PROGRESSIVE OR REGRESSIVE: EFFICACY OF INNOVATIVE URBAN PUBLIC TRANSPORT SYSTEMS ON URBAN MOBILITY IN THE CITY OF TSHWANE

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ABSTRACT

Innovative approaches to public transport systems in response to socio-economic needs and complex urban mobility challenges facing developing countries have emerged as a focal point of discussion in development planning academic discourse. This is more so in countries like South Africa where cities are characterised by a fragmented spatial form and socio-economic disparities. Thus, public transport systems that provide efficient and reliable services affordable by all income groups while contributing to improved accessibility of opportunities have been advocated for. This paper assessed the role of innovative approaches to urban public transport systems in improving urban mobility and redressing past imbalances. The study followed a mixed approach by combining qualities of qualitative and quantitative approaches through administering of questionnaires and semi-structured interviews. An inductive approach to data analysis to study patterns within themes of accessibility, efficiency, affordability and reliability was followed. Study findings and international experiences observed affirm that innovative urban public transport systems play a commendable role in improving urban mobility. However, there is limited effort towards a multi-modal network in response to the fragmented spatial form characterising cities in the global south. The paper concludes by accentuating stakeholders' collaboration and modal integration in a manner that is responsive to spatial and socio-economic disparities.

Key works: Innovations, public transport, urban mobility, integration and spatial form.

1. INTRODUCTION

Public transport infrastructure investments have been advocated as catalysts for spatial integration and socio-economic transformation in spatial fragmented cities that battle with the negative consequences of colonial and apartheid legacies (Litman, 2017; Pojani & Stead, 2015; Jennings, 2015). Road and rail transport investments have been regarded as pivots of functional economic nodes and communities (Risimati & Gumbo 2018a). Thus, considerations for innovative strategies to improve public transport operations as part of investment in public transport infrastructure in a manner that is responsive to spatial and socio-economic challenges has gained momentum in government institutions worldwide (Musakwa & Gumbo 2017). The common envisaged outcome of public transport operations improvement is a spatially integrated urban form through a multi-modal public transport network that enhance efficiency, reliability, affordability and accessibility (Karim, 2017).

In the City of Tshwane, colonial and apartheid spatial planning mechanisms in form of geographic and racial segregation policies contributed to the current land use pattern which perpetuates increased travel times and costs from most townships to economic nodes for employment and socio-economic needs (Ndwandwe & Gumbo 2017). This is a common trend countries that previously experienced colonial or apartheid segregation policies prominent through a fragmented spatial form, where a mass public transport rail network was used as the main mode of public transport with buses limited. This saw the rise of the mini-bus taxi industry (mostly black owned) as an alternative form of public transport to take people from isolated residential areas to places of employment. In South Africa, since 1994, the democratic dispensation has developed policy and legislative frameworks including the 1995 white paper, the National Land Transport Transition Act, 2000, the National Land Transport Transition Amendment Act, Accelerated Modal Upgrades and Integrated Rapid Public Transport Networks (IRPTNs) for public transport improvements with the aim of redressing past spatial and socio-economic disparities (Jennings, 2015; Page, 2012)

The aim of the paper was to investigate the efficacy of innovative urban public transport systems in improving spatial integration and urban mobility. This paper discusses spatial integration and functionality of innovative urban public transport systems in the City of Tshwane's Pretoria Central and Hatfield nodes. The paper focuses on the themes of spatial connectivity and functionality of innovative urban public transport systems from which spatial integration and improvement of urban mobility since the introduction of Gautrain and A Re Yeng were investigated. The four principles of urban mobility namely: accessibility, affordability, efficiency and reliability form the core of discussions in this paper. The paper concludes by providing a synthesis of the findings in form of conclusion and recommendations.

2. PUBLIC TRANSPORT INNOVATIONS

The deficiencies in urban public transport infrastructure have resulted in innovative strategies to urban mobility and public transport infrastructure development being sought (Gakenheimer, 1999). Thus, innovative urban public transport systems means adoption of innovative strategies towards provision of adequate public transport systems that will enable improved quality of public transport operations and services characterised by improved levels of integration and urban mobility, stakeholder corporation for an integrated public transport network and operations, integrated billing systems and user friendly communication tools on and off the public transport systems. Innovative urban public transport systems seek to respond to market failures and help to improve consumer experience. Traffic congestion problems resulting in increased travel times is one of the challenges tackled through public transport (Vasconcellos, 2004). Considerations are also made to the socio-economic needs of people served by the public transport network.

