

Performance of BRTS using Spatial Planning and Land Use Management Act (SPLUMA) Principles: A Case Study of City of Johannesburg

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Abstract

Cities worldwide have been battling to adopt and implement better ways of addressing a wide range of spatial development challenges towards sustainable economies through various policies and legal instruments. Interestingly, much attention has been placed upon transport planning as part of transforming cities and thus urban public transport has become a cornerstone given its potential of integrating and commuting large communities to desirable destinations. In developing worlds very few but albeit interesting and successful initiatives are notable leveraging socio-economic and environmental benefits. This is particularly so in South African cities with City of Johannesburg Metropolitan Municipality leading; introducing Bus Rapid Transit Systems through corridors of freedom project (COF). Using secondary data generated from intensive literature review and primary data collected through survey & observations within COJ regions, this study investigated the extent to which BRTS has implemented SPLUMA Principles in COJ. The findings revealed that BRTS if well planned is crucial for the ambitious spatial visions of SPLUMA. With its increasing technological usage (smartcard system, surveillances and upcoming Vayamoja App) the BRTS (Rea Vaya) proved to be on the right path. It is hoped that this work may prompt further study and help in understanding its praxis and theoretical application.

Keywords

Bus Rapid Transit Systems (BRTS), Spatial Planning and Land Use Management (SPLUMA), Corridors of Freedom (CFO), Rea Vaya, City of Johannesburg (COJ)

1. Introduction

There is no denying that BRTS practices have gained popularity worldwide and have increasingly become at the forefront of scholarly attention. This kind of urban development have advocated for densified and compact cities supported by various other nodes. This provision however, seems to be a challenge in developing economies due to an increased individual vehicle ownership which in turn creates a competition among other modes (Pucher & Kurth, 1996). In a similar way, urbanization subsequently fuels this. As a response, Cervero (2013) emphasized the need to plan for the imperative challenge of public transport through corrective and reactive interventions that deal with the growth forces unleashed by modernization. This is why most municipalities in developing countries have provision of public transport as one of their priority in the task of urban planning. The City of Johannesburg (COJ) is one of no exception. This paper highlights how Bus Rapid Transit system (BRTS) is performing on Spatial Planning and Land Use Management (SPLUMA) development principles within the COJ jurisdiction. For this study, the purpose was to see whether the public transport provided herein satisfies the development principles that apply to spatial planning, land development and land use management as indicated in Chapter 2 (section 7) of SPLUMA Act 16 of 2013 given that

the previous legacy left the country largely mangled (Christopher, 1992). For, it is imperative to ensure that the transit system conforms to those principles since it is impossible to undo history.

Since South African cities are exclusionary (Bosworth, 2016), the paper attempts to answer the quest for a social and inclusive economy through public transport. This is done within the COJ jurisdiction, also called Jozi which was established in the year 2002. The rationale for this is based upon the city's capabilities of holding an account for 13.7% national output (Todes, 2012: 159), thus making it an economic hub of South Africa. Despite this, however, this metro remains confronted by a number of spatial challenges hence it came to the author's realization that it is necessary to align the city's development with the enacted spatial strategies (SPLUMA development principles in this case) given that they highlight the need to uplift economically depressed areas. For it cannot be that those areas must await for development instead those communities must also be given the opportunity of a sense of belonging in their urban areas of which they were neglected in the previous ruling.

Considering a number of public transports, this paper suggests a review of BRTS (the Rea Vaya) as the subject matter in terms of public transport to evaluate its performance upon SPLUMA principles. These principles include, namely; the principles of spatial justice, spatial sustainability, spatial efficiency, spatial resilience and good administration which will be further discussed as the paper reads. It is imperative for one to understand that the BRTS is a well-known transport system and has been implemented internationally and its implementation is seen as an economic development project with short, medium and long term impacts and benefits (Heather, 2013). With this said therefore, it will be possible to outline findings as to whether the system has been successful in meeting its aims by evaluating its performance on SPLUMA principles. In light with above, South Africa just like other countries also placed interest in this type of public transport for its people having reports of its popularity worldwide (Cervero, 2013). The country prioritised investments in its transport sector for the development of such bus system as a way to acknowledge its 'colonially inspired and tainted spatial planning system' (Van Wyk & Oranje, 2014). Therefore it can be noted that there is a direct relationship between the supply of transportation infrastructure and urban form (Duarte *et al.*, 2016). As part of this, the mass public transport system was introduced through the Corridors of freedom project introduced in May 2003 (COJ, 2003).

2. Literature Review

Transportation is credited as the cornerstone towards achieving a strong and prosperous economy (Department of transport, 2011). In South Africa, Walters (2012) accentuates that public transport is foremost placing interest in the planning system as of today. To be specific, the road mode of transport given the fact that it was given low priority at the time of colonial period (Van Walbeek & Pienaar, 1997). This caused a gap in the development of road mode of transport (Abuhamoud *et al.*, 2011). Acknowledged by Marsay (2005), at that time Europeans preferred rail system as a means of transporting materials due to the cost of construction and high profit rail transport would bring to them because of the slave trade.

In spite of this, however, roads are currently the main means of transportation within each nation in Africa and around the world (Trans-Africa, 2008:66). They play an essential role in providing access to various opportunities (be it economic or social), trade and industries (Holtmann & Jansen, 2007:2-4). Therefore, road transport should be viewed as a crucial factor contributing to the economic development of any country. Nonetheless, most cities are still faced with long-term challenge of providing a viable public transport that meets all users' needs aligned with SPLUMA. Taking for example, the work by Bethlehem (2013), reflects that the public transport service levels in Johannesburg just like in other cities in developing countries is insufficient to meet user's needs. This is why this research attempts to verify whether the aforesaid hypothesis is true or not.

2.1. BRTS Defined

One cannot go forward without understanding what BRTS is as it is imperative on the reader's side. BRTS is an acronym that stands for Bus Rapid Transit Systems (BRTS) as per the implementation guidelines of USA (Levinson *et al.*, 2003); the latest transport initiative around the world. By way of definition it can be defined as "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"(Wright and Hook, 2007) citing the New York-based Institute of Transportation & Development policy

(ITDP). Interestingly, it is also defined as “a flexible, rubber-tired form of rapid transit that combines stations, vehicles, running ways and information technology elements into an integrated system with a strong identity” (Ugo, 2014) citing (Levinson et al., 2003:10–26). From the two definitions, it can be noted that words used to describe the BRT system can be summed up as energy efficient, low-cost and huge volume bus-based system.

According to Bassett & Marpillero (2013), the BRTS has its root in Brazil and Colombia. Initially, its development was however been limited to continents in the North and South of America at late 90s (Adewumi & Alopi, 2013); till date the concept became trendy. This is also evident from the work by Milligan & Company (2003) that the BRTS is a trending planning concept viewed as the future of sustainable transport system based on its success across the world. At its inception the system emerged as a necessary option for Beijing to reduce emissions from traffic and particularly the rising private car ownership (Basett & Marpillero-Colomina, 2013). As a result, it offered a cost-effective solution to city traffic supplementing the rail network at one tenth of the cost of a rail system to construct (Gauthier & Weinstock, 2010; Basett & Marpillero-Colomina, 2013). Today, more than 40 BRTS are in operation in Latin America, Northern America, Europe, Australia and Asia (Adewumi & Alopi, 2013).

