THE QUESTION OF ROAD TRAFFIC CONGESTION AND DECONGESTION IN THE GREATER JOHANNESBURG AREA: SOME PERSPECTIVES

JAMES CHAKWIZIRA*

CSIR Built Environment
P. O. Box 395
Pretoria 001
Tel: +27 12 841-2942
Fax: +27 12 841-4054
E-mail: jchakwizira@csir.co.za

ABSTRACT

This paper is concerned with the road traffic congestion problems and decongestion initiatives in the Greater Johannesburg Area (GJA). A rapid appraisal of the traffic congestion and decongestion map and atlas of the GJA was conducted with the objective of advancing a pragmatic approach to transforming the problems into opportunities and seed through the deployment of transportation scientific knowledge and ideas into positive tangible outputs and deliverables. In this regard, an analysis of a sample of measures and instruments used to regulate road traffic and transport challenges in the GJA was undertaken. It is premised on the view that traffic and transport perspectives and paradoxes characterizing the region and practice are a direct output of local traffic and transport processes, systems and institutions which are poorly customized and formatted to be pro-actively responsive to the dynamics, evolving and mutating challenges of the GJA transportation demands. A sample of transport proposals, systems and initiatives adopted and adapted to date were collectively analyzed to gauge their potential impact and contribution in resolving key traffic congestion and decongestion challenges bedeviling the study area. The synthesis uses the matrix technique for analysis while the research is based on extensive literature review, physical observation and key informant views. The findings highlight that a gap exists between the traffic and transport images hypothesized and conceptualized in the plans and professional practice on the one hand, and the traffic and transport realities as experienced on the ground. The major conclusion is that an integrated and comprehensive land, air and road based strategic transportation framework and perspective plan reflecting input from all stakeholders could lay the foundation on which an appropriate, responsive and sustainable congestion and decongestion framework, mitigation and response mechanism can rest.

1.0 INTRODUCTION

This paper is about traffic congestion and decongestion in the Greater Johannesburg Area (GJA). The problem investigated is the exponential rise in traffic population vis-à-vis a fixed inelastic supply of the road and route network infrastructure, leading to recurrent and non-recurrent congestion affecting and impacting on the GJA transportation and built

environment infrastructure and landscape. The paper's main argument is that the traffic congestion and decongestion challenges, although partly attributable and maybe a consequent of the apartheid philosophy and legacy, can be resolved and overturned through integrated and pro-active comprehensive transport planning, networking, collaboration and partnerships between transportation experts, institutions and organizations within and without South Africa. The argument is premised on the view that synergies provide for enhanced models, holistic responses and approaches to tackling traffic congestion and decongestion challenges. It is further suggested and projected that the mismatch and gaps between urban transportation plans aimed at addressing traffic congestion and decongestion peculiar to the GJA among other noble initiatives and intentions and the realities at and during implementation are key to explaining why transport plans and performance are at variance with envisaged views and expectations of politicians, society and the professional group at large. Developing systems and methods that can close the gap between envisaged transportation images and realities cannot be over-emphasized. At the same time, continued experimentation and funding of science and technology, research and development institutions remains important if the ultimate aim is to turn around traffic congestion and decongestion challenges in the GJA into a success story of taming, calming, re-directing and platooning off traffic congestion and decongestion. Various scenarios, models and perspectives , some implemented wholly, others implemented in parts, others completely shelved, others discarded and some never tabled are sieved and distilled and the traffic congestion and decongestion map and atlas presented, analyzed and discussed.

A repertoire of methods and techniques were used in conducting the traffic congestion and decongestion study in GJA. Extensive literature review was undertaken to establish key traffic congestion and traffic decongestion themes and main responses and approaches adopted and implemented to date. The situational analysis provided the base parameters for traffic congestion and decongestion projections, modelling and simulation that form the core of traffic congestion and traffic decongestion perspectives chronicled and debated in this paper. Key informant and expert panel discussions and interviews were also done with transport officials, academics and professionals in the transportation industry. In addition, physical audits, windshield and roadside, and major route/arterial on-the-spot studies and observations were executed. The combination of these different methods and techniques were meant to approximate the actual traffic congestion and traffic decongestion challenges in GJA by way of building-in, reliability, validity and authenticity in the study instrumentation.

The remaining sections of the paper cover the background to the study area and problem, problem analysis, recommendations and conclusion. The key findings of the GJA traffic congestion and decongestion study in were analyzed and discussed in the context of both long-term and short-term initiatives and perspectives with regard to establishing, developing, entrenching and sustaining an effective framework for resolving traffic congestion and decongestion challenges in GJA.

2.0 BACKGROUND TO STUDY AREA AND PROBLEM

Johannesburg is a sprawling city with a dual transport system (Saint Laurent, 1998:2). It consists of a car-based system in the most developed areas, where automobile use is almost compulsory; a semi-managed system in the poorest areas, where people move through transport modes such as walking, cycling, bus et cetera. Transport is either by way of commuter trains that serve limited areas of townships, minibus taxis or state subsidized bus companies. Commuters and shoppers walk long distances to access

facilities (Beavon, 2002:10). During the apartheid era separate and differential transport systems were supplied to the white and black communities as an explicit strategy, which legacy still has a significant influence on the current configuration of services.

Johannesburg mass transit metro railway system connects central Johannesburg with Soweto, Pretoria and most of the satellite towns along the Witwatersrand, transporting huge volumes of workers everyday. However, the railway system built during Johannesburg's infancy covers largely the older areas of the city. However, in the past 50 years, Johannesburg has grown largely northwards and none of the areas including key districts of Sandton, Midrand, Ranburg and Rosebank have any meaningful rail infrastructure. It is in this context that the Gautrain rapid rail link has been proposed and is being implemented, in part, to relieve traffic congestion on the N1 freeway between Johannesburg and Pretoria which record traffic loads of over 160 000 per day (Wright, 2005).

Johannesburg is served by OR Tambo International Airport which will also be linked by the Gautrain . Other airports include Rand airport, Grand Central Airport, and Lanseria. These airports have witnessed significant increases in traffic volumes over the years, which by extension, feeds into the road network.

Johannesburg is not built near a large navigable river. This means that from the beginning, land transport has been a leading method of transporting people and goods in, around and beyond the GJA. Johannesburg ring/orbitals road is comprised of three freeways that converge on the city. The N3 eastern by pass links Johannesburg with Pretoria town. The N12 southern bypass links Johannesburg with Witbank and Kimberley. There is also the busy N1 route. The N3 was built with asphalt. The N12 and N1 western by pass are constructed of concrete. In spite of being up to 12 lanes wide in some areas (6 lane one direction), the Johannesburg ring road is frequently congested.

Spatially, the Johannesburg metropolis which covers an area of approximately 2 300km^2 (Beavon, 2002), is a highly structured, fabricated and interlocked poly and multi-centric urban mosaic. On the one hand, it stands for "*the luxury city and city of control"* as reflected by Sandton, for example. The walled and gated communities in the northern suburbs, Midrand, Yeoville and Melville, for instance, reflect the *"gentrified city and the city of advanced services".* The middle class South African areas such as Triumph (Sophia town) lend themselves to the *"suburban city and city of direct production".* The largely previously segregated townships for Africans and Coloureds which are remnants of apartheid highlight the *"tenement city and the city of unskilled work".* Finally the *"abandoned city and the city of the informal city"* are depicted by the informal settlements which are generally located on the edges of townships or in any unused spaces such as reflected by the inner areas, for example, Hilbrow. While the foregoing description does not do justice to a complex urban environment, it certainly provides a basis to frame the analysis.[i] .

Gauteng's road network has to cope with an annual traffic increase rate of 7% with 1.8 million drivers and 2.8 million registered vehicles (Malefane, 2006). 40% of the national fleet and traffic has been increasing on the M1/N1 corridor roughly 7% a year over the past 10 years. The average travel time to work in GJA has increased from 41,5 minutes in 1995 to 50 minutes in 2003, that is, a 17% increase over eight years (Shaw, 2005:11). Traffic congestion affects thousands of people daily in Gauteng Province. During the peak hours, impacts of accidents and the resulting delays add to the general navigation difficulties for road users. Generally traffic congestion in GJA is evidenced and observed through routine

vehicle delays on major junctions and interchanges, vehicle queuing, traffic jam congestion and delay induced and sparked accidents that characterize the morning, mid-afternoon and evening traffic peak periods.

It should be noted that central and local government have a number of strategies and proposals at their disposal to counter the ever-increasing congestion on modern urban freeways and arterials such as expansion of the road network by means of the provision of new infrastructure, the upgrading/widening of existing infrastructure and the optimization of the use of existing infrastructure by means of congestion management instruments with the aid of technology. However, worldwide, a menu and specimens of urban mass transportation theories, approaches, models, policies, plans and strategies have been experimented, modified and implemented with mixed results (Banjo, 1984; Serageldin, 1993).

Congestion may be defined as the saturation of road network capacity due to regular and irregular reductions in service quality exemplified by increased travel times, variation in travel times and interrupted travel. Congestion can be categorized into recurrent and non-recurrent congestion. Recurrent congestion is caused by factors that relate to rapid growth in population, urbanization and related growth in car ownership and use. Recurrent congestion occurs mainly when there are too many vehicles at the same time, consequently reducing traffic speed and increasing personal commuting time. This occurs typically during peak hours but can occur off peak i.e. at other weekday hours and during the weekend. On the other hand, non-recurrent congestion is associated with random conditions or special and unique conditions, including traffic incidents (ranging from disabled vehicles to major crashes), work zones which slow traffic down and weather and special events (Banjo, 1984; Highway Capacity Manual, 2000). Because of the random character of this type of congestion, non-recurrent congestion is more difficult to predict and address. The impact of non-recurrent congestion on predictable and reliable travel time is nonetheless important. The potential effects of traffic congestion are many ranging from time and productivity loss, change in accident frequency and characteristics, increase in air pollutants and GHG[ii] emissions, increased vehicle operating costs and increased noise nuisance (Serageldini, 1993). These consequences represent a loss of scarce resources, which can amount to a significant value. At a certain level of severity, these consequences could explain the location and relocation of land based activities (i.e. industries, businesses, retail establishments, etc.) as well as the choices of individuals to relocate their homes or even to change jobs or schools. It is therefore important to study traffic congestion and decongestion challenges in GJA so that practical mitigation solutions and policy responses are generated to sustain and protect an area that is a joy to live, work and recreate in for all.

3.0 PROBLEM ANALYSIS AND FINDINGS

3.1 One target, multiple simulations, different perspectives and contradictions

Discussions, interviews and literature distillation of key informants, practitioners, researchers and academics yielded the conclusion that resolving traffic congestion and decongestion in GJA is and will always be desirable. However, opinions and recommendations differed based on the best practice and scenarios that would address the problems. Such contradictions and divergence of opinion are quite healthy and expected especially when dealing and confronted with a mammoth and complex task such as traffic decongestion and traffic congestion in GJA.

3.2 Gender issues

A cross-cutting issue that stands out is that traffic congestion and decongestion responses/actions should not be carried out without a detailed and sober consideration of the impact and scope of gender in the transportation equation and matrix. Insook Kang (2006:5) argues that women's experience in urban built environment is different from men's. Gender differentiated transport needs in GJA are intensified by the impacts of gendered economic processes of globalization on Johannesburg. In short, this underscores the need for a revolution and metamorphosis to transport planning and land use management to re-align and define new methodological and philosophical underpinnings that are gendered indeed, not only in theory but in practice, if the exclusion and marginalization of women in efforts to address traffic congestion and traffic decongestion in GJA is to be achieved. Adopting Molyneux (1985) (in Moser, 1993:38-39), gendered transportation analytical tool which distinguishes between strategic gender needs and practical gender needs can be a useful starting point.

The importance of urban land use planning to uncover male bias in urban transport is based on the fact that transport is the single most important human activity bridging all other activities undertaken in different places. Where people live and where they work, go to school or shop will decide the exchange of trips between areas and roads, and transit lines can channel these flows into corridors (Contrans, 2001:11). This leads to traffic congestion and decongestion desire lines and impact zones which affect everyone although the philosophical foundations and assumptions driving the decision making urban framework are male based, orientated and projected. In addition, public transport has served more frequently the peak hours than the off-peak hours and transport routes are oriented to automobile users and focus on mobility rather than accessibility (Levy, 1992:94-95). Incidentally the peak hours services more men than women given the differentiated access to jobs and higher percentages of males employed in various productive sectors as compared to women in Johannesburg. In a way, this may imply lower congestion and decongestion exposure and direct consequences to women than men.

On the other hand, urban sprawl and increasing land use specialization have been aggravated by the automobile cultures. The automobile oriented transport planning and suburbanization is based on a deeper belief that all household members have equal access to the automobile. However, in fact, male breadwinners usually get priority in using the family car, resulting in women's lack of mobility (Pickup, 1984 & Fox, 1983; in Levy, 1992:97). This may imply and indicate that men are affected severely and more exposed to traffic congestion and decongestion challenges in Greater Johannesburg Area than women.

3.3 Long term projections and simulations

3.3.1 Gautrain rapid rail link project within the context of enhanced urban mass transportation in GJA

While South Africa has a fairly well developed commuter rail network operated by a government owned corporation, the country lacks modern inter-city service (Wright, 2005). With the introduction of the Gautrain, an approximately 80km route will connect Johannesburg and Pretoria with trains running at 80 miles an hour. Six trains per hour will run 18 hours a day between the two cities. Most of the Gautrain route in Johannesburg and its suburbs will be underground, moving from park station in the city centre under the Johannesburg hospital in Park town towards Rosebank and on to Sandton.

The train is expected to cut the number of cars on the N1 Ben Schoeman highway by 20% with 135 000 passenger trips per day by 2010. However, figures released by the Gauteng provincial government in 2003 indicate that the project will do little to alleviate traffic on the over-used Ben Schoeman highway as traffic volumes will be higher when Gautrain is completed and operating at full capacity in 2010. Rider ship projections and environmental considerations are other areas were divergence of opinion flourish (http:/www.joburg.org.za/city).

One key leading argument is that a single lane cannot solve the GJA traffic congestion and traffic decongestion challenges. However, it should not be forgotten that the Gautrain was and is not meant to be a substitute for road based transportation and was never conceived as an alternative to urban mass public transport. In a way, the Bus Rapid Transit (BRT) proposal and initiative answers to that call as well as complementing the Gautrain project. The Curitiba experience could be informative as a reference and benchmarking point. At the same time, it is important to also view the Gautrain rapid rail link line as a starting point and line from where other lines and extensions are to be developed. This lends credence to the concept of Gautrain as the anchor rail line from which an inner and outer ring rapid rail link lines would integrate with the mass transport system in GJA. This requires further research, studies, thought and discussions of models, approaches and strategies within the ambit of the proposed national transport master plan 2005 - 2050 for South Africa. In the same vein, the scope for implementing parallel mono and light rail projects could also be explored.

Another argument provided for the Gautrain project is that it is a very expensive project that takes away scarce transportation resources that could be used in various transport projects in Gauteng Province as well as the nation at large. Cox (2005) indicates that the estimated project cost has increase seven fold from the initial cost of R3,5-4 billion in 2002, R7 billion in 2003, R20 billion in 2005 and over 22.5 billion in 2006. Even this 2006 estimate is more likely to be surpassed when the final books are done by 2010.

While existing railways in South Africa use the narrower than standard Cape gauge of 1 067mm (3 feet 6 inches), Gautrain will be built to standard gauge (1435mm or 4 feet 8½ inches). According to Gautrain, standard gauge “is safer and more comfortable for speeds of 130km/h and higher and will allow for cost-effective procurement of rolling stock”. Bombadier Transportation’s Electrostar, a model of train common in south – east England, has been selected for the system. The trains will be assembled by UCW Partnership in South Africa from components made in Britain. A science and technology view highlights the need to develop a rolling plan of skills and knowledge transfer to the locals so that sustainability of the project and maintenance and rehabilitation costs will be reduced in the long run. At the same time foreign currency is saved as substitute local companies are established and developed to manufacture and service the Electrostar model trains infrastructure and service needs.

3.3.2 Underground urban mass transportation railway system for Gauteng

The proposed underground urban mass transportation railway for Gauteng can only be described as the direct opposite of the Gautrain. This is expected to complement and assist in reducing traffic congestion and decongestion on the main road based systems in Gauteng. The idea and proposal are not new as they were first conceived in the 1970s but there was no follow through to implementation. Figure 1, shows various stages and cycles through which the idea of an underground urban mass railway transportation system for Johannesburg has passed through.

1971	1974	1975	1985	1994	2003
The underground transport idea was first mooted by the consultancies London Transport Executive & Mort, Hay & Anderson	The committee Recommended government spend R92 million a year on urban transport infrastructure.	The Driessen Committee revived the idea of a Johannesburg underground transport project but no firm decision was made on the matter because of huge cost	The scraping of influx control which restricted the urban movement for all but whites could be foreseen, therefore the 1971 study was overhauled	The Masstrans plan recommended that the north-south line be built first to come into operation in 1994	The city of Johannesburg transport department found that the rail was the most "effective mode of transport for one way passenger volume of more than 40 000 a day". This suggests that an underground option may still be the way to go in the long term

Figure 1: Timeline Perspectives on Underground Railway Project for Greater Johannesburg Area
(Source: Michael Schmidt, 2006:15)

Figure 1, sustains Schmidt's (2006) argument that Johannesburg daily traffic congestion and decongestion challenge may never have become a grim reality for millions of commuters if an underground rail network had been built, as suggested 20 years ago. Figure 2, shows the proposed underground railway layout for the then GJA. If implemented, over time, the line could be extended incrementally in response to demand as well as looking at options of optimizing its own efficiency through inner lines or outer lines so that the underground railway train system is also functionally and internally coherent and connected.

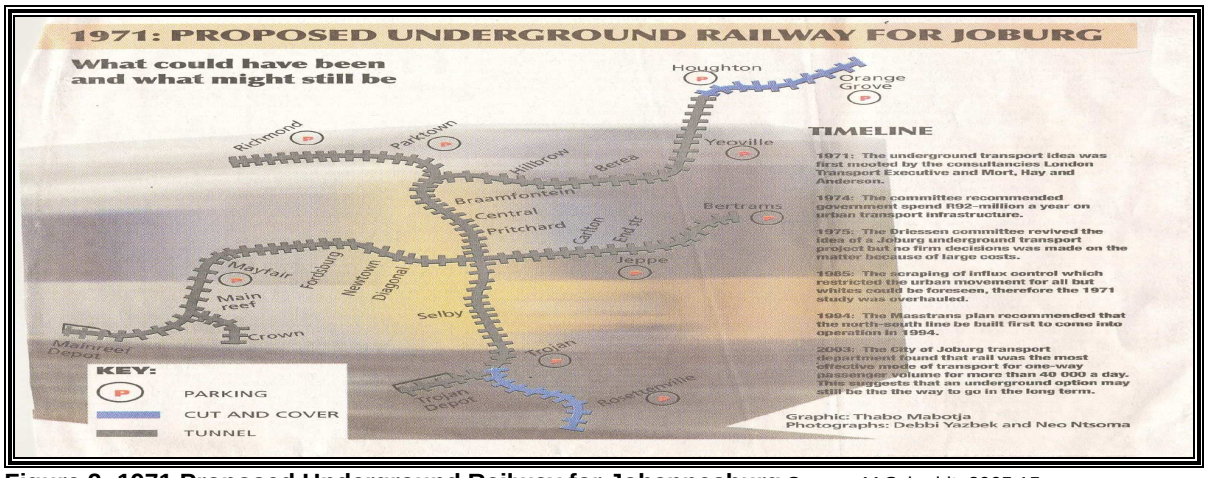

Figure 2: 1971 Proposed Underground Railway for Johannesburg Source: M Schmidt, 2005:15

The fact that this plan was not implemented reflects the fact that previously transportation plans were inward looking rather then being outward. There was no institutional setup to champion the GJA transportation needs. However, with the advent of the new political dispensation in 1994, efforts and feelers have been made in this regard. The Gauteng transport master plan and framework, for example, will most certainly tackle this gap.

3.3.3. Midtran: a new approach to community transport

Midtran was established in 1993 as a unique transport management company located in Midrand to look at various options for providing refreshing and innovative means of public transportation for its local community. Transport services were developed and implemented as a functional venture between the commuting public, the private sector and local government. Although in depth planning and restructuring was a lengthy process, the formation of Midtrain resulted in a new culture in which transportation systems could emerge. An important dimension to this is the clean commute initiative, a joint venture with the International Institute for Energy Conservation (IIEC) and the South African Department for Minerals and Energy Affairs. It encouraged car-pooling, flexi time and transportation for staff working over time, in an attempt to create alternative approaches to

commuting patterns that help optimize transport time and density. Midtrain and Eskom (the largest electric utility) have also co-operated to test an electric car shuttle service at a large business park in Midrand (Wonfor, 1998). The important issue stressed here is that the initiative aims at tackling the traffic externalities which increase in traffic congestion conditions since the travelling and idling time is increased.

3.1.5 SANRAL's intelligent transport systems

Technology combined with telecommunications can be utilized very effectively to do real time monitoring of road network conditions, process the information and make informed decisions to manage the road network. This technology can also be used to improve incident management. The speed of response to an accident has a direct influence on the safety of persons involved in the incident/accident as well as the extent of congestion caused directly or indirectly by the aforementioned.

South African National Roads Agency Limited (SANRAL) commenced with the implementation of an intelligent transport systems (ITS) pilot project along the N1 Ben Schoeman freeway in Gauteng in 2005[iii]. This project is branded SANRAL i-traffic (intelligent – traffic) project. The project was done in cooperative partnership with the Gauteng Department of Transport, Roads and Works, the Tswane, Johannesburg and Erkurhuleni Metropolitan Councils, as well as the South African Police Service (SAPS). Continued research and experimentation to determine tailor made solutions for local conditions are still underway and results are still tentative. The ITS project highlights the potential role and scope of telematics in resolving traffic congestion and decongestion within the GJA and the transportation field generally.

3.4 Short term interpolations and simulations

3.4.1 Car pooling and introduction of the "efficient lane"

Oxford and Rivonia roads are set to have dedicated public-transport lanes for exclusive use by buses, and taxis, encouraging traffic shy motorists to use public transport. It is still too early to make formative evaluations on the impact of dedicated transport lanes in GJA although indications so far are encouraging. Plans to establish cycling lanes and bicycle facilities at Gautrain stations are a welcome development. Travel demand management strategies including concessions for high occupancy vehicles (HOV) will also incentivise private car users to move to public transport.

3.4.2 Scope for non-orthodox business operating styles and working hours

One can argue that the traffic congestion and decongestion challenge in GJA is deeply ingrained and embedded in the business operating paradigm and mindset, which offers itself to the fact and principle that working hours start at eight (8 a.m.) in the morning and finish roughly at four (4 p.m.) in the late afternoon. This means that schoolchildren, workers, industrialists are all bundled and packed together to synchronize and fit simultaneously their trips and activities in that time slot. They indeed all have to wake up and rush to conduct their daily activities at almost the same time and finish off their activities and rush back home at approximately the same times. This means an approach that can reverse and challenge the practice can offer respite in resolving the traffic congestion and decongestion puzzle and jigsaw in GJA.

The National Household Travel Survey report(Statistics South Africa, 2006) shows that a South African who uses their own vehicle spend at least 1½ hours in traffic each day, while 10 million people who use public transport spend 2 hours getting to and from work. The need to alleviate traffic congestion and traffic decongestion can not be any greater. One

proposal is to adopt a proposed 9 – 5 radical traffic plan in GJA (Molele 2006:1). To smoothen and platoon off traffic congestion and decongestion through managing the working hour is part of traffic demand and supply management techniques. This can take the form of flexi-time; staggered working hours; extended working weeks to finally compressed working weeks. The idea and concept has been experimented with throughout the world with mixed results. However, piloting and customizing the project and learning through implementation is considered prudent given the severity of traffic congestion in GJA and its negative impact on productivity.

3.5 Distilling the greater Johannesburg area transportation challenge

The melting pot of traffic congestion and decongestion challenges and responses adopted so far are summarised in Figure 3. Suffice to say that an intergrated comprehensive strategic transportation planning, management and sustainability approach is underlined as key to resolving the issues at hand.

PROJECTS/PROGRAMMES/ACTIONS/INITIATIVES/PROPOSALS				*TRANSPORT FRAMEWORK*	
Variable	***BRT & Rea Vaya Concept & Proposal***	***Gautrain Rapid rail Link Project***	***Johannesburg Underground Railway Proposal***	***TSF***	***DSM***
Approach	• Focus more on public mobility more than accessibility • Hardware transportation infrastructure & facilities orientation more than software transportation services and systems • Micro-projects, initiatives, prototypes & demonstration projects based			• Macro- transportation stakeholders decision making, strategies, plans, activities & environmental focus • Macro-transportation policy, legislation, systems, institutions approach	
	• bus rapid mass transit system • BRT	• Rail rapid transit system • RRL	• Rail mass transit system • URL	• Generic & broad • Municipal Integrated Transport System • Spatial Development Frameworks • Hubs & Satellite Concepts • DoT Action Plan • Johannesburg ITP	• Specific & detailed • Dedicated Lanes • HOV lanes • Car Clubs • Car Pooling • ITS • Business Operating & Management Strategies
Justification	• Public Transport • Congestion • Pollution • Traveling Time • Mobility	• Public Transport • Congestion