Innovative urban public transport systems allow for a Public Transport Cooperation where interdependent stakeholders and public transport service providers can collectively and effectively respond to public transport needs and challenges (Page, 2012). The end goal should be a multi-modal public transport network that brings together operations of all modes of public transport consistent with public transport needs (Litman, 2014). Thus, innovative urban public transport systems create a much-needed platform for multi-modal public transport coordination. Such innovations range from technologically inclined, high quality passenger transportation, stakeholders' cooperation and integrated billing systems across all modes of public transport systems. The common goal is always providing efficient, reliable and affordable urban public transport systems.

The said innovative strategies has been witnessed mostly in rapid rail transport, light rail transport and Bus Rapid Transit (BRT) systems which are becoming major investment pillars for most governments at local and international level (Tsay & Herrmann, 2013). The major investments associated with these innovations are understood to be key drivers of economic growth and social development. It is therefore important to understand each mode of public transport, the type and quantity of passengers it carries, and the role they play it can play in improving urban mobility. The most important consideration for developing countries is ensuring that they do not go for public transport options that are too costly to implement, rather seek innovations that are within their financial capabilities.

2.1 Integration and densification along public transport corridors

Integration of residential areas and economic nodes enhance affordability of public transport systems by the urban poor, thus enabling people to participate actively in the economy (Prim, 2016). The urban poor spend most of their hard-earned money on transport as they often use more than one mode of transport for one trip resulting in multiple fares which perpetuate poverty and deepens inequality (Franklin, 2014). People's ability to obtain easy access to economic and other urban opportunities at an affordable transport fare is a considerable, main contributing factor towards socio-economic transformation, especially given the socio-economic needs and challenges of the urban poor.

Integration of various urban opportunities in an urban area is to a large extent dependent on the state of urban public transport infrastructure and its ability to enable local people to access available opportunities through affordable public transport, especially the urban poor. Thus, densification along public transport corridors has been advocated for as a mitigation mechanism to redress the spatial imbalances of the past (Wilkinson, 2006). Even in the developed world, rapid urbanization and population growth has meant that provision of adequate public transport is a top priority for urban growth management (Aljoufie, Zuidgeest, Brussel & van Maarseveen, 2011). In developing countries, governments have a two-fold responsibility to subsidise public transport for the urban poor and subsidise rental accommodation for others to reside closer to economic opportunities as part of decongesting over-crowded, often isolated townships.

2.2 Urban Mobility

The primary objective of public transport infrastructure is to facilitate urban mobility by improving movement of people, goods and services (Rodrigue, Comtois & Slack, 2009). Given prominent spatial disparities in the developing world, innovative urban public transport systems policy interventions seek to improve urban mobility by effectively facilitating spatial integration to create a vibrant socio-economic environment (Jennings, 2015). The existing body of knowledge reveals that there are four interlinked and interdependent components which serve as indicators of efficacy of public transport systems namely, accessibility, affordability, efficiency and reliability (Litman, 2017; Cervero, 2013; Roux, Mfinanga & Del Mistro, 2012). Public transport systems that reflect a cross-balance on these themes can be deemed as contributing meaningfully to improved urban mobility.

Urban mobility is concerned with the time spent travelling where distance covered is central to the state of urban mobility within the urban environment (Lucas, Tyler & Christodoulou, 2009). Furthermore, Peng (2005) argues that urban mobility policy interventions and investments should look beyond addressing issues of congestion and traffic problems by being responsive to urban development needs to ensure fully functional and economically viable cities and communities without neglecting or systematically excluding the urban poor.

Subsequently, when deliberating on innovative urban transport systems, one cannot neglect the demand for improved urban mobility characterized by improved access to opportunities, affordable public transport and provision of efficient and reliable service.

3. METHODOLOGY

This study followed a mixed approach by using both qualitative and quantitative methods of data collection and analysis. Spatial configuration of innovative urban public transport systems in relation to improving access to economic and employment opportunities was used as a reference point to determine extent of spatial integration. Qualitative data collection included interpretation of data collected through key informant interviews and field observations to assess level of spatial connectivity. Quantitative data collection through administering of questionnaires incorporated collection and quantifying socio-economic data to assess the impact of innovative urban public transport systems on urban mobility. The inductive approach to data analysis by way of studying patterns within themes of urban mobility and spatial connectivity was then followed.

