SUSTAINABLE TRANSPORTATION IN EAST AFRICA

THE BUS RAPID TRANSIT EVOLUTION IN ADDIS ABABA, ETHIOPIA

Yorgos Voukas, M.Sc
Derek Palmer, MSoc

Conference CODATU XV
The role of urban mobility in (re)shaping cities
22 to 25 October 2012- Addis Ababa (Ethiopia)
Sustainable transportation in East Africa
The Bus Rapid Transit evolution in Addis Ababa, Ethiopia

Yorgos Voukas, M.Sc.*, Derek Palmer, MSoce**

*Senior Consultant, Transport Research Laboratory (TRL), UK, +44(0)1344770785  yvoukas@trl.co.uk
**Head of Sustainable Transport Planning, Transport Research Laboratory (TRL), UK, +44(0)1344770432  dpalmer@trl.co.uk

Abstract
Addis Ababa, capital city of Ethiopia, is currently facing rapid urbanization and high population growth. Overall population is expected to grow from 3.2 million to 5.5 million inhabitants by 2020 and reach double figures within the next two decades. Car ownership is still significantly low in Addis Ababa, though rapidly increasing mainly due to economic growth and the introduction of low cost private vehicles into the local market. Non-motorised transport, and particularly walking, still dominates the modal split for daily trips in Addis Ababa with an approximate 62% of total trips, whereas public transport service is not adequate to accommodate the respective demand.

As a response, the city government of Addis Ababa has recently adopted a city-wide transport plan in order to modernize public transport, support the use of non-motorized transport and tackle the congestion that is generated from the increasing use of private vehicles. The current transport plan includes the construction of seven BRT (Bus Rapid Transit) and two LRT (Light Rail Transport) corridors, as well as improvements in pedestrian facilities, non-motorized transport and parking management. This paper attempts an evaluation of the BRT demonstration corridor (Meskel square to Kaliti) in order to provide recommendations towards a full BRT implementation and set an example of BRT design that can be used as a reference for the future BRT systems in Ethiopia and East Africa. The evaluation takes into consideration aspects such as BRT infrastructure, accessibility, road safety, operational efficiency, traffic and parking management, and integration of non-motorized transport features.

Keywords: Bus Rapid Transit, Addis Ababa, sustainable transportation, bus operations, demonstration corridor, Anbessa.
1. Introduction

TRL is leading the Addis Ababa element of the GEF funded UN-Habitat three cities project on sustainable urban mobility, providing technical support in respect to the forthcoming implementation of the BRT and LRT mass transit corridors.

Technical work started in November 2011; the TRL team visited Addis Ababa for a series of meetings with local stakeholders, as well as to collect data and study the proposed BRT corridors. Derek Palmer (Project Director) and Yorgos Voukas (Technical Leader) visited the current BRT demonstration corridor, in order to carry out a preliminary evaluation of the bus operations and identify areas of improvement at the particular corridor. Site visits took place at the second week of November 2011, as well as the first week of February 2012. Given the short time of the visits, only basic data has been collected in respect to infrastructure, bus occupancy, headway of service, traffic management, accessibility and road safety issues. This evaluation does not include official data from local authorities with respect to the demand on the corridor, the number of buses in operation, the schedule of operations and other official information, thus any information is based on observations made on site without the benefit of extensive field studies (demand studies, bus occupancy measurements, etc). The TRL team travelled along the corridor several times, by car, by bus and on foot (from one end to the other), in order to best observe the characteristics of the operation.

Interviews with stakeholders were essential in order to understand the progress of the project. The authors are therefore grateful to the city officials, experts and professionals who provided data and valuable information for the development of this study.

2. Addis Ababa

2.1 City and mobility

Addis Ababa, capital city of Ethiopia, lies at an altitude of 2,300 metres and has a population of 3.3 million inhabitants. Due to rapid urbanization and population growth, it is expected that overall population will reach 5.5 million inhabitants by 2020 (UN HABITAT, 2011).

