

# Examining the Role of Public Transport Interchange Hubs in Supportive Public Transport Integration in City of Johannesburg

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## 1 ABSTRACT

The focus on developing integrated urban public transport systems have become major priorities globally, particularly in developed and transitional economies in order to achieve effective mobility. Similarly, increasing the connectedness and efficiency of urban public transport modes has become a necessity within cities of developing countries. Subsequently, the City of Johannesburg formulated relevant policies, strategies and frameworks that seek to inform the development and operation of efficient and integrated urban public transport systems. Thus, interchange hubs are starting points of public transportation ride and the first points of interaction commuters have with the available service. Subsequently, this study aims to examine the role of public transport interchange hubs in supportive of integration between Gautrain and Rea Vaya BRT operations in Johannesburg metropolitan city, using a phenomenological case study survey design and mixed methods approaches consisting of spatial, quantitative and qualitative data. The exploratory approach was used to formulate the research problem for comprehensive investigation, whereas descriptive approach was used to gather broad and accurate information. Research techniques such as social media, crowd-sourcing, and interviews were used to collect data. Whilst data analysis and interpretations were conducted with techniques such as Echo-Echo, main content analysis, Geographic Information Technologies. This study presents novel data analysed into empirical results suggesting that public transport interchange hubs play a pivotal influence in supportive the integration of Gautrain and Rea Vaya operations in city of Johannesburg. The findings further reveal the complexity of spatial and communicative platforms in multiplicity of urban public transport modes resulting in complex models of urban public transport operations.

Keywords: public transport, efficiency, interchange hubs, commuters, Gautrain, Rea Vaya BRT, integration.

## 2 INTRODUCTION

In contemporary years, increasing emphasis has been placed on the development of intermodal transport hubs as tools with which to improve urban mobility. Mobility appears as a fundamental component of the daily lives of people. However, mobility patterns are clearly linked to urban density and the relative location of activities. Hence, Integration of multimodal transport systems has received particular interest in recent years to promote mode switch. In developed and transitional economies, where transit is widely spread, commuters are served by an intermodal transport system, integrating a number of bus routes and a rail line connected at different transfer stations (Paulley and Webster, 2017). In such a system, commuters may need one or more transfers to complete their journey. Hull (2008) emphasized the importance of maintaining interoperating and interconnectivity across service providers to optimize intermodal public transport systems. Long transfer times significantly deteriorate the service quality when the system is operated without coordination. Effective intermodal integration significantly enhances the attractiveness and productivity of a combined bus and rail transit system (Hickey, 1992). Indeed, maintaining a stable headway along a bus route is difficult due to traffic congestion, vehicle breakdown, incidents and the variation of demand over time and space (Filippi et al., 2013). Pure schedule synchronization for connecting routes at transfer stations may not reduce the transfer time effectively (Datta, 2015). Conversely, holding times added into the schedules of coordinated routes required to increase the probability of successful connection.

Conversely, integration of multimodal urban public transport system has remained on of the major policy agenda for a relatively long time in the City of Johannesburg. Increasing the connectedness and efficiency of urban public transport systems has become a major issue for the City of Johannesburg, owing its culpabilities to the historic segregation and rapid urban population growth (Moswane and Gumbo, 2016). The City of Johannesburg formulated relevant policies, strategies and frameworks that seek to inform the development and operation of efficient and integrated urban public transport systems. Thus, interchange hubs are starting

points of public transportation ride and the first points of interaction commuters have with the available service. Subsequently, this study aims to examine the role of public transport interchange hubs in supportive of integration between Gautrain and Rea Vaya BRT operations in Johannesburg metropolitan city, using a phenomenological case study survey design and mixed methods approaches consisting of spatial, quantitative and qualitative data.

### 3 STUDY AREA: LOCALIZING THE CONETEXT

The greater Johannesburg metropolitan city is the political capital and the largest economic hub of the Republic of South Africa, yet it is the smallest in terms of physical size in its located province of Gauteng, as depicted by figure 1. The City of Johannesburg covers an area of 1,645 square kilometers, starting from Orange Farm in the South to Midrand in the North (Smith, 2013). The City of Johannesburg is the driving economy or an economic engine of the country and a place of opportunity to many. It is the most densely urbanized area of the Republic and it is home to 11.3 million publics.

