes. In general, system designers have found solutions even in the most spatially constrained environments, such as the historical centre of Quito.

Communications

A failure to communicate the new public transport plan to key stakeholders and the general public can greatly undermine the ultimate viability of the project. Misunderstandings and misconceptions can be quite common at the outset of a project. Those organisations and individuals who feel threatened by the new system may act to hinder or even halt the project's progress and ultimate implementation. As the initial step in a communications plan, a ***stakeholder analysis*** of all persons and entities affected by the new system should be completed. Such stakeholders may include existing public transport operators, taxi owners and drivers, car owners, retailers, environmental and other civic organisations, governmental agencies, and the traffic police. Strategies should be developed to address the possible concerns that could be expressed by these groups. A strategy should also be established for communications with the news media, including newspapers, radio, and television. Finally, the planning and design process can particularly benefit from the

Fig. 3
Curitiba BRT system.
Photo courtesy of Volvo Bus Corporation

direct inputs of citizens. Few individuals are more qualified to provide insight on customer needs than the customers themselves. A substantive ***public participation*** process in which ideas and recommendations are solicited from a range of citizens (*e.g.,* public transport users, motorists) may be an effective means to a high-quality design.

2. Operational design

Network and service design

At the outset of the project, a few basic decisions regarding operational design will have profound ramifications on the quality of the service and the overall financial sustainability. To an extent, the system's business structure will be largely defined by whether to choose a ***closed system*** or an ***open system***. A "closed system" implies that the corridor access is limited to a prescribed set of operators and a restricted number of vehicles (*e.g.,* Bogotá and Curitiba). By contrast, an "open system" generally permits any existing operator to utilise the busway (*e.g.,* Kunming, Taipei). To date, most open-type systems have been of somewhat lower quality than closed systems and have been prone to busway congestion, particularly at stations and intersections.

Another major initial operational decision involves whether to choose a ***trunk-feeder*** configuration or a ***direct services*** configuration. A "trunk-feeder" system allows smaller vehicles to be utilised in lower-density areas while the main corridors can operate more efficiently with larger, trunk-line vehicles. Although this configuration can lead to high system efficiencies, it can also mean that many customers will require a terminal transfer. By contrast, "direct services" will generally use a single vehicle to connect a residential area to the central districts of the city. Thus, direct services will help reduce the number of transfers required but potentially at the expense of operational cost efficiency. While to date direct services have been utilised within lower-quality open systems, the advent of new systems utilising "direct services" in a closed system offer the potential to deliver highly-flexible operating conditions and a high-quality service.

Unlike rail-based transit systems, BRT holds the advantage of easily accommodating a large number of route permutations. With multiple options at the disposal of the customer, the number of required transfers can be greatly reduced. ***Express*** and ***limited-stop services*** can be particularly popular with customers, especially when significant travel time savings are realised.

System capacity and speed

From a customer's perspective, a car-competitive public transport service is one that competes in terms of total travel time, comfort, cost, and convenience. Thus, designing a BRT system to handle high passenger demand in a rapid manner is one of the pillars to delivering a car-competitive service. The capacity and speed characteristics of BRT are defining features that set it apart from conventional bus services.

To date, the highest-capacity BRT system serves approximately ***45,000 passengers per hour per direction*** (Bogotá's TransMilenio). A standard BRT system without passing lanes for express services will provide a maximum of approximately 13,000 passengers per hour per direction. Most high-quality BRT systems achieve average commercial speeds of approximately ***23 to 30 kilometres per hour***.

Fig. 4
Brisbane busway.
Photo courtesy of Queensland Transport.

Achieving a high-speed and high-capacity system depends on a range of operational design characteristics, including multiple stopping bays at stations, express and limited-stop services, articulated vehicles with multiple wide doorways, off-board fare collection and fare verification, platform level boarding, and optimum station spacing. In general, the bottleneck point for most BRT systems will be vehicle congestion at the stations. Mechanisms that help to de-congest the station area and lead to rapid boarding and alighting of passengers will likely return the greatest dividends in terms of speed and capacity.

Intersections and signal control

Intersections represent a critical point along any BRT corridor. A poorly designed intersection or a poorly timed signal phase can substantially reduce system capacity. Finding solutions to optimising intersection performance can do much to improve system efficiency.

There are normally design solutions which optimise the total time savings for all modes. In developing countries, where typically the number of passengers and the number of buses per hour is much higher, where intersections tend to be fewer, and where traffic signal maintenance is less reliable, BRT system designers tend to rely more heavily on ***turning restrictions*** to improve intersection performance. Turning movements for mixed traffic vehicles, though, can be accommodated through selective turning strategies.

The efficiency of the intersection will also be influenced by the ***location of the BRT station***.

Stations located near the intersection may be more convenient at times for passengers, but a mid-block location may be preferred if mixed traffic will be turning at the intersection. Finally, priority traffic signal control can be option to consider in some circumstances.

Customer service

If a system is designed around customer needs and wants, then success is almost assured. If customer service issues are ignored, then failure is also almost assured. From the customer's perspective, small and simple measures that improve comfort, convenience, safety, and security are more important than sophisticated vehicle technologies or busway designs.

Many persons do not utilise public transport simply because they do not understand how the system works. ***Clear signage*** and system maps can do much to overcome the information barriers to usage. Electronic displays and digital voice announcements both within vehicles and stations can also ease system understandability.

Friendly, ***professional staff*** dressed in smart uniforms helps to create the right system image that bolsters customer confidence. High-quality illumination and the presence of ***security personnel*** can do much to encourage ridership, even during the late evening hours. The ***cleanliness*** and aesthetic appearance of the system infrastructure also sends a message regarding the customer friendliness of the system.

3. Physical design

Infrastructure

The system's design and engineering depends upon several key factors that will dictate the eventual form of the infrastructure. Theses factors include: cost, functional attributes, climatic and topological conditions, aesthetic attributes, and cultural preferences. The physical design and engineering of the system directly follows from the chosen operational and customer service characteristics. The corridor selected, expected capacities, and service options all influence the physical design.

The infrastructure design must encompass a wide range of system components, including ***busways, stations, intermediate transfer stations, terminals, depots, control centres, traffic control signals, integration facilities, public utilities***, and ***landscaping***. The choice of asphalt or concrete as the busway material will hold long-term ramifications on performance and maintenance costs. In general, concrete will be required at station locations in order to maintain a level platform height. Stations must be designed not only for functional purposes but also customer comfort and convenience. Passive solar design techniques can do much to moderate outside temperatures. The profile of many BRT systems has been raised through creative architectural designs for the stations. Terminals must be properly sized to efficiently handle feeder-to-trunk transfers. Likewise, depot areas must be designed to handle a range of tasks including re-fuelling, cleaning, maintenance and repair, and vehicle parking. A control centre allows system controllers to ensure a timely service to the customer as well as the ability to respond to any problems or emergencies.

Fig. 5
BRT depot in Bogotá.
Photo courtesy of TransMilenio SA

Unlike other public transport options, BRT's infrastructure costs are relatively affordable, even for a developing-nation city. In general, a BRT system will cost between ***US$1 million and US$8 million per kilometre***. The actual capital cost of the system depends on a range of factors including the complexity of the street environment, the need for flyovers or underpasses, the number of busway lanes, and the need for property acquisition. Frequently costs escalate because when reconstructing a corridor the municipality will decide to address other infrastructure issues not directly related to the BRT project. If extensive road widening and property acquisition is required, the total cost can quickly escalate. Any expropriation of property must be handled in a transparent, open, and fair manner, especially if the confidence of the international finance community is to be retained. The typical cost components within a BRT project include busways, stations, transfer stations, terminals, depots, pedestrian infrastructure, bicycle and taxi integration facilities, control centre, and property acquisition.

Technology

Few decisions in the development of a BRT system invoke more debate than the choice of bus propulsion technology and bus manufacturer. However, it should always be remembered that BRT is far more than just a bus. The choice of bus technology is important, but not necessarily more so than the myriad of other system choices.

Vehicle technology options involve both the vehicle size as well as propulsion system. For high-demand corridors, 160-passenger articulated vehicles have become standard. Feeder vehicles from lower-density residential areas will typically range from small mini-buses or vans to standard-sized buses, depending on the demand profile of the area. Innovative new technologies and fuels have substantially reduced BRT vehicle emissions. EURO III vehicle emission levels are increasingly becoming the standard worldwide. Such clean vehicle technologies include clean diesel, compressed natural gas, liquid petroleum gas, biofuels, hybrid-electric vehicles, and electric trolleys.

Fig. 6
Pedicabs can be the perfect zero-emission feeder service.
Photo courtesy of INSSA

Fare collection and verification systems also represent a range of technology options that vary by cost and features. The versatility of smart card systems has prompted many leading BRT systems to adopt this technology option. However, there also exist many lower-cost technologies that provide excellent value to the customer. Magnetic-strip technology has long been utilised in leading metro systems world-wide. Additionally, simple coin-operated machines, as applied in Quito, have proven to be a robust and highly cost-effective solution.

Finally, through ***intelligent transportation systems*** (ITS) such as real-time information displays, customers gain vital system knowledge that makes journeys more efficient and less stressful. ITS also sometimes plays an important role in system management by giving the BRT authority the power to track and control the speed and location of operators.

4. Integration

Modal integration

BRT systems cannot be designed and implemented in isolation. Instead, such systems are just one element in a city's overall urban framework and set of mobility options. To be most effective, BRT should be fully integrated with all options and modes. By maximising the BRT system's interface with other options, system designers are helping to optimise the potential customer base. The BRT system does not end at the entry or exit door of the station, but rather encompasses the entire client capture area. If customers cannot reach a station comfortably and safely, then they will cease to be customers.

If it is not convenient or easy to walk to a BRT station, then customers will be discouraged from using the system. Providing a Safe Route To Transit is therefore the first step to providing an effective BRT service. High-quality ***pedestrian access*** can be defined through design factors such as directness and connectivity, aesthetics, ease of movement, legibility, safety, and security. Mapping the quality of pedestrian facilities around the BRT station is a basic first step to identify barriers and difficulties faced by the customer. Pedestrian-only zones, shared space, and covered walkways are some of the design solutions that can encourage a strong linkage between a community and the BRT service. In general, customers prefer secure at-grade crossings over pedestrian bridges and tunnels, although the latter can also be effective if designed properly.

Integrating the BRT system with ***bicycle*** usage can significantly increase the customer catchment area. Allowing bicycles to enter the BRT vehicle permits the customer to use the bicycle as a feeder service on both sides of their journey. Alternatively, secure bicycle parking facilities at stations gives customers the confidence to leave the bicycle at the station during the day. Integrating BRT with ***taxis*** can produce a win for both the taxi operators and the BRT system. Formal taxi parking facilities next to the BRT station provides each mode with a complementary set of customers. ***Pedicabs*** are increasingly seen as a clean taxi alternative, especially for connecting BRT to nearby residential areas.

Transportation demand management and land-use

A high-quality public transport system is the "carrot" to encourage car owners to try an alternative. ***Transportation demand management*** (TDM) measures are an effective "stick" to help further discourage car and motorcycle use. Such measures include congestion charging, parking fees, vehicle ownership fees, and day usage restrictions.

Finally, BRT should also be fully integrated with ***land-use policies*** in order to ensure the growth of transit-oriented development around stations. The location of shops, services, and residences within walking distance of stations can ensure that as the city grows, the BRT system will serve the mobility needs of new residents.

