

Establishing the State of Spatial Integratedness of Innovative Public Transport Systems in Gauteng, South Africa

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1 ABSTRACT

Travelling requires transportation. Globally, movement of people from one location to the next is done by public transport systems. Developed countries around the world use innovative public transport systems for convenience, reliability and efficiency. Mostly, these systems are integrated in order to make ridership to be desirable and effective. In Africa, public transport is highly used and mostly the public transport systems are not integrated, making travelling by public transport undesired. South African public transport systems are challenged with connectedness. Government at all spheres in the past decade has been trying to develop systems that can work together in order commuters can travel easy around the province. Gautrain and Gaubus has been developed which moves through the three Metropolitan municipalities (the City of Johannesburg, City of Tshwane and Ekurhuleni) in Gauteng province. In the City of Johannesburg (COJ) and the City of Tshwane (COT) a development of Bus Rapid Transit (BRT) system has been established. Commuters are challenged with switching from one mode of public transport to the next. The systems were introduced to provide effective public transport services. The state and level of integration of the province's innovative speed train system and the BRT systems has not been sufficiently studied and documented. The systems were introduced to provide a reliable and efficient formal urban public transport services. This paper therefore investigates the state of spatial connectedness of the innovative urban public transport (train and bus systems) and aim to find possibilities to integrate the two systems. The study adopted qualitative research design that facilitated the gathering and analysis of spatial and qualitative data from the urban public transport (Gautrain/Gaubus, A re Yeng (BRT) and Rea Vaya (BRT)) officials/authorities and commuters (Gautrain/Gaubus, A re Yeng (BRT) and Rea Vaya (BRT)) in Gauteng. The study discovered that spatially, there are physical connections between the Rea Vaya, the Gautrain/Gaubus in the COJ and A re Yeng, Gautrain/Gaubus in the COT. However, there are no signals indicating these systems to be connected to each other leading to difficulties for commuters to switch in between the three modes. The work concludes that each mode travel to different routes and places, hence synchronising the system would benefit commuters at large and be able to travel smoothly in the province.

Keywords: Innovative public transport, Spatial Integration, Efficiency

2 INTRODUCTION

Urban public transportation systems provide accessibility to different land uses and economic activities to the majority of urban residents. It is therefore essential for such systems to be sustainable, efficient and reliable at all times (Olivková, 2017). Developing countries have challenges with inefficient and unreliable urban public transport. Integrated public transport systems assist with efficiency, effectiveness and reduction of time delaying. The operation and management of urban public transport in African countries need to adopt techniques that developed countries use, more especially from European countries such as Austria, German, Australia, Czech Republic, Spain, UK etc. so that their urban public transport systems become efficient, reliable and effective. In a post -1994 South Africa, cities and various role players have been faced with the mounting challenge of using urban public transport systems to overcome the barriers of the apartheid spatial legacy, reconnecting isolated nodes and communities long disconnected from opportunity. Not only this, but in the process enable urban regeneration which sustain the ongoing growth and development of the city for future generations. These challenges are further compounded by the increasing rates of urbanisation being experienced, locally and globally. Gauteng province, City of Tshwane and the City of Johannesburg has developed innovative urban public transport as a solution to establish a reliable, convenient and efficient system that will satisfy commuter's to reach their places of interest. However, there are still challenges faced by commuters with these public transport modes developed. Therefore, the aim of this paper is to investigate the state of integratedness of the formal urban public transport operations (Gautrain/Gaubus and BRT (A Re

Yeng and Rea Vaya) in Gauteng. Further, recommend on how these system can reduce or eliminate the challenges.

3 LITERATURE REVIEW

Public transport makes movement of all people to be easy regardless of the conditions as in general, most of them are affordable. Many people around the republic use urban public transport for different reasons, some people use it to reduce traffic congestion as on certain hours roads are congested and some it is the only mode of transport accessible for travelling. Promoting the use of public transport is to count urgently with a sustainable, effective and efficient citizen's mobility, and simultaneously with a positive effect in air pollution and energy costs reductions (De Pablos et. al, 2011). Public transport has a major role to play in alleviating congestion and improving traffic flow. With the number of trips made in urban areas set to rise exponentially in the years to come, governments will need to smarter mobility solutions. If these new trips are made by private vehicles, governments will see a significant hike in their energy bills, and a greater dependence on fossil fuels and imported oil. Further, cost to the economy as in cities with a high share of public transport, walking and cycling, the cost of transport for the community can be as much as 50% lower than in cities where the private car dominates and the creation of job opportunities as public transport is also a major contributor to national and local economies through the jobs it provides directly (All together for public transport growth 2013). Therefore, the above mentioned benefits outlines why the use of urban public transport should be encouraged and why the need for action to have a good functioning urban public transport that is integrated and function as one system.

