

RELIABILITY OF RAPID BUS TRANSIT IN PROVISION OF PUBLIC TRANSPORT SERVICES IN DAR ES SALAAM CITY, TANZANIA

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Abstract

The establishment of Bus Rapid Transit system in Dar es Salaam city is one of the strategic initiatives in addressing the issue of unreliable public transport services in the rapidly urbanized cities in Tanzania. Other cities such as Arusha, Mwanza, Mbeya, Tanga and Dodoma Capital City are urbanizing very rapidly which influence demand for rapid bus transit services indicated in the master plans. The implementation BRT system with exclusive lanes, electronic ticketing, large terminals and bus stations aimed at reducing public transportation problems in Dar es Salaam city. It also intended to decrease passengers waiting times at the bus stops, reducing travel times from one bus stop to another, control overcrowding by expanding the capacity of buses and size of bus stops, and maintaining safety and security to passengers including vulnerable groups. The study observed the improvements in public transportation services realised by implementation of BRT and challenges specifically in operation buses and suggested to regulatory authority and policy makers the best ways of effecting reliability of public transport services in the fast-growing cities in Tanzania.

Keywords: Reliability of public transport services, Bus Rapid Transit (BRT), rapidly urbanized cities

1. INTRODUCTION

Public transport system is one of the potential urban services that drive the growth development of any developing cities [1] [2]. Popular urban transport systems such as Bus Rapidly Transit, city buses, passenger's trains, Min-Buses and ferries allows smart movement of people to different destinations [3]. Reliability of the mentioned public transport increases the quality of life, increase community integrations, fasten industrial productivity, increase affordability by reducing costs of travel, and travel times in urban areas [4].

Tanzania cities such as Dar es Salaam, Arusha, Mwanza, Mbeya and Dodoma Capital City are among the fast-growing cities in Africa. As indicate in the Master Plans [5] [6] [7] [8]; cities are facing the rapid population growth and higher rate of urban expansion, but served with minibuses, small buses and few commuter buses. The public transport services are characterized by overclouded buses during peak hours, average of 1-3 hours travel times especially during morning and evening peak hours, and acute traffic congestions. As indicated in Table 1, all master plans have indicated BRT as the major public transport system in solving problems affecting urban mobility.

Table 1: Proposed public transport systems in the City Master Plans

Sn	City	Proposed Public Transport System	Status
1.	Dar es Salaam	<i>Bus rapid transit (BRT) system</i>	<i>Implemented (on-going)</i>
		Commuter buses in peri urban areas	Available
		Boats along beach zone	Not yet implemented
		Light rail transit (LRT) system,	Few routes- old ones
2.	Mwanza	<i>Bus rapid transit (BRT) system</i>	<i>Not yet implemented</i>
		Daladala commuter buses	Available
3.	Mbeya	<i>Bus rapid transit (BRT) system</i>	<i>Not yet implemented</i>
		Commuter rail	Not yet implemented
		Daladala commuter buses	Available
4.	Arusha	<i>Bus rapid transit (BRT) system</i>	<i>Not yet implemented</i>
		Commuter rail	Not yet implemented
		Daladala commuter buses	Available
5.	Dodoma Capital	<i>Bus rapid transit (BRT) system</i>	<i>On-gong ring roads construction</i>
		Light rail transit (LRT) system,	Not yet implemented
		Tramline facilities,	Not yet implemented
		Buses and Min-Buses in peri urban areas	Available

Source: Master Plans of respective cities

The government initiatives of implementing BRT system in Dar es Salaam City were indicated in the Five Years Development Plan [9]. The execution of phase one corridors between Kimara and Morocco to Gerezani and kivukoni started in 2012, and the operation started in 2016. As presented by [10], BRT intended at reducing traffic congestion, travel costs and travel times within the city. Adaptation of BRT as alternative means of transport was very potential for economic

development, increase of productivity and reduce urban poverty [11]. The system expected to fasten movement of city dweller from place residence to work, services, recreations, shopping, schools, and other welfare activities which could lead to saving time, increased production and improve economic development [12]. On the other hand, BRT anticipated the modal shifts on which users of private cars, motorcycles and tricycles (Bajaj) have to switch to BRT buses. Consequently, the system provides for park and ride services through parking lots established near the BRT terminals [13].