Car ownership is still significantly low in Addis Ababa (below 100 vehicles per 1000 of population), though rapidly increasing mainly due to economic growth and the introduction of low cost private cars into the local market. Road infrastructure is poor (see photo 2), existing roads are poorly maintained and often traffic lights are not installed or, when installed, are often out of order. As a result, traffic congestion is already significant in many parts of the city (see photo 1), and air pollution is a serious concern given the old vehicle fleet of Addis Ababa and the poor quality of diesel (there is no low sulphur diesel).
Non-motorised transport, and particularly walking, still dominates the modal split for daily trips in Addis Ababa with an approximate 62% of total trips. Public transport (provided by public operator “Anbessa” and individual mini-bus operators) occupies more than half of the remaining 38% of the motorised trips, while private cars and taxis make up a small proportion of trips.

It is noteworthy that despite the low levels of motorisation of Addis Ababa, air pollution is very high and traffic accidents result to an average of 370 fatalities and 1300 injuries per year (UITP, 2010).

2.2 Public Transport Plan

The current public transport service in Addis Ababa is provided by mini and midi buses, collective taxis, as well as 12 metre and articulated city buses operated by Anbessa. Minibuses, locally known as “Wuyeyet”, move the majority of the daily passengers, though Anbessa has a significant modal share and a network of routes that provide good coverage of the city.

The Ministry of Transport recently adopted a plan to reform public transport and invest in mass rapid transit solutions. Apart from the ongoing renovation of Anbessa’s fleet, the ministry aims to implement a network of 7 Bus Rapid Transit corridors, as well as 2 Light Rail Transit ones in the next few years. According to the feasibility study of the French Development Agency (AFD, 2010) the routes are as follows (see figure 3):

- **Light Rail Transit lines (North – South and East – West axis):**
  
  L1: Ayatt – Megenagna – Tor Hailoch – Ayer Tena
  
  L2: Shiro Meda – Merkato – La Gare – Kaliti

- **Bus Rapid Transit (seven lines).** Those lines were designed to serve the main areas of the city and to feed and complement the two LRT lines:
  
  B1: Ayer Tena – Tor Hailoch – Wingate
  B2: Gofa Gabriel - Mexico – Merkato – Wingate
  B3: Gofa Gabriel – La Gare – Gulele
  B4: Megenagna – Arat Kilo – Shiro Meda
  B5: Megenagna – Bole
  B6: Bole Airport – La Gare
According to the Addis Ababa City Road & Transport Bureau, the B2 BRT corridor that connects the north (Wingate) to the south (Gofa Gabriel) of Addis Ababa has been selected as the first full-BRT corridor; construction is expected to start soon.

3. BRT Demonstration Corridor

The current BRT demonstration corridor runs from north to south, along the Light Rail route L2, though without covering the entire route from Shiro Meda to Kaliti. By February 2012, the BRT infrastructure was in place only between the city centre (south from La Gare) and a point northern of Kaliti (see map 1, red line). This evaluation took into consideration only the particular segment where basic BRT infrastructure is already provided.

The corridor is designed as an LRT corridor, thus BRT infrastructure is temporary. The Ethiopian Railway Corporation aims to replace this infrastructure with Light Rail infrastructure soon.

The BRT corridor is open to all buses above 23-seats capacity (see figure 4), and is thus used by both Anbessa buses and privately owned midi buses along the corridor. The corridor forms part of the itinerary of various bus routes, and currently there is no exclusive BRT service on the corridor (e.g. a service that operates only along the BRT corridor).
At present the corridor length is 9.6 km. Land uses are principally commercial and density around the corridor is relatively low (see figure 5). At the southern end, the corridor is connected to the ring road of Addis Ababa, as well as the Ethio-China Friendship Avenue. At the northern end, the corridor reaches Meskel square, in the city centre.

3.1 Infrastructure

Given that the corridor has been originally designed as an LRT corridor, the current infrastructure is only for temporary use, and with the aspiration that soon it will be converted to light rail infrastructure. The segment that is operated as BRT operates with full segregation of the bus lanes and BRT traffic occurs separately to the general traffic. Table 1 summarises the observations on status of the different elements of the infrastructure.