In South Africa, the Department of Transport (DOT) highlighted the importance of BRTS and that it should be a number one priority to the success of country’s transport system (DOT, 2007; DOT, 2011). Indeed, the subject matter came into effect on the 30th August 2009 and it is now in operation in the following cities, Johannesburg; Ekurhuleni; Cape Town; Pretoria; Durban and Port Elizabeth (Wood, 2013; Ugo, 2014). Till date the system is still expanding. This means that the country see the potential of this system in addressing its history as a way to prepare for a future characterised by no further segregation, inequality, inefficiency and deprivation of access aspects just as addressed in SPLUMA.

2.1.1. International Examples

A number of countries have implemented the BRTS in their cities given its advances of reducing greenhouse gas emissions, improving travelling time and most importantly contributing in the public transport travel amongst others (Adewumi & Allopi, 2013; Buehler et al., 2016). However, a challenge is faced throughout the world with regards to increasing growth on car ownership especially in developing countries (Dimitrou & Gakenheimer, 2011; UN Habitat, 2013). This in turn causes a downward trend in the demand for public transport and a greater competition among other modes (Pucher & Kurth, 1996).

For developed countries however, the above is quite the opposite. Recent studies have reported a steady decline in car ownership and this is evident in countries such as the USA, Canada, Australia, France, the UK, Sweden, Germany, and Japan (Millard-Ball and Schipper, 2011; Kuhnimhof et al., 2012; Goodwin & van Dender, 2013). Most importantly, these countries are facing a decline in the share of trips by car and an increase in mode of sharing through walking, bicycling and public transport (BRTS); aspects that relates to a global trend of sustainable transport said Buehler et al., (2016). Perhaps the most famous examples are Singapore, Hong Kong, Seoul, London, Paris, Copenhagen, and Stockholm (Cervero, 1998; Newman & Kenworthy, 2015; UN Habitat, 2013).

Given an increase in public transport usage, BRTS seems to be a leading mode with the essence of improving bus operating speed and reliability on streets so as to reduce delays in various types. The system’s success stories are reported to be have evolved from Brazil with Curitiba excelling in terms of performance amongst other 30 cities (Cervero, 2013). With Brazil leading, other American countries including Colombia, Mexico, Chile, Peru and Ecuador followed and has adopted the system making America the core of global BRT movement. Acknowledging this is Goodman *et al.*, (2006) stating that the popularity of Curitiba’s BRT had an effect on a modal shift from car travel to bus travel. Data from the two most recent national travel surveys indeed reports a fall in car mode share of daily trips (all trip purposes) from 86% in 2001 to 83% in 2009 (USDOT, 2010). Just like many American countries, Colombia also adopted BRTS in its transport sector called TransMilenio which began to operate from 18 December 2000 (Cain et al., 2006). This system came into effect due to the inspiration from all-bus network transit system implemented in Curitiba, Brazil. Therefore it is obvious to say the Bogota BRT was developed so as to improve upon the Curitiba system in Brazil.

2.1.2. Local Examples

South African transport system includes both public and private modes of travelling. Thus, the country has multiple transport services categorised in roads, air, rail and water transport. Considering a variety of modes of transport, roads are currently the main means of transportation within each nation in Africa and around the world (Trans-Africa 2008:

66-68). They are an important public transport plays in connecting the previously disadvantaged groups located on the peripheral areas of cities.

Even though taxis have long existed, Todes (2012: 408) highlighted an increasing concern about their safety and efficiency also that they are well adapted for urban sprawl. Complaints are mixed between the social class (rich and poor), as poor people are concerned about the safety and facilities of the public transport services whilst rich people are concerned with car congestion. As a result, this then left the country with no others options except for adoption of a sustainable transport as a solution to moving forward.

This is why public transport is experiencing a process of transformation in the greater part of the country's urban areas. This transformation is more towards enhancing the quality of public transport supply. In consequent, this country began to encourage the growth and facility of BRTS accommodating everyone whether low income people, middle or rich people across the country (Jeffery & Swilling, 1985). Indeed, efforts have been made in the transport sector and the BRTS are fast becoming part of the country's urban landscape (Healer, 2013; Gautheret al, 2013).

Just like other countries, South Africa's BRTS got its roots from Curitiba. For South Africa, BRTS first came into effect on the 30th August 2009 (Wood, 2014), with the rationality to improve on public transportation sector as it was degrading in a greater rate while the urban population was increasing drastically (Healer, 2013; Gautheret al, 2013). Another aspect that stimulated to the emergence of the system in the country was the 2010 FIFA World Cup to be hosted in Johannesburg (Allen, 2013). Today, this system is in operation in the following biggest cities, Johannesburg; Cape Town; Tshwane and Durban. Evident in the City of Johannesburg is the Rea Vaya, City of Cape Town has the MyCiti (BRTS), Tshwane has A re Yeng and eThekweni has Go!Durban (Adewumi, 2014). Given the City of Cape Town Metropolitan Municipality, the city has established the BRT system in its transport sector as a viable mode of transport compared to rest, beginning of 2010 (Adebambo & Adebayo, 2009; Moboreola, 2009; Ugo, 2014). This system was developed not only to improve the city's public transport; rather it is designed to emphasize the need for integration with other modes of transport (MyCiti, 2013).

Bringing this to the City of Johannesburg context, the city also embarked on a journey of transforming its spatial development through transit system development. Magni (2013) accentuates that the city indeed invested into its public transport through the Capital Investment Framework with the hope to achieve great benefit economic wise. More so, with the hope to provide a public transport that is viable for its citizens especially the previously disadvantaged groups, those in Black townships to have the privilege of accessing the urban services as they were neglected (Todes, 2012). The adopted BRT is termed the Rea Vaya and was established as part of the Corridors of freedom project.