Qualitative data analysis was through the interpretation of data from key informant interviews that were held with officials from City of Tshwane Transport Planning Sections which informed discussions and analysis on the spatial configuration of the Public Transport Systems. Field observations for visual analysis to enhance the researcher's perspective on the spatial connectivity and urban mobility, i.e. efficacy or functionality of innovative urban public transport systems. The economic nodes of Pretoria Central and Hatfield were use as the focus points for the spatial analysis since they both have the A Re Yeng BRT, Gautrain rapid rail and Gautrain buses as latest innovations fully operational while also containing high percentage of commercial and multi-unit residential land uses.

For quantitative analysis, data from questionnaires was analysed through SPSS statistical tool and exported to excel spreadsheet for producing of pie charts and bar graphs. The questionnaires focused on examining the efficacy or functionality based on consumer's experience focusing on the themes of affordability, accessibility, efficiency and reliability. The researcher interpreted the data from pie charts and bar graphs by grouping respondents' negative and positive responses according to similarities and patterns.

4. SPATIAL CONFIGURATION OF INNOVATIVE PUBLIC TRANSPORT SYSTEMS

The fragmented nature of the urban public transport network operated by various service providers (i.e. taxi operators, multiple bus operators, and multiple government/municipal modes transport operators) together with the fragmented spatial form suggest that public institutions' responsibility goes beyond public transport infrastructure. Different service providers often use different billing systems, some with distinct technological tools and service patterns which complicates things for the commuters. Notably, lack of integration and cooperation amongst service providers has perpetuated increased travel times and costs, as people use more than one mode of transport to get to their destination, making them to pay for every leg of the journey which points to the need for innovative strategies for integrated billing systems. Bringing together all stakeholders directly and indirectly involved with public transport infrastructure is therefore becoming an integral part of improving public transport operations.

Evident during the key informant interviews was that urban public transport systems are at the centre of improving the state of urban mobility through multi-modal integration for spatial connectivity. As already indicated under urban mobility sub-section above, based on the

existing body of knowledge, the principles of accessibility, efficiency, affordability and reliability serves as key indicators in determining the impact and efficacy of the innovative urban public transport system and the state of urban mobility in any given city or town. Evidently, there has been a commendable effort to cater for spatial connectivity given spatial configuration of the physical infrastructure as more areas have access to public transport. However, duplication of various modes of public transport that are operationally disintegrated leaves much to be desired, hence the need to multi-modal integration. Figure 6 below depicts Gautrain and A Re Yeng routes in the Pretoria Central-Hatfield precincts.