Table 1: Current status of infrastructure on BRT demonstration corridor

<table>
<thead>
<tr>
<th>Element</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus lane</td>
<td>Fully segregated</td>
<td>Fully segregated –exclusive- bus lanes, bi-directional and located as the central lanes. Well protected by concrete and fence.</td>
</tr>
<tr>
<td>Pavement</td>
<td>Asphalt</td>
<td>Asphalt pavement along the corridor; there are still short segments that are unpaved (e.g. in the northern segment)</td>
</tr>
<tr>
<td>Terminals</td>
<td>N/A</td>
<td>No terminals at the extremes of the corridor</td>
</tr>
<tr>
<td>Bus stations/ Stops</td>
<td>Bus stops only</td>
<td>There are no platforms or stations, though bus stops are predetermined and signed</td>
</tr>
<tr>
<td>Traffic lights</td>
<td>N/A</td>
<td>There are no traffic lights along the corridor</td>
</tr>
</tbody>
</table>
Footways/ Cycle ways

| Footways exist on most of the corridor; there is no infrastructure for cycles, (parking at bus stops, or cycle lanes) |
|---|---|
| BRT regulatory/informative signage | N/A | No vertical or horizontal regulatory signage; no informative signage about BRT operation |

Source: TRL

3.2 Operation

Observations indicated that the corridor is not exclusively assigned to BRT operation. Entry to the bus corridor is permitted to any bus with capacity of 23 –or more- seats, thus both Anbessa and midi bus operators are using the segregated bus lanes. Bus headways vary significantly; private operators run buses every 90 to 120 seconds, though Anbessa runs a service without a regular headway and that may vary from 5 to 30 minutes. This may be due, in part at least, to congestion delaying buses on other, unsegregated, parts of the route, especially at junctions.

Existing bus routes use part of the corridor, though there is no particular BRT service for the corridor to run from north to south. Anbessa runs the following routes along the corridor:

(R for route): R4, R14, R25, R27, R29, R56, R60, R76 and R77.

Some of the routes run the entire corridor, whereas others use it only for a few kilometres; all routes were existing conventional routes and none have been implemented only for the BRT operation. Anbessa dispatches all buses early the morning (after 6:00) and does not retire them to the depots until the end of service. All the available fleet is in operation during the entire day (6:00 to 20:30) and no peak-hour/off-peak hour scheduling is applied.

Anbessa buses stop at predetermined and sign posted bus stops (see figure 6) that are located every 500 to 700 meters. Fares are collected inside the bus, from an employee that is assigned (in a special booth) to sell tickets. The bus driver is not involved in the fare collection process at all (see figure 7).

Figure 6: Anbessa bus stop ©TRL

Figure 7: Ticket booth inside an Anbessa bus ©TRL
Parallel to the corridor, other public transport continues to operate: mini buses (less than 23 seats), collective taxis and taxis, which are mixed with general traffic (see figures 8, 9).

**Figure 8:** Mini bus/collective taxi (below 23 seats) © TRIL  **Figure 9:** Taxi © TRIL

3.3 Traffic & Parking Management

The demonstration BRT corridor occupies two lanes, one in each direction, without overpasses at bus stops. General traffic occupies 2 or 3 lanes in each direction, in parallel to the BRT operation (see figures 10, 11).

**Figure 10:** Distribution of traffic along the corridor  **Figure 11:** Distribution of traffic along the corridor © TRIL

Intersections are not controlled by traffic lights; left turns and U-turns are permitted along the corridor. The general traffic lanes are open to all vehicles, including heavy lorries which are mainly found at the southern section of the corridor where much of construction is taking place. Traffic police are present at most of the intersections during peak hours. It is not known whether there is a traffic control centre.
in the city or any technology for traffic monitoring (e.g. cameras, road sensors, etc).

Parking along the corridor is common; no particular parking management or signage has been observed.

3.4 Bus Fleet

Anbessa runs its BRT routes with 12m buses of three different types (see figure 12):

1. Jonckheere, Diesel
2. DAF Berkhof, Diesel
3. Huanghai, Diesel Euro III

All buses have a high floor, front engine and three doors for boarding and alighting. A ticket booth is located inside all buses for fare collection, just before the back door of the bus. Huanghai buses are being incorporated into Anbessa’s fleet, as part of an ongoing fleet modernization programme.