Integrated public transport is a structural practice by which fundamentals of the commuter public transport systems (network and infrastructure, fares and ticketing systems, information and marketing components) and a variety of carriers who serve different transportation modes, interact more closely and efficiently, to generate an overall improvement in service quality level and enhanced performance of the combined public and individual transportation (Solecka and Zak, 2014). In general, the implementation of different transport integration solutions may result in the following benefits (Prospects 2003): decrease time spent traveling, public transport prices/costs, traffic jam and environmental and pollution. Transport integrating solutions may improve the urban public transportation system accessibility and overall competitiveness as well as assure better utilization of different transportation means and infrastructure.

4 APPROACH/METHODOLOGY

A mixed method research design was adopted where qualitative data and spatial data analysis was used. Research instruments employed are interviews as they assisted to give the views of both commuters and the authorities/ officials as they are key stakeholders, ArcGIS assisted with creating Gautrain/ Gaubus routes maps showing locations serviced and participant observations gave the authors an opportunity to understand the two public transport modes without the decisions being influenced. BRT, Gautrain/ Gaubus passengers, BRT, Gautrain/ Gaubus officials and documented studies relating to this one are the sources of data. Comparative analysis was deployed highlighting the different location serviced by both public transport modes and content analysis were used to review previous documented studies. The results of the paper will assist with policy brief indicating current level of speed train and BRT system, possibilities of integrating these modes of public transport and recommending on how best it could be strengthen.

Purposive sampling was conducted for both commuter and officials of Gautrain/Gaubus and BRT. It is crucial to interview daily commuters as they have a daily experience of what happens during journeys by these modes of public transport. Further, relevant information can be acquired from experienced officials of Gautrain/Gaubus and BRT. Twenty interviews were conducted with current users of Gautrain, Gaubus, and BRT in the City of Tshwane and the City of Johannesburg. Questions asked were based on how easy commuters access public transport, with the current location of bus and train stations if they are travelling to areas that need them to switch public transport, do they switch smoothly from one mode of transport to the other immediately, and their needs and preferences. Such data was analysed to provide guidelines and policy recommendations on rail and road integration purposes. Fifteen interviews were conducted with officials from Gautrain/ Gaubus, BRT and department of public transport. Data collected from officials was mainly the policies that currently guide developments, their plans, targets and needs. This assist to provide at the end of the study relevant and up-to-date information that help officials to adjust their policies, plans, targets in

line with realities, needs, expectations and preferences of current and potential users of public road and rail transport systems in the Gauteng province.

5 RESEARCH ANALYSIS AND FINDINGS/RESULTS

80% of Gautrain/ Gaubus officials gave a positive response in regards to physical integration of Gautrain and Gaubus. Officials indicated that next to Gautrain stations there are Gaubus stations or bus pick up spots, this strategy was developed to make the system more efficient and reliable. Gautrain/Gaubus commuters are positive towards integrated public transport as they indicated that it creates seamless travelling. Commuters do not encounter challenges when they switch from Gautrain to Gaubus as most stations are 100m or less apart from one another (from Gautrain to Gaubus). 20% of the Gautrain/Gaubus commuters, agree that integrating the two systems (Gautrain and BRT) could benefit commuters of both systems as spatially are within a good walking distance for switch in-between. BRT Officials highlighted that spatially, the routes that are serviced by the busses are mostly the busier routes hence why they are chosen and there are potential routes extensions planned to increase the BRT bus services to other locations in the City of Tshwane and the City of Johannesburg. 40% feedback from the commuters was positive. They indicated that BRT transport them to the desired locations around the CBD, and these responses were mostly from University students and residents residing and working in the City of Tshwane and City of Johannesburg. 40% feedback from commuters indicated that BRT does not go to they are desired locations and integrating it with Gautrain/Gaubus is not going to make much of a difference as the routes that are used by both systems do not service their locations. 20% of BRT commuters are unsure about the positive change to be made by the integration, however, they feel like it's a good initiative as on some occasion such alternative might be needed for travelling to other locations.