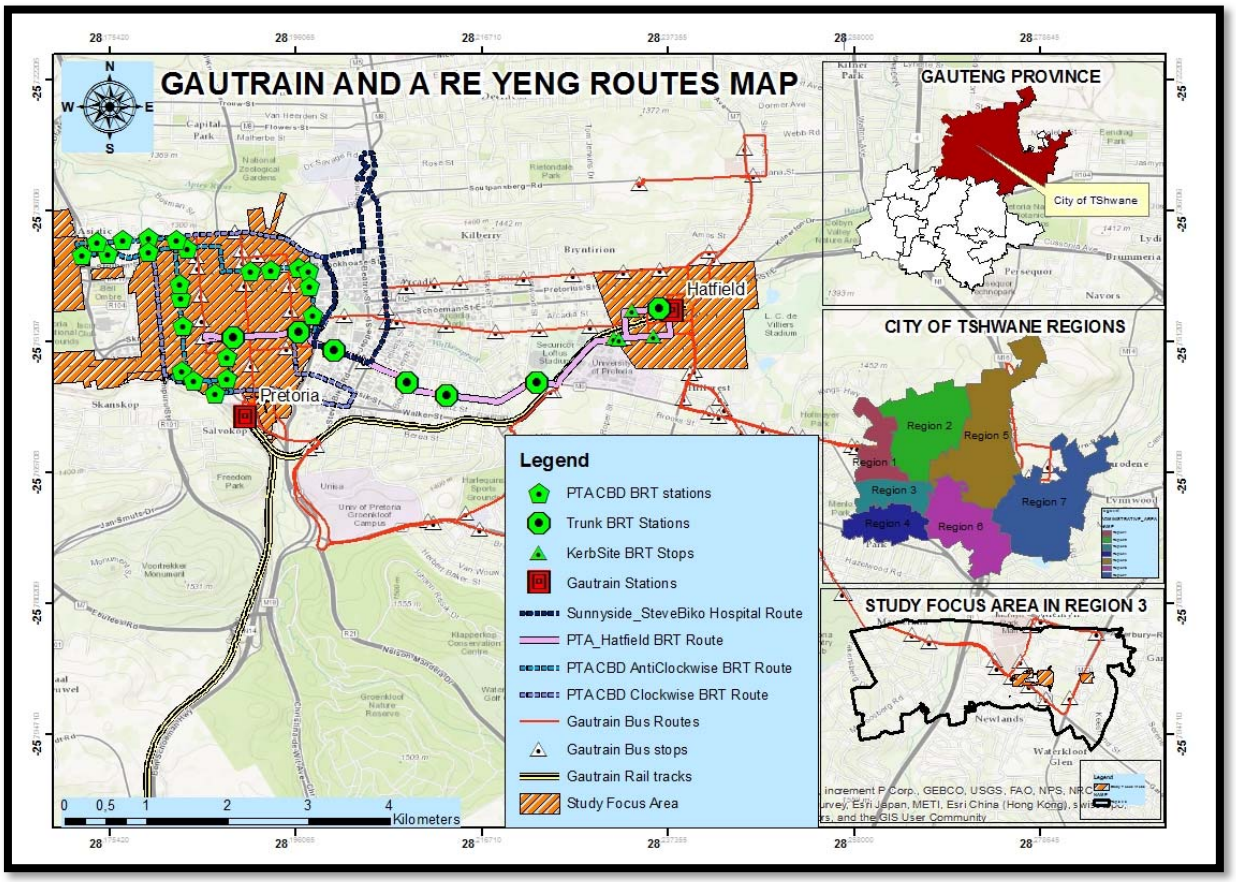

Figure 1: Gautrain and A Re Yeng routes overlay (Source: City of Tshwane & Gautrain spatial data)

As Figure 1 shows, A Re Yeng and Gautrain buses often cover similar routes, yet they are not operationally integrated as they use different billing systems and fare medium which makes commuters and commuters pay for each service separately. This depicts lack of collaboration and operational integration amongst organs of state responsible for implementing innovative public transport systems in line with national policy directives (Gauteng Provincial Government responsible for Gautrain and the City of Tshwane Municipality responsible for A Re Yeng). As such, despite commendable effort in improving urban mobility through physical infrastructure, lack of operational integration means that latest innovations are also not responsive to the Tshwane public transport needs linked to spatial and socio-economic disparities.

There are no indications for a multi-modal public transport network towards ensuring that all areas are effectively and adequately covered trough a comprehensive, integrated public transport network. Even Gautrain and A Re Yeng appear to be operational independent additional modes of public transport to the already operational mini-bus taxis and other bus services. The need for stakeholders' cooperation and operational integration (multi-modal

integration) is therefore evident. The mini-bus taxi industry is still not fully integrated in the innovations that are currently taking place, despite them being responsible for transporting sizeable portions of the population, especially from previously disadvantaged communities. Modal integration will ensure that the poor living in the outskirts of the urban core benefit from a reliable and convenient public transport service. The connecter points and waiting areas should be designed so that they encourage informal traders and provide adequate facilities for commuters to enhance their convenience. Mechanisms must be developed to ensure that public transport investments and decisions do not compromise or neglect public transport social-economic needs of the people.

5. FUNCTIONALITY OF INNOVATIVE URBAN PUBLIC TRANSPORT SYSTEMS.

The ability of innovative urban public transport systems to contribute meaningfully to improved levels of access to opportunities has become an essential consideration to enhance positive returns of public transport infrastructure investments. For spatial fragmented cities, like in South Africa, a comprehensive public transport network that provides an efficient and reliable service at an affordable price for all income groups while ensuring accessibility of opportunities is the backbone of functionality and socio-economic vibrancy of urban areas. As indicated in the introduction section, government has produced policies and legislative frameworks which champion spatial integration and socio-economic transformation with the intentions of redressing past spatial and socio-economic disparities. However, prevailing spatial and socio-economic disparities leave much to be desired.