Figure 12: From left to right, Johckheere, DAF, and Huanghai ©TRL.

4. Evaluation

4.1 Technical evaluation of BRT demonstration corridor

The current corridor has been evaluated according to the requirements and characteristics of a “high end” (Hidalgo, 2010) BRT system. Evaluation is limited in a supply side approach, given that evaluation of performance (travel times, average commercial speed, bus occupancy, demand figures, etc) requires extensive field studies and data collection. Although the BRT corridor is still in its demonstration phase and with the limitation that it is designed to become a LRT corridor, the evaluation seeks to identify the improvements that may upgrade it to a full-BRT system, providing top quality public transport services. Thus, the evaluation took into consideration the following BRT elements as a reference standard.
Table 2: Reference standard for BRT

<table>
<thead>
<tr>
<th>Component</th>
<th>“High end” BRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running Ways</td>
<td>• Longitudinal segregation</td>
</tr>
<tr>
<td>Traffic Engineering</td>
<td>• Geometrical adjustments</td>
</tr>
<tr>
<td></td>
<td>• Left and right turn controls</td>
</tr>
<tr>
<td></td>
<td>• Traffic signal priorities for buses</td>
</tr>
<tr>
<td></td>
<td>• Modern traffic signal technology</td>
</tr>
<tr>
<td>Stations/ Bus stops</td>
<td>• Enclosed facilities</td>
</tr>
<tr>
<td></td>
<td>• Level boarding and prepayment</td>
</tr>
<tr>
<td></td>
<td>• Passing lanes (when required)</td>
</tr>
<tr>
<td>Vehicles</td>
<td>• Multiple doors</td>
</tr>
<tr>
<td></td>
<td>• Easy boarding and alighting</td>
</tr>
<tr>
<td></td>
<td>• Low emissions</td>
</tr>
<tr>
<td>Services</td>
<td>• Mixed services (local, accelerated, express; short loops)</td>
</tr>
<tr>
<td></td>
<td>• Design according to the service needs</td>
</tr>
<tr>
<td>ITS</td>
<td>• Automatic vehicle location/ centralized control</td>
</tr>
<tr>
<td></td>
<td>• Traffic signal priority</td>
</tr>
<tr>
<td></td>
<td>• Electronic fare collection/ fare integration</td>
</tr>
</tbody>
</table>


This section discusses how the features of the BRT demonstration corridor compare with this reference standard. The findings are then summarized at table 3. The BRT demonstration corridor presents very good segregation for the bus lanes. Bus lanes are “protected” by a 1m wide concrete central reservation along the entire corridor (see figure 13), thus bus flows are completely isolated from general traffic. Traffic engineering is also good; the corridor doesn’t have any serious inconsistencies in terms of geometry, though it lacks adequate signage and law enforcement to prevent left and U-turns (see figure 14) which can impede bus operations.
Road infrastructure along the corridor is not yet complete; therefore there is still a short unpaved segment in the north that is closed to traffic which also creates delays to bus travel times (see figure 15). It is noteworthy that on the same road segment there is a large construction site (highway overpass) that creates a traffic “bottle neck” and severe delays to general and BRT traffic (see figure 16).

Intersections lack traffic light management, as well as horizontal and vertical signage for cars and pedestrians. Given that left turns are not prohibited, cars often block the intersections, causing delays to the bus operation and increasing the risk of road accidents.

Although bus stops are predetermined for Anbessa buses, private midi-bus operators are free to make more frequent stops, pick up and drop off passengers almost at any point. That creates more congestion along the corridor and weakens the competitiveness of Anbessa on the corridor. There are no bus stations or shelters at the moment, thus no protection from rain and heat for the passengers. Bus stops are often located far away from intersections and pedestrian crossings, thus access to the stops is not easy (see figure 17). Waiting areas at the bus stops are also inadequate and unsafe to accommodate...
large number of passengers without them having to enter the roadway –especially during the boarding and alighting periods- which is dangerous and may cause delays to buses (see figure 18).