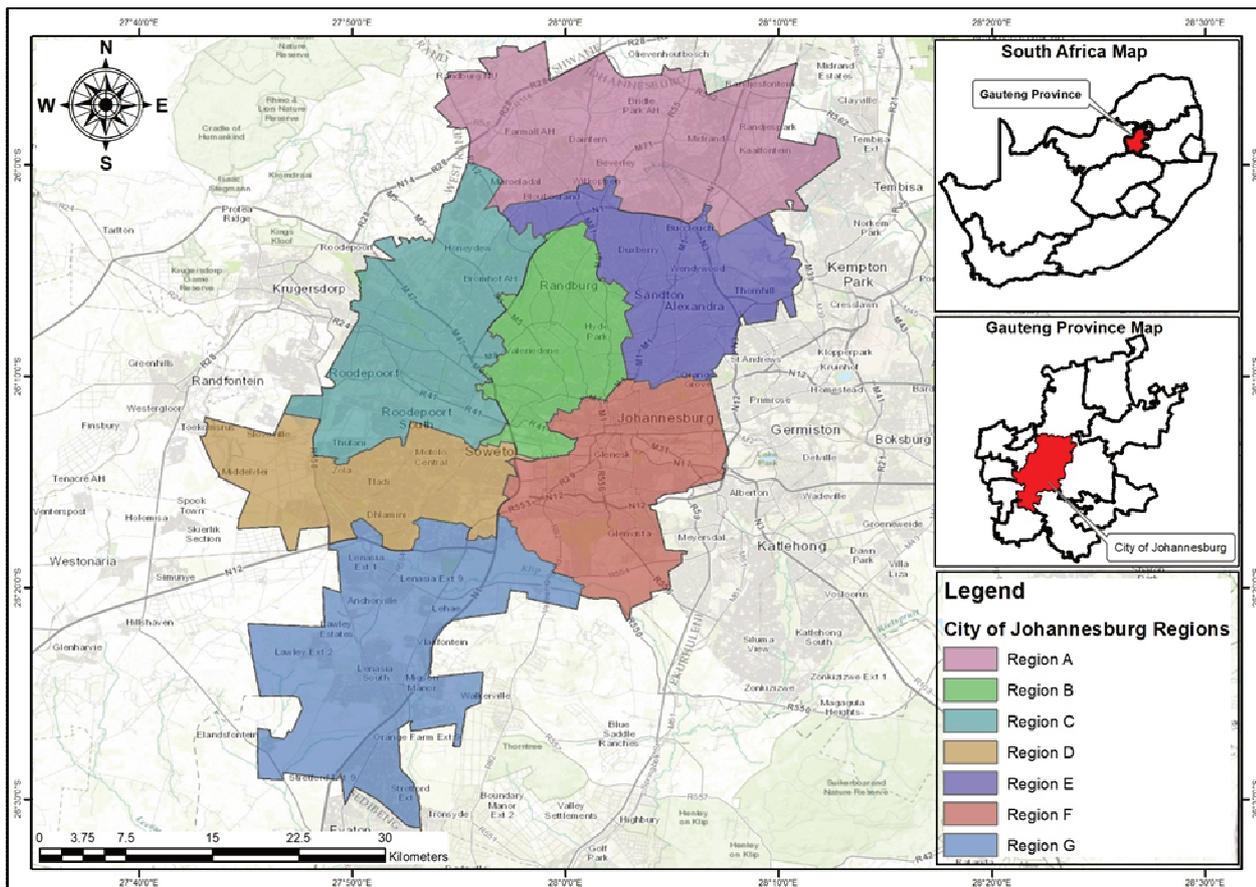


Figure 1: City of Johannesburg Map (Source: Author, 2017)

The Rea Vaya BRT and Gautrain are located in City of Johannesburg of Gauteng province, Republic of South Africa. The Rea Vaya operates only under the jurisdiction of the City of Johannesburg in southern part. Whilst Gautrain operates within the three metropolitan cities in Gauteng province which include City of Tshwane, City of Johannesburg and City of Ekurhuleni in the East Rand of Gauteng Province. The three metros, as mentioned earlier they form the region which is the economic hub of the Republic of South Africa and are only cities in the entire African continent that has a rapid transit train. These two public transport modes started operating during the 2010 FIFA World Cup which was hosted by South Africa.

### 4 METHODOLOGY

The study adopted a phenomenological case study survey research design. A mixed-methods research approach was used, where spatial qualitative and quantitative data was collected and analysed. The study examined the role of public transport interchange hubs in supportive public transport integration in City of Johannesburg, thus the exploratory approach was used to formulate the research problem for comprehensive investigation, whereas descriptive approach was used to gather broad and accurate information. Key

onformat interviews were used conducted with key informant officials from Johannesburg Roads Agency (JRA), Gautrain Management Agency (GMA) and Gauteng Department of Roads and Transport to give more accurate information on the role of Johannesburg Park Station in supportive of the urban public transport integration in City of Johannesburg. In addition, socia media data and crowd-sourced data were collected from echoecho. Whilst data analysis and intepretations were conducted using techniques such main content analysis, Geographic Information Technologies.