Despite of deliberate efforts on implementation of BRT system in Dar es Salaam city to ensure effective and efficient public transport service that could meet the travel demand, it has been stated by [14] that BRT passengers and other city dwellers are appreciating the service but sometimes questioning the challenges facing BRT in Dar es Salaam city. In some cases, BRT users are complaining for reliability of services. Reliability is described into two major perspectives; the first perspective is based on punctuality, regularity and times of BRT buses are supposed to arrive and depart on the bus stop or terminals. Second perspectives, reliability is measured based on lengths of the waiting times at bus stop, the trip and route travel times, and other quality aspects such as security, safety, smart fair collection and comfortability while on board .

The frequent movement of buses and time intervals to arrive and depart to the and from the bus station or terminal determine and justify the reliability of services in one part and the headway adherence becomes more important from the perspective of a passenger. On other part, poor headway adherence causes bus bunching, and overcrowding in the busses leads to stay longer at the bus stop and sometimes increase the waiting times. Adhering the schedule of buses maximize utility of the passengers towards BRT services [15].

The challenges in provision and management of public transport services in Dar es Salaam and other cities in Tanzania raised the concern for introduction of Bus rapid transit system. Efficient, appropriate and affordable transit system connects people to daily life activities. Reliability of public transportation services is very fundamental for city development and human wellbeing [16] [17]. The findings of this study is very essential and useful to transport planners and engineers, transport agencies, regulatory authorities and policy makers. A high-quality public transport system remains an essential element in creating smart cities and providing easy access to jobs, education and public services.

2. LITERATURE REVIEW

Public transport also known as mass transit which is used to transporting passengers by groups owned by individual or the general public. It is fairly managed for the sake of public, routes operated in schedules and charges or fees for each trip are posted openly. It differs distinctly in Asia, North America and Europe. In Asia, it is profit driven, privately owned and openly operated either by companies or public transit systems. In North America, it is owned and operated by municipal transit authorities, while in Europe, it is owned and operated by the public and private companies. Public transport services are either profit driven whereby the passengers has to pay full charges of fare rates, or part of charges regulated and possibly subsidized by the government or fully subsidized free of charge services and all operation costs paid by the government [18].

Public transport is characterized by major three aspects. First is convenience and liability of services to the city travelers. Services should be available to ensure

reasonable waiting times whereby buses are frequently operated equivalent to passenger densities during peak hours [19]. Second aspect is the system of information flow to potential users of public transport. The bus schedules, travel times and fares per route should be clearly presented and kept up-to-date on the bus stations/stops; and booking and payment options are accessible online. The third item is security and safety that should be ensured in public transport services. The public transport facilities should be monitored by CCTV camera and other safety facilities .

2.1 Overview of Bus Rapid Transit (BRT) on public transport services

Bus Rapid Transit (BRT) is among the most effective public transportation system in terms of quality services, low costs and reliability of services in both developed and developing countries. BRT permits fast growing cities to provide mass transit that serves the public's daily travel needs including vulnerable groups. In countries of the Global South, BRT was initially implemented in Curitiba city in Brazil, Bogota city in Colombia and Quito city in Ecuador [20]. Other cities included Nagoya City in Japan, Taipei and Beijing cities in China, Bangkok city in Thailand, Delhi, Pune, and Ahmedabad in India, Dhaka city in Bangladesh, Jakarta city in Indonesia and Seoul City in South Korea. In Africa, the BRT system has been implemented in Lagos City in Nigeria, Cape Town City in South Africa, Dakar City in Senegal and Dar es Salaam City in the United Republic of Tanzania.

2.2 Theoretical and conceptual framework of reliable transport system

There are three major variables which expresses the reliability of transport services in fast growing cities. The presented aspects include convenience, efficiency and quality of services. As presented in Figure 1, convenience include accessibility of transport services, how it operate and smartness in terms of technological applications. Efficiency expresses the travel times, waiting times and excess travels. Quality of services is determined by safe, secured and comfortability of transport services.