Anbessa runs 12m buses along the corridor, whereas private operators run buses of lower capacity. Anbessa buses use multiple doors (3) to facilitate easy boarding and alighting, whereas smaller buses have only 1 door for embarkation and disembarkation. Anbessa’s new Huanghai buses come with EURO III motors and thus fulfil lower emission standards. However the fleet is currently a mixture of new and old buses so emission reductions are probably not significant.

As previously mentioned, there are no specific BRT services; all routes are conventional and thus use the corridor as part of their itinerary.

Currently, the technology is very limited. There is no passenger information, traffic signal priority, electronic fare collection system or bus monitoring through GPS or GPRS. Paper tickets are issued onboard, and fares are distance based. The ticket booth onboard and the front-located motors\(^1\) together quite considerably reduce the available space for passengers and thus the overall capacity of the bus (see figures 19, 20).

\(^1\) Anbessa purchases all buses with front engines for operational reasons; buses perform better in sloped roads when motor is placed in front.

CODATU XV - Le rôle de la mobilité urbaine pour (re)modeler les villes
The BRT demonstration corridor presents considerable advances but there remain areas that require improvement. Table 3 summarizes the major findings of the evaluation and provide recommendations that may improve the operation of the BRT corridor.

Table 3: Summary of BRT demonstration technical evaluation and recommendations

<table>
<thead>
<tr>
<th>BRT Component</th>
<th>Advances</th>
<th>Elements to improve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running Ways</td>
<td>- Strong longitudinal segregation with solid central reservation</td>
<td>- Unpaved BRT segment</td>
</tr>
<tr>
<td></td>
<td>- Median busways</td>
<td>- Quality and maintenance of existing pavement</td>
</tr>
<tr>
<td></td>
<td>- Unpaved BRT segment</td>
<td></td>
</tr>
<tr>
<td>Traffic Engineering/</td>
<td>- Good geometry</td>
<td>- Control left turning movements</td>
</tr>
<tr>
<td>Management</td>
<td>- Traffic police at intersections</td>
<td>- Install traffic lights/ traffic signage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Improve pedestrian crossings</td>
</tr>
<tr>
<td>Stations/ Bus stops</td>
<td>- Predetermined bus stops</td>
<td>- Enclosed bus stops (protected by shelter)</td>
</tr>
<tr>
<td></td>
<td>- Signed posted bus stops</td>
<td>- Informative signage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Access to/ from the bus stops; relocate bus stops closer to pedestrian crossings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Level boarding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Adequate space for waiting passengers</td>
</tr>
</tbody>
</table>
### BRT Component

**Vehicles**
- Multiple door-12m buses
- Euro III emission standards (for Anbessa’s Huanghai only)
- Modernization of entire BRT fleet
- Improve bus capacity (remove ticket booth)
- Informative signage for routes and services within the bus

**Services**
- Variety of routes with origin and destination beyond the limits of the corridor
- Connectivity with other bus routes
- Reduced need for transfers
- BRT exclusive services (short loops, express routes, feeder lines, etc)
- Frequencies and reliability of bus service
- Competition with conventional service (remove midi buses and collective taxis)

**ITS**
- N/A
- Prepaid fare collection system
- Bus monitoring system (GPS)
- Traffic signal priority

**Parking management**
- Some segments of the corridor are controlled by parking attendants and respective signage
- Parking restrictions along the corridor
- Law enforcement
- Park & Ride facilities

Source: TRL

Most - but not all - of the recommendations require considerable capital investment; though if implemented, the corridor may be converted to a full-BRT corridor, offering top-quality and low cost mass transit services. Alternatively, the recommendations may provide the technical standards for the conceptualization of the next full BRT line in Addis Ababa and particularly the B2 BRT corridor.

#### 4.2 Road safety & accessibility concerns

Public transport in Addis Ababa requires a particular concern in respect to road safety and accessibility. Thus, in parallel to the technical evaluation of the corridor, this paper also assesses safety risks, highlighting the major improvements that are required in order to reduce the risk of accidents, both in respect to vehicles and pedestrians who are vulnerable to road accidents. The results of the safety assessment are summarised in Table 4.