5. Business plan

Business and institutional structure

The best BRT systems achieve a high quality of service not only because of the "hardware", (buses, stations, busways, and other infrastructure), but because BRT redefines the way public transport services are managed and regulated. The infrastructure investments can help the transport authority to negotiate a better quality of service from private operators. Traditional bus services tend to either operate as a single public monopoly or as thousands of individually-owned and operated businesses. Neither of these business structures have proved satisfactory in terms of delivering high-quality, subsidy-free services.

The experiences to date indicates that giving appropriate roles to both the public and private sectors can lead to optimum results for both the customer and the operator. A privately operated system through a system of ***competitively-tendered concessions*** can provide the right set of incentives for profit and customer service. In conjunction with a strong oversight role by a public agency, this type of system can deliver a high-quality product to the customer.

Bogotá's TransMilenio system provides one of the best examples of combining private sector competition with strong public oversight. In this case, there is much competition for the market but little of the competition in the market that can produce poor-quality service. Typically, concessioned ***operators are paid by the number of kilometres*** travelled rather than by the number of passengers. Further, operators can be penalised or awarded depending on their performance levels. Such incentives do much to focus operator efforts on providing a quality service.

A range of options exist over the institutional and regulatory arrangements presiding over the system. In some cases, focused ***specialised agencies*** are effective in catalysing a new type of public transport service for a city. Some cities such as Bogotá intentionally create new agencies or public companies to oversee the project's development. Bypassing the established regulatory agencies helps to create a new system unbounded by past problems and restrictions.

Alternatively, a ***single department*** with responsibility over planning, infrastructure, and operational oversight helps ensure each component of the process is mutually compatible. A single agency approach also ensures that the system accountability is clearly defined.

In all cases, a strong hands-on role by the leading political official, a Mayor or a Governor, is recommended. The direct involvement by the leading political official ensures that the project remains a priority and that any difficulties can be swiftly addressed.

Operational costs and fares

In the developing world, BRT systems should always be designed to function with no ***operational subsidies*** from the project's outset. By carefully understanding operational cost components and the expected revenues from an affordable fare level, a cost equation can be developed to the benefit of all.

If the expected passenger fare level is sufficient, then equipment items such as vehicles and even fare systems can be included as operational costs. Alternatively, equipment costs can be capitalised and included in the initial infrastructure budget financed by the public sector. The traditional components of operational costs include repayment of capital (*e.g.,* vehicle depreciation and cost of capital), fixed operating costs (*e.g.,* driver salaries, administrative costs, insurance), and variable operating costs (*e.g.,* fuel, parts, and maintenance).

The distribution of revenues relates closely to the business structure. Generally, an independently concessioned fare company will collect the passenger revenues. A "trustee" company will then distribute the revenues based on the previously agreed upon contractual arrangements. The parties that will likely receive a share of passenger revenues include trunk-line operators, feeder operators, a fare collection company, and possibly the public transport authority as well. A highly ***transparent and accountable*** revenue distribution system is imperative to ensuring the confidence and participation of all parties.

Financing

Financing is rarely an obstacle to implementing a successful BRT project. In comparison to other mass transit options, BRT's relatively low capital and operational costs puts the systems within the reach of most cities, even relatively low-income developing cities. Some developing-nation cities have actually found that loans and outside financing are unnecessary. ***Internal municipal and national funding*** may be sufficient to fully finance all construction costs. However, in the event some financing is required to implement the system, many local, national, and international resources are available to interested cities. At the local level, existing transport budgets, congestion charges, parking fees, petrol taxes, and vehicle ownership fees are all possibilities. Additionally, cities can generate revenue from property development around stations and corridors as well as from system advertising and merchandising. ***Private sector lending and investment*** may also be options to consider. Private-Public Partnerships (PPPs) typically involve private firms funding all or part of infrastructure development in exchange for exclusive, long-term operational concessions. While PPPs have a mixed record of both successes and problems, such investment schemes will likely increasingly be an option for cities to consider.

Finally, ***international development banks*** have been increasingly interested in supporting BRT projects. The World Bank has been particularly active in financing BRT initiatives.

Marketing

While marketing BRT as a new public transport option to the public is not an easy task, the public is also rarely satisfied with current transit service. The negative stigma of existing bus systems may be a formidable barrier to overcome in selling any bus-based concept, but it is also creates an opportunity to bring change. The marketing strategy will likely begin with the appropriate branding of the system through the ***system's name and logo***. System names such as TransMilenio, TransJakarta, TransMetro, and Rapid have done much to create a new image for bus-based transport.

The marketing plan will also include a ***media strategy*** involving promotions and announcements placed in newspapers, magazines, community flyers, radio, and even television. This media strategy may not only promote the new system, but also highlight public dissatisfaction with the existing system. A ***public education plan*** helps to describe the BRT concept to the public and to explain how the specific system will work. Information kiosks, demonstration stations, and direct community outreach may be some of the tools utilised by a city to introduce the new system.

6. Evaluation and implementation

Evaluation

In many respects, the success or failure of a system can be apparent from public reactions to the system. The customer's opinion is perhaps the single most important measure. However, to obtain an objective and quantifiable indication of a system's overall performance, a defined ***monitoring and evaluation plan*** is fundamental. The feedback from such a plan can help identify system strengths as well as weaknesses requiring corrective action. Projected environmental and social impact analysis may also be an important step in securing financing from an international development bank.

On-going performance indicators, such as passenger satisfaction levels, ridership numbers, on-time performance, and average travel times, will help system developers judge the system's value as well as suggest areas for improvement. Information collection will likely involve both real-time quantitative data as well as qualitative inputs from surveys.

Additionally, the system's impact on the economy, the environment, and the city's social well-being will indicate BRT's overall value to the city and may be the determining factor if further system expansion is to occur. ***Economic impacts*** can include both direct and indirect employment, shop turnover and sales, and property values. ***Environmental impacts*** will include local air quality improvements (*i.e.,* CO, NOx, PM, SOx), greenhouse gas emission reductions, and noise level improvements. ***Social impacts*** will encompass social equity issues, social interactions, and crime levels.

Implementation plan

The production of a BRT plan is not the end objective of this process. Without implementation, the planning process is a rather meaningless exercise. The final stage of the planning process should be the formal preparation for construction and full implementation.

The ***construction plan*** will address not only the physical work to be completed but the procedures to ensure the minimal disruption to the functioning of the city. The closing of roadways, the construction noise, and the blowing dust can all give the new system a negative first impression to the population. Thus, organising the construction work in a city-friendly manner should be a top consideration.

Fig. 7
The ultimate test of any public transport system is the happiness of the customer.
Photo courtesy of TransMilenio SA

A ***contracting plan*** will help to ensure that the entire process of legal and concession agreements take place in an open, transparent, and competitive environment. Many different types of contractual arrangements will be developed as the implementation process unfolds. Some of the parties to be contracted include consultants, trunk-line operators, feeder operators, fare collection company, fiduciary company, and construction firms. These contracts will specify the activities to be undertaken, the expected final products, the duration of the activity, and the means for receiving compensation.

Introduction

"By far the greatest and most admirable form of wisdom is that needed to plan and beautify cities and human communities."

—Socrates, Greek philosopher and dramatist, 469–399 BC

Effective public transport is central to development. For the vast majority of developing city residents, public transport is the only practical means to access employment, education, and public services, especially when such services are beyond viable walking and cycling distances. Unfortunately, the current state of public transport services in developing cities often does little to serve the actual mobility needs of the population. Bus services are too often unreliable, inconvenient and dangerous.

In response, transport planners and public officials have sometimes turned to extremely costly mass transit alternatives such as rail-based metros. Due to the high costs of rail infrastructure, cities often can only construct such systems over a few kilometres in a few limited corridors. The result is a system that does not meet the broader transport needs of the population. Nevertheless, the municipality ends up with a long-term debt that can affect investment in more pressing areas such as health, education, water, and sanitation. Moreover, the probable need to subsidise the relatively costly rail operations can place a continuing strain on municipal finances.

Fig. 8
Bogotá's TransMilenio system clearly illustrates the potential to provide a metro level of quality in mass transit through BRT.
Photo courtesy of Volvo Bus Corporation

However, there is an alternative between poor public transport service and high municipal debt. Bus Rapid Transit (BRT) can provide high-quality, metro-like transit service at a fraction of the cost of other options (Figure 8). This BRT Planning Guide provides municipal officials, non-governmental organizations, consultants, and others with an introduction to the concept of BRT as well as a step-by-step process for successfully planning a BRT system.

This introductory section to BRT includes the following topics:

i. Defining BRT
ii. History of BRT
iii. Public transport in developing cities
iv. Overview of the BRT planning process

i. Defining Bus Rapid Transit

"Cities are an invention to maximise exchange opportunities and to minimise travel… The role of transport is to help maximise exchange."
—David Engwicht, writer and activist (1999, p. 19)

What is BRT?

Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service. BRT essentially emulates the performance and amenity characteristics of a modern rail-based transit system but at a fraction of the cost. A BRT system will typically cost 4 to 20 times less than a light rail transit (LRT) system and 10 to 100 times less than a metro system.

The term "BRT" has emerged from its application in North America and Europe. However, the same concept is also conveyed around the world through different names, including:

- High-Capacity Bus Systems;
- High-Quality Bus Systems;
- Metro-Bus;
- Surface Metro;
- Express Bus Systems; and
- Busway Systems.

While the terms may vary from country to country, the same basic premise is followed: A high quality, car-competitive public transport service at an affordable cost. For simplicity, the term "BRT" will be utilised in this document to generically describe these types of systems. However, it is recognised that the concept and the term will undoubtedly continue to evolve. Several previous documents have also contributed definitions for BRT. These include:

> BRT is "a flexible, rubber-tired rapid-transit mode that combines stations, vehicles, services, running ways, and Intelligent Transportation System (ITS) elements into an integrated system with a strong positive identity that evokes a unique image."
> (Levinson *et al.,* 2003, p. 12)

> "BRT is high-quality, customer-orientated transit that delivers fast, comfortable and cost-effective urban mobility." (Wright, 2003, p. 1)

> BRT is "a rapid mode of transportation that can combine the quality of rail transit and the flexibility of buses" (Thomas, 2001).

All of these definitions set BRT apart from conventional bus services. In fact, the definitions tend to suggest that BRT has far more in common with rail-based systems, especially in terms of operating performance and customer service. Rather than represent a lower-quality upstart to rail interests, BRT is actually a compliment to what many urban rail systems have achieved to date. BRT has attempted to take the aspects of LRT and metro systems most cherished by public transport customers and make these attributes more accessible to a wider range of cities. The main difference between BRT and urban rail systems is simply that BRT can usually provide high-quality public transport services at a cost most cities can afford.

Today, the BRT concept is becoming increasingly utilised by cities looking for cost-effective transit solutions. As new experiments in BRT emerge, the state of the art in BRT will undoubtedly continue to improve. Nevertheless, BRT's customer focus will likely remain its defining characteristic. The developers of high-quality BRT systems in cities such as Bogotá, Brisbane, Curitiba, Ottawa, Guayaquil, and Rouen astutely observed that the ultimate objective was to swiftly, efficiently, and cost-effectively move people rather than cars.