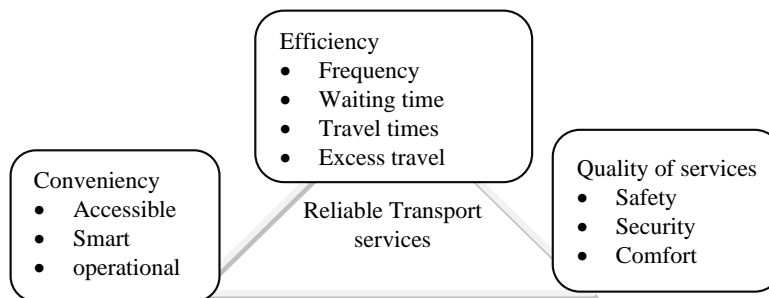


Figure 1: Conceptual variables of reliable transport services

Source: Adopted from Diab, at el. 2015

The efficiency of public transport systems results to frequent movement of buses and other operating conditions that lead to achieving good and acceptable services [21]. Speed of buses, short waiting times, good behaviors of drivers, vehicle age and volume of passengers on bus stations are elements that increasing efficiency. Cities ranked with higher values on these elements tended to have higher efficiency scores [22]. The price of bus tickets, road conditions and traffic management systems also affect efficiency of public transport services in fast growing cities especially in developing countries. [23], [24].

In many situation, conveniences reduce the costs of travels (euros/dollars per hour or cents per minute) and so provides benefits equivalent to an increase in travel speed. [25] identify five main types of convenience relevant to how consumers make decisions. They include decision convenience, access convenience, transaction convenience, benefit convenience, and post-benefit convenience. All convenience decisions determine how much time and effort has to be put into deciding on a course of action, and how much time and effort has been expended to access and initiate the benefits of a service. Smart ticketing can also give confidence to public transport users that they will be charged the minimum possible for their journey.

Service quality is a determinant of increasing public transport rider satisfaction [26]. Bus riders in all segments likely underestimated traffic safety, security and environmental friendly factors to define public service quality. enhancing passenger information, rider care, and comfort are recommended as the most practical and economic measures in the short run. However, the city government should improve availability and accessibility to promote public transport ridership in the long run [27].

2.3 Bus Rapid Transit in Dar es salaam, Tanzania

Dar es Salaam city is one of the quickest developing city in Sub-Saharan Africa which has been affected by poor public transport systems and absence of security for commuters [28] [29]. The Government of Tanzania started to implement Bus Rapid Transit (BRT) system in 2012 under Dar es Salaam Rapid Transit (DART) Agency. DART was established through the GN No. 120 of 25th May 2007 under the Executive Agencies Act No. 30 of 1997. The primary role of DART Agency was to establish and operate the Bus Rapid Transit (BRT) in Dar es Salaam [30]. The Agency aimed at branding Dar Rapid Transit (DART), organizing traffic movement on urban streets and highways as well as ensuring effective administration and operation of BRT system. The Agency operates under the supervision of the President's Office, Regional Administration and Local Government (PO-RALG).

The BRT is operated jointly between Usafiri Dar es Salaam Rapid Transit (UDART) and DART. UDART is a company specifically for provision of public transportation services in Dar es Salaam. The company comprises UDA; the agency that offered public transport service before the establishment of DART and the associations of Dar es Salaam Commuter Bus Owners Association (DARCOBOA) and UWADAR [31]. Currently, BRT in Dar es Salam city is operating under Public and Private Partnership (PPP). It is guided by the Land Transport Regulatory Authority (LATRA) which was formerly known as Surface and Marine Transport Regulatory Authority (SUMATRA). It regulates routes, fares and issuing of licenses to Bus Rapid Transit operators [32].

3. METHODOLOGY

The study employs case study strategy, where by phase 1 BRT corridol in Dar es Salaam City was selected as case study.