---

2 Methodology adopted by D. Hidalgo, EMBARQ/ World Resources Institute (2010)
Table 4: Summary of safety assessment of BRT corridor

<table>
<thead>
<tr>
<th>BRT Component</th>
<th>Risk</th>
<th>Improvement</th>
</tr>
</thead>
</table>
| Intersections     | ● Poor signage at intersections, absence of traffic lights, and uncontrolled left-turn movements increase the risk of car accidents                                                                        | ● Install traffic lights for vehicles and pedestrians  
● Implement adequate signage (zebra crossings, vertical signage, speed reduction before intersection, etc)  
● Law enforcement                                                                 |
| Stations/ Bus stops | ● Location of bus stops and absence of pedestrian crossings force passengers to cross the road at unprotected points (see photo 21)  
● Bus stop area is inadequate for passengers (see photo 22)                                                                 | ● Relocate bus stops when necessary  
● Implement adequate pedestrian crossings for all bus stops  
● Re-design bus stops to provide adequate space and protection from traffic and weather (rain, sun)                                                                 |
| Footways          | ● Footways are poorly maintained and often generate risks for pedestrians (see photo 23)                                                                                                             | ● Rehabilitate all footways along the corridor  
● Provide wheelchair ramps at all intersections                                                                                         |
| Buses             | ● Buses lack infrastructure for passengers with disabilities or elderly people (see photo 24)                                                                                                           | ● Provide accessible buses (with ramp) on regular headways  
● Elevate platforms at bus stop entrance level (when possible)                                                                              |

Source: TRL
4.3 Anbessa City Bus Enterprise

As part of the analysis, an evaluation of Anbessa City Bus Enterprise, the only formal urban public transport company in Addis Ababa, has been conducted. The analysis is discussed in this section and summarised in Tables.

Anbessa, the only state-owned bus operator in the city, currently operates 101 routes and transports approximately 320,000 passengers per day. Anbessa operates all routes between 6:00 am and 20:30 pm, providing bus headways of approximately 30 minutes (UITP, 2010).

4.3.1 Institutional Capacity

Anbessa is organised as any modern bus operator, having a very solid organizational structure. Strong in-house capacity allows Anbessa to perform all planning, operation, ticketing and bus maintenance tasks without external contracting. Maintenance is a benchmark activity for Anbessa, given that their
workshops provide maintenance to other heavy vehicles as well (e.g. fire trucks, tow trucks, etc). Moreover, Anbessa provides extensive training to their drivers and other employees and runs a bonus-scheme for drivers with a zero-accident record to promote safe driving.

The average number of employees per bus is relatively high (2,774 employees for less than 500 buses), though this may be explained by the complete absence of advanced technologies for the bus operation and fare collection.

The General Manager has the overall responsibility for the company and seems to have an excellent understanding of public transport issues. Furthermore, the areas of maintenance, operation, fare collection and administration are also managed by skilful professionals with long experience in public transport operations.

4.3.2 Bus fleet

Due to a modernization programme, Anbessa recently purchased 500 new buses from Chinese bus manufacturer Huanghai, aiming to replace the 462 old 12-metre buses made by DAF and Jonckheere. Delivery of the new fleet was programmed for 2011, though teething problems in the Huanghai production line in Ethiopia resulted in a late start and consequently the total fleet will be delivered within 2012. By February 2012, Anbessa had received from Huanghai:

- 256 Euro III 12 metre buses
- 23 Euro III, 18 metre articulated buses

New buses are suitable for BRT operation; they provide high capacity, relatively easy access due to the multiple doors, safety, as well as comfortable interior design. Articulated buses may offer greater capacity, though 12-metre buses are more flexible and better suited for off-peak hours. Older buses cannot meet the standards for a reliable, comfortable and fast service; therefore they should be gradually removed from BRT operation.