## 5 THE JOHANNESBURG PARK STATION, THE CITY OF JOHANNESBURG INTERCHANGE HUB AND ITS ROLE IN SUPPORTIVE PUBLIC TRANSPORT INTEGRATION

The approach to the Concept interchange, the Johannesburg Park Station taken in the City of Johannesburg is a wide one, as it is stated in the document Towards Commuter Intermodality in the EU (2004), “intermodilty is a policy and planning principle that aims to provide a commuter using different modes of transport in a combined trip chain with seamless journey”. Henceforth, the intermodality is crucial for the integration of various modes of public transport into one efficiency system. Conversely, the co-presence of multiple modes of public transport, even at the same building is not enough for an interchange, an interchange approach should focus on transfers’ easiness and should aim at a seamless trip. This further yields a sharp distinction between station and interchange. Whereas stations are mainly about access and dispersal to a transport system, interchange involve interconnection of various transport systems. The Johannesburg Park Station, an interchange hub of the City of Johannesburg is one of the most important components of urban transport. It is created and evolves with socio-economic and transport development in Johannesburg Metropolitan City, whereas simultaneously having aggregation and scale effects on the City. However, factors that have an impact include socio-economic development, urban structure regional transport conditions, and the need for sustainable development. Figure 2 illustrate the location of Johannesburg Park Station within the City of Joahannesburg.

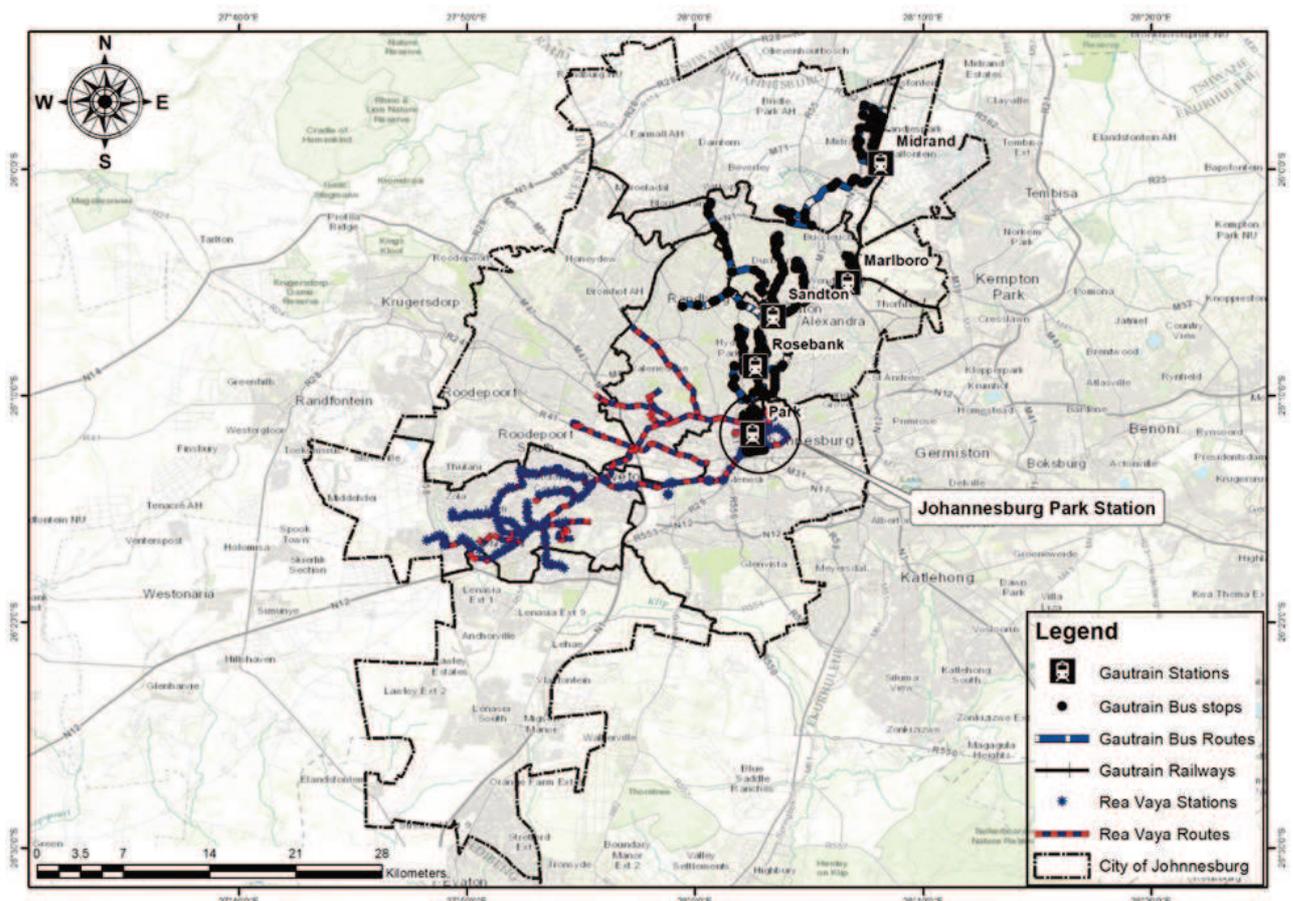


Figure 2: Johannesburg Park Station Location (Source: Author, 2017)