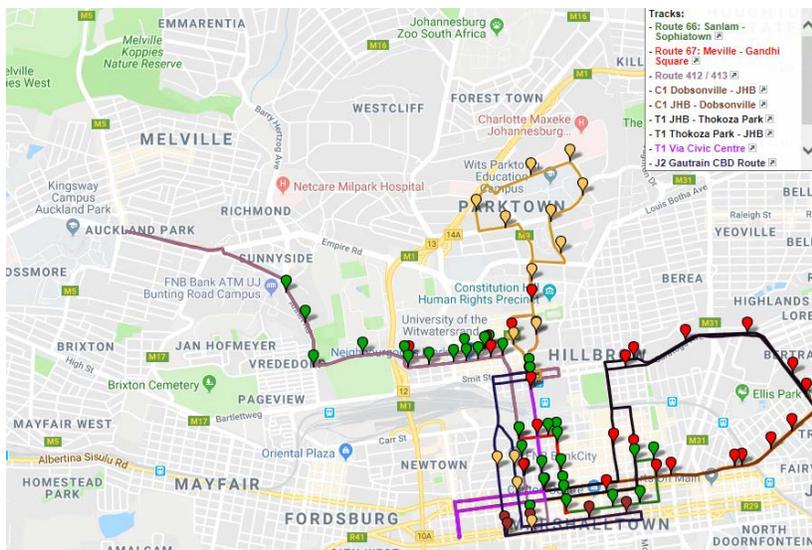
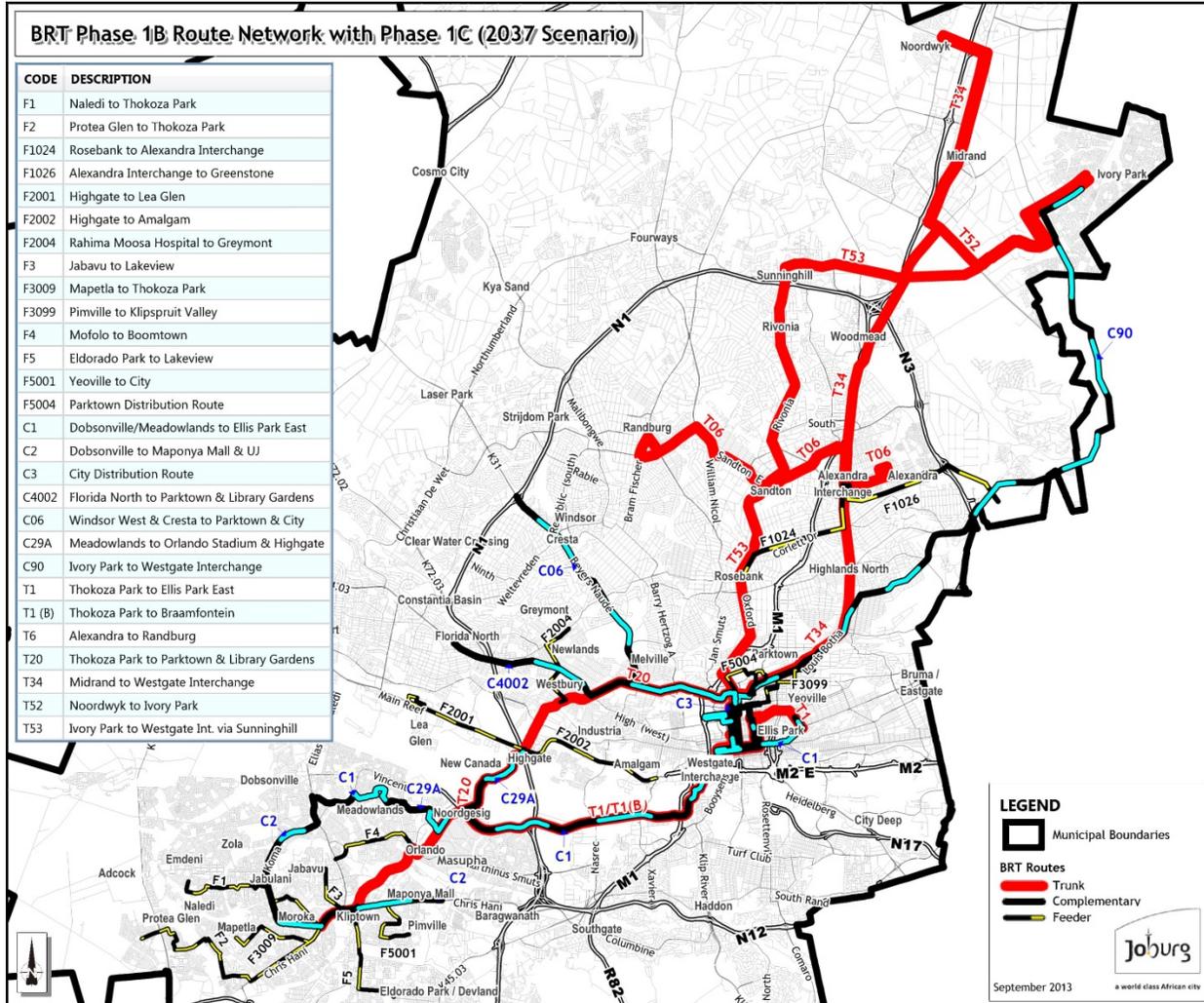


Figure 1: ReaVaya routes

Source: <https://www.reavaya.org.za/reavaya-integrated-map>

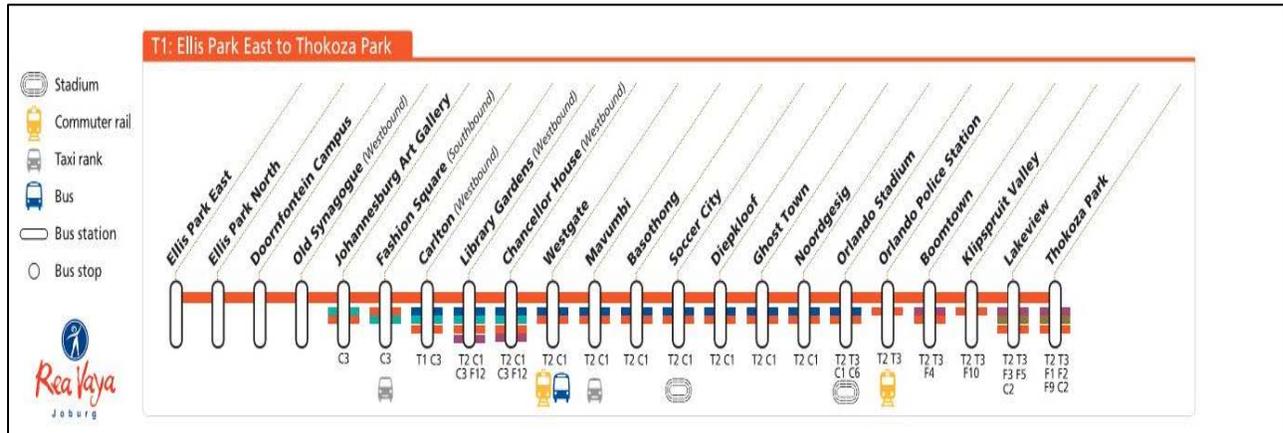
From above it can be observed that the Rea Vaya has been introduced in phases with 3 exclusive BRT bus lanes T1, T2 and T3 (phase 1A and phase 1B) plus their complementary and feeder lines. To this extent, the city has implemented and completed phase 1A and 1B; phase C is still under construction and it will be launched in September-October 2017 (<http://www.reavaya.org.za>).