5.1 State of urban public transport and spatial integration in Gauteng

Gauteng is in the smallest province in the nine provinces that makes up the Republic of South Africa. The province attracts a large number of people due to opportunities afforded and it is the most populated. It is an economic hub, which has a lot of economic concentration and has three Metropolitan municipalities. These metros are City of Tshwane, City of Johannesburg and City of Ekurhuleni. COT Metropolitan is the capital of the country. COT contains numerous institutions of the republic than any other city in the country and its population is around 3275152 square metres (Stats SA, 2016). On the hand, the City of Johannesburg has a population of 4.5 million (Statistics South Africa, 2012) and afford many job opportunities than any city in the republic. In the smart mobility domain, the city of Johannesburg has promoted non-motorized transport and the city embarked on a 70 million South African Rand project to build cycling lanes in Johannesburg CBD and in nodes such as Sandton (Johannesburg, 2015) and other areas in Soweto. Likewise, the city has also focused on promoting the use of public transit systems. Accordingly, the city is promoting transferring demand from private cars to public transport is an integral part of smart mobility (Mokoena and Musakwa, 2017). The city of Johannesburg has established a bus rapid transit system known as the Rea-Vaya project. Rea-Vaya is arguably Africa's first full Bus Rapid Transit (BRT) and it was mainly meant to improving the quality of life of the city's residence through a public transport system (Rea-Vaya, 2017). Rea Vaya operates in Region A to F in the Johannesburg Metropolitan City. It has completed the construction of Phase 1A and 1B and currently developing Phase 1C. Rea Vaya's Phase 1A has a trunk route operating between Ellis Park in Doornfontein and Thokoza Park in Soweto, linking with several feeder routes in Soweto (Rea-Vaya, 2017). The inner city circular route travels around the CBD from Hillbrow and Braamfontein, to Ellis Park in the east and Chancellor House on the western edge of the city (Rea-Vaya, 2017).

Apart from the Rea-Vaya, the Gautrain high-speed train was also launched in 2010. The Gautrain is not a city project but a Provincial initiative with a major impact in the City of Johannesburg. The Gautrain system is Africa's first world-class, modern rapid rail and bus service for Gauteng province (Musakwa, 2014; Van Der Westhuizen, 2007). The Gautrain is a state-of-the-art rapid rail connection between Johannesburg (Africa's business capital), Pretoria, South Africa's administrative capital and Ekurhuleni, South Africa's manufacturing hub (Donaldson and Van De Westhuizen 2011). The Gautrain has two routes the South-North and West-East routes. The North South route begins at Johannesburg park station in central Johannesburg to, Sandton and Pretoria and Hatfield in the north cutting across Johannesburg and Pretoria metropolitan municipalities. The West-East route takes passengers from Sandton Station, via Marlboro, to Rhodesfield Station in Kempton Park and then to OR Tambo International Airport (GMA, 2010b).