The Park Station hub functions as a vibrant intermodal transport node (see figure 2). However, it represents the gateway to City of Johannesburg for many commuters, not only from other cities, conversely also from other African countries. Gautrain and Metro Rail and bus services at park station provide for inter-city

transport as well as intra-city and regional transport services. The Park Station hub provides access to the inner city, and it also provide access to Braamfontein, a well-established high-density precinct that has undergone significant regeneration in contemporary years. Also Braamfontein hosts a diversity of government departments, education facilities (of which Wits University is the most prominent), student accommodation, local retail businesses, and financial and municipal institutions. Due to Braamfontein’s urban function, plenty of people commute on a daily basis through the area, resulting in pressure on the levels and standards of service delivery.

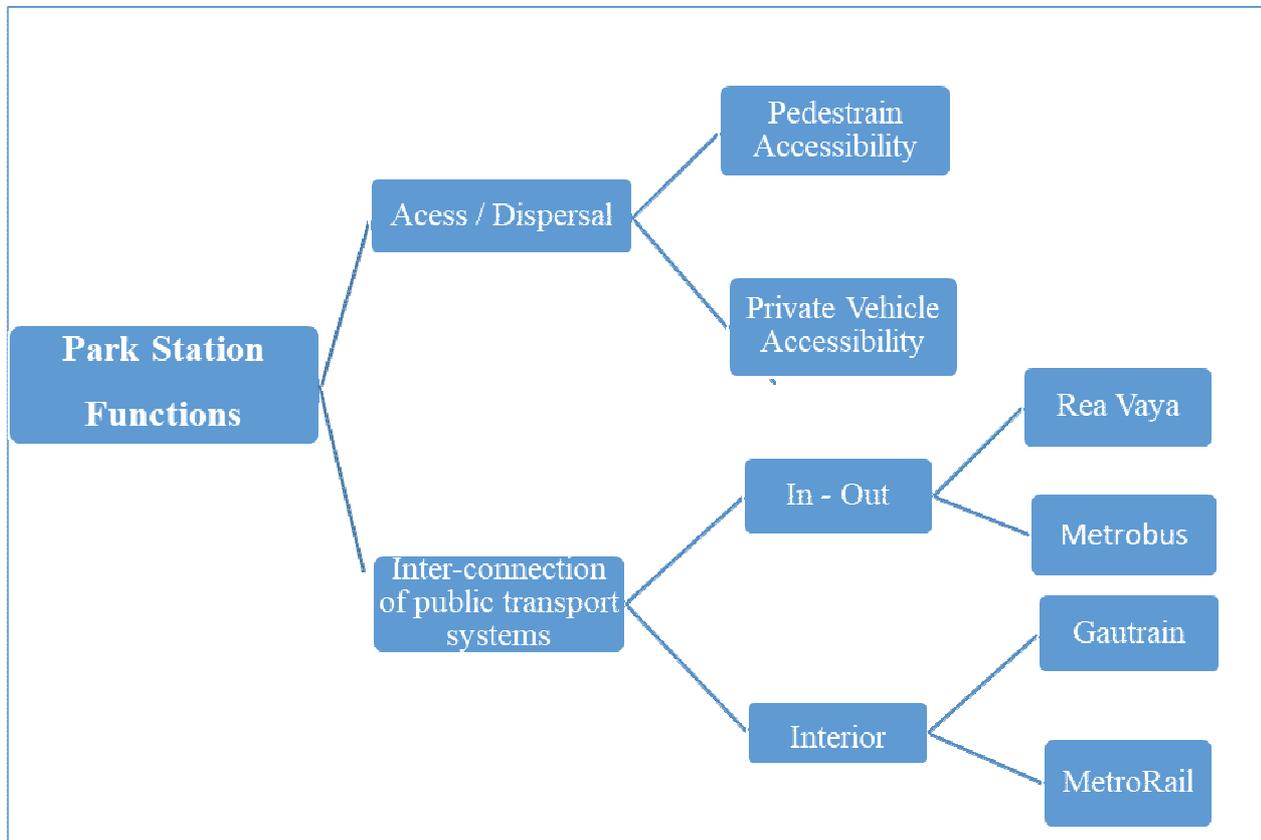


Figure 3: Park Station Functions and Urban Environment (Source: Author, 2017)

The Interchange is characterised by a mixture of high intensity land uses ranging from clustering of mostly commercial land use to the south of the interchange to a concentration educational and other government, commercial, parking and other mixed land uses to the north. Because of the high intensity of land uses in the area as well as the high volumes of people working or visiting government, educational or commercial facilities, public parking is a necessary requirement. Given that Park Station is a prominent transport terminal in Johannesburg, Gauteng, and South and southern Africa, distribution terminals in the form of bus stations, metro rail stations and platforms, and taxi ranks are located in the close proximity to the Park Station precinct. The Gautrain Park Station, bus routes as well as the Bus Rapid Transit routes should also be noted as an essential feeder and distributor routes in the area.