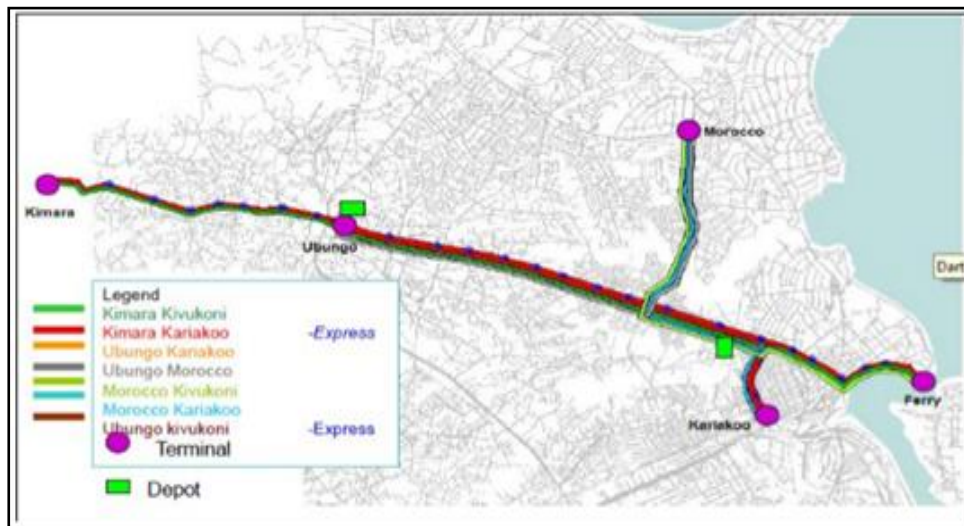


Figure 2: BRT Route from Kimara to city center

Source: BRT Reports

Data were collected by conducting interviews to passengers, drivers, ticket operators, DART officers and few government officials in LATRA, PO-RALG and Ministry of transport and communications. The travel time, waiting time at the bus stop, travel cost, comfortability, waiting seats at bus stop, bus station security, accessibility and frequencies of bus movement were the elements studied and analyzed.

As indicated in Map 1, the route along Morogoro road from Kimara terminal to Ferry was the main study route. The most populated bus stations along this route were Manzese, Magomeni and Fire, and bus terminals were Kimara, Ubungo and Ferry. These are stations used during data collection.

Interviews were conducted to three BRT officials, tickets operators in each bus station and terminal, twenty BRT drivers and 127 BRT passengers for the average of 20 passengers per bus station and 22 passengers in each terminal.

4. RESULT AND DISCUSSION

This section provides detailed analysis of BRT services in Dar es Salaam city based on travel patterns, preferences, costs, travel times, distance and excess times used in public transport service. The discussion covers the facts from BRT users, passengers and observed operations and facilities along BRT lanes.

4.1 Travel Patterns

The travel pattern along BRT is presented in Figure 2. Work, school and business travels are very high in the morning and evening peak hours and very few in the non-peak hours, whereas health, recreational and relative related travels are very high in non-peak hours and very few in peak hours. Dispersion of travel patterns which is mainly caused by the fixed time for reporting and departing at work, business and at schools has great impacts in BRT services during peak hours. Free times to health services, recreational facilities and visiting relatives allow consistent movement of buses during non-peak hours.