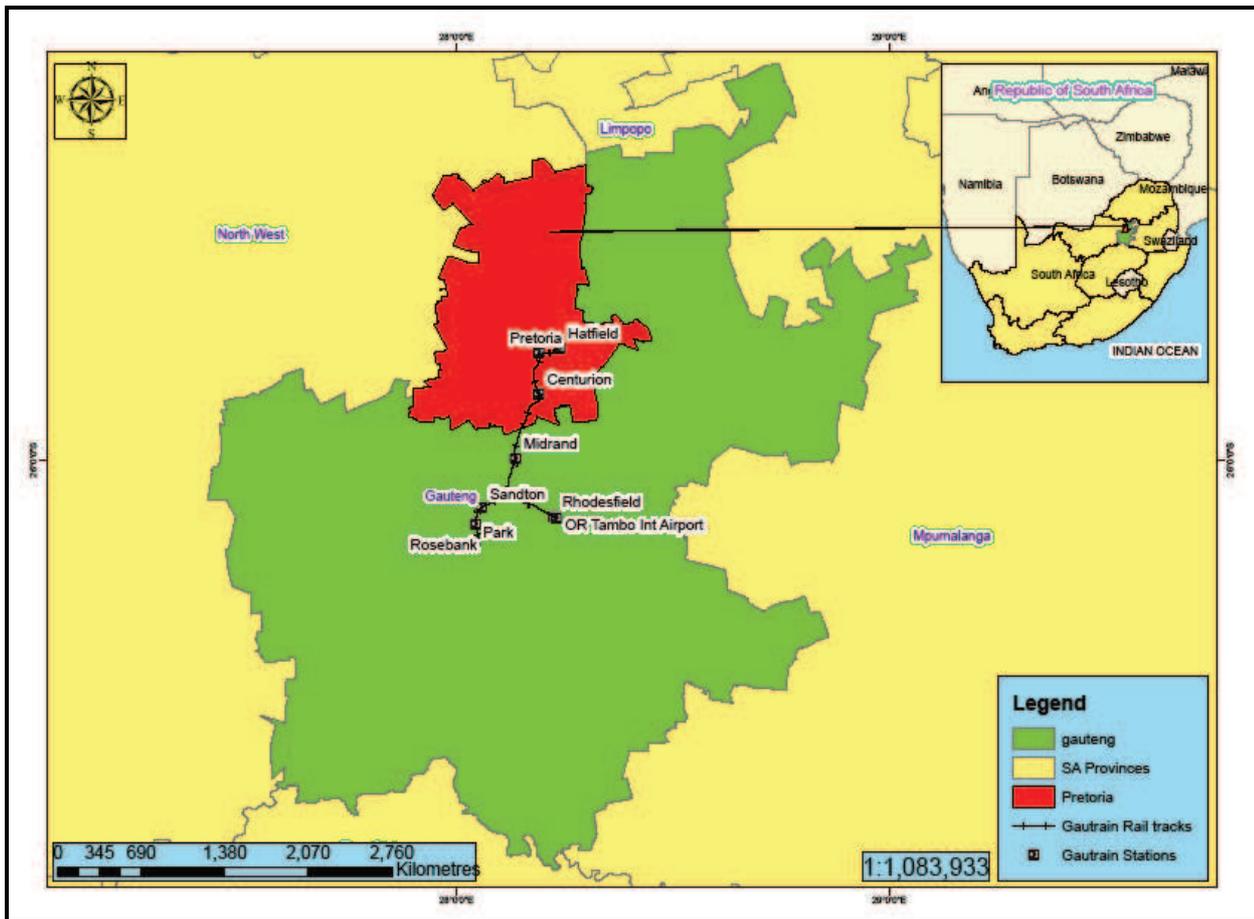


Figure 1: Gautrain map (Authors, 2018)

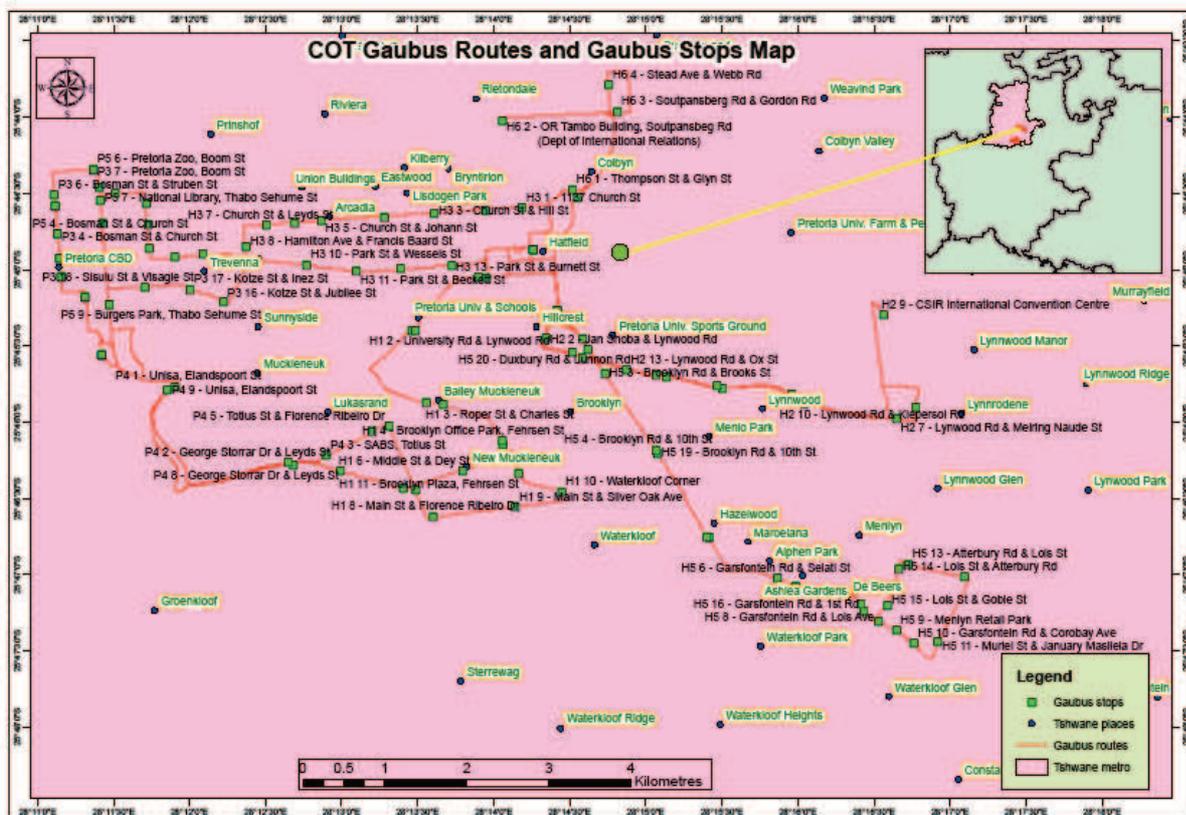


Figure 2: Gaubus stops and routes Map (Author's, 2018)