Features of BRT

BRT can be defined more precisely through an analysis of the features offered by the system. While few systems have achieved status as a complete BRT system, the recognition of the key characteristics can be invaluable to system designers and developers. The following is a list of features found on some of the most successful BRT systems implemented to date:

1. Physical infrastructure

- Segregated busways or bus-only roadways (Figure 9), predominantly in the median of the roadway;
- Existence of an integrated "network" of routes and corridors;
- Enhanced stations that are convenient, comfortable, secure, and weather-protected;
- Stations provide level access between the platform and vehicle floor;

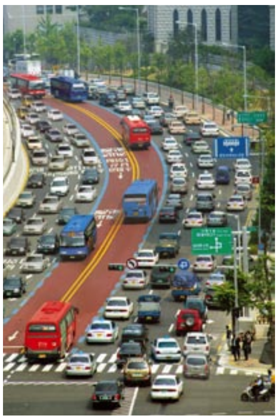


Fig. 9
Segregated median busway in Seoul.
Photo courtesy of the Seoul Development Institute

Fig. 10
At-level platforms provide rapid boarding and alighting in Quito.
Photo by Lloyd Wright

Fig. 11
High-technology vehicle on Eindhoven BRT corridor.
Photo courtesy of Advanced Public Transport Systems (APTS)

Fig. 12
Wheel-chair friendly boarding in Beijing.
Photo courtesy of Kangming Xu

- Special stations and terminals to facilitate easy physical integration between trunk routes, feeder services, and other mass transit systems (if applicable);
- Improvements to nearby public space.

2. Operations

- Frequent and rapid service between major origins and destinations;
- Ample capacity for passenger demand along corridors;
- Rapid boarding and alighting (Figure 10);
- Pre-board fare collection and fare verification;
- Fare-integration between routes, corridors, and feeder services.

3. Business and institutional structure

- Entry to system restricted to prescribed operators under a reformed business and administrative structure (*i.e.*, "closed system");
- Competitively-bid and wholly-transparent processes for awarding all contracts and concessions;
- Efficient management resulting in the elimination or minimisation of public-sector subsidies towards system operations;
- Independently operated and managed fare collection system;
- Quality control oversight from an independent entity / agency.

4. Technology

- Low-emission vehicle technologies (Figure 11);
- Low-noise vehicle technologies;
- Automatic fare collection and fare verification technology;
- System management through centralised control centre, utilising applications of Intelligent Transportation Systems (ITS) such as automatic vehicle location;
- Signal priority or grade separation at intersections.

5. Marketing and customer service

- Distinctive marketing identity for system;
- Excellence in customer service and provision of key customer amenities;
- Ease of access between system and other urban mobility options (such as walking, bicycles, taxis, paratransit, private motorised vehicles, etc.);
- Special provisions to ease access for physically-disadvantaged groups, such as children, the elderly, and the physically disabled (Figure 12);
- Clear route maps, signage, and/or real-time information displays that are visibly placed within stations and/or vehicles.

In a similar manner, Levinson *et al.,* (2003, p. 13) put forward seven principal components of BRT: 1. Runways, 2. Stations, 3. Vehicles, 4. Services, 5. Route Structure, 6. Fare Collection, and 7. Intelligent Transportation Systems. To

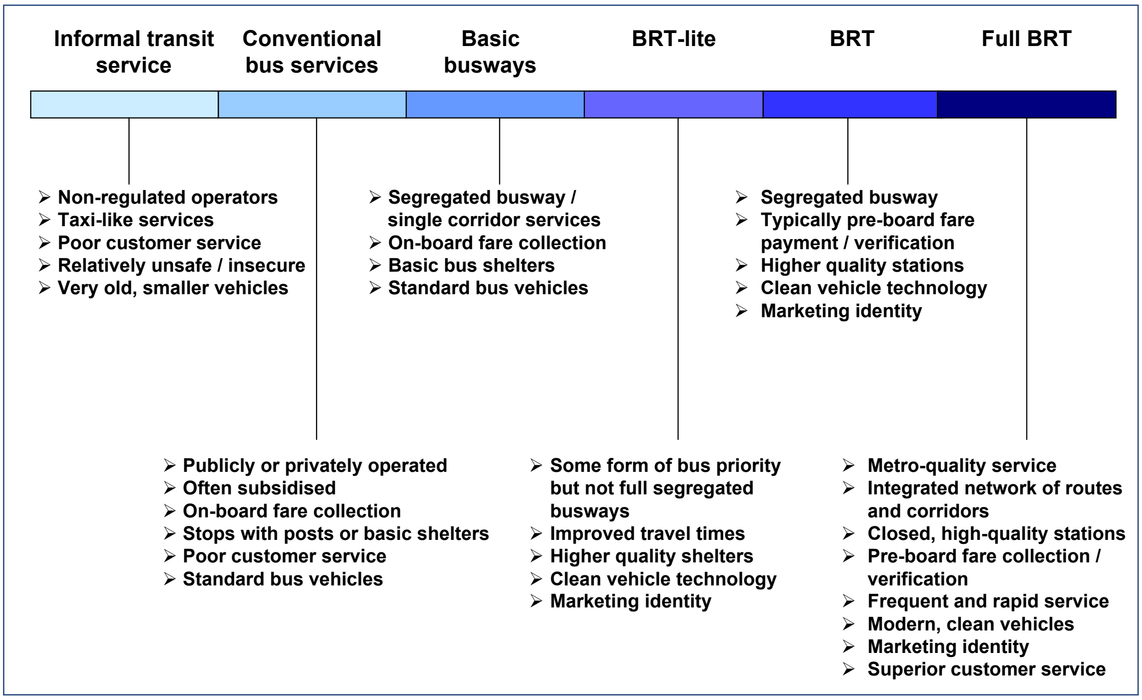


Fig. 13
The quality spectrum of tyre-based public transport.

qualify as a BRT system, each of these factors must be enhanced to quality levels well beyond those of conventional bus services.

Local circumstances will dictate the extent to which the above characteristics are actually utilised within a system. Small- and medium-sized cities may find that not all of these features are necessary or feasible to achieve within cost constraints. Nevertheless, serving customer needs first is a premise that all cities, regardless of local circumstances, should follow in developing a successful public transport service.

Full BRT and standard BRT

The difficulty in providing a precise definition of BRT stems from the wide-variety of systems currently in operation. Rather than representing a discrete set of qualities, the various BRT systems form more of a spectrum of possibilities (Figures 13 and 14). A range of local factors affect the extent to which a complete package of BRT attributes are achieved. These factors may include local preferences and culture, population density, distribution of trips, climate, geography, topography, available financial resources, local technical capacity and knowledge, existing business and institutional structures, and, perhaps most importantly, the degree of existing political will to implement a high-quality system.

Determining what qualifies as BRT is also likely to be more than the sum of a system's quantitative characteristics. Certainly system capacity, average vehicle speeds, and network size are key determinants in providing a high-quality service. However, it must also be recognised that many key characteristics of excellence in public transport services are at least partially qualitative in nature. These characteristics may include: ease of accessing system, comfort of stations and vehicles, sense of system safety and security, legibility and clarity of system maps and signs, friendliness of staff and drivers, wide-spread recognition of system name and image, and overall cleanliness and professionalism. There is clearly more to public transport than simply moving people about. A successful BRT system does not simply move persons from point A to point B. A successful BRT system invokes a feeling of confidence to its users, creates a sense of community pride, and helps to transform the very nature of a city's urban form. To date, too few public transport systems have achieved this level of impact on its citizenry.

This Planning Guide will observe a tiered approach to defining the BRT concept. The

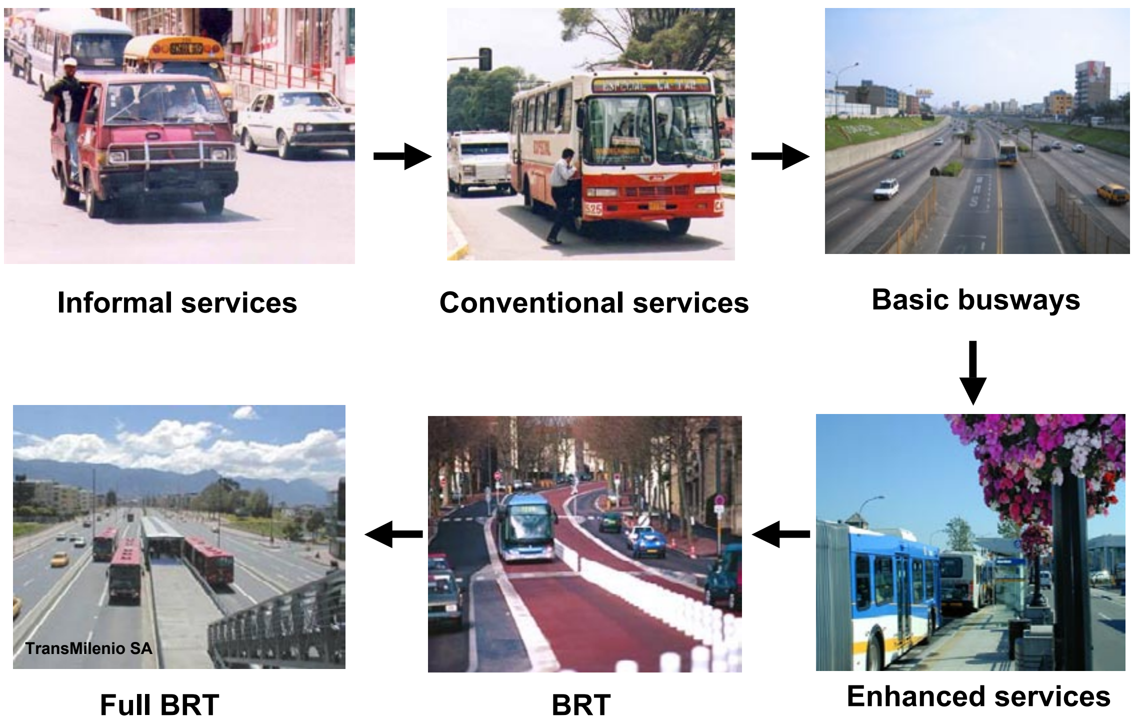


Fig. 14
Public transport evolution.

concept of "full BRT" will reside as the top tier. A system providing exemplary levels of public transport service and encompassing the most critical features of BRT will be recognised as achieving "full BRT" status. In this case, a "full" BRT system is defined as systems with the following minimum characteristics:

- Segregated busways or bus-only roadways over the majority of the length of the system's trunk / city centre corridors;
- Location of the busways in the median of the roadway rather than in the curb lane;
- Existence of an integrated "network" of routes and corridors;
- Enhanced stations that are convenient, comfortable, secure, and weather-protected;
- Stations provide level access between the platform and vehicle floor;
- Special stations and terminals to facilitate physical integration between trunk routes, feeder services, and other mass transit systems (if applicable);
- Pre-board fare collection and fare verification;
- Fare- and physical-integration between routes, corridors, and feeder services;
- Entry to system restricted to prescribed operators under a reformed business and administrative structure ("closed system");
- Distinctive marketing identity for system.

Based upon this strict definition, as of March 2007, there exists only two truly "full BRT" systems in the world:

- Bogotá (Colombia);
- Curitiba (Brazil).

This lack of a significant number of "full BRT" systems is in part due to the relatively recent nature of the BRT concept. It is also notable that "full BRT" has only occurred in the two cities with the highest levels of political commitment towards quality public transport.