3 Huanghai buses does not offer level access to the sidewalk or platform
4.3.3 Operation

Anbessa is a labour-intensive company, where intelligent transport systems are not yet applied for day to day operation. That apparently reflects the operation, given that the lack of adequate technology limits the efficiency in data collection, bus scheduling and maintenance. The current operation is not sufficiently reliable or frequent; it is common for a passenger to wait up to 30 or 40 minutes before the next bus arrives. Sometimes, buses come in “waves” or “convoy”, meaning that 2 or 3 buses pass within only few minutes and then there is no bus for half an hour. It is also notable that Anbessa runs a flat bus schedule for the entire day, without a distinction in between peak and off peak hours, which means that either the number of buses is not necessarily adequate to cover the transport demand or that there is an excess in transport supply during off-peak hours.

Reliability at the service is an essential element for BRT operations. In order to operate a “high-end” BRT system, intelligent transport systems are necessary, as well as capacity building and continuous training for the employees. A prepaid fare collection system, GPRS and central bus monitoring as well as specialized software for bus scheduling are crucial elements for improving Anbessa operations. A summary of the advances and elements to improve in Anbessa’s operation is provided in Table 5.

Table 5: Summary of advances and elements to improve in Anbessa’s operation

<table>
<thead>
<tr>
<th>Area</th>
<th>Advances</th>
<th>Improvement</th>
</tr>
</thead>
</table>
| Institutional structure | • Solid organizational structure  
                      • Highly qualified General Manager  
                      • Experienced personnel | • Capacity building in BRT operations  
                      • Optimization of Human Resources |
| Fleet/ depots   | • New buses in operation  
                      • Euro III emission standard  
                      • Large and well located bus depots  
                      • New workshop from Huanghai | • More buses  
                      • Full renovation of bus fleet  
                      • Improve facilities at depots (e.g. asphalt pavement, workshops) |
| Operation       | • Extended network  
                      • Good coverage  
                      • Weekly schedule/ programme  
                      • Periodic and preventive maintenance | • Increase headways/ frequencies  
                      • Improve reliability of service  
                      • Improve efficiency of operation (operate peak and off peak schedules)  
                      • Implement and operate more exclusive bus lanes throughout the city |
| ITS             | • N/A                                                                   | • Implement modern control centre  
                      • Monitor bus fleet via GPRS  
                      • Implement prepaid/ electronic fare collection system  
                      • Software for bus scheduling and maintenance |
### Marketing & Communications

- Clear corporate image and identity
- Competitive fares
- Improve passenger information
- Offer flexible tariff policy (e.g., monthly passes, off peak discounts, etc.)
- Measure customer satisfaction (opinion surveys)
- Use distinct livery to improve image and identity of the BRT service and differentiate it from regular service

Source: TRL

### 5. BRT concept; best practices from around the world

Bus Rapid Transit systems have been introduced for the first time during the 1970s in Curitiba, Brazil, as an alternative to metro and light rail systems that can offer a high capacity service, based on bus operations. Although, it was not until the late 1990s with the introduction of Transmilenio at Bogota, Colombia, that the concept became very popular in South America and soon after expanded to other regions, with successful projects in China, Indonesia, India, South Africa and various European and North American cities. The following photos provide examples of BRT elements, such as bus lanes, stations, fare collection systems, and accessibility that may be appropriate for BRT planning in Addis Ababa and particularly the design of the B2 BRT corridor.

- **Bus lanes**

  BRTs usually have one lane per direction, though in some systems there is a second lane either along the entire corridor or simply along by the stations, in order to permit operation of express services.

  **Figure 27: Jakarta, Indonesia (1 lane)**  
  **Figure 28: Bogota, Colombia (2 lanes)**

  Source: [www.itdp.org.cn](http://www.itdp.org.cn)  
  Source: Yorgos Voukas

- **BRT Stations**
BRT stations are always covered by shelters and can be either elevated or at street level. In most cases, fares are collected inside the station, and access is usually controlled by turnstiles.

**Figure 29: Xiamen, China**

![Xiamen, China](image1)

**Figure 30: Curitiba, Brazil**

![Curitiba, Brazil](image2)

Source: Ko Sakamoto

Source: www.urbanhabitat.org

- **Ticketing**

Fares are usually collected within the station area, though sometimes can be collected onboard. In both cases, electronic ticketing is the most popular practice, although many systems may also accept exact payment in coins.