The Johannesburg Park Station provides for an integrated and effective of routing and circulation that reduces the number of transfer required; ensure safety for higher level of commuter; promotes the use of public transport and non-motorised modes of transport; and also encourages the integrated development of surrounding land uses. The Park Station links various modes of transport in one location, wjile also improving the efficiency of land uses and other resources. Each transport mode at the Johannesburg Park station supports the other by helping to redistribute commuter overloads among them and caters to commuters commuting requirements and demand. Thus, the diverse needs and features of each transport mode should be considered during the planning and design state to develop a sustainable and viable design, particularly in terms of contruction and operation in order to achieve effective mobility.

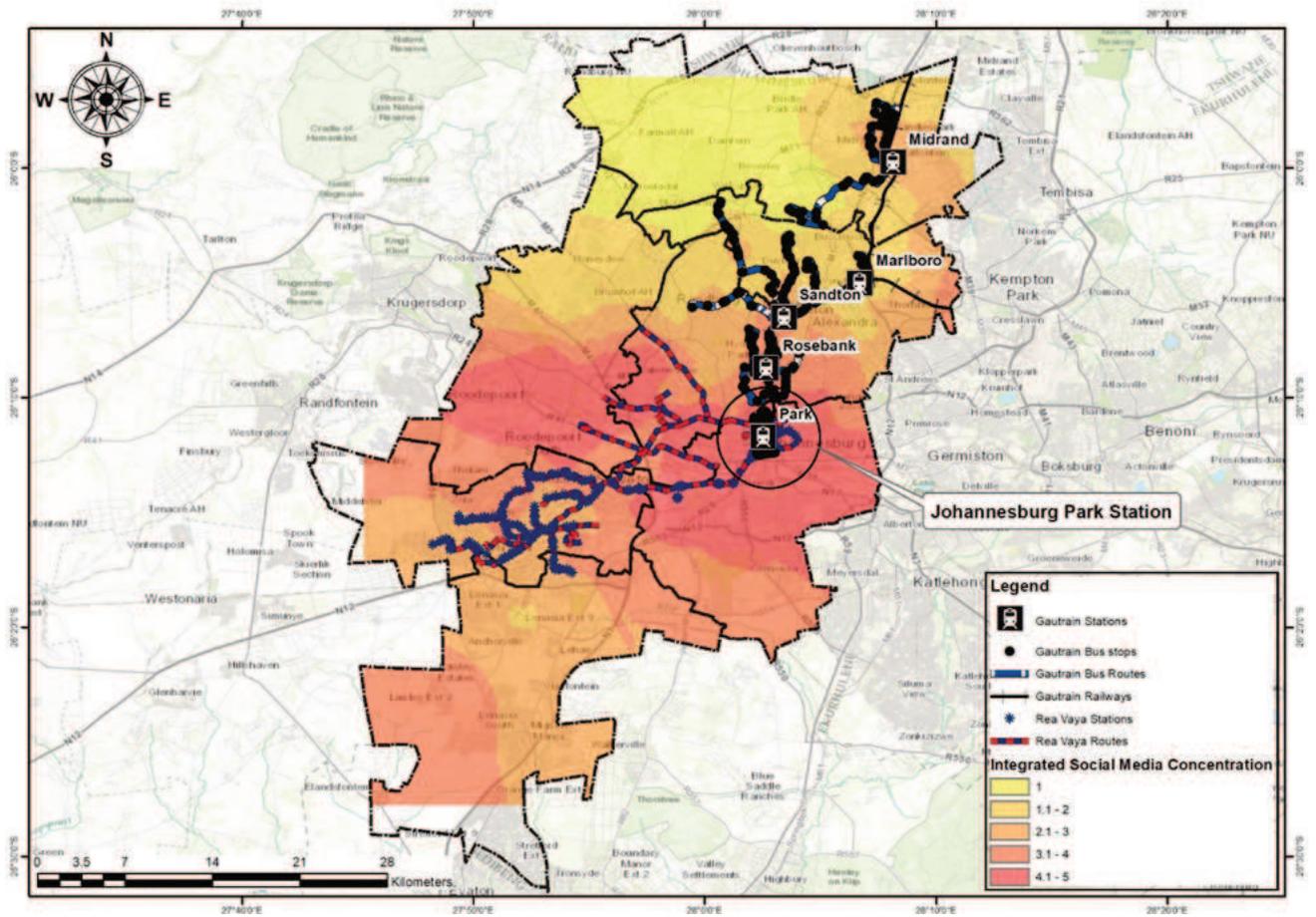


Figure 4: Johannesburg Park Station and Integrated Social Media Concentration Analysis