Effectiveness of the methodology or approach followed in implementing A Re Yeng in Tshwane is questionable as it did little to strengthen already existing public transport operations and is rather seen as another “tick-box” government expenditure that duplicates international renowned public transport modes (i.e. BRT Systems and Rapid Rail) with little regard to local conditions. As It has already been indicated in the above section that Gautrain and A Re Yeng Services are not operationally integrated, it also important to note that A Re Yeng is not even operationally integrated to the Tshwane Bus Services (i.e. the two uses different billing systems and fare mediums despite both being services being operated by the Municipality). Fundamentally, public transport systems should be operationally integrated to facilitate an efficient, affordable urban public transport network for spatial connectivity and socio-economic prosperity. Figure 2 below depicts commuters’ experience of service rendered through innovative public transport systems in line with the principles of affordability, accessibility, efficiency and reliability.

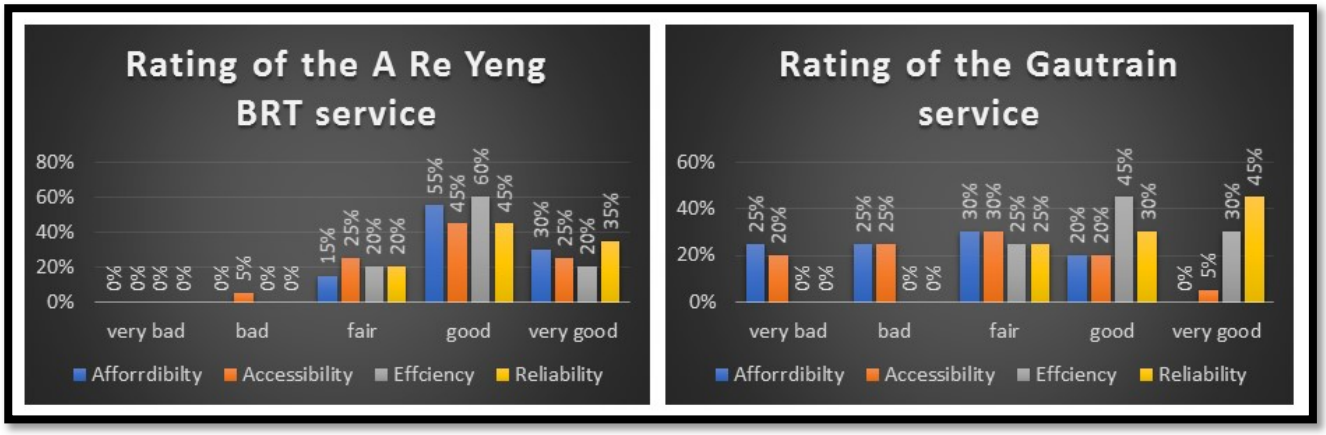

Figure 2: Commuter experiences of innovative urban public transport systems (Source: Primary data collected and analysed).

A Re Yeng appears to be more accommodating to the low-income earners when it comes to affordability. Despite providing the more efficient and reliable service, the Gautrain high travel costs and massive costs to implement its infrastructure does not justify the Gautrain being one of the most prioritized public transport options. To some, it is seen as a systematic exclusion, even if it is expanded further to townships (as envisaged) due to its fares being unjustifiable to township people who are predominantly low-income earners and most reliant on public transport for their daily travel needs. This may further deepening segregation and inequality along income categories which spatially and racially manifest itself due to apartheid polarized labour market and geographic segregations based on race.

5.1 Affordability of innovative urban public transport systems

The apartheid inherited fragmented spatial form is to a certain extent, irreversible as most people have. The need for a multi-modal public transport affordable by all is thus unavoidable as more people continue to use more than one mode of public transport to commute from home to work. The urban poor are often the main users of public transport, but due to their financial constraints they are sometimes unable to afford public transport fares and are forced to walk long distances (Roux, et al., 2012). Like any South African city, City of Tshwane's fragmented spatial form means that the urban poor travel long distances and pay more when traveling to access socio-economic opportunities. Sometimes, public transport does not take commuters directly to their intended destination which then propel them to use two or more modes of public transport. Some give up their jobs when most of their hard-earned money goes to transport costs before they can even cover their basic needs. This then perpetuate unemployment, i.e. discouraged workers. Increased travel times and costs can negatively impact the productivity of workers due to tiredness after travelling long distances.