The above-depicted map figure 1 indicates Gauteng province. The green area represents Gauteng as a whole and the red area represent the City of Tshwane, which is also known as Pretoria. Implementation of innovative urban public transport systems in Gauteng are being practiced. Figure 1 shows the innovative urban public transport rail tracks and train stations that has been developed in the province. The concept of the Gautrain is still new in South Africa and there are plans for it to grow further and be accessible from all nine provinces of the republic. As shown on figure 3 the speed train operates using 10 train stations. However, there are three Gautrain stations that operates in the City of Tshwane. These areas with Gautrain stations are mainly areas affording job opportunities to many individuals. Further, in the City of Johannesburg, there are four Gautrain station which are Rosebank, Park, Sandton and Midrand.

When Gautrain was developed, Gaubus was developed as well. Figure 2 shows all the bus stops and routes available for Gaubus in the City of Tshwane CBD. All the Gautrain stations in the City of Tshwane are provided with the gaubus stops outside the Gautrain stations. The Gaubus assists with the movement of penetrating inside the city for efficiency and reliability purposes. The strategy of having gautrain and gaubus plays a big role in urban public transport in the City of Tshwane (COT) as there are locations that do not have the train stations, but there are Gaubus stops to transport the commuters.

PRETORIA CBD- P3		PRETORIA ZOO- P5	
Bus type	Bus stop & routes serviced	Bus type and stops	Bus stop & routes serviced
P3-1	Transvaal Museum, Paul Kruger St	P5-1	Transvaal Museum, Paul Kruger St
P3-2	Bosman St & Nana Sita St	P5-2	Bosman St & Nana Sita St
P3-3	Bosman St & Pretorius St	P5-3	Bosman St & Pretorius St
P3-4	Bosman St & Church St	P5-4	Bosman St & Church St
P3-5	Bosman St & Johannes Ramokhoase St	P5-5	Bosman St & Johannes Ramokgoase St
P3-6	National Department of Transport, Struben St	P5-6	Pretoria Zoo, Boom St
P3-7	National Library, Thabo Sehume St	P5-7	National Library, Thabo Sehume St
P3-8	National Treasury, Thabo Sehume St	P5-8	State Library, Thabo Sehume St
P3-9	Sammy Marks, Madiba St	P5-9	Burgers Park, Thabo Sehume St
P3-10	South African Reserve Bank, Sisulu St		
P3-11	Louis Pasteur Hospital, Sisulu St		
P3-12	Sisulu & Visagie Str		
P3-13	Burgers Park, Thabo Sehume Str		

Table 1: Physical locations of Gaubus in Pretoria CBD

In the City of Tshwane CBD, P3 Gaubus service Bosman Street and there are three bus stops that are found along the street see table 1. There are two bus stops in Madiba Street but only two streets long serviced in Madiba Street. On Sisulu Street, there are three Gaubus stops and the Gaubus service six streets long. Paul Kruger Street and Thabo Sehumo Street, each street have one bus stop and each service four streets long. Further, Struben Street and Vesagie Street also have one Gaubus stop and each service three streets long.

In Accordance with the above, P5 Gaubus service eighteen streets long in Thabo Sehumo Street with three bus stops. Four bus stops provided on Bosman Street and the Gaubus service 11 streets long. One bus station found in Boom Street which provide direct access to the National Zoo. On Paul Kruger Street there is one bus stop and the Gaubus service four streets long. Gaubus stops on Bosman Street and Thabo Sehumo Street are used by both P3 and P5 Gaubus.

Table 2 indicates Gaubus stops, routes serviced by the Gaubus at Hatfield and see figure 2. The Gaubus is differentiated into four types according to locations serviced from Hatfield Gautrain station which are Hatfield to Brooklyn (H1), Hatfield to Lynnwood (H2), Hatfield to Arcadia (H3) and Hatfield to Menlyn (H5). From Hatfield Gautrain station, H5 Gaubus transport commuters to Menlyn through different routes from H1, H2 and H3. Jan Shoba have two bus stops and service four streets long, Jan Shoba connect to Duxbury Road which have two Gaubus stops, and Duxbury Road connect to Garsfontein Road which have five Gaubus stops and connecting to other streets and roads in Meyln. From Hatfield Gautrain station, H1 Gaubus transport commuters to Brooklyn through Burnett Street which have two Gaubus stops, Burnett Street connect to University Road which also have two Gaubus stops, University Road connect to Charles Street that has two Gaubus stops as well, Charles Street connects to Fehrsen Street, and Fehrsen have one Gaubus stop connecting with other streets in Brooklyn. Consequently, from Hatfield Gautrain station, H2 transport commuters to Lynnwood through Duncan Street which have three Gaubus stops, Duncan Street connect to Lynnwood Road which have 9 Gaubus stops, and Lynnwood Road connects to other streets and roads in Lynnwood. Further, from Hatfield Gautrain station to Arcadia, H3 transport commuters through Church Street which connect to Beckett Street, Beckett Street connect to Hamilton Street, and Hamilton Street connect to Park Street which has five Gaubus stops and Park Street. Gaubus goes around Arcadia.