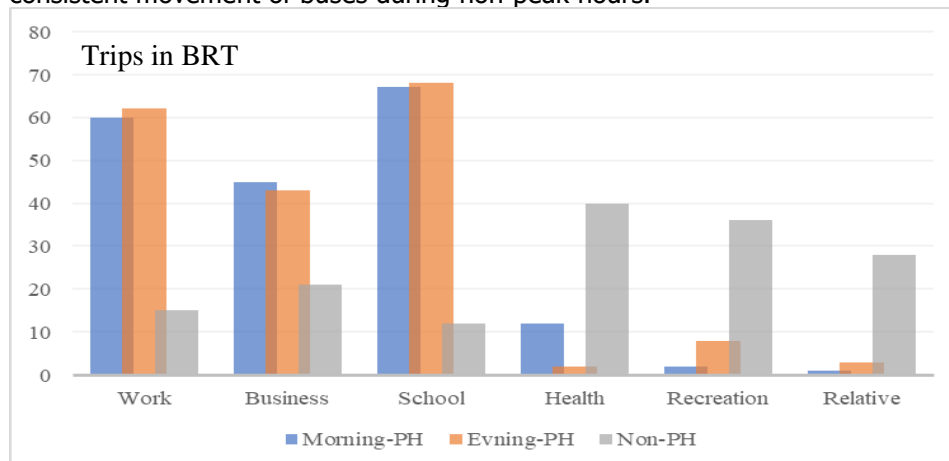


Figure 3: Travel patterns along BRT lanes

Source: Household survey, 2023

4.2 Preference of BRT

BRT is the most preferable mode of transport in Dar es Salaam city. As presented in Figure 4, a great number of pedestrian opted BRT. Passengers using other means of transport such as private cars, minibuses, motorcycles and tricycles or Bajaj have switched to BRT. Passengers in the city prefer to use BRT due to its consistency and regularities of bus flows which are scheduled on time. A reduced amount of waiting times and travel times through exclusive lanes attract more passengers to opt BRT as compared to other mode of transport. Most of private car owners and drivers park their private cars along the BRT stations and board buses to different destinations.

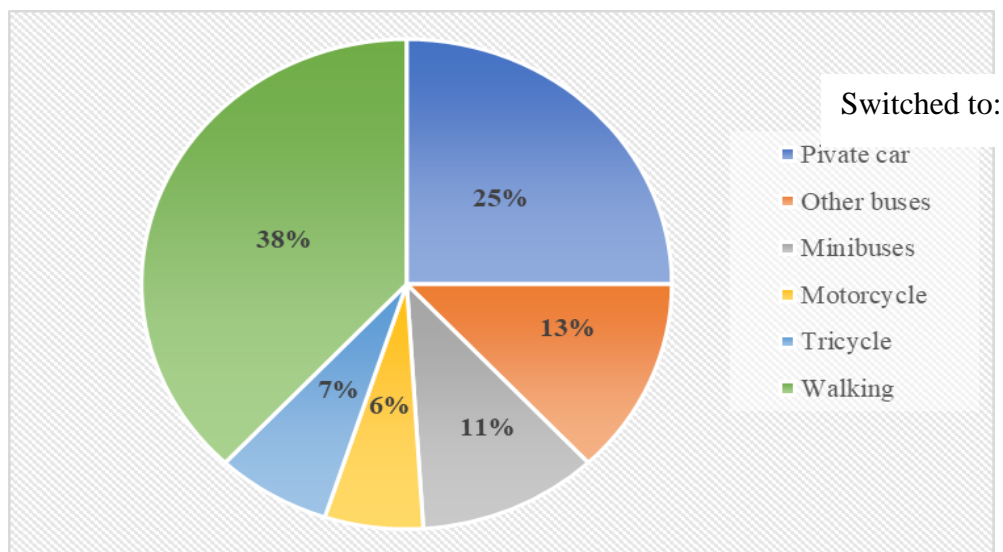


Figure 4: Percentage of BRT users switched using other mode of transport

Source: Passengers interviews, 2023

4.3. Waiting time at the BRT stop

The average waiting time at BRT bus stops is between 30 minutes during peak hours and 60 minutes for non-peak hours; however, the planned waiting time is between 5-10 for peak hours and 11-15 minutes for non-peak hours. The long waiting time during peak hours is mostly caused by deficit of buses and large number of passengers which make them full and overcrowded. For non-peak hours, buses are not full, but the flow of buses is very low. The waiting times are not reasonable since most passengers stay at the bus stations beyond time limit. The waiting times reflects high demand of BRT transport service compared to the available buses.

4.4 Travel and access times

Adherence to schedule of buses and allocated travel times are other factors to passengers' acceptance of BRT services in Dar es Salaam city. As presented in Table 2, the bus schedules are adequately managed and the allocated times from one terminal or bus stop to another are controlled. The indicated excess times are

significantly low resulted from manual traffic control performed by the traffic police at the road intersections during peak hours. Other delays are caused by pedestrian crossings, boarding and drop off passengers especially when busses are overloaded. The maximum excess time from terminal to terminal is ± 4 which is acceptable.