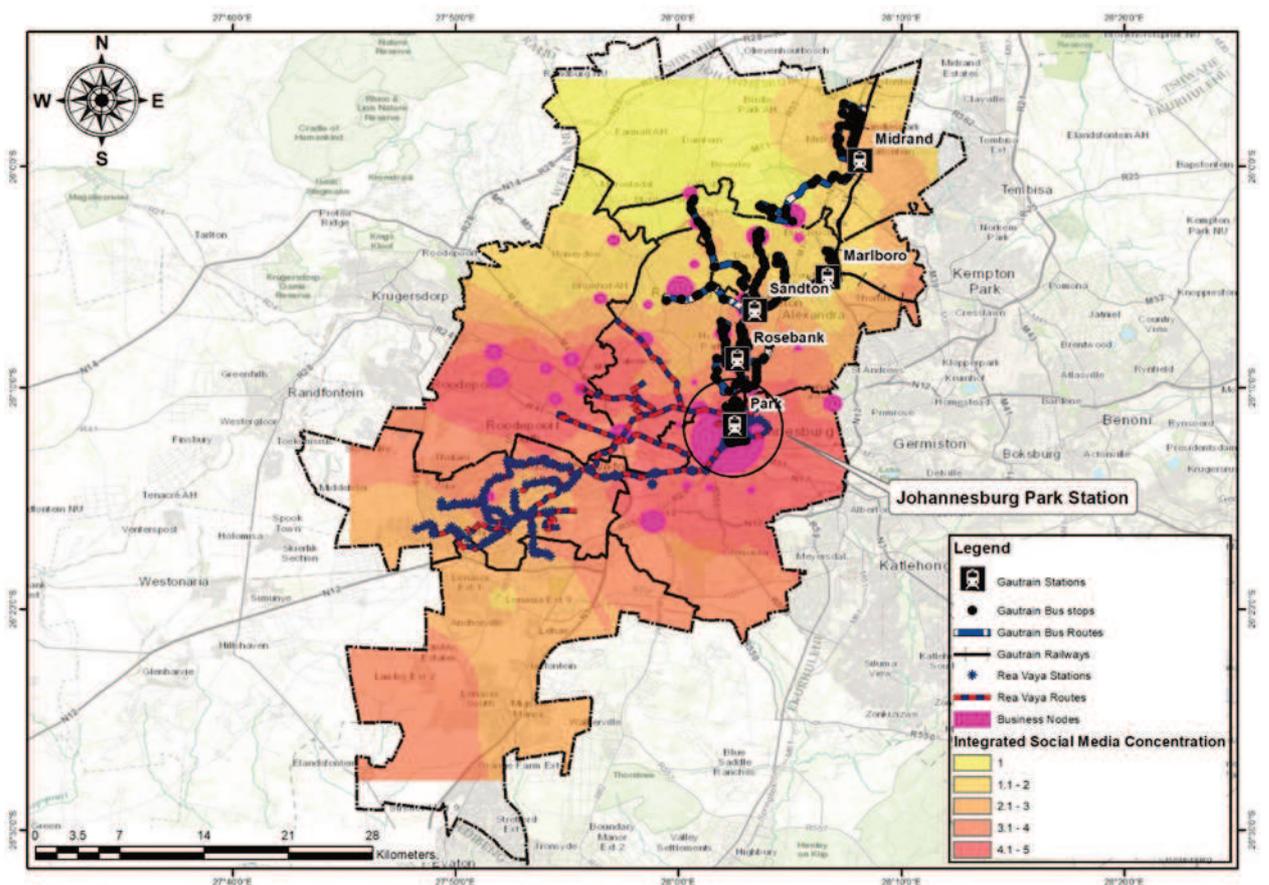


Figure 5. Park Station and Integrated Social Media Concentration

Given that the commuter concentration zones of the Gautrain and Rea Vaya were overlapped on a ratio of 50:50, to ascertain which stations should be used as the initial geolocations to promote multi-mobility. The Johannesburg Park Station had the highest integrated commuter concentration as display in figure 4. With this high commuter integration, improving commuter transfer in the geolocation would be a good idea, as the infrastructure and commuter numbers are already pre-existing. Moreover, it will be cost effective for the Johannesburg Park Station operators to partner with various Rea Vaya and Gautrain agencies towards promoting multi-mobility within the Johannesburg Metropolitan region, then building separate infrastructure, as the Gautrain links commuters to economic and business nodes in the Northern parts of the city, namely: Rosebank, Sandton, Marlboro and Midrand; and Rea Vaya links commuters to in the Southern part of the City, as presented in figure 5.