Hatfield-Brooklyn H1		Hatfield-Lynnwood H2		Hatfield-Arcadia H3		Hatfield-Menlyn H5	
Bus type	Bus stop & routes serviced	Bus type	Bus stop & routes serviced	Bus type	Bus stop & routes serviced	Bus type	Bus stop & routes serviced
H1-1	Burnett St & Festival St	H2-1	Duncan St & Duxbury Rd	H3-1	1137 Church St	H5-1	Jan Shoba & Duxbury Rd
H1-2	University Rd & Lynnwood Rd	H2-2	Duncan St & Lynnwood Rd	H3-2	Church St & Festival St	H5-2	Duxbury Rd & Lunnon Rd
H1-3	Roper St & Charles St	H2-3	Hillcrest Blvd, Lynnwood Rd	H3-3	Church St & Hill St	H5-3	Brooklyn Rd & Brooks St
H1-4	Brooklyn Office Park, Fehrsen St	H2-4	Lynnwood Rd & Kings Highway	H3-4	Church St & Eastwood St	H5-4	Brooklyn Rd & 10th St
H1-5	Middel St & Brooklyn Circle	H2-5	Hoërskool Menlopark, Lynnwood Rd	H3-5	Government Ave & Beckett St	H5-5	Dely Rd & Elandslaagte Rd
H1-6	Middel St & Dey St	H2-6	Lynnwood Rd & Kiepersol Rd	H3-6	Union Buildings	H5-6	Garsfontein Rd & Selati St
H1-7	Middel St & Florence Ribeiro Dr	H2-7	Lynnwood Rd & Meiring Naude St	H3-7	Hamilton St & Edmon St	H5-7	Garsfontein Rd & Mante St
H1-8	Main St & Florence Ribeiro Dr	H2-8	Davenry St & Hallisham Ln	H3-8	Hamilton Ave & Francis Baard St	H5-8	Garsfontein Rd & Lois Ave
H1-9	Main St & Silver Oak Ave	H2-9	Innovation Hub	H3-9	Park St & Cilliers St	H5-9	Menlyn Retail Park
H1-10	Waterkloof Corner	H2-10	CSIR Gate 2	H3-10	Park St & Wessels St	H5-10	Garsfontein Rd & Corobay Ave
H1-11	Brooklyn Plaza, Fehrsen St	H2-11	CSIR (International Convention Centre)	H3-11	Park St & Beckett St	H5-11	Muriel St & January Masilela Dr
H1-12	Fehrsen St & Muckleneuk St	H2-12	Lynnwood Rd & Kiepersol Rd	H3-12	Park St & Eastwood St	H5-12	Atterbury Rd & January Masilela Dr
H1-13	Charles St & Roper St	H2-13	Hoërskool Menlopark, Lynnwood Rd	H3-13	Park St & Burnett St	H5-13	Atterbury Rd & Lois St
H1-14	University Rd & Lynnwood Rd	H2-14	Lynnwood Rd & Kings Highway			H5-14	Lois St & Atterbury Rd
H1-15	Burnett St & Festival St	H2-15	Lynnwood Rd & Ox St			H5-15	Lois St & Gobie St
		H2-16	Lynnwood Rd & Pienaar St			H5-16	Garsfontein Rd & Ist Rd
		H2-17	Duncan St & Duxbury Rd			H5-17	Garsfontein Rd & Matroosberg Rd
						H5-18	Elandslaagte Rd & Dely Rd
						H5-19	Brooklyn Rd & 10th St
						H5-20	Duxbury Rd & Lunnon Rd
						H5-21	Jan Shoba & Duxbury Rd

Table 2: Spatial locations of Gaubus in Hatfield



Figure 3: A re Yeng Map routes and Stations (Author's, 2018)