Findings by this study suggest that BRT should be prioritized as an option that is accommodating to the urban poor as it provides a more affordable public transport option for the urban poor, with the Gautrain being perceived as less affordable while its implementation is costlier. Though the Gautrain provides an efficient service, its affordability by the urban poor leaves much to be desired. Light rail that has been successfully implemented in the City of Linz (Austria) and Addis Ababa (Ethiopia) could be a more affordable innovative rail transport to implement. Light rail may also cover more geographical areas compared to Gautrain given minimal infrastructural implementation complexities. In addition, an integrated billing system like that of Rio de Janeiro (Brazil), where one travel card, i.e. BilheteÚnicoIntegrado (BUI) or Integrated Ticket Fare for different modes of transport can help reduce travel costs as commuters will pay per trip and not each time they change from one mode of transport to another during a single trip.

5.2 Innovative urban public transport systems' impact on Accessibility

Accessibility is concerned with people's ability to easily connect (obtain access) to opportunities, i.e. goods and services characterised by reduced travel times and walkable human settlements (Litman, 2017). Thus study findings reveal that innovative urban public transport systems contribute meaningfully in improving connectivity thereby improving level of access by enabling people to easily move between residential, employment and other socio-economic opportunities. In complementing accessibility, the City of Tshwane is anchoring densification along public transport corridors to aid improved access, as more people will have housing opportunities close to economic and other opportunities located along these public transport corridors and activity nodes.

Though densification along public transport corridors help improve level of to access, accommodating low income earners proves to be challenging, as private developers seek to invest in profitable projects. They often resist accommodating low-income earners and prioritize profitability of their investments on prime densification areas along corridors. Evident from key informant interviews with the City Planning section of the City of Tshwane, accommodating the urban poor within core urban areas is challenging and often too costly for municipalities. This may indirectly perpetuate “apartheid-like” segregations, except that this will be along income categories, where low-income earners will be subjected remote areas as their only residential option.

5.3 Efficiency of innovative urban public transport systems

The efficiency of public transport systems is concerned with the cost-effectiveness, adequacy of the public transport system, quality of services provided and safety and security of commuters (Cervero, 2013). Evident from the City of Tshwane given the commuters perception on innovative urban public transport systems, adequacy and quality of service provided is commendable, with safety and security of commuters also taking top priority. Despite the unaffordability concerns by the urban poor, the Gautrain has proven to have contributed meaningfully in providing an efficient service between major economic nodes through reduced travel times which enhancing business operations. The Gautrain seems to be providing an efficient service for business related trips, whilst the A Re Yeng is more user friendly in integrating various land uses as it takes people closer to their destination. Though the Gautrain also has the Gautrain bus operating in residential areas, this appears to be a duplication without difference due to lack of operational integration with A Re Yeng.

5.4 Reliability of innovative urban public transport systems

Gautrain is regarded as most reliable as it a technological advanced system that is not prone to traffic and other public transport challenges. A Re Yeng shares the road with other modes of public transport but has its dedicated lane which makes it more reliable in terms of reduced travel times, where its users escape traffic congestion. However, some have raised concerns that this add to traffic congestion for mini-bus taxi commuters when lanes are reduced to cater for A Re Yeng. This points to the need to operationally integrate mini-bus taxi industry into public transport innovation strategies a multi-modal public transport network. Though reliability of innovative urban public transport systems was rated highly by commuters, lack of multi-modal integration has compromised prominent positivity on reliability with some commuters opting for mini-bus taxis as the preferred mode of public transport citing convenience. Thus, for reliability, provision of a convenient, multi-modal public transport network which integrates various land uses should be at the centre of public transport innovations for functionality and sustainability cities or communities.

6. CONCLUSION AND RECOMMENDATIONS

Spatial integration through an integrated (multi-modal) public transport network is still not effectively pursued when implementing innovative urban public transport systems, with different spheres of government implementing their projects independently. Thus, there is duplication of multiple modes of public transport in the same geographical area without making any meaningful contribution to effective spatial connectivity. Even innovative urban public transport systems operate independent from each other as they are not operationally integrated with other existing forms or modes of public transport. Instead they align themselves as additional public transport options. Under such circumstances, spatial integration will be hard to attain regardless of how many modes of public transport are

introduced, even if they are innovative and technologically advanced. Mini-bus taxis and rapid rail (Metrorail) should form an integral part of the public transport modal integration as they transport most people from previously disadvantaged communities and therefore

Through multi-modal integration, public transport infrastructure investments can be utilized effectively without unnecessarily duplicating public transport services in one geographic area. It is important to define the role and purpose of each mode or type of public transport in the overall public transport network to improve urban mobility. This will enable demarcation of connector points and linkages where various modes of public transport feed into each other for a comprehensive public transport network. For example, Gautrain may be designated to connect major economic nodes while other modes of public transport focus on commuting passengers between residential and economic or other opportunities.