Source: Rea Vaya phase 1B business plan (n.d)

This study is concerned with phase 1A that forms the Soweto to inner city Johannesburg corridors. The phase has a length of 25km and includes 22 stations transporting passengers of an average of 42 000 per day (Transport Mobility of South Africa, 2013). This phase is serviced by the trunk 1 and 2 buses (T1 and T2) connecting Soweto to the CBD and Ellis Park. To expand the area's coverage, the trunk route is accompanied by four complementary routes making up 90km (Grütter, 2011) and five feeder routes that make up 54km (see figure 5).

Figure 2: Chosen Routes



Source: https://www.reavaya.org.za/routes/images/t1_ellisparkeast_to_thokoza.gif

Given that the city has 4 BRTS routes running (T1 via Civic center, T1 Thokosa to Ellis park East, C1 Dobsonville to Ellis Park East and C3 Inner city route); only T1 forms the subject matter of this study given its number of stations in route T1:Thokosa to Ellis park East (a part of Phase 1A) and its proven potential to move thousands of groups to and from the CBD. Agreeably, as stated by the Strategic Integrated Transport Plan Framework (2013) the Rea Vaya BRTS moves as many people more than the metro Bus, with only 10% of the cost. This is a stepping stone towards smart transportation systems within the City of Johannesburg, as BRTS provide a consistency of standards from townships such as Soweto to Johannesburg’s Central Business District (CBD). However, since the route is long with about 22 stations, this study will be specifically based on three stations areas- the Doornfontein campus and Carlton found in the Central Business District (CBD) of Johannesburg (Region F)-the heart of Johannesburg situated in the Gauteng province and Thokoza Park station-situated in Soweto Township (Region D) (COJ, 2010/11).

In South Africa, the BRTS is strategically developed with running ways well thought for a harmonious relationship with various transport systems. They have their own dedicated lanes making it effectively within the City center as well as in the townships (Moboreola, 2009). This provides easy access within the cities, and especially in areas where traffic congestion is immense. Stations provide public commuters the ability to integrate with various users of the BRTS, as stations are sheltered with seats which allow commuters to rest while waiting for their transport (Beukes, 2015). The greater part is that it provides passengers’ with information about various timeframes as well as the availability of the next bus (Curtis et al, 2009). These bus systems are mounted with an automated vehicles GPS location and are integrated from the city center to the local areas as they are time framed (Suzuki *et al*, 2013). The regulatory aspect of the BRTS is through the use of the off-vehicle collection, of smart cards which can be loaded on daily basis or monthly basis. The fare collection contributes to road maintenance and contributes to BRTS service management (Deng & Nelson, 2011). To this extent, BRTS are still rare in urban transport networks in African cities. This is because some cities like Cape Town are faced with challenges such as lack of limited capacity in public agencies for transport planning, design, operations and policy (Seftel & Rikhotso, 2013). It therefore becomes clear that South Africa’s planning is based on ideas and experiences drawn from other countries. However, a big question remains as to whether much has also been done in terms of implementation of what is in the SPLUMA of 2013.

2.2. Corridors Development

The word corridor in its simplest term refers to nodes (Marrian, 2001). Another word of the corridor development is as linear city models (Priemus & Zonneveld, 2003). Central to the idea of corridor is to recognise development as not just a matter of infrastructure improvement but also that development ought to be integrated with other economic opportunities such as trade and investment and include efforts to address social and other impacts arising from increased connectivity (Kollamparambil, 2016). This idea of corridor development is not necessarily a new concept and can be seen as a complex area of ‘braided’ infrastructure said (Priemus & Zonneveld, 2003). It was first developed by the Spanish urbanist Arturo Soria Y corridor in the 1880s as an alternative for the densely populated and concentric industrial city of Madrid (Chapman et al., 2003).

Since then, it became popularised and emerged in various forms around the globe including urbanization corridors, ecological corridors, transportation corridors. Ntamutumba (2010) asserts that for some countries they have only road transport corridors while most occur as more than one mode of transport and thus term it a transport corridor. In the words by Ntamutumba (2010), “a Transport Corridor is a multi-modal corridor connecting two points of economic activity (together with as many places of economic concentration as possible along its length) as reliably and as cost effectively as possible. Its primary focus is on economic efficiency rather than economic distribution and it should ideally provide users with transport choices.” From the local context, South Africa like other countries around the world also adopted the corridor development to transform its spatial form to a desirable one. According to Rogerson (2002), such development in the local case dates back to 1995 where a meeting was held in Maputo between the Ministers of Transport of Mozambique and South Africa, which culminated into the development of the Maputo Development Corridor. This corridor was a cross border corridor part and parcel of national programmes which at their heart was to promote regional development potential in the post-apartheid space economy of both South and southern Africa (Ndebele & Ogra, 2014).

The emergence of the COF was in may 2013. this project is intended to improve present rooted settlement designs of the city that resulted from urban sprawl and uncontrolled spread of low density advancements on the edges of the city to high density improvements made up of a blend of residential space with offices, retail as well as recreational opportunities. The undertaking is likewise about creating compelling and reasonable public transport to all city members empowering riders to save time, distance. The development of this corridor is threefold, the Soweto to CBD corridor termed the Empire-Perthcorridor, the CBD to Alex corridor termed the Louis Botha, and the Turffontein corridor. Below herewith is a diagrammatic representation of the proposed COF.

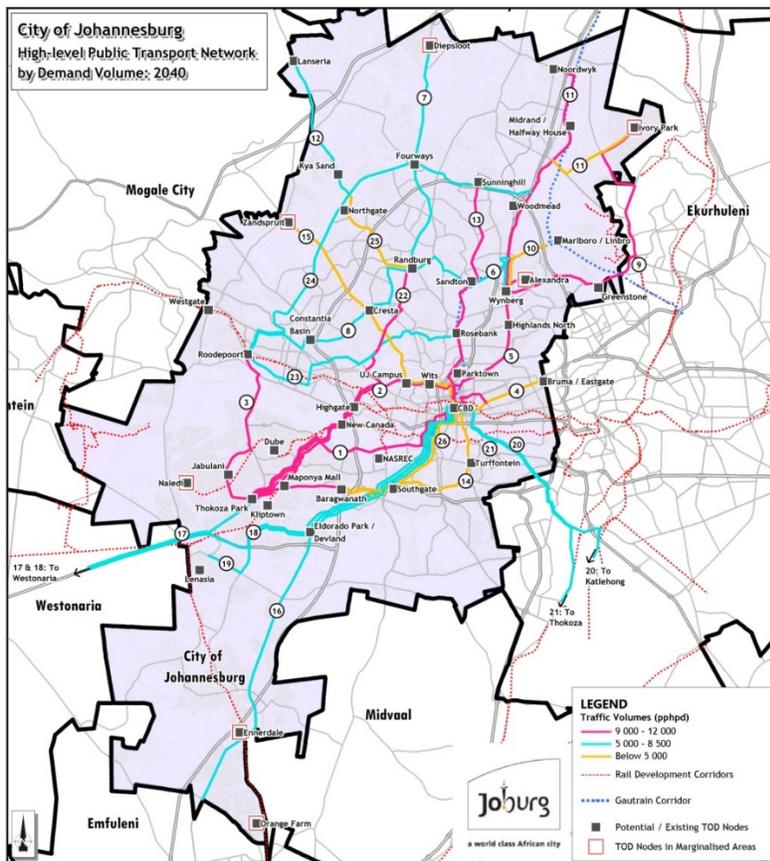


Figure 3: Corridors of Freedom

Source:

[https://www.joburg.org.za/Campaigns/Documents/2014%20Documents/CoJ%20SITPF%20Draft%202013%20May%202013%20\(1\).pdf](https://www.joburg.org.za/Campaigns/Documents/2014%20Documents/CoJ%20SITPF%20Draft%202013%20May%202013%20(1).pdf)

Demonstrated above is the coverage of the Corridors of Freedom (COF) within the COJ jurisdiction. As observed, the COF identifies key routes that have or will implement BRTS (and some Gautrain) developments. This corridor helps us understand better the relationship between the newly introduced transport system (BRTS), its infrastructure and other urban development processes. By so doing the corridor thus attempts to achieve an integration of nodes through Transit Oriented Development and spatial transformation across the COJ jurisdiction and thus establishing a sustainable city which (Bickford, 2014) refers to it as a liveable city.

The COF is designated for:

The Louis Botha Development Corridor linking the CBD to Alexandra, The Empire-Perth Development Corridor to link the CBD to the mining belt and Soweto and the Turffontein Development Corridor which will link the CBD to the mining belt and southern suburbs (COJ, 2013). Thus far, construction works along the Perth Empire corridor have been completed and the Bus Rapid Transit (BRT) service is in full operation. The Louis Botha development corridor has been taken as the second phase of the project, with construction works therein currently underway (COJ, 2013).

The ultimate goal of setting up a sustainable transport corridor lies upon transforming transport systems into “Development Corridor” which is characterized by the integrated nature of its programs and typically focuses on the upgrading of transport and energy infrastructure, attracting investment from all sectors (starting from those with the potential to exist toward developing sectoral economic projects and subsequently into related sectors that bring about integrated development) at local and regional level (Cervero, 2013; Bickford & Weakley, 2014). The extent to which BRTS (an aspect of COF) has fully implemented SPLUMA principles is the question for today.

2.3. SPLUMA Development Principles: Transport Sector

The Spatial Planning and Land Use Management Act (abbreviated SPLUMA) Act no. 16 of 2013 is a legal framework act meant for all spatial planning and land use management systems in South Africa (Njenga, et al., 2014). This act typically provides a flexible and adaptable approach to managing and achieving the results of complex processes that involve disparate components; hence the current trends in urban planning are towards sustainable development. In terms of SPLUMA section 6(2), it is stated that general principles should be developed to be applied to all aspects of spatial development planning, land development and land use management (SPLUMA, 2013). Suzuki et al., (2013) highlight that this act in fact seeks for integration amongst land uses through spatial planning policies and practices which in turn influence the nature of places and how they function. Therefore this act necessitates the functioning and determination of spatial outcomes.

- Principle of Spatial justice

As outlined in SPLUMA, the principle of spatial justice speaks to an urgent matter of addressing inequalities exacerbated by the fragmented planning system (Walters, 2014). Emphasis herein is based upon spatial injustices that exist in the country. From a more general perspective Wyk (2015) accentuates that injustices are based on race, class, ethnicity and gender; the products of the then planning system. In this regard, the principle simply seeks to eliminate the observed injustices.

Looking at the history of South Africa, discrimination and marginalisation are major spatial injustices faced (Curtis, 2008). This reminds ourselves of how massive and unjust the spatial apartheid system really was and secondly to show that structurally, so much needed to be done after 1994 to start addressing, adjusting and repairing the system. Therefore, organisation of space is central to this principle. Given this, transport sector has undertaken this matter as a priority hence a variety of new public transports have been introduced (Ugo, 2014). Spatial justice in relation with transportation simply implies the provision of a variety of public transports that are widely accessible and inclusive servicing all groups (Harvey, 2008). Given the country’s history, it cannot be that those areas must await development instead those communities must also be given the opportunity of a sense of belonging in their urban areas of which they were neglected before. As a result, when analysing spatial justice, space and societies are deemed necessary.

Furthermore, the principle gives more flexibility to allow for a variety of public transports and the upgrading of existing ones. It calls for the need to redress the injustices with the hope that integration between transport and land use planning will be achieved (Curtis, 2008). Therefore integration, inclusivity and location are taken into consideration in this regard (Wyk, 2015). Location in this sense simply relates to accessibility of transport mode. For this study, accessibility of BRTS becomes pivotal. In the end, for one to say spatial injustice has been employed, the

BRTS should be able to have eradicated segregation, prioritise on densifying and intensify mixed land uses Principle of Spatial sustainability

- Principle of spatial sustainability

SPLUMA also contains the principle of sustainability of which its components can be reduced to encouraging viable communities at the same time limiting urban sprawl. According to Poveda (2011), the quest for achieving sustainability has been widely discussed and thus it is not necessarily a modern concept. Being widely documented however, this concept seems to be a challenge to many including Miller (2014). A review of several literatures building on this phenomenon including (Wiber et al., 2004; Weaver, 2005; Kearney et al., 2007; Donald, 2008; Wheeler, 2009; Schädler et al., 2011) provides a more common recognisable definition of this term via three pillars of human development namely, social, economic and environmental. This requiring the creation of balance among the pillars (Murphy, 2012); as it is assumed that without them then there is no true sustainability achieved.

In light with that, SPLUMA points out that the whole notion of principle of spatial sustainability entails spatial and land use planning that comply with environmental laws, protect prime and unique natural land through limited urban sprawl (SPLUMA, 2013). From this definition, it can be noted that protection of the natural environment is pivotal to this principle. However, reality check, humankind's actions are always against this. Ted (2013) highlights that these people are major contributors of habitat destruction (natural environments) through land use change. Yet, those environments are rich in species making up an ecosystem important for environmental sustainability.

With this said, given that South African cities are segregated and this cannot be undone; this aspect becomes a challenge as the travelling distance is huge. Therefore the relevancy of this principle in transport sector would be whether the transport system implements infrastructures that promotes green planning since it is impossible to reorganise space. That is, the assessment of this principle will be based upon travelling distance (sustainability of the spatial structure of an area) which pose a threat to environmental health be it through toxic emissions or consumption of non-renewable resources. By so doing, a sustainable public transport would be one that promotes environmental protection.