Several existing systems, though, are quite close to being considered "full BRT" systems. The system in Goiânia (Brazil) just lacks the higher quality level of "full BRT". If the multiple corridors in Quito (Ecuador) were combined into a seamless network, then this city too would likely qualify. If the systems in Brisbane (Australia) and Ottawa (Canada) eventually implemented off-board fare collection and fare verification, then these systems will certainly have all the qualities of "full BRT". As the limited-corridor systems in Guayaquil (Ecuador), León (Mexico), Mexico City (Mexico), and Pereira (Colombia) expand into complete networks, then these systems will also likely qualify. As Jakarta (Indonesia) makes its feeder services more fully integrated with its trunk services, then it too will be a full BRT system. Until such upgrades are made, though, all of these systems will remain under the general "BRT" heading.

In many ways, the idea of "full BRT" is similar to defining an "ideal" public transport service. However, the most appropriate type of system for a particular city is very much dependent on local circumstances. Thus, the concept of an "ideal" or "full" BRT system may not be the right solution for a given set of local conditions. The purpose of these BRT categorisations is merely to highlight differences between existing systems. These categorisations should not be construed as necessarily implying superiority of one BRT philosophy over another.

It is also recognised that the general "BRT" term is a fairly subjective notion, depending on the features chosen to define a system. For the purposes of this Planning Guide, the term "BRT" will be reserved to systems with the following characteristics:

- Segregated busways or bus-only roadways over the majority of the length of the system's trunk / city centre corridors.

And, at least ***two*** of the following features:

- Existence of an integrated "network" of routes and corridors;
- Enhanced stations that are convenient, comfortable, secure, and weather-protected;
- Stations provide level access between the platform and vehicle floor;
- Location of the busways in the median of the roadway rather than in the curb lane;
- Pre-board fare collection and fare verification;
- Special stations and terminals to facilitate physical integration between trunk routes, feeder services, and other mass transit systems (if applicable);
- Fare-integration between routes, corridors, and feeder services;
- Entry to system restricted to prescribed operators under a reformed business and administrative structure ("closed system");
- Distinctive marketing identity for system;

- Low-emission vehicle technologies (Euro III or higher);
- System management through centralised control centre, utilising ITS applications such as automatic vehicle location;
- Special physical provisions to ease access for physically-disadvantaged groups, such as children, the elderly, and the physically disabled;
- Clear route maps, signage, and/or real-time information displays that are visibly placed within stations and/or vehicles.

Table 1 provides a list of cities that currently qualify as possessing BRT systems.

In addition to these existing systems, there are numerous BRT projects both under construction and within the planning process. Many of these new systems may open as "full BRT" systems. Further, many existing BRT systems and busway systems are being extended and undergoing improvements, and these systems likewise may soon become "full BRT" systems (*e.g.,* Jakarta and León). Tables 2 lists cities with BRT systems under construction.

In reality, there are currently more BRT systems under development than in existence. Again, this situation may say much about the significant recent upsurge in interest towards BRT systems. While such rapid expansion of BRT does pose difficulties in terms of ensuring the provision of quality technical support, the many cities involved means that there are multiple opportunities for experimentation and improvement to the existing notions of best practice. Table 3 lists cities with BRT systems in the process of being planned.

In addition to the new systems being developed as noted in Table 3, several of the existing BRT systems are in the process of extension and improvement. Table 4 therefore lists the existing systems that are currently undergoing major expansion.

As noted, the BRT concept invokes a range of both quantitative and qualitative attributes that together help to create a high-quality transit experience for the customer. Annex 1 of this document provides a comparative matrix of the many qualitative and quantitative attributes that define a BRT system. Similar type of information can also be found in several other publications including Menckhoff (2005), Levinson *et al.,* (2003), Rebelo (2003), and Mereilles (2000).

Table 1: Cities with BRT systems, as of March 2007

Continent	Country	Cities with BRT systems
Asia	China	Beijing, Hangzhou, Kunming
	India	Pune
	Indonesia	Jakarta (TransJakarta)
	Japan	Nagoya (Yutorito Line)
	South Korea	Seoul
	Taiwan	Taipei
Europe	France	Caen (Twisto), Clermont Ferrand (Léo 2000), Lyon, Nancy (TVR line 1), Nantes (Line 4), Nice (Busway), Paris (RN305 busway, Mobilien, and Val de Marne busway), Rouen (TEOR), Toulouse (RN88)
	Netherlands	Amsterdam (Zuidtangent), Eindhoven, Utrecht
	UK	Bradford (Quality Bus), Crawley (Fastway), Edinburgh (Fastlink), Leeds (Superbus and Elite)
	Germany	Essen (O-Bahn)
Latin America and Caribbean	Brazil	Curitiba (Rede Integrada), Goiânia (METROBUS), Porto Alegre (EPTC), São Paulo (Interligado)
	Chile	Santiago (Transantiago)
	Colombia	Bogotá (TransMilenio), Pereira (Megabus)
	Ecuador	Quito (Trolé, Ecovía, Central Norte), Guayaquil (Metrovía)
	Guatemala	Guatemala City (Transmetro)
	Mexico	León (Optibus SIT), Mexico City (Metrobús)
North America	Canada	Ottawa (Transitway)
	United States	Boston (Silver Line Waterfront), Eugene (EmX), Los Angeles (Orange Line), Miami (South Miami-Dade Busway), Orlando (Lynx Lymmo), Pittsburgh (Busway)
Oceania	Australia	Adelaide (O-Bahn), Brisbane (Busway), Sydney (T-Ways)

Table 2: Cities with BRT systems under construction, as of March 2007

Continent	Country	Cities with systems under construction
Africa	Tanzania	Dar es Salaam
Asia	China	Jinan, Xi'an
Europe	France	Evry-Sénart, Douai, Clermont-Ferrand (Line 1 Lohr system)
	Italy	Bologna
Latin America and Caribbean	Colombia	Bucaramanga, Cali, Cartagena, Medellín
	Venezuela	Barquisimento, Mérida (Trolmérida)
North America	United States	Cleveland
Oceania	Australia	Canberra
	New Zealand	Auckland (Northern Busway)

Table 3: Cities with BRT systems in the planning process, as of March 2007

Continent	Country	Cities with systems in the planning process
Africa	South Africa	Cape Town, Johannesburg, Port Elizabeth, Pretoria
	Other Africa	Accra (Ghana), Dakar (Senegal), Lagos (Nigeria)
Asia	China	Chengdu, Chongqing, Guangzhou, Shanghai, Shenyang, Shenzhen, Wuhan, Wuxi
	India	Ahmedabad, Bangalore, Delhi, Indore, Jaipur
	Taiwan	Chiayi, Kaohsiung, Taoyuan, Taichung, Tainan
	Other Asia	Bangkok (Thailand), Colombo (Sri Lanka), Haifa (Israel), Hanoi (Vietnam), Ho Chi Minh (Vietnam), Jerusalem (Israel)
Europe	France	Cannes, Montbéliard, Besançon, Lorient, Amiens, Metz, Nancy (Line 2), Caen (Line 2), Valenciennes/Pays de Condé, Nimes, Le Havre
	UK	Cambridge, Coventry, Kent Thames-side, Leigh
Latin America and Caribbean	Colombia	Barranquilla, Soacha (Bogotá)
	Mexico	Aguas Calientes, Chihuahua, Guanajuato, Monterrey, Querétaro, Torreón, Zapopan
	Other Latin America and Caribbean	Lima (Peru), Managua (Nicaragua), Fort-de-France (Martinique, France), Posadas (Argentina), Rio de Janeiro (Brazil), San José (Costa Rica), Tegucigalpa (Honduras)
North America	Canada	Brampton, Calgary, Durham region, Edmonton, Mississauga, St. John, Toronto, Victoria, Winnipeg
	United States	Albany, Atlanta, Baton Rouge, Charlotte, Chicago, Denver, Detroit, El Paso, Fort Collins, Hartford, Houston, Louisville, Milwaukee, Minneapolis and St. Paul, Montgomery County, New York City, Reno, Sacramento, St. Petersburg, Salt Lake City, San Diego, San Francisco, San Jose, Seattle, South Brunswick, Tampa Bay
Oceania	Australia	Melbourne

Fig. 15
A rubber-tyred vehicle on an elevated track provides public transport services between the terminals of London Gatwick Airport.
Photo by Lloyd Wright

Table 4: Existing BRT systems undergoing expansions, as of March 2007

Continent	Country	Cities with BRT systems
Asia	China	Beijing
	Indonesia	Jakarta (TransJakarta)
	South Korea	Seoul
Europe	France	Paris (Mobilien)
Latin America and Caribbean	Brazil	Curitiba, Porto Alegre (EPTC), São Paulo (Interligado)
	Chile	Santiago (Transantiago)
	Colombia	Bogotá (TransMilenio)
	Ecuador	Quito (Trolé, Ecovía, Central Norte)
	Mexico	León (Optibus SIT), Mexico City (Metrobús)
North America	United States	Boston (Silver Line)
Oceania	Australia	Brisbane

There are also rubber-tyred, fixed guideway systems utilised at many airports, including Amsterdam Schipol, Frankfurt Airport, London Gatwick (Figure 15), Orlando Airport, and Osaka Kansai International. Depending on one's definition of BRT, these systems could also be categorised as formal BRT systems. However, given the specialised nature of these systems, they are not treated as BRT in the context of this Planning Guide.

Fig. 16
Lima's "Via Expresa" was a forerunner to the modern BRT system.
Photo by Dario Hidalgo

Basic busways

This Planning Guide will mostly concentrate upon systems meeting the described standards for "BRT" with the objective of promoting "full-BRT" systems. However, it is also recognised that there exists quality public transport systems which do not fully meet the definition of BRT. There are cities that have implemented basic "busway" corridors that, while do not meet the amenity and performance standards of BRT, have helped to improve travel times for residents. In many instances, these busway systems predated BRT and have contributed immensely to the development of the BRT concept. For example, the "Via Expresa" service in Lima (Peru) was a forerunner to many of the BRT systems in Latin America and elsewhere (Figure 16). Such services provide a basic level of service that at least provides priority to public transport vehicles, leading to potential savings in travel times.

In the United States, basic busways have been utilised along freeway corridors in order to provide rapid, express services from suburban areas into city centres. The lack of stops along these corridors has produced some of the highest recorded commercial speeds for bus service operations. In such examples, the median lanes of the freeway are given over to exclusive bus use. In other cases, these lanes are designated for "high-occupancy vehicle" (HOV) use only, and buses share the lanes with other multiple-passenger vehicles. Cities such as Los Angeles, New York, and Perth (Australia) all make use of some form of freeway priority measures of public transport. Table 5 provides a list of cities with basic busways services.

While these simple busways can result in improved travel times, they typically lack the other characteristics of BRT that are key to realising a high standard of customer service. In many instances, "open" busways, which allow all operators to enter, suffer from congestion with buses backing up near stations and intersections. Thus, many of the potential travel time benefits are effectively negated by inefficiencies.