### 5.1 nIntegration of Existing Transport Systems around the Hub

#### 5.1.1 Influence of Johannesburg Park Station on the Nearby Road Network

The Johannesburg Park Station draws in large commuter flows in a short time, generally during the rush hours when a large number of trains, buses, and long-distance commuter transport coaches arrive. During the period of immediately after trains or coaches such Gautrain and Metrorail have arrived, commuters need to be distributed to their various destinations by various modes of transport such as Gaibus, Rea Vaya, Metrobus or walking, a process which will be supported by the surrounding road network. However, the surrounding road networks need to be accommodate the large flow of commuters and vehicles from the Park station to minimize congestion that can hamper the normal operation of the Johannesburg traffic network. Thus, Johannesburg Station was planned to take into consideration the demand for gathering and distributing commuters.

Figure 6 Shows the Johannesburg Park Station surrounded by an existing road network which forms a ring road network by connecting surrounding roads with interchanges and the South and North Johannesburg roads. The ring road has three access points, which help reduce traffic congestion due to large commuter flows on the surrounding road network.

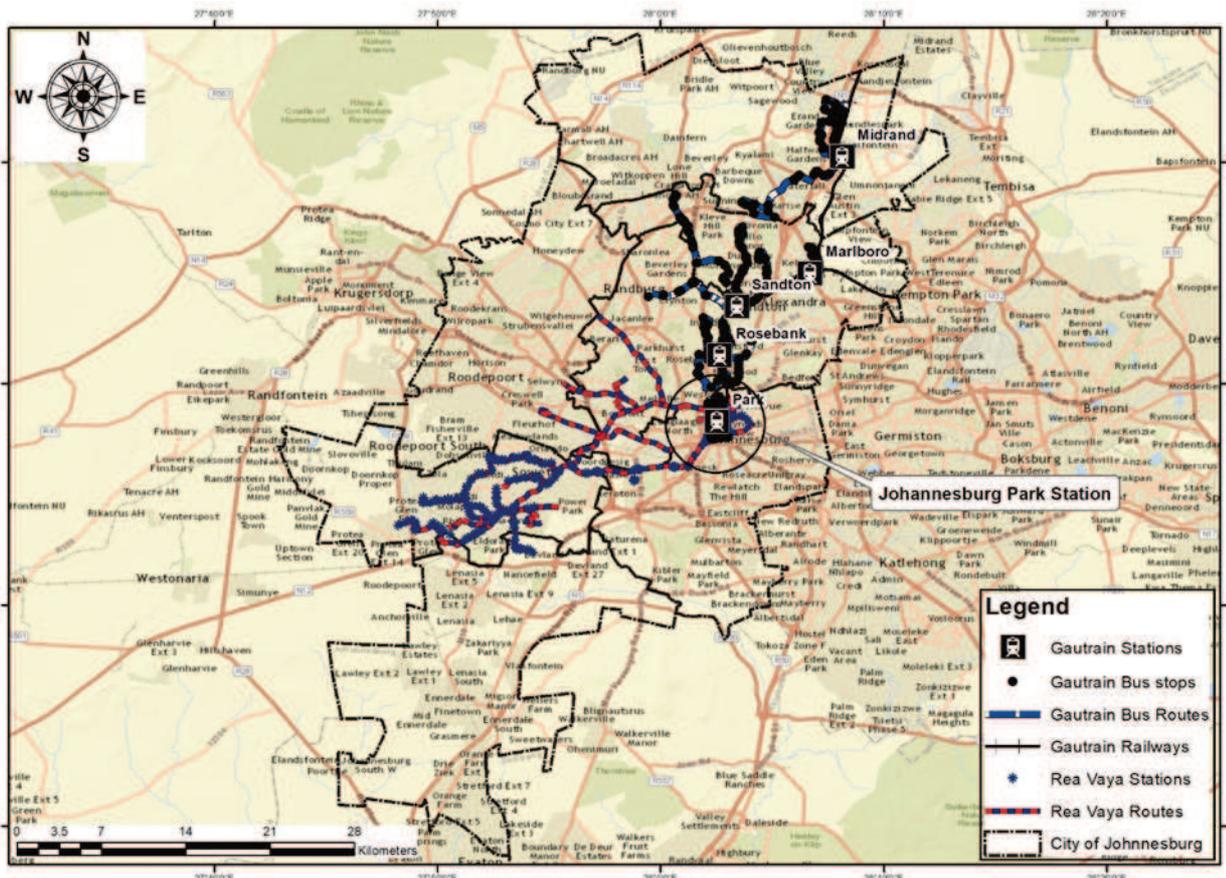


Figure 6. The Johannesburg Park Station surrounding road networks

### 5.1.2 Transit Mode share targets

Transit mode share is the percentage of commuters using a precise type of transportation, for instance bus, train, taxi, car or non-motorized transport. Moreover, it may refer to the number of trips that commuters take in relation to their preferred mode of transport. Conversely, gauging transit mode share enables hub operators and planners to get an overview of commuter demand, develop strategies (in terms of policies, structure and layout, and marketing) to create a more balanced mode share, and identify the best way to integrate different transportation modes. In the case of Johannesburg Park Station, initial estimates predicted that the Metrorail would accommodate 40% of the total number of commuters, whereas the remaining 60% would use buses, taxis and private vehicles. Nevertheless, according to this comparative ratio, it was found that surrounding roads did not have sufficient capacity to deal with such a huge volume of commuters, henceforth, another subway line, the Gautrain was built during the preparation 2010 FIFA World Cup to pass through the Johannesburg Park Station, to accommodate and shift the 60% of the total number of commuters towards the use of the line. This resulted to a corresponding decrease in road traffic.

Analysing transit mode share within the range of influence of the interchange hub enables planners to manage traffic demand as well as passenger behaviour. Therefore, it should be noted that non-motorized transport, such as walking, cycling and other variants has not been taken into account when shrewd the transit mode share for public transport interchange stations in South Africa. In fact almost all public transport stations in Johannesburg do not contain parking areas for bicycles. However, these bicycle parking areas were consequently reduced for the following reasons: (i) cycling has gradually been replaced by perceived “convenient” methods of transport, such trains, buses and private cars; (ii) the volume of private vehicles is rapidly increasing and private vehicles have proven to be more popular than bicycles; (iii) cycle parking provision should be improved, as there is a high risk of bicycles getting stolen when commuters leave the in station overnights.