- Principle of Spatial efficiency

This principle of spatial efficiency as outlined in SPLUMA is concerned with the efficient use and optimisation of existing resources and infrastructure (SPLUMA, 2013). Central to this principle is the need to reduce inefficiencies. This implies that decision-making over land use should be designed to minimize negative financial, social, economic or environmental impacts (Agarwal *et al.* 2006). This means that planners' decisions over land should implement innovative approaches to improve on achieving efficiency in all aspects. Although the term can be variously defined and analysed, it has been a critical consideration in various sectors including both policy and operational decisions of public transport operators (Barnum *et al.*, 2011). Therefore by planning efficiently it means producing results with little wasted effort. In return then more benefits will be yield with minimal impact on public health, the environment and natural resources.

In an attempt to measure spatial efficiency, there is need ensure that land development (public transport infrastructure in this essence) is within the fiscal, institutional and administrative means of the country as well as the broader notion of environmental, social, economic and agricultural preservation and sustainability (Cruz (2000). The public transport should make use of the existing infrastructure and resources as a way to comply with this principle. Components to measure can be summed up as resource use, emissions, safety and liveability (Ozbeket *al.*, 2009; Barnum *et al.*, 2011; Rajasekar & Deo, 2015).By so doing then it would mean that transportation planning is not entirely present-oriented (focusing on the connectivity and improvement of the quality of life of users); instead it would be future oriented (bearing in mind the needs of future generations) having that resources are scarce. For this study evaluation of the efficiency of the transit will be based upon numerous factors such as the number of users of the BRTS in relation to population, kilometres of routes provided in relation to area and the level of satisfaction, low operational costs to users and a minimum number of vehicles but without a decrease in the quality of service provided.

- Principle of Spatial resilience

This principle speaks of the need to ensure that development is robust yet flexible to accommodate unexpected change (SPLUMA, 2013). Simply put, flexibility in spatial plans, policies and land use management systems are accommodated to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and

environmental shocks. Hence, sustainability and resilience are complimentary concepts (Barnes & Nel, 2017). Just like, the concept of sustainability, resilience has been largely contested and it has various definitions for various contexts. In the former, managing resources to guarantee welfare and equity now and in the future is central (Elmqvist *et al.*, 2014: 20) and should be the essential goal of development while the latter (which is a broader concept) is a means of achieving it (Harrison *et al.* 2014; Martin-Breen and Anderies 2011). Therefore, if resilience refers to strength to resist change and flexibility to accommodate extremes without failure and the robustness to rebound quickly from disaster impacts; then spatial resilience simply deals with spatial variations (location, properties and the nature of its boundaries)

For transport planning, this simply means that the systems should be planned cautiously taking into account the vulnerability to environmental degradation (Heather, 2013). That is, one needs to plan while ensuring that ecological systems are protected. For example, the public transport system should reduce environmental degradation so as to avoid threatening the functioning of ecosystem. In this regard, when planning for transport systems there is need to include green infrastructure to create balance between built and natural environment (Seeliger & Turok 2013). As a result then, the system will be able to maintain its identity. The elements of spatial resilience includes the spatial arrangement of transport systems components and interactions; the system's properties (such as its size, shape, and the number and nature of system boundaries like whether hard or soft, and temporary variable or fixed over time scales of interest).

As noted, this principle speaks to the one mentioned previously as for both resources are made sure they do not replenish and the environment is protected from any harm for future use.

- Good administration

In this principle, there is need for a transparent system wherein there is alignment and integration with relevant sector involved in the application process of a certain development while empowering the public through participative planning (SPLUMA, 2013). It brings about equality amongst individuals in terms of resource distribution in a society ensuring that the whole notion of individuals being equal before the law is fundamental and put into operation in a society. Just like good governance, good administration is a necessary aspect for democracy (Rondinelli, 2007). Once more, this principle talks to transparency. Reflecting on findings by (Wiber *et al.*, 2004), this dimension speaks to openness of state towards its people (the public). Transparency requires freedom of information, including an act to ensure that citizens can acquire information about how government makes decisions, conducts business, and spends public money (Attoh, 2011). This is important because in the end, whatever is planned will affect citizens; therefore it is imperative to take into account the issue of openness.

From planning perspective, good administration arises from a concern for equal treatment before the law. Helao (2015) accentuates that it entails that urban development is influenced by complex interaction between stakeholders or groupings. Furthermore, it speaks to the point that the government should operate in the service of the public good (Rodinelli, 2007). The primary elements herein will be transparency and accountability. Like any other development, the concern herewith is the inclusion of all stakeholders in transport planning and the citizens affected from the planning process to the implementation of the BRTS. In this essence, it means freedom of information, including an act to ensure that citizens can acquire information about how government makes decisions, conducts business, and spends public money is applied. Undoubtedly, then, in the end then conflict that is usually observed will be reduced and then, the aspect of democracy will be implemented.

3. Research Approach & Methodology

The prime aim of this research paper was to assess various strategies on how best to reduce inequality and enhance accessibility in public transport. What has been considered herewith is the cognisance of the fact that the existing BRTS is rather fully operational along the chosen corridor/nodes making it easier for assessing its performance upon SPLUMA. In the end, thus key determinants of SPLUMA principles applicable to the BRTS were identified. An exploratory & descriptive research designs were adopted for the study. From Brown (2006), exploratory research tends to tackle new problems on which little or no previous research has been done. In this regard, it is exploratory in the sense that although there's a considerable number of a literature in the field of transit priority, measures of its performance on SPLUMA development principles is still new. Therefore, it was imperative to use this design given the high levels of uncertainty aimed at exploring more on the little that is known. Once more, a descriptive research design is also used with the rationality to provide an accurate and valid representation of data pertaining to the research question. It is also descriptive in the sense that it aims to provide the status quo of Rea Vaya, supported by experimental

theories from observations. Therefore, data collected was in the form of observations within the BRTS stations & surveys (questionnaires and interviews).

Questionnaires were strictly directed to commuters and parties affected (those in close proximity to the BTRTS stations) to help assess the performance of BRTS through the experiences and views they have with regard to the latest public transport initiative. On the other hand, interviews were directed to particular personnel from Gauteng department of transport (Johannesburg Road Agency, Gautrain), City of Johannesburg (Town Planners, Policy Specialists from City Transformation and Ward Councillors) for increased knowledge with regards to SPLUMA implementation, BRT performance and the relationship of SPLUMA principles on transport sector. In addition, observations will be also part of the study to understand what is happening on the sites. With that said, the data collected was useful to test the success of BRTS on SPLUMA principles so as to meet the objectives drawn in this study. However, various views amongst commuters and the affected people were expected; hence a mixed method was utilised to help analyse all different views and findings. As a result, data analysis was made to compare the responses and the observations made to draw a conclusion.

The work applied the quantitative research approach to reveal the direct and indirect socio-economic benefits as well as human-environmental ones (aspects of sustainability) of operating the BRTS. To be specific, primary and secondary data were collected through the use of observations within the COJ regions and also from intensive literature review, and relevant published documents on corridors (such as journal articles, government publications, census reports, earlier research reports and books). Observations were made along the identified routes to create comparisons amongst these and identify any correlation factors. A purposive sampling method was used to identify key informants involved in the public transit system provision within Region F and Region D. Data was presented in the form of a framework for measuring BRTS performance that highlight the economic, social, environmental and institutional principles. That is, the collected data collected was analysed in the form of content analysis. Simply put, information from literature study and observations were analysed to outline meaning and purpose they carry.