The existence of a basic busway can help set the stage for later upgrades to BRT. Prior to the development of the TransMilenio system along Bogotá's Caracas Avenue, the corridor featured a median busway. While the performance of this busway was poor due to uncontrolled op-

Fig. 17
Kunming is currently attempting to upgrade its basic busway into a BRT system.
Photo by Lloyd Wright

Table 5: Cities with basic busways, as of March 2007

Continent	Country	Cities with basic busways
Africa	Ivory Coast	Abidjan (Boulevard de la Republique)
	South Africa	Johannesburg (Soweto Highway)
Asia	China	Beijing (Qinghua Dong Road), Shejiazhuang, Shenyang
	Japan	Nagoya ("Key" Routes)
	Turkey	Ankara (Besevler-dikimevi), Istanbul (Taksim-Zincirlikuyu)
Europe	Belgium	Liege, Evry
	Italy	Genoa
	Spain	Madrid (Paseo de la Castellana)
	UK	Ipswich (Superoute 66), Runcorn
Latin America and Caribbean	Brazil	Belo Horizonte (Avenida Cristiano Machado), Campinas (Amoreiras), Manaus, Recife (Avenidas Caxangá, Joaquim Nabuco, Sul, and Herculano Bandeira), Rio de Janeiro (Avenida Brasil)
	Chile	Santiago (Avenida Grecia)
	Peru	Lima (Paseo de la República or "Via Expresa", Avenida Abancay, and Avenida Brasil)
	Trinidad and Tobago	Port of Spain
North America	United States	Los Angeles (San Bernardino Freeway, Harbor Freeway), New York City (Lincoln Tunnel), Philadelphia (Ardmore busway), Providence (East Side bus tunnel)
Oceania	Australia	Perth (Kwinana Freeway)

Fig. 18 and 19
While corridors such as the Los Angeles Metro Rapid service on Wilshire Boulevard (left photo) or the Vancouver B-Line (right photo) may not be "full" BRT systems, they do represent an improvement for users.
Photos courtesy of the National Bus Rapid Transit Institute (NBRTI)

erations and severe congestion, the existence of the infrastructure set a precedent from which the new system could evolve. In a similar manner, the Kunming busway system is currently undergoing an upgrade towards BRT status (Figure 17). Thus, in many instances, busways may represent an early stage of development towards the realisation of a BRT system.

Enhanced bus services

In addition to busways, there exists another category of bus services that deserves special notice. This Planning Guide has made a segregated busway a requirement in order for a system to be labelled as a BRT system. However, there are several systems that possess many of the other qualities of BRT but do not have a significant busway component. In some instances, these systems may utilise bus lanes or even run amongst mixed traffic. These type of systems will be termed "Enhanced Bus Services". Some authors also refer to such systems as "BRT Lite". Most of these "Enhanced Bus Services" are found in developed nations, especially in Europe and North America. In the context of cities with low public transport usage and low-density development, the difficulty in procuring exclusive right-of-way for public transport vehicles can be significant.

Nevertheless, systems in Europe, North America, and elsewhere have added BRT-like enhancements to conventional bus services, and in the process, have achieved marked improvements in travel times and patronage (Figures 18 and 19). Such "Enhanced Bus Services" include systems in the cities of Hong Kong, Boston

(US), Las Vegas (US), London, Los Angeles, Oakland-San Pablo (US), Vancouver (Canada), and York (Canada). Table 6 provides a listing of some of the systems regarded as "Enhanced Bus Services".

London's bus network serves 5.4 million passenger trips each day, far exceeding the city's underground metro system. London is one of the few cities in the world in which bus ridership has consistently risen over the past ten years (Figure 20). London's success has been predicated upon four broad goals of service quality: 1. Frequency ("turn up and go" service with waits of 12 minutes or less); 2. Reliability (enforced bus lanes); 3. Comprehensiveness; and 4. Simplicity. To accomplish these goals, London has implemented many BRT-type features within a conventional bus service:

- Accessible low-floor vehicles for fast boarding and alighting;
- Pre-board fare collection in central areas;
- Real-time information displays at stations;
- Quality incentive contracts with concessioned operators;
- Enhanced driver training;
- Priority lane measures.

Box 1: Bus lanes or busways

Bus lanes and busways are quite different in design and effectiveness. While some well-demarcated and well-enforced bus lane systems in developed nations have succeeded (*e.g.,* London), in general, bus lanes alone, particularly those situated in the curb lane, do little to enhance the effectiveness of public transport. Bus lanes are street surfaces reserved primarily for public transport vehicles on a permanent basis or on a specific hourly schedule. Bus lanes are not physically segregated from other lanes. While the lanes may be painted, demarcated, and sign-posted, changing lanes is still feasible. In some cases, bus lanes may be shared with high-occupancy vehicles, taxis, and/or non-motorised vehicles. Bus lanes may also be open to private vehicle usage near turning points.

Busways are physically segregated lanes that are permanently and exclusively for the use of public transport vehicles. Entrance to a busway can only undertaken at specific points. The busway is segregated from other traffic by means of a wall, curbing, cones, or other well-defined structural feature. Non-transit vehicles are generally not permitted access to a busway although emergency vehicles often also may utilise the lane. Busways may be at surface level, elevated, or underground, but if located on a mixed traffic arterial tend to be in the median of the roadway. BRT systems typically consist of busway infrastructure.

Table 6: Cities with Enhanced Bus Services ("BRT-Lite"), as of Jan. 2007

Continent	Country	Cities with enhanced bus services
Asia	China	Hong Kong
Europe	UK	London
	Italy	Trieste
	Netherlands	Almere
Latin American and Caribbean	Puerto Rico (US Commonwealth)	San Juan (Río Hondo Connector)
North America	United States	Alameda and Contra Counties (AC Transit Rapid Bus), Albuquerque (Rapid Ride), Boston (Silver Line Washington Street), Chicago (NEBR), Denver (16th Street Mall), Honolulu (City / County Express), Kansas City (MAX), Las Vegas (MAX), Los Angeles (Metro Rapid Wilshire Boulevard), Phoenix (RAPID), Santa Clara (VTA)
	Canada	Gatineau, Halifax, Quebec City (Metrobus), Montreal (STM R-Bus 505), Vancouver (B-Line), York (Viva)

Fig. 20
London's use of camera-enforced bus lanes and off-board fare payment has improved system performance considerably.
Photo by Lloyd Wright

While London has not strictly implemented busways, the frequent use of well-demarcated and enforced bus lanes has helped to increase average speeds and overall reliability. Hong Kong has achieved many of the same successes as London with priority bus lanes, integrated fare structures with other mass transit options, incentive-based contracts with concessioned operators, and higher-quality vehicles.

AC Transit's "Rapid Bus" in the San Francisco Bay Area and the "Viva" service in York have set high standards in terms of customer service and performance. Both the AC Transit "Rapid Bus" and the York "Viva" systems utilise innovations such as queue-jumper lanes and signal priority at intersections to give to transit vehicles priority over other traffic. The Viva system has also installed fare machines at stations to facilitate pre-board fare collection. Thus, these systems have done much to replicate many of the features of BRT but in situations where segregated busways are not yet possible.

Likewise, the new MAX system in Las Vegas utilises the Civis vehicles that were originally popularised in French systems. Las Vegas has attempted to employ an optical guidance system for docking vehicles at the system's modernistic stations.

As many of these enhanced systems exemplify, whether a system is termed "BRT" or not may be less relevant than the quality of the service provided and the degree to which continual improvement is achieved. Most conventional bus services can be upgraded substantially by considering some of the low-cost customer service enhancements that are evident in BRT systems. Further, in many instances, these "Enhanced Bus Services" may well be upgraded to BRT status with the later addition of exclusive busways. The second phase of the York Viva system calls for the development of exclusive busways.

However, there are limitations to the extent that technology-based solutions alone will create a high-quality public transport service. Many of the enhanced bus services, especially in the US, rely upon expensive vehicle technology alone to create a new system image. New vehicles, though, will do little to encourage new ridership if other changes, such as priority access, are not also addressed. High technology is not a substitute for the political leadership required to give a clear priority to public transport. Enhanced bus services must thus avoid the risk of placing flair over substance in terms of providing real value to the customer.

What BRT is not

BRT has little in common with conventional bus services. For much of the world, conventional bus services are slow, infrequent and inconvenient, uncomfortable, and distinctly lacking in status and service. Systems invoking small, cosmetic changes to conventional services are unlikely to reap the benefits witnessed in the best BRT systems to date. Bus services carry a long-standing negative stigma regarding poor operational performance and inadequate customer service. "Public transport" often brings with it the same connotation of unpleasantness as "public toilets" can. Overcoming this negative image requires a complete revamping of every aspect of service and operational performance. The "BRT" banner should not be expropriated to systems that make only a marginal effort towards performance improvement.

BRT should also not be confused with "bus lanes". In many cities, a lack of enforcement has rendered bus lanes to be grossly ineffective (Figures 21 and 22), particularly when located in the curb lane. In such instances, bus lanes are a token gesture to public transport customers, and have made only a small difference in service quality. Box 1 discusses the differences between busways and bus lanes in more detail.

Temporary parking by taxis and delivery vehicles can do much to degrade the usefulness of the bus lane. In such cases, buses will likely just cease to make use of the lanes (Figures 23 and 24).

In other instances, bus lanes have been regularly enforced and do provide a discernible service improvement. For example, the colour coding and camera enforcement of the London bus lanes have served to maximise the usefulness of the lanes. However, due to the unavoidable conflicts from turning vehicles and limitations in narrow street configurations, even well-managed bus lanes will unlikely ever match the efficiency of a full busway. Further, enforcement by traffic police can wane with time and new political ad-

Fig. 21▲
A "bus-only" street in San José (Costa Rica) is invaded by private vehicles.
Photo by Lloyd Wright

Fig. 22▲
The view from the front of a Mexico City bus travelling in a "bus-only" lane.
Photo by Lee Schipper

ministrations. The bus lanes in Bangkok worked reasonably well when first introduced in 1973, but in a short time the traffic police decided not to enforce private vehicle intrusions and thereby rendered the scheme ineffective.

ii. History of BRT

"If you want to make an apple pie from scratch, you must first create the universe."
—Carl Sagan, scientist and writer, 1934–1996

The predecessors to BRT

BRT's history resides in a variety of previous efforts to improve the public transport experience for the customer. While the modern era of BRT development is credited to the opening of Curitiba's system in 1974, there were several efforts prior to Curitiba that helped to establish the idea. Further, BRT has also benefited greatly from applications of high-quality urban rail systems. In many respects, BRT has borrowed concepts from light rail and metro rail systems in order to provide a quality customer experience but at a lower cost than traditional rail systems.

The origins of the BRT concept can be traced back to 1937 when the city of Chicago outlined plans for three inner city rail lines to be converted to express bus corridors. Exclusive

Fig. 23◀ and 24▼
In cities diverse as Sydney (left photo) and São Paulo (photo below), the intent of bus lanes are thwarted by constant invasions from delivery vehicles, taxis, and other obstructions.
Left photo courtesy of Todd Litman;
Right photo by Lloyd Wright

busway plans were developed for several other cities in the US, including: Washington, DC (1955-1959), St. Louis (1959), and Milwaukee (1970) (Levinson *et al.,* 2003).

However, actual implementation of bus priority measures did not occur until the 1960s with the introduction of the "bus lane" concept. In 1963, counter-flow express bus lanes were introduced in the New York City area. A year later, in 1964, the first "with-flow" bus lane was implemented in Paris.