Table 3. Travel times and excess times on BRT bus stations and terminals

Origin terminal	Items	Destination terminal			
		Kivukoni	Fire	Ubungo	Kimara
Kivukoni	Distance (Kilometers)	0	3.3	11	15.4
	Travel time (Minutes)	0	14	39	48
	Excess time (Minutes)	0	-3	+1	+1
Fire	Distance (Kilometers)	3.3	0	8.8	14
	Travel time (Minutes)	15	0	35	45
	Excess time (Minutes)	-3	0	-4	+2
Ubungo	Distance (Kilometers)	11	8.5	0	5.2
	Travel time (Minutes)	39	35	0	11
	Excess time (Minutes)	-3	-4	0	+2
Kimara	Distance (Kilometers)	15.4	14	5.2	0
	Travel time (Minutes)	48	45	11	0
	Excess time (Minutes)	+1	+2	+2	0

Source: Bus departure and arrival reports, June 2023

4.5 Operation of buses

BRT route is serviced by a fleet of 140 buses which provide the services in 18 hours from 05:00 am to 23:00 pm. About 14 buses are reserved in case of any damage or emergencies. As presented in Figure 5, the carrying capacity of buses is 155 passengers per trip for articulated buses, 90 passengers for feeder buses and 80 passengers for rigid buses. During peak hours buses are overcrowded because there are few buses compared to the demand which is reflected by the passengers in the bus stops and terminals.



Figure 5: Types of BRT buses in Dar es Salam city

5. EFFECTIVENESS OF BRT

The importance of BRT in Dar es Salaam city is measured on the lengths of time passengers travel from one place to another. Before BRT, the travel times in the corridor of Morogoro from Kimara to Kivukoni were ranging from 1 hour for non-peak hours to 3 hours during peak hours [33]. Traffic congestion were very high and the costs of travel to from home were relatively high. This situation affected the working hours, wake-up and departure time work, access to health and education services for school going children were chaotic. BRT system is more advantage to workers, employers and business people. Along BRT corridor, data indicated relative reduction of time and costs of travel, and decrease of traffic congestion which has great implications in productivity and urban economy. Despite of other factors, the economy of Dar es Salaam has increased from 14.2 percent GDP contribution in financial year 2014 up to 25.2 percent GDP contribution in financial year 2022 [34].

During pre-BRT periods, the minibuses which are commonly used were not enough to serve the large population in the city that depend on public transportation. Buses were overloading with limited security to passengers, and limited access to disadvantage groups including disabled, elders, pregnant women and school going children. Currently, along BRT corridors, the public transport buses are reliable and services have improved. The consistent movement of buses that follow the scheduled routes and electronic bus control system has shown a great improvement. Even though overloading is taking place during peak hours but is very controlled to ensure safety and security to all passengers including disabled, elders and women. School going children have a great priority during boarding and alighting times to ensure free access and security to young pupils.

The design of BRT systems that include locating exclusive lanes along the central part of the highways enhance fast movement of buses from one point to another without being interfered with other road users. The significant advantage of locating BRT lanes at the center is to equal distance for the pedestrians to access bus stops from both sides of the road. It maximizes safety and equal chance to the passengers to access BRT services rather than locating bus lanes and stations in one side which could limit access for the passengers from the opposite side, and sometimes for case of four lanes roads in Dar es Salaam it may cause accidents during road crossing. The lanes are closed with curbs kept away from violation of other traffics and other road users which ensure constant flow of buses as per

schedules. Locating bus lanes in the center of the road ensuring safe access from the bus stop platforms.

The secured, shaded and attractive stations and bus stops, together with provision of carpooling areas along major terminals such as Kimara and Gerezani terminals have improved the quality of public transport in Dar es Salaam. Private car users have switched to BRT transport which absolutely reduce travel times, traffic congestions and fuel consumptions. On the other hand, the connectivity between BRT stations or bus stops with substations of other modes of transport including motorcycles, tricycles and taxis, and allocation of major terminals along central railway station, marine terminals and ferry enhances accessibility and attracts more travelers to use BRT system.

The loading and unloading of passengers is significant safe and well organized. However, during peak hours create scumbles and people pushing each other while struggling to get into the buses. For the bus stops with large number of passengers such Kimara and Manzese buses quick therefore loading and unloading of process endanger passengers, and is more dangerous to the people with wheelchairs and other disabled passengers. The study is suggesting additional of time from 2 minutes to 5 minutes to ensure smooth services along the most populated bus stops.