4. Key Findings

The chosen study area was City of Johannesburg located in Gauteng province (COJ IDP, 2013:16). It is home to 4.4 million people and is approximately 1645km² in extent. Below herewith is a representation of the city together with its demographics.

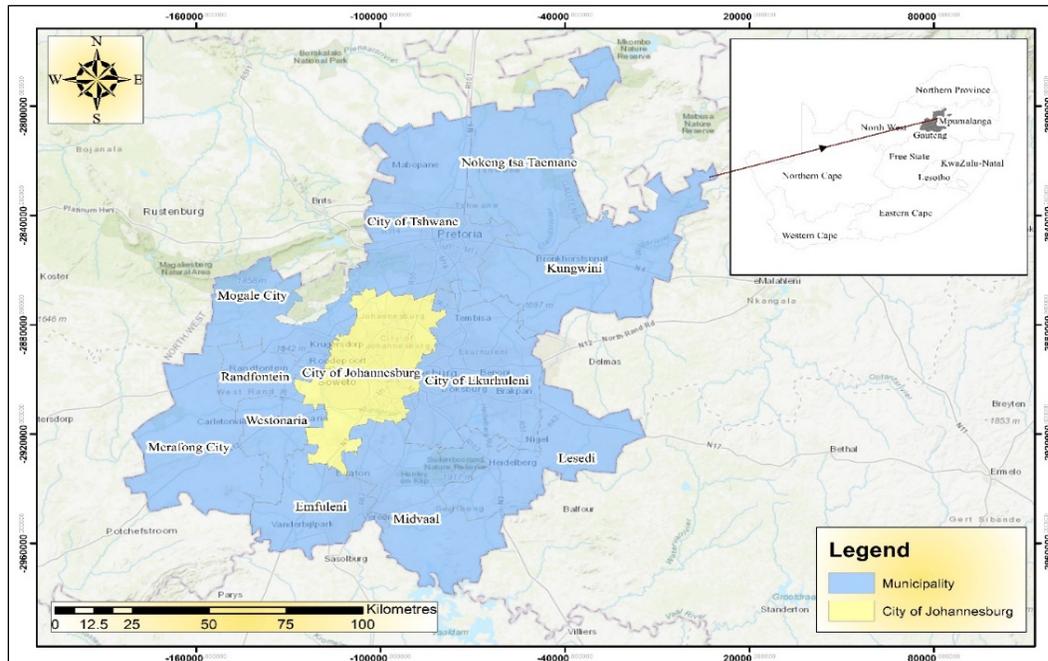


Figure 2: Location of City of Johannesburg

Source: Authors (2018)

The City of Johannesburg is bordered by two other metropolitan municipalities (City of Tshwane Metropolitan Municipality & City of Ekurhuleni Metropolitan Municipality) and local municipalities like Mogale City, Westonaria amongst others. In an extent, the city covers an area of 1,645 square kilometres starting from Orange Farm in the south to Midrand in the north. This is why it is one of the 40 largest metropolitan areas in the world (COJ IDP, 2013:16).

According to Statistics South Africa (2011) there are about 1,434,856 households in the CoJ municipality with an average household size of 2.8 people per household. About 64.7% households have piped water, 26.9% have access to water in their yard and about 1.4% of households do not have access to piped water. More so, there is about 2 261 490 economically active people in CoJ, 25% are unemployed and 31.5% is unemployed youth between the ages of 15 to 35 years (Stats SA, 2011).

As an economic hub, COJ has elevated amounts of job opportunities to reduce challenges of poverty as well as abnormal amounts of inequity faced with. According to the 2011 census StatsSa (2011), about 72% of the people have jobs (1,696,520 individuals) whereas 28% are jobless (564970 individuals). Interestingly, of the general population working, 78% (1,328,219) individuals portrayed are in the formal segment, 8% (143 859) individuals as informal sector workers in addition 13% (223,302) individuals as being hired in private families. Undoubtedly, the city can become the springboard for companies into South Africa and Africa at large. Through its sustainable strategies, the financial services sector must be looked at wherein as well a priority is to set the city to become a financial trading hub linking international companies with that of South Africa and Africa.

Presented below are the results or findings within the identified routes. The data has been collected in the form of observations and intensive literature review from relevant sources to help draw conclusion and recommendations.

- **Current state**

Within the aspect of social sustainability, the following were found.

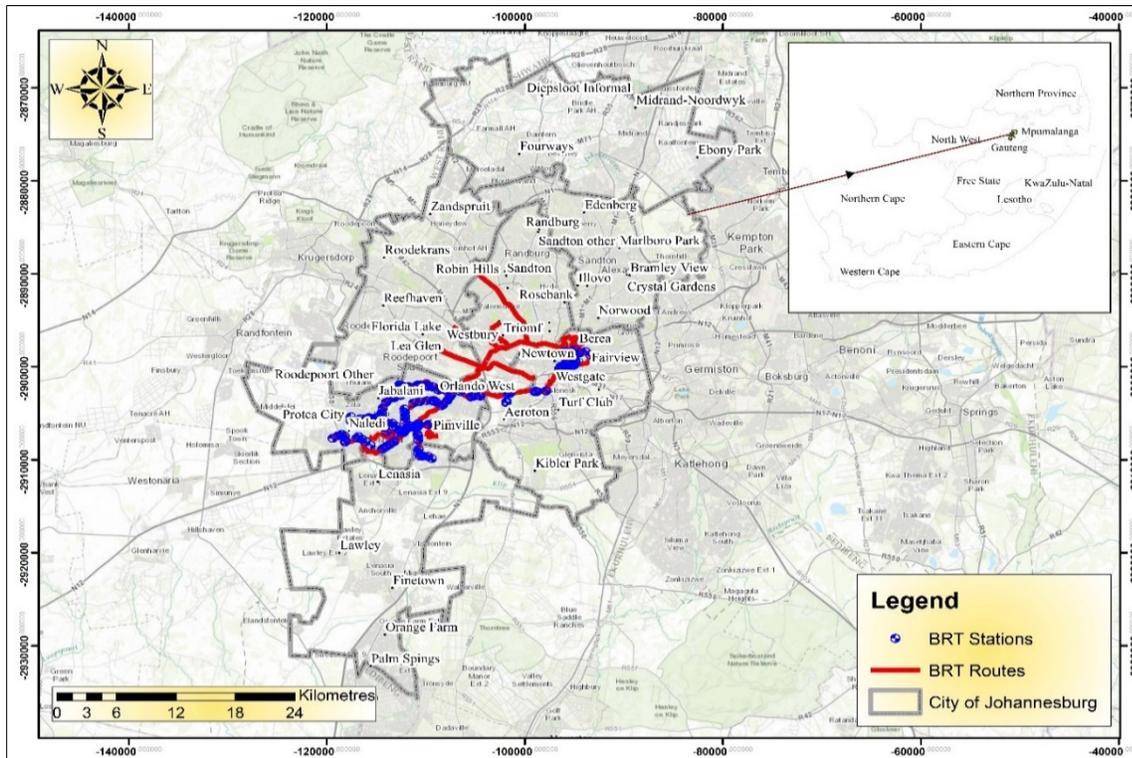


Figure 3: BRTS station
Source: Authors (2018)