In 1966, the first dedicated median busways appeared in the US (in St. Louis) and in Belgium (in Liege) as a result of converting tram systems to bus use. The first high-speed busway was constructed in the United States in 1969 with the opening of the first 6.5-kilometre section of the Shirley Highway Busway in Northern Virginia (Figure 25). In 1971, the city of Runcorn (UK) opened a busway corridor which also acted as a catalyst for new town development.

The first developing-nation busway was developed in Lima (Peru) with the 1972 introduction of a basic, dedicated busway known as "Via Expresa". The Via Expresa covers a distance of 7.5 kilometres, and still provides an effective, albeit basic, service to the area. The arrival of the first "bus-only" street was also in 1972 with the conversion of London's Oxford Street from a major traffic route to a bus-and-taxi only street. One year later in 1973, the 11-kilometre El Monte busway was developed in Los Angeles (Figure 26).

Fig. 25
The Shirley Highway busway in Arlington (US) was amongst the first median busway efforts.
Image courtesy of the US TCRP Media Library.

Fig. 26
An advertisement attempting to lure motorists out of their cars for the El Monte busway in Los Angeles.
Image courtesy of US TCRP media library.

Modern BRT systems

"When you have little money, you learn to be creative."

—Jaime Lerner, former Mayor of Curitiba

BRT's full promise was not realised, though, until the arrival of the "surface metro" system developed in Curitiba (Brazil) (Figure 27). The first 20-kilometres of Curitiba's system was planned in 1972, built in 1973, and opened for service in 1974. In conjunction with Curitiba's other advancements with pedestrian zones, green space, and innovative social programmes, the city became a renowned urban success story across the world. Ironically, Curitiba initially aspired to constructing a rail-based metro system. However, a lack of sufficient funding necessitated a more creative approach. Thus, under the leadership of Mayor Jaime Lerner, the city began a process of developing busway corridors emanating from the city centre.
Like many Latin American cities at the time, Curitiba was experiencing rapid population growth. Beginning at a level of some 600,000 residents in the early 1970s, the city now has over 2.2 million inhabitants.

In much of Latin America, private sector operators had dominated the public transport market. However, left uncontrolled and unregulated such operators did not meet the needs of commuters in terms of comfort, convenience, or safety. Lacking the resources to develop either a rail-based transit system or a car-based urban form, Mayor Lerner's team created a low-cost yet high-quality alternative utilising bus technology. Today, Curitiba's modernistic "tubed" stations and 270-passenger bi-articulated buses represent a world example. The BRT system now has five radial corridors emanating from the city core. Construction of a sixth corridor is now underway through funding provided by the Inter-American Development Bank (IADB). Currently, the Curitiba system features 65 kilometres of exclusive busways and 340 kilometres of feeder services. The system annually attracts hundreds of city officials from other municipalities, all seeking to study the organisational and design features that have shaped Curitiba's success. The success of Curitiba's BRT system has propelled the career of Jaime Lerner, the political backer of the original concept, as he has been twice elected as Mayor and twice elected as Governor of the state of Paraná in Brazil.

The oil crisis of the early seventies put pressure on many governments to find quick ways to improve public transport. Thus, the 1970s represented a relative flurry of activity regarding early busways. The potential for busways to encourage public transport usage was recognised in the United States through reports by the National Cooperative Highway Research Program (NCHRP) in 1973 and 1975. These reports highlighted the benefits of bus use on highways as a form of rapid commuting. Likewise, the publication in 1976 of busway design guidelines by the Paris transit operator, Régie Autonome des Transports Parisiens (RATP), helped to propel busway interest in France. With Curitiba serving as example, several other Brazilian cities followed this model with basic systems being deployed in São Paulo (1975), Goiânia (1976), Porto Alegre (1977), and Belo Horizonte (1981) (Meirelles, 2000). The São Paulo BRT system is currently the largest in the world with 142 kilometres of exclusive busways serving over two million passenger-trips each day.

With the development of these early systems, the World Bank also came to recognise the potential of busways through its 1975 urban transport policy paper. Subsequently the World Bank went on to finance the first busway in Africa (in Abidjan, Ivory Coast) in 1977. The city of Pittsburgh (United States) also opened its first busway in 1977.

Fig. 27
Under the leadership of former-Mayor Jaime Lerner, Curitiba became a world leader in effective public transport.
Photo courtesy of Volvo Bus Corporation

Despite Curitiba's success and relative fame within the transport planning profession, the overall replication of the BRT concept stalled over the next decade. As the first oil crisis receded, governmental interest with public transport began to wane. At the same time, short-sighted private bus operators, enjoying stable or increasing ridership, resisted BRT system developments for fear of losing the benefits of minimal taxation and weak regulation. Nevertheless, the 1980s did see the advent of the first "guided busways". As an alternative to a planned light rail system, the city of Essen (Germany) opened its guided system in 1980 (Figure 28). This innovation uses side guide wheels to control

Fig. 28
In 1980, Essen became the first system using a mechanical guidance system.
Photo courtesy of the TCRP Media Library

Fig. 29
Quito's "Trole" line provided an early example of BRT in Latin America.
Photo by Lloyd Wright

Fig. 30
The BRT systems in Rouen (photo above) and other cities of France have introduced many new features, especially high-technology vehicles and guidance systems.
Image courtesy of Connex

vehicle movement within a track roughly the width of a bus. Adelaide (Australia) followed with a guided busway of its own in 1986. Eventually, the guideway concept did make it to a few other cities, including the UK cities of Ipswich (1995), Leeds (1995), and Bradford (2002) as well as the Japanese city of Nagoya (2002). However, due to the relatively high cost of the guided busway infrastructure, the concept has seen relatively little further adoption.

It was only in the late 1990s that BRT's profile became more widely known. By the late 1990s, many bus operators in Latin America faced a crisis of declining ridership due to competition from private motor vehicles and informal sector minibuses, and this moderated the resistance to change. In 1996, Quito (Ecuador) opened a BRT system using electric trolley-bus technology (Figure 29). Quito then added its "Ecovía" corridor in 2001 and its "Central Norte" corridor in 2005. Beyond Latin America, the 1990s saw the first interest in BRT in Asia. In 1999, Kunming developed the first median busway system in China. Taipei (Taiwan) also has developed a median busway system with the first put into place in 2001. Likewise, renewed interest from developed-nation cities also sparked in the late 1990s with new systems being implemented in Vancouver (Canada) in 1996, Miami (US) in 1997, and Brisbane (Australia) in 2000.

In France during the late 1990s, innovations in vehicle technology produced a blurring of the distinction between BRT and light rail. Vehicles such as the Civis by Irisbus and the TVR (Transport sur Voie Reservée) by Bombardier have utilised a rounded body and covered wheels to produce a highly-sophisticated product. The systems in Caen (2002), Clermont-Ferrand (2001), Lyon (2004), Nancy (2001), and Rouen (2000) have utilised these types of vehicles (Figure 30). The "TEOR" BRT system in Rouen is particularly sophisticated through the use of an optical guidance system.

The Bogotá transformation

Even by the 1990s, though, BRT was not seen as a serious mass transit option capable of full rail-like service. BRT was more of a niche market for small- and medium-sized cities (*e.g.,* Curitiba) or as a lower-quality alternative for a few isolated corridors (*e.g.,* São Paulo). Transport engineers widely believed that BRT could not comfortably serve more than 12,000 passengers per direction per hour per lane at any reasonable speed. However, the advent of the "TransMilenio" BRT system in Bogotá has now radically transformed the perception of BRT around the world (Figure 31). As a large-sized city (7.0 million inhabitants) and a relatively dense city (240 inhabitants per hectare), Bogotá has provided the proof that BRT is capable of delivering high-capacity performance for the world's megacities.

The main ingredient in Bogotá was a visionary Mayor, Enrique Peñalosa, who recognised that

Fig. 31
In just a few years time, Bogotá planned and constructed the first phase of its world-leading BRT system.
Photo courtesy of TransMilenio SA

the timely delivery of a quality mass transit network could not be achieved through expensive rail technologies. Instead, Mayor Peñalosa and his team examined the experiences of cities like Curitiba, Goiânia, and Quito, and concluded that BRT could work for Bogotá as well. In the course of just a few short years, the first phase of Bogotá's TransMilenio system came to fruition with a launch in December 2000. As of March 2007, the TransMilenio system encompasses 84 kilometres of trunk corridors and 420 kilometres of feeder routes. At this time, the system is moving over 1.2 million passenger-trips per day. By the time the entire system is completed in 2015, an estimated five million passenger-trips per day will be served over a trunk network of 380 kilometres.

Simultaneously, Bogotá has implemented many complementary measures that support public transport usage. These measures include 300 kilometres of new cycleways, pedestrian and public space upgrades, a Sunday closing of 120 kilometres of roadway to private motorised vehicles (Figure 32), and the world's largest car-free weekday. Additionally, Bogotá has implemented car restriction measures through parking restrictions and a programme that only permits peak-hour vehicle use on certain days, based on one's license plate number.

Today, with both Bogotá and Curitiba acting as catalytic examples, the number of cities with actual BRT systems or with systems under development is quite significant. Most new BRT systems owe a direct lineage to the experiences of these two cities.

The influence of the Curitiba experience has directly assisted the launching of BRT initiatives in other cities, such as Seoul (2004) and Beijing (2005). Further, in 1998, the Administrator of the United States Federal Transit Agency (USFTA), Gordon Linton, visited the Curitiba BRT system. Based on the findings of this visit, a national BRT initiative was launched in the United States. For many US cities, the combination of high automobile ownership and low-density sprawl development has made the development of rail systems difficult from a standpoint of financial viability. Today, the US BRT programme of the USFTA encompasses 17 demonstration/partner cities. In November 2005, the 17-kilometre Orange Line opened in Los Angeles. Further, three high-quality BRT systems are being constructed, in Eugene, Cleveland, and Las Vegas. The extent to which these new systems can encourage mode switching from cars to public transport will determine how successful BRT can be in the context of car-dependent nations such as the US.

Like Curitiba, Bogotá's influence has been felt far and wide across the globe. Since TransMilenio's inception in 2000, Bogotá has hosted both major public transport conferences as well as specialised technical missions from a range of

Fig. 32
Bogotá hosts a range of innovative transport and public space measures, including a closing of streets to car traffic on Sundays.
Photo by Lloyd Wright

Fig. 33
Over 1,000 transport professionals from more than 30 countries have travelled to Bogotá to experience the TransMilenio system.
Photo courtesy of Fundación Ciudad Humana

cities (Figure 33). In part due to visits to Bogotá, the following cities have undertaken BRT efforts: Barranquilla, Bucaramanga, Cali, Cartagena, Guatemala City, Guayaquil, Juarez, Lima, Managua, Medellín, Mexico City, Panama City, Pereira, Querétaro, San José, Santiago, Soacha, Accra, Dar es Salaam, Delhi, Guangzhou, and Jakarta. Clearly, a few highly successful efforts, such as Bogotá and Curitiba, can have profound ramifications around the globe.

iii. Public transport in developing cities

"The newly motorising countries can see what a mess the North has made and how inefficient are its very large investments in a transport system that fails to deliver health, social equity and regional equity. It is possible for a newly motorising country to leapfrog the last 40 years of European and the last 70 years of North American transport development and move directly into a sustainable strategy that genuinely conserves resources, reduces pollution and pays great attention to the poorest when disbursing scarce cash."