6.1 Recommendations

Integrated multi-modal public transport network prioritization will enable cities to become hotbeds for innovation where trade, tourism, commerce, services and education will be improved. Based on the cross-cutting issues on accessibility, affordability, efficiency and reliability several similarities and patterns, six crucial areas for decision making for public transport infrastructure investments are recommended as per depicted in figure 3 below to move towards spatial integration and socio-economic transformation (figure 3 below).

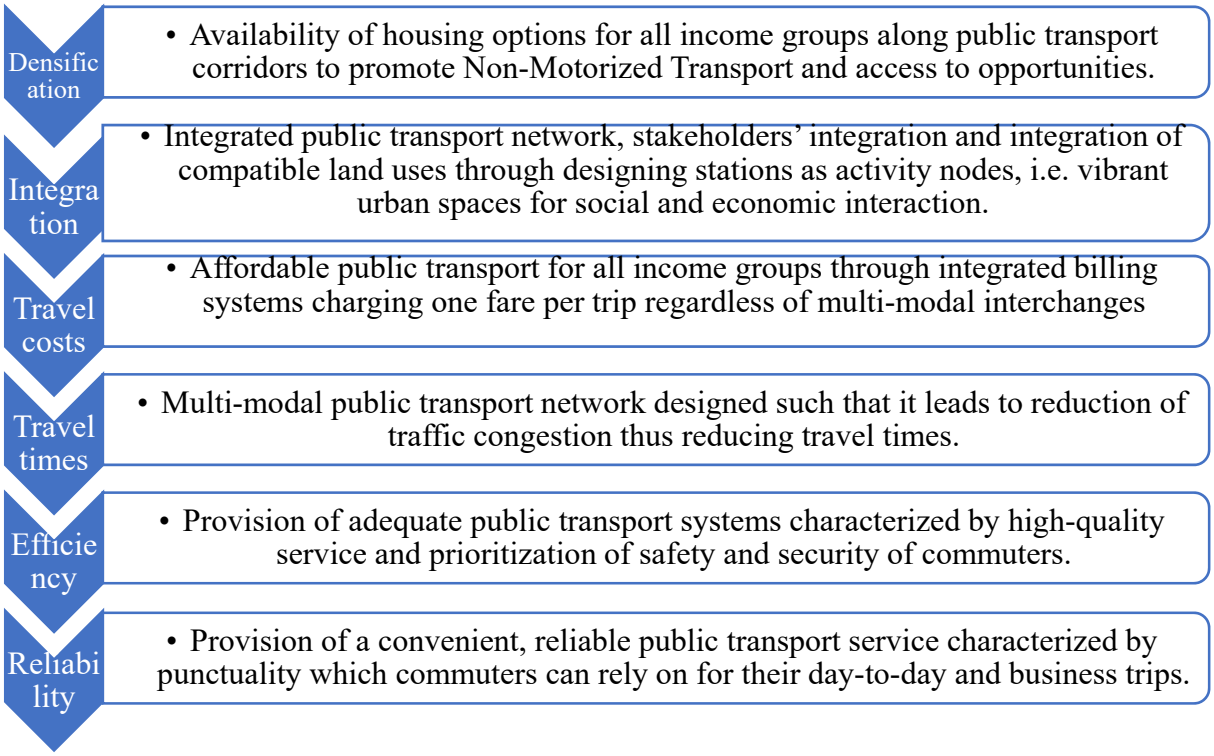

Figure 3: key components for spatial integration and socio-economic transformation

A Public Transport Corporation where all public and private public transport service providers collectively manage operations of an integrated (multi-modal) public transport network and billing system is recommended. Government should refrain from autonomously imposing itself on the taxi industry by dictating terms to the taxi industry either to replace it or compete for routes with it. Rather, government should incorporate mini-bus taxi industry into Public Transport Corporation as an important stakeholder in a multi-modal integration without neglecting cultural and organizational complexities influencing operations within the taxi industry.

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