The above picture shows the spread or coverage of BRTS stations within COJ. As observed, the aspect of linking those in the southern townships like Soweto are accounted for. There exists more stations towards those previously disadvantaged areas, a sign of trying to give access to those societies the joy of the services and opportunities within the CBD. In this manner, the city has taken much efforts in achieving spatial justice. However, this can be looked at in an opposite way wherein social equity is lacking. This lacks in the sense that there is skewed development. It means the CBD remains the main node experiencing mixed uses and more opportunities as opposed to those townships. As such this requires more interventions.

As observed at the 3 stations, there exist a dedicated lane for Rea Vaya busses with no car travelling by the lane. This enhances travelling time with no other modes disturbing it. This therefore implies some sort of efficiency in travelling as the bus does not have to navigate through to arrive on time to the next station. The lane then enables ease and flow of movement which can be attribute to operational efficiencies and safety. In contrast, for as much as the dedicated lane reduces the time spent on the roads, it on the other hands limit space in small townships like those in Soweto. That is, dedicated lanes developments have impacted on the physical formation of the townships and the use of space. What happens is that there are more division and limited areas that are safe to cross roads and in some instances, streets that were used as play areas cannot be used for such purposes without risks of accidents. Thus, the social benefit is to some extent inconvenienced with. Additionally, the struggle for the use of the limited space that use to be a wide sidewalk and been taken by the BRT reducing the traffic lanes to ways divided by medians. Where children are playing on a sidewalk on a historically taxi route, the taxi has to use the same area where the children are playing and where pedestrians opposed to walk as a loading and a drop off zone. Consequently, not only does that affect the community or the residential community but the broader car owners and drivers including drivers of other public transport like taxis and busses. The clash for the right to use the road in a specific manner from the different affected person's point of view has even resulted in fatal accidents where residents and mainly children have been killed by accidents involving the BRT buses.

From questionnaires, observations and interviews, findings are presented as follows and thus forms part of the framework for measuring the BRTS on SPLUMA principles.

- **Spatial justice**

Central to this principle is mixed use developments, parking spaces and sufficient provisions for accessibility to people with disabilities. At this juncture, the Rea Vaya fails to address the call for spatial justice. As analysed from the interviews, parking is a major challenge that requires subsidies of which at this point there is no hope as to where such incentives will be found. Also, there is an observed lack of sufficient provisions for the disabled at some of the stations and the design does not necessarily accommodate them. However, in terms of mixed use developments the Rea Vaya seems to be doing well considering the zoning that exists there.

- **Spatial efficiency**

Due to many stops and stations, the BRTS has proven not to be effective in longer distance travelling. Also, the method of payment and travelling through the use of smartcard seems to have addressed the principle of efficiency in the sense that each trip is calculated by distance instead of paying the same amount as someone travelling for longer than the trip taken. However, in this case the challenge is that smartcards are only bought at Thokoza Park and not the Ellis Park and Carlton Eastbound station and this inconveniences people. With ITS technologies in place, efficiency has been increased in the Rea Vaya system wherein surveillances are used to safeguard commuters' belongings and for their own feeling of comfort. This aspect was well observed at Thokoza Park station where there is free Wifi installed at the station. Not only does this help the operation management of the system; instead it serves as a measure of crime prevention having records of all activities occurring on the surrounding or within the facility. However, human kind also play a role in this factor and that is with the presence of security guards and metro police safety measures are in place.

- **Spatial sustainability**

Through the findings and analysis it can be concluded that people choose to use the Rea Vaya because of better services it offers of comfort, reliability and safety. The overall safety concerns is based upon the system's low level in crime experiences and the likeliness of having less or no accidents. This is premised upon the fact that the system uses its own dedicate lane with no disturbance from other modes. However, the challenge faced herewith is the weak law enforcement wherein bribery and fraud are viewed not problematic nor as a crime. The potential of ITS technology also goes beyond safety towards a comprehensive operational management. This includes the use of archived data and

automatic passenger counters for planning towards improving the efficiency of the system and for customer satisfactory. Once more, this technology assists with scheduling activities (termed Automated Scheduling) wherein commuters get to know about travelling information. These includes, bus arrival and departure times as displayed at each station and in the buses.

- **Principle of spatial resilience**

From resilience perspective, the key determinant is the availability of sufficient green infrastructures to promote green planning. Results from the respondents was inadequate but the interview with Zarina Goondiwala provided that the system implements aspects of that contributes or takes into account environmental considerations. This was proven from observations at the Thokoza Park station and Ellis Park East where there are trees supporting the structure and more so space allocated for walking and cycling. Nonetheless, in the latter the challenge is that of space especially in the Carlton Eastbound station.

- **Principle of good administration**

Lastly, the study reveals that there are different communication platforms provided by the city with internet taking a leading role. While digital communication may be seen as the best communication platform to reach all stakeholders, it is not always the case that it might be easy for others to understand information displayed there. Again, while public meetings were held to inform citizens about the inception of the Rea Vaya system, only certain groups willing to attend did and thus riots arose due to still fails to attend these public meetings.

5. Conclusion

The research sought to demonstrate the extent to which the Rea Vaya conforms to the SPLUMA development principles. Overall, the BRTS shows good performance when evaluated on the SPLUMA principles. Nonetheless, the Rea Vaya is not yet fully addressing the spatial vision of SPLUMA principles (refer to findings). This may be based upon the rationale that SPLUMA came into effect while Rea Vaya (T1 route) is already operating. That is, even though the BRTS is good and have provided some potentials, in relation to socio-economic aspects, however, there is always a room for improvement given its challenges. More so, even though the system may have failed to reverse the previous planning idea herein; that does not necessary apply to other areas (due to study limitations and sampling size).

In light with the above, the realisation of the corridors of freedom project is bound to make a difference in transforming the city into a sustainable one that is liveable, competitive, bankable, well-managed, & well-governed. Not only to that, the city will move towards a more holistic approach of being smart city. At this juncture, the improved BRTS performance will translate to smarter business processes which will result in the reduction of cost and freeing up budget for other initiatives. In overall, the system is still viewed as a good system implemented at the wrong time (prior to the development of SPLUMA) at the right place to help rectify the planning mistakes of the past. Hence, there is no doubt about the success of BRTS and its integrated corridors, but feeder to these corridors is equally important so as to reduce the isolated network system.

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