The above figure 3 shows the routes and stops for A re Yeng bus. There are numerous colours which represents certain routes and location serviced by A re Yeng busses. Each bus has a certain identity for example F4 is a feeder route from Sunnyside to Muckleneuk, to Groenkloof, Groenkloof is represent with a

pink color and there are seven A re Yeng bus stops provided which are Mahatma Ghandi, Sunnyside inbound in Justice Mahomed Street/ Silver Street, Sunnyside in Justice Mahomed Street/Johnson Street, Bailey's Muckleneuk in Florence Ribeiro Drive/Totius Street, Bailey's Muckleneuk in Florence Ribeiro Drive/Sibelius Street, Groenkloof in Totius Street/Steger Street and Tuks Groenkloof. In Arcadia and Sunnyside, there are five A re Yeng bus stops and are represented with a light blue color. A re Yeng bus stops found within Arcadia to Sunnyside are Ruth Mompati in Travena, Arcadia in Hamilton Street, Arcadia in Hamilton Street/Petorius Street, Riviera in Steve Biko Road/Rose Road and Steve Biko Hospital. Consequently, A re Yeng bus from Sunnyside to Lukastrand service different routes and there are seven bus stations serviced by F7 A re Yeng bus. These bus stops are Tuks Groenkloof, Preller, Sanpark, Unisa and Mears which are also represented with a pink color. Further, F5 A re Yeng from Pretoria CBD to Trevena service Eighteen bus stops which are Belle Ombre, Lower Marabastad, Middle Marabastad, Upper Marabastad, Upper Bloed, Marabastad in Bloed Street/7th Avenue, Lower Kgosi Mampuru, Middle Kgosi Mampuru, Pretoria in Kgosi Mampuru Street/Minaar Street, Pretoria in Kgosi Mampuru Street/ Nana Sita Street, Bosman Taxi Rank, Pretoria station, Pretoria in Scheiding Street/Van Der Walt Street, Unisa Sunnyside, Sunnyside in Rissik Street/Troye Street, Pretoria in Rissik Street/Joubert Street , Trevena in Sisulu Street/Minaar Street and Nana Sita. F6 Service Pretoria Central with eleven Gaubus stops transporting commuters from Belle Ombre to Nana Sita station.

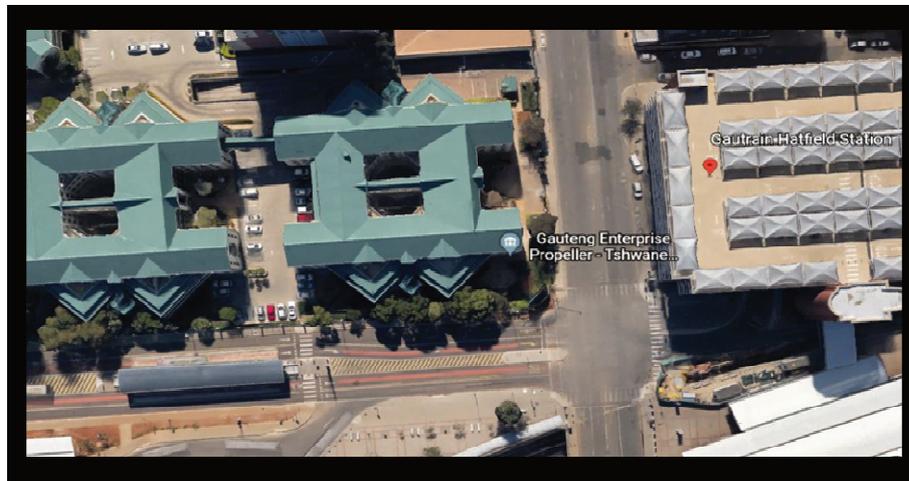


Figure 4: Spatial integration in Hatfield (Google earth, 2018)



Figure 5: Spatial integration in Pretoria Station (Google earth, 2018)

In line with the above, A re Yeng bus have T1 and T2 which are Trunk routes. T1 transport commuters from Pretoria Central to Sunnyside and Hatfield, T1 service ten A re Yeng bus stations. T2 transport commuters

from Wonderboom to Capital Park and Pretoria CBD. T2 service six bus stations which are Hector Pieterse, Moses Mordru, Enoch Sontonga, Anton Lembede, Rivonia Trial and Pretoria Central.

Spatial integration of urban public transport makes it easier for commuters to switch smoothly from one mode to the next and it gives commuters alternatives to use the available transport mode in regard to the time convenient to them. At Hatfield in the City of Tshwane there is spatial integration as indicated on figure 6. Gautrain/Gaubus and A re Yeng bus are close to each other. A re Yeng and Gaubus are 25 metres away from each other. Both Gaubus and A re Yeng bus are 100 metres away from the Gautrain station which is convenient for commuters to walk the distance. Therefore, the planning of formal urban public transport in this location indicates that all stakeholders involved considered integrating these system spatially in order to make the movement of commuters easier.

In Pretoria station Bosman Street, Gaubus is immediate outside when you exit Gautrain station. This distance is close enough for smooth switch in between made by Gautrain/Gaubus for commuter convenience purposes, and the system functions well. Central station (A re Yeng bus stop) on Skinners is approximately 800m away from Pretoria station (Gautrain/ Gaubus). Further, in the City of Johannesburg 100 metres away from Gautrain Park station there is BRT (Rea Vaya) station.

6 RESEARCH CONTRIBUTIONS

The work will provide strategies and policy recommendations that will promote the development and running of effective, efficient, reliable and well integrated public transport systems (road and rail) that foster socio-economic benefits and spatial transformations, thus providing a conduit to best practices that can be replicated to other provinces and countries within the African continent.

7 RESEARCH LIMITATIONS

A challenge encountered in conducting this research is related to the collection and capturing of information, instead of 20 interviews, 15 interviews were conducted with transport authorities/ officials. At least 80% of feedback was received and 20% could not be acquired for capturing and analysis. Secondly, in terms of data collection while conducting interview questions with the commuters of Gautrain/ Gaubus and BRT, some participants did not respond according to how the question wanted, due to the lack of understanding of the study topic or question posed to them. Authors did not manage to get BRT (Rea Vaya and A Re Yeng) GIS data for routes and bus stops to create maps and thorough analyse the spatial data. This weakened the data analysis and led to some of the data being missing. Thirdly, some participants gave biased answers, for example they responded out of what they felt it should be done rather than what the question wanted.

8 FURTHER RESEARCH STUDY

Connecting Bus Rapid Transit (A re Yeng bus in the City of Tshwane and Rea Vaya bus in the City of Johannesburg), Gautrain and Gaubus in Gauteng Province through the use of integrated mobile payment and information system to develop seamless travel in the province.

9 DISCUSSIONS AND CONCLUSION REMARKS

Gautrain/ Gaubus system is physically integrated, all Gautrain stations have Gaubus stops. However, the Gaubus only go to certain locations not all and does not go deep inside Pretoria townships and other areas. Gautrain and A re Yeng bus are spatially connected in Hatfield station and Pretoria Central. Gaubus and A re Yeng are connected on some location which are Hatfield locations, Arcadia, Sunnyside, Lukastrand, Pretoria Central, Trevena. However, they do not service the same routes. As there is spatial integration on some locations, it is suggested that the use of electronic integration (one smart card, combined online information timetabling) is introduced in order to support the areas that are spatially connected and this can strengthen the overall public transport to service more locations and routes. Gautrain and Gaubus indicates that bus and train can be integrated and can be compatible with one another if the system is designed in such a way that the two modes are not far from each other and there are elements such as payment, and information distribution systems linked together. Further, in the City of Johannesburg, Gaubus and Rea Vaya service different areas, however, on some instances they can be found in the same area but service different locations and streets. Rea Vaya service more of the South of Johannesburg (Soweto) areas to the CBD. Gaubus does not service South of Johannesburg areas but more from the CBD to the north areas (Midrand, Sandton,

Rosebank etc.). Most of the Soweto residents work in the CBD and North areas (Sandton etc.) and the Rea Vaya does not service some of the routes going to those areas and some of the areas does not have Rea Vaya but they have access to Gaubus. It has been noticed that the situation of the locations of Gautrain/ Gaubus and the BRT system in the City of Tshwane and the City of Johannesburg is more of the same. BRT and Gautrain/ Gaubus do not service the same routes. Therefore, there is a need of these modes of public transport to be connected to one another for commuter's convenience.

The spatial planning of public transport between Gautrain/ Gaubus and BRT shows good physical integration on some locations in the City of Tshwane and City of Johannesburg CBD. This indicates that transport authorities, urban planners and other officials consider integration of urban public transport as a crucial factor for fast movement and commuters not to struggle when they want to switch in between different modes of public transport. As indicated that on some locations of Gautrain and BRT are spatially connected. Consequently, the routes used by Gaubus and BRT are different, connecting these modes will assist commuters to reach to places of interest reliably and have more alternatives to choose from for swift travelling. The paper recommend an integrated online application for BRT, Gautrain/Gaubus commuters for convenience and establish seamless traveling. Consequently, this could achieve high accuracy levels and become very useful and valuable for public transport users, as commuters who use both modes to get to their destination can switch smoothly with minimal delays. This paper is envisaged to assist with beneficial information for guidance in the operations of urban public transport in the Gauteng province. Essentially, the work will provide guidelines and policy recommendations that will promote the development and running of effective, efficient, reliable and well-integrated public transport systems (road and rail) that foster socio-economic benefits and spatial transformations.

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