**Figure 31: Mexico City, Mexico**

![Mexico City, Mexico](image3)

**Figure 32: Ahmedabad, India**

![Ahmedabad, India](image4)

Source: www.itdp.org

Source: http://ahmedabadbrts.com/

- **Control Centres**

Although very expensive to implement, control centres are essential for the monitoring and optimization of a BRT operation. Control centres may monitor all buses in real time, identify irregularities at the operation, respond to incidents and re-schedule bus operation when necessary.
Buses

There is no standard design for BRT buses. Buses are usually selected according to the operational characteristics of the BRT service (e.g. design of the corridor, passenger demand, platform height, etc). A BRT system may operate with fleets of 9 to 12 metre buses, 18m articulated or 25 metre bi-articulated buses as well as single or double decker buses. Propulsion technologies may also vary; most BRT buses use diesel motors, though there are examples of hybrid (Mexico City, Mexico) or electric buses (Quito, Ecuador) as well.

Integration

Integration between BRTs and other transport modes is common and often supported by adequate infrastructure. Many BRT systems integrate trunk and feeder lines, whereas integration with metro systems and cycle ways or public cycle schemes is also very popular. Physical integration may also be supported by fare integration, to facilitate intermodal trips for BRT passengers.
6. Conclusions

BRT is widely considered as a cost-effective solution for mass transit, particularly in developing countries. There is a practical reason for this; well-designed BRT can provide the same level of service as rail rapid transit at a fraction of the cost and in a shorter implementation period and, for a given budget, BRT can be delivered to far more urban corridors than could be served with a costlier rail. Furthermore, by being surface systems, BRTs stimulate urban renewal and generate significant improvements in shared spaces.

The BRT demonstration corridor in Addis Ababa cannot yet be considered as a light or full BRT corridor, mainly due to the inadequate infrastructure, low bus service and poor traffic/parking management. Taking into consideration the decision of the authorities to convert the corridor into a LRT system, it is probably unnecessary to make any major improvements to the existing BRT segment if LRT construction is about to start soon. However, there are significant advances that could be used...
as a reference for the conceptualization of the future BRT projects in Addis Ababa. The current demonstration corridor provides a good example of bus priority in Addis Ababa and prepares the ground for the development of a full-BRT operation. Exclusive bus lanes should be maintained in the concept of the next BRT corridor, as well as clear segregation from generic traffic. On the other hand, infrastructure should be improved, providing safe and comfortable conditions for BRT users. Likewise, an emphasis should be given in modern technologies for fare collection systems, passenger’s information and bus monitoring. Application of regulatory measures (e.g. parking and traffic management) is also essential in order to improve the operation of buses on the corridor and public transport in general.

Although easier than rail to implement, BRT projects are, nevertheless, complex and require extensive technical and financial studies to ensure successful implementation. The mass rapid transit programme of Addis Ababa is an ambitious endeavour to establish —for first time in East Africa— a sustainable public transport network that will also provide a strong reference for future applications across the region. Thus strong leadership, extensive collaboration among key stakeholders and thorough development of the technical, institutional and operational elements of the system are required in order to fulfil with the expectations of the project and furthermore deliver comprehensive results.

References


GTZ, 2010. Sustainable Transport; A Sourcebook for Policy Makes in Developing Cities: Eshborn, German Technical Cooperation (GTZ).


Interviews (Addis Ababa)

Bedilu Assefa Alemayehu, General Manager, Anbessa City Bus Service Enterprise: November 9th 2011, February 3rd and February 7th 2012.


Fekadu Haile, General Manager, Addis Ababa City Roads Authority: February 6th 2012.

Mr. Maikonen, Senior Consultant, Beza Consulting: February 7th 2012.


Tibleste Asgedom, Head of Transport Office: February 7th 2012, Addis Ababa

Yehualaesht Jemere, Project Manager, Ethiopian Railway Corporation: November 8th 2011

Yetmyet Berhanu, Director, Strategic Management Directorate, Ministry of Transport: November 7th 2011 and February 3rd 2012.