BRT is most preferred since it is protected from crime. There are security guards patrolling day and nights to make sure all bus stops, terminals and surrounding area are safe. Available security systems take into account the presence of police patrols, lighting, visible monitoring, together with CCTV cameras installed in major terminals to facilitate visibility and communication.

Safety is additional advantage of BRT system. There are special areas designated for the passengers to cross BRT lanes which are protected with bumps, humps and zebra crossing signs. Areas with high populations such as Manzese, Ubungo terminal, Kimara terminal and Morocco terminal are provided with crossing bridges, and areas along junctions are controlled with traffic lights. These crossing facilities play an important role to maintaining safety to commuters and other road users.

Fair affordability is another factor of BRT in Dar es Salaam whereby passengers recognized the cost to be moderate and suitable for all. Few respondents urged on the flat rate of fair distributions which is 600 Tanzania Shillings. It was proposed the fair rates to consider the travel distance per routes rather than using a normal fair rates for the entire route. [35] [36] insisted BRT projects to target poor in terms of fair rates and should be linked to a larger policy agenda intended to reduce poverty by improving access and reducing the costs of transport.

6. CHALLENGES OF BRT

BRT corridor has indicated potential contributions in provision fast and efficient public transport services in Dar es Salaam city. Due to its attractiveness and smart services, the corridor encountered internal and external challenges. Internal challenges include:

- Deficit of buses which causes overcrowding of passengers during peak hours. Due to shortage of buses, passengers are scrambling to enter buses, and even to go outside the buses. Under this situations people with disabilities have limited access to BRT services.
- Rescheduling of bus routes is taking place several times because of bus defects, route closing and other weather circumstances. This situation causes delays and extend the waiting times in the bus stops. However,

interventions such as using reserve buses at the time of defects. Also traffic police intervene and provide alternative ways or routes immediately.

- Getting ticket at BRT station create inconveniences which result to long time of getting tickets especially during peak hours. In some cases ticketing systems stack. The smart ticketing system is taking too long to be installed whereby passengers can buy ticket through mobile phone.

External challenges are mainly caused by the factors outside DART system and the solutions are beyond the DART capacities. These are highlighted as follows:

- The petty traders blocking the pedestrian ways along the access to BRT bus stations. In highly populated bus stations such as Manzese, Kimara and Kivukoni, petty traders are using walkways as part-time shopping area during afternoon and evening hours. The blocked walkways destruct passengers way leaves and walkways and create disturbance to BRT commuters.
- The floods which normally take place on the road section between Fire and Magomeni stations commonly named 'Jangwani' area. This is main link between the Central Business District of Dar es Salaam and the residential area. During rain seasons, the flooding area constrain bus travels. Commuters are therefore forced to find another way with which they can reach their final destination. Heavy rains forced Bus rapid transit to suspend transport service due to high volume of water and cause serious transportation problem.

7. CONCLUSIONS

BRT is a potential public transport system in fast growing city. The system is effective in provision of adequate and reliable services based on quality of bus lanes, stations and terminals, smart systems of bus timetable, route schedules and monitored travel times which have controlled excess times and waiting times. As observed in Dar es Salaam city, before BRT system being installed in 2016, the public transportation services were in worse situations. Then after, BRT have achieved the intended goals by attracting more passengers opting public transportation mode and switching from other mode of transport like private cars, motorcycles, tricycles and walking. The efficiency, reliability, accessibility, affordability, safety and security attributes have raised the level of acceptance among the city dwellers. The properly managed and controlled system reduce travel times, assist students, elders, pregnant women and people with disabilities to easily access and use public transport service.

The underlined shortcomings of BRT services including shortage of buses during peak hours which causes passenger's scramble and pushing one another while boarding the bus, the ticketing systems and rescheduling of bus routes are the major defects of BRT operations. Since the population of Dar es Salaam is growing very fast anticipating about 5 million people in 2025, the responsible authority should add more buses to cater for the demand of public transport services. Also, the improvement of road section at Jangwani area should be done to avoid flood effects during rain seasons and make BRT corridor passable throughout the year. Consequently, the responsible authorities should guide or restrict petty trading along the walkways near BRT lanes to avoid inconveniences to passengers and other BRT users.

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