## 5.2 Potential Benefits of Johannesburg Park Station

There are number of city-wide benefits that resulted from the establishment of the Johannesburg Interchange hub, the Park Station. As supported by local residents, jurisdiction and operators, the Park Station provides for an effective system of routing and circulation that reduces the number of transfer required; ensures safety for higher level of commuters; promotes the use of public transport and non-motorised modes; and encourages the coordinated development of surrounding land uses. In addition, Park Station enhance service integration, reduces the time and distance penalties of rail to rail and rail to bus interchanges.

Currently, plenty of middle-income residents in Johannesburg have abandoned private automobile in favour of public transport. Whereas auto ownership has been on the rise in past 2 decades, the economic boom of the democratic era in South Africa has brought a dramatic rise in the number of auto-oriented trips. However, the prospect of an integrated system of the Park Station and accompanying land uses persuade many of the residents to rely on public transport for most trips., effectively lessening the negative impacts of auto mobile use, for instance urban congestion, inefficient use of resources and poor air quality. For example, the location of business nodes and commercial activities near the park station to address the growing trend towards ‘trip chaining’ between work and home.

Moreover, another potential benefit of the Park Station is the improvement in the quality of public transport services feeding into the city. Subsequently, park station plays an essential role in safer, more efficient, off-street boarding and alighting; and in better travel times, particularly during rush periods. Conversely, if the Rea Vaya bus priority can improve the speed and reliability of bus services, it will offer opportunities to extend the catchment area Gautrain stations and increase the importance of bus feeder systems.

## 6 CONCLUSION

To conclude, study examined the role of public transport interchange hubs in supportive of integration between Gautrain and Rea Vaya BRT operations in Johannesburg metropolitan city. Moreover, study presented novel data analysed into empirical results suggesting that public transport interchange hubs plays a pivotal influence in supportive the integration of Gautrain and Rea Vaya operations in city of Johannesburg. The Johannesburg Park Station, an interchange hub of Johannesburg metropolitan City facilitate urban mobility by integrating existing urban public transport network. It also enhances the journey experience through people-oriented facilities and feature. Beyond improving urban mobility, the interchange hub also

function as a major element of urban development and renewal. The huge potential of interchange hub is that it highlights the need for a guide that can be used by planners, government agencies, and other experts to learn from the good practice that is being developed. The findings further reveal the complexity of spatial and communicative platforms in multiplicity of urban public transport modes resulting in complex models of urban public transport operations. Conversely, it is recommended that there should be conscious efforts in planning and developing public transport interchange hubs that are integrated to promote efficiency of public transport systems. In addition, the diverse needs and features of each transport mode should be considered during the planning and design stage to develop a sustainable and viable design, particularly in terms of construction and operation in order to achieve effective mobility.

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