—John Whitelegg, author and lecturer, (1997, p. 220)

For much of the world's population, public transport is a necessary evil that must be endured rather than appreciated. For many individuals and families, the ultimate goal is to one day afford individual motorised transport, either in the form of a motorcycle or automobile. The state of public transport implies discomfort, long waits, risk to personal safety, and restrictions on movement. Customer satisfaction with the myriad of informal and formal vans, minibuses, and full-sized buses that ply developing city streets is typically extremely low.

Under such conditions, it is not surprising that such services are losing passengers at alarming rates. The private vehicle continues to make gains in virtually every city. If present trends continue, public transport may have a rather doubtful future. As incomes rise in developing nations, private vehicles are gaining usage while public transport's ridership is almost universally declining. A selection of developing cities indicates that public transit systems are typically losing in the area of between 0.3 and 1.2 percentage points of ridership each year (Table 7) (WBSCD, 2001).

The reasons for public transport's demise are not difficult to discern (Figures 34 through 37). Poor public transport services in both the developed and developing world push consumers to private vehicle options. The attraction of the private car and motorcycle is both in terms of performance and image. Public transport customers typically give the following reasons for switching to private vehicles:

1. Inconvenience in terms of location of stations and frequency of service;
2. Failure to service key origins and destinations;
3. Fear of crime at stations and within buses;
4. Lack of safety in terms of driver ability and the road-worthiness of buses;
5. Service is much slower than private vehicles, especially when buses make frequent stops;
6. Overloading of vehicles makes ride uncomfortable;
7. Public transport can be relatively expensive for some developing-nation households;

Table 7: Changes over time in daily average public transport trips, selected cities (includes bus, rail, and paratransit)

	Earlier Year				Later Year			
City	**Year**	**Population (million)**	**Public Transport Trips/day**	**Percent of all Trips**	**Year**	**Population (million)**	**Public Transport Trips/day**	**Percent of all Trips**
Mexico	1984	17.0	0.9	**80**	1994	22.0	1.2	**72**
Moscow	1990	8.6	2.8	**87**	1997	8.6	2.8	**83**
Santiago	1977	4.1	1.0	**70**	1991	5.5	0.9	**56**
Sao Paolo	1977	10.3	1.0	**46**	1997	16.8	0.6	**33**
Seoul	1970	5.5		**67**	1992	11.0	1.5	**61**
Shanghai	1986	13.0	0.4	**24**	1995	15.6	0.3	**15**
Warsaw	1987	1.6	1.3	**80**	1998	1.6	1.2	**53**

Source: WBCSD, 2001




Fig. 34, 35, 36, and 37
Public transport options in today's developing-nation cities are often quite poor (photos clockwise from top left):
1. Dar es Salaam
(photo by Lloyd Wright)
2. Dhaka
(photo by Karl Fjellstrom)
3. Manila
(photo by Lloyd Wright)
and
4. Santo Domingo
(photo by Lloyd Wright)

8. Poor-quality or non-existent infrastructure (*e.g.,* lack of shelters, unclean vehicles);
9. Lack of an organised system structure and accompanying maps and information make the systems difficult to understand; and
10. Low status of public public transport services.

However, the demise in public transport is not pre-ordained. BRT is public transport's response to this decline, with an attempt to provide a car-competitive service. Recent BRT experience demonstrates that it is possible to ensure urban mobility which is independent from ever-increasing car congestion, thereby generating considerable economic and environmental benefit.

With the introduction of the TransMilenio BRT system in Bogotá, public transit ridership has actually increased in that city. Although the system had only opened two of its 22 planned lines in December 2000, the system achieved an immediate 6 percent of transport mode share. Private vehicle usage declined from 18 percent of daily trips in 1999 to 14 percent in 2001 (Como Vamos Bogotá, 2001). A more detailed study along the TransMilenio corridor indicates that the system captured nearly 10 percent of trips that would have been otherwise undertaken by private vehicle. (Steer Davies Gleave, 2003). Curitiba's BRT system witnessed a similar increase when initially opened, and was able to increase ridership by over 2 percent a year for over two decades, enough to maintain the public transport mode share when every other Brazilian city was witnessing significant declines.

BRT attempts to address each of the identified deficiencies in current services by providing a rapid, high quality, safe and secure public transport option.

iv. Overview of the BRT planning process

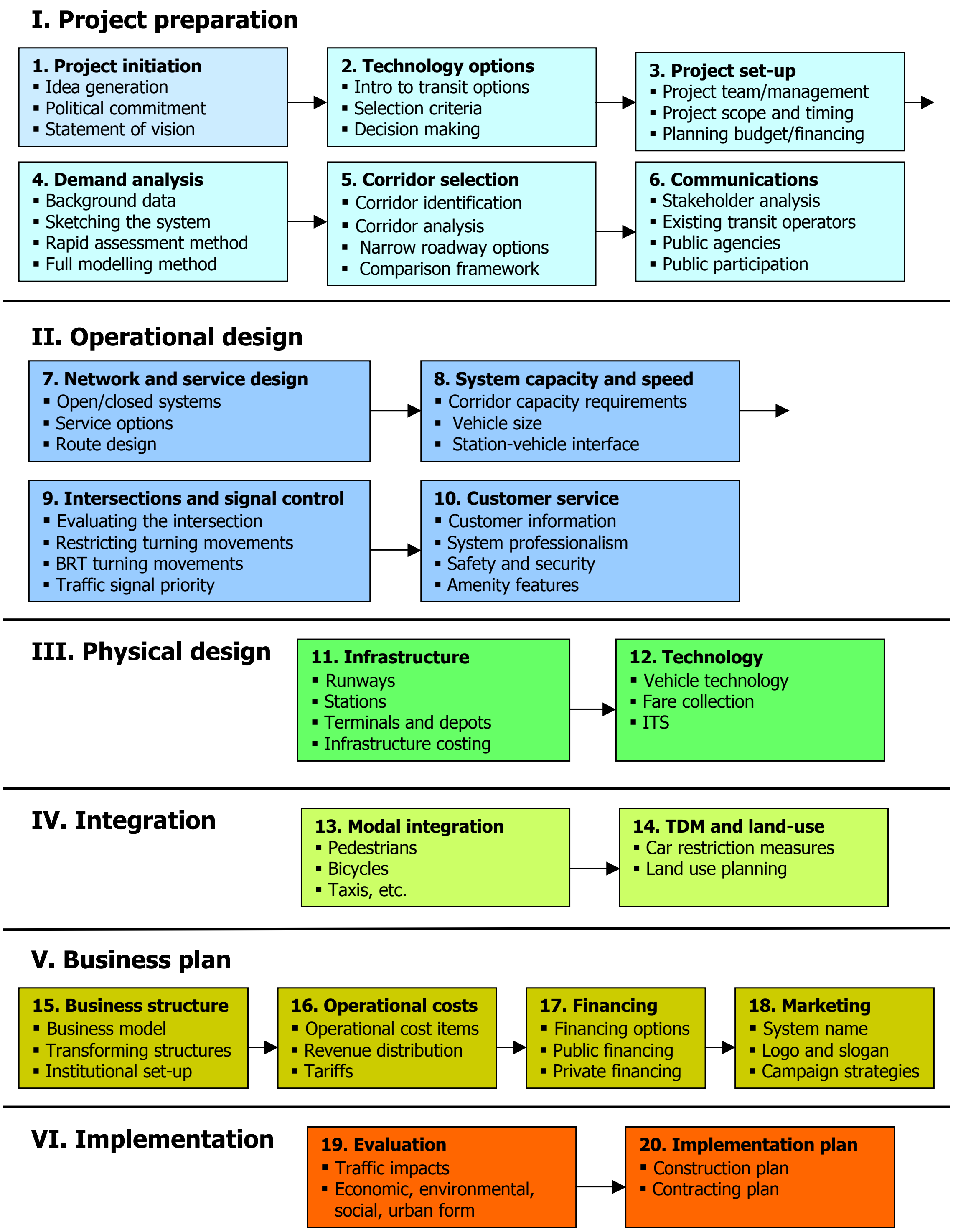
"Plans are nothing; planning is everything."
—Dwight D. Eisenhower,
former US President, 1890–1969

This BRT Planning Guide seeks to help build the institutional and technical capacity of developing city municipalities that are interested in achieving improved public transport services. This section provides an overview of the structure and contents of a BRT plan. While these planning elements have been extracted from some existing BRT plans, it must be recognised that planning practices vary greatly by location and circumstances. Thus, actual BRT plans in a particular city may necessitate other elements which are not discussed in this Planning Guide.

Outline of the planning process

The exact nature of any city's BRT plan depends greatly on local circumstances. Most plans are a combination of rational analysis and advocacy for a particular set of solutions and interventions. Frequently a "pre-feasibility" study is largely an advocacy tool to give the public and decision-makers a general idea of what BRT might look like in their city as they consider various options, while a feasibility study would be a more serious analysis of the viability of BRT once a preliminary decision has been

Fig. 38
Overview of the BRT planning process



made. The less secure the political commitment, the more important the plan is as an advocacy tool. The stronger the political commitment, the more urgent is the need for the planners to provide accurate information to decision-makers about how to implement the project successfully in a timely manner.

Promoters of BRT must enter into whatever planning process exists in a particular city. The content and order of the planning process may be partly determined by code and law. In some cities transportation master plans are powerful legal documents, in other cases they are a meaningless compendium of various projects being pushed by different promoters, and in other cases there is no transportation master plan. Some cities and financial institutions may require a detailed "cost-benefit analysis" before public funds can be expended; others may have entirely ad hoc off-budget mechanisms for financing major projects.

Ideally, a BRT plan should grow out of an earlier transportation master planning process, which in turn grew out of an integrated urban development plan. The transportation planning process should start with an analysis of the level of existing and projected future transport demand in all major corridors, and should then proceed to an analysis of alternatives for addressing these mobility and access needs with the greatest benefit and the least cost, within the constraints of available resources. Ideally, this process should be done with extensive stakeholder participation throughout.

In very few cities, however, is the transportation planning process ideal. Objective, rational assessment of alternatives is the exception rather than the rule. In many developing country cities, BRT was largely unknown until recently, so having BRT emerge out of a rational transportation master planning process was unlikely. Furthermore, most transportation plans are developed as the result of support from the promoters of a specific public transport technology. Resources for an objective analysis of alternatives are rarely available. As a general rule, though, proponents of BRT would benefit from a wholly transparent and rational planning process.

If several competing mass transit proposals are already in active discussion, it will be insufficient to merely prepare a basic appraisal of the potential feasibility of BRT. A realistic estimate of BRT ridership and modal shift potential will need to be coupled with a thorough analysis of the alternatives presented, including an analysis of the soundness of the data and the methodologies used. In the developed world there is a formal certification process that is emerging for such proposals, but in the developing world the proposals of project proponents are rarely subjected to rigorous scrutiny.

Most of the planning information presented in this guide will be most useful once decision makers have already decided that a BRT project should go forward. However, the following chapter on transport technology aims to assist with a rough assessment of likely alternative proposals.

An overview of the entire BRT planning process is provided in Figure 38. This planning template is based upon BRT planning documents from several cities. Not all cities need to follow this process, but it is hoped that the planning template will help reduce the amount of time required to move from the conceptual phase through to implementation. The sharing of BRT planning documents from other cities also presents an opportunity to greatly reduce planning costs. A focused BRT planning process can be reasonably completed in a period of 12 to 18 months.

Figure 38 identifies five major activities in the realisation of a BRT plan:

1. Project preparation;
2. Operational design;
3. Physical design;
4. Integration;
4. Business plan;
5. Evaluation and implementation.

This guidebook will detail the content of each of these planning activities.

The planning stages outlined in this guide are presented in roughly chronological order. However, BRT planning is an iterative process. There is significant interaction between the different stages, and many activities must be undertaken simultaneously. For instance, the financial analysis should influence infrastructure and technology decisions, and routing decisions should impact busway design options. In this sense, each topic should be addressed in

Table 8: Constituent planning components

Planning component	Description
Pre-feasibility study	Early study to document options for improving the city's public transport conditions.
Feasibility study	The feasibility study attempts to prove the financial, institutional, and physical viability of a particular transit option; this stage frequently involves a "cost-benefit analysis".
Transport demand modelling	Existing transport demand is documented on the major city corridors of interest.
Stakeholder analysis and communications plan	At the outset, a communications plan for key stakeholders such as existing transit operators should be conducted.
Conceptual study • Operations • Infrastructure • Modal integration • Technology • Business and institutional structure • Costing and financing • Impact analysis	The conceptual plan is a rapid overview of each major planning component. The idea is to quickly cover each aspect of the plan in order to gain a general sense of the project prior to committing further planning resources.
Detailed BRT plan • Operations • Infrastructure • Modal integration • Technology • Costing	The core of the BRT planning process consists of the design and technical specification process. Likewise, detailing the business and institutional structures, along with detailed cost analyses, is key to ensuring the system's financial viability.
Business and institutional plan	This plan establishes the structural relationship between the public and private sectors. The business plan helps to ensure that the system is financially viable from an operational standpoint.
Detailed engineering design	Once the body of the BRT plan is approved, then a highly detailed analysis of each physical component is conducted; every metre of busway infrastructure is designed in detail.
Financing plan	As a complete cost analysis is completed, the exact financing requirements become known and can be fully addressed.
Marketing plan	The marketing plan involves developing the system's name, logo, and outreach campaign.
Impact analyses	Once the final technical plan is approved, more precise analyses of traffic, economic, environmental, social, and urban impacts can be undertaken.
Implementation plan	As the project moves toward implementation, construction contracts and timelines must be developed.

an iterative manner. Different scenarios may be attempted until an optimum solution is reached.

Proper planning brings with it an array of well-proven benefits, including reduced costs, increased efficiency in system delivery, and greater confidence in the form and nature of the final product. However, a point can be reached where additional planning can be counter-productive. If a city explores all alternatives, technologies, alignments, contractual mechanisms, and design issues, the resulting delay may mean that a new system will never be realised. With any political administration, there is but a brief window of opportunity to lead a project to actual implementation. A high-quality, thorough investigation that merely results in a non-implemented study is a failure. Thus, one of the most important recommendations is to plan with a bias towards implementation, with an eye towards spelling out the key decisions that the Mayor or Governor must make and in what time frame, rather than planning for the absolutely ideal solution.

BRT planning components

"Would you tell me which way I ought to go from here?" asked Alice.

"That depends a good deal on where you want to get," said the Cat.

"I really don't care where" replied Alice.

"Then it doesn't much matter which way you go," said the Cat.

(Alice's Adventures in Wonderland, 1865)

—Lewis Carroll, novelist and poet, 1832–1898

In reality, the idea of a "BRT plan" is a misnomer. There are likely to be multiple plans that each addresses a particular aspect of the project. The term "BRT plan" is used as an over-arching concept representing the compendium of all these individual planning components. Table 8 lists some of the most common planning components within an overall BRT plan.

Pre-feasibility study

The pre-feasibility work is frequently conducted for cities in the exploratory phase of assessing public transport improvement options. The pre-feasibility study may thus only include BRT as one of many different public transport options. In many cases, groups initiating the pre-feasibility work will orientate the study contents towards obtaining eventual political support for a public transport improvement initiative.

The pre-feasibility period may include some of the following types of activities:

- Identification of major transit corridors;
- Summary of previous demand figures and mass transit studies;
- Rough estimates of potential benefits of a new transit system (impacts on traffic, economy, environment, social equity, and urban form);
- Missions and technical visits to existing systems in other cities;
- Production of simulation videos or models to show how a new system may look in the local context.

Thus, the pre-feasibility stage typically does not involve a great deal of design or analytic work. However, the outcome will likely determine whether a transit improvement project gains political momentum.

Feasibility study

In many instances, a feasibility study may be required to justify the expenditure of public funds on the project. A cost-benefit analysis is one of the principal tools used to justify the use of public funds. Clearly, though, to conduct such an analysis, more detail on the potential transit project must be known. Some of the factors that will require determination include:

- Approximate size of project (*e.g.,* length of transit corridors);
- Projected passenger demand using the new system;
- Initial cost estimates;
- Estimates of economic savings from system (time savings, reduction of petrol use, emission reductions and health benefits, etc.).

Clearly, the determination of these factors will require a certain amount of analysis and investigation. However, the feasibility study is not an in-depth BRT plan. Instead, approximate estimations are utilised to produce reasonably accurate results to help the decision-making process. The objective of the feasibility study is to determine if a project is warranted under the local conditions.

The feasibility work may also involve analysis of a variety of alternative public transport options, including enhanced bus services, BRT, light rail transit (LRT), and elevated / underground rail metro technology. Each technological option is tested to the local operational conditions, design needs, and financing capacity. While some cities may restrict the analysis to a single public transport option, testing all options through a rigorous comparative process may provoke the type of competition resulting in the most appropriate choice. It is no accident that project developers almost always deliver a verdict of "feasible" for the particular technology being proposed. Personal biases and financial incentives can deliver a feasibility study that is less than completely objective and transparent. Ultimately, allowing such biases undermines the credibility of the public transport project, regardless of its merits. An honest and open process is the best way to instil long-term confidence in the project and ensure that public funds are used in the most appropriate manner.

A full BRT plan, by contrast, should include all the information necessary to successfully implement the system.

Transport demand modelling

The projection of passenger demand figures will affect a range of system sizing decisions. Chapter 4 of this document outlines different techniques for determining passenger demand, including both full modelling and other more economical techniques.

Stakeholder and communications plan

A new mass transit system implies a number of dramatic changes, including changes to the form of a city, the competitiveness of the local economy, and the structure of transit operations and employment. For many, any such dramatic change is viewed with concern or even outright opposition. Developing a communications strategy for key groups, such as existing transit operators, car owners, and government agencies, is fundamental to ensuring an informed decision-making process. Chapter 6 discusses the nature of an effective communications strategy for a BRT project.

Conceptual study

Public transport planning is more often an iterative process rather than a linear, step-by-step

Fig. 39
The conceptual phase involves providing an overall vision of the future system.
Illustration courtesy of Lane Transit District (Eugene, US)

procedure. Committing extensive planning resources to detailed design prior to establishing the basic conceptual outline can result in needless and costly duplication of efforts. If a city was to only proceed sequentially, then it is possible a great deal of detailed work may have to later be re-done when it is determined the situation dictates a different approach. For example, a costing analysis may prove that initial design characteristics are inconsistent with the expected budget. Answering basic questions about the nature of the system can do much to focus the subsequent analysis and planning. Thus, the development of a conceptual study is a highly cost-effective early activity.

Decisions made on these types of items will help to shape the detailed planning process as well as inform all parties of the effort required to produce the full plan. The conceptual study will also help give political officials a better perspective on the direction of the project. In some instances, the results of the conceptual study may define the contents of the "Terms of Reference" for consulting contracts related to the plan's development.

The conceptual study will likely be completed in a matter of just a few months. It is essentially a rapid overview of the entire planning process. However, a conceptual study can provide sufficient detail to allow political and technical decision-makers the ability to make big picture decisions on system size, costs, business structure, and features. Some of the initial issues that are often raised during the conceptual phase include:

- Most likely corridors for mass transit operations;
- Best corridors for an initial project phase;
- Trunk-feeder services or direct services;
- Targeted service frequency;
- Targeted tariff levels for customers;
- Potential business and administrative structures for system;
- Estimates of expected capital costs;
- Estimates of expected operating costs;
- Understanding of potential financing sources;
- Level of cooperation expected from private sector operators;
- Listing of all major stakeholder groups, organisations, and individuals;
- Potential design characteristics (stations, busways, terminals, vehicles, fare collection systems, etc.).

The issues raised in the overview study should be seen as initial concepts and not immovable decisions that are forever fixed. Clearly, later circumstances and new information may well necessitate in alterations from the earlier decisions noted in the conceptual study. However, the conceptual study is a worthwhile head start on the overall project.

Detailed BRT plan

The detailed BRT plan is the principal focus of this Planning Guide. Over the course of one year of more, all aspects of project development are thoroughly covered within a detailed BRT plan. Chapters 7–14 of this Planning Guide provide more detail on the nature of the detailed BRT plan as well as the many design options available to city officials. This portion of the planning encompasses operational design, physical design, and integration with other transport modes.

Business and institutional plan

Finding the right balance of roles for both the public sector and the private sector greatly affects the long-term financial and operational viability of the system. This plan establishes the structural and contractual nature of the relationship between the public and private sectors. A detailed examination of expected operational costs will help determine whether the estimated customer demand and tariff levels can produce a system without the need for operational subsidies. Much of the effort in the business plan is to devise the right set of incentives to ensure private sector operators are motivated to provide a quality level of service to the customer. Chapters 15 through 18 of this Planning Guide discuss different aspects of the Business Plan.

Detailed engineering design

Once all physical aspects of the BRT plan are determined, the detailed engineering work can commence. Utilising specialised software design tools, the engineering team will design in detail each physical aspect of the system. In some instances, each distinct metre of the busway infrastructure will receive its own design treatment. The detailed engineering design will later be used as the basis of bid documents for different infrastructure components.

Fig. 40
The detail engineering design will involve designing and mapping every infrastructure component.
Graphic courtesy of the Municipality of Barranquilla (Colombia)

Financing plan

As the details of the physical design requirements become known, cost analyses will indicate the amount of capital required for system construction. Unlike other public transport technology options, BRT is reasonably affordable to most cities. Nevertheless, some cities may look to outside financing sources as an option to consider. Chapter 17 of this Planning Guide outlines the variety of financing options available to cities interested in developing a BRT system.

Marketing plan

Perhaps one of the most important decisions in a system's development is the name and marketing image of the system. The right promotional strategy will greatly influence the public's perception of the system and the ultimate level acceptance and ridership. Chapter 18 of this Planning Guide discusses different BRT marketing strategies.

Impact analysis

At the outset of the project, developers likely estimated the system's impact on the economy, traffic levels, environment, social equity, and urban development. Once the system is fully planned, it is worthwhile to revisit these estimates. A more accurate set of impact projections is possible once all design and planning components are completed. A detailed impact analysis will give decision-makers the confidence to fully commit to system construction. Further, once a system is operational, an evaluation plan is useful for assessing the system's performance and for identifying areas of improvement. Chapters 19 discusses issues related impact analysis and project evaluation.

Implementation plan

The principal objective of any transit planning process is not to merely to produce a plan. Rather, the extensive planning effort should be focussed upon delivering an actual system. In order to prepare for the construction process, an implementation plan encompassing timelines, construction plans, and contracting procedures should be developed. Chapter 20 of this Planning Guide outlines the typical steps in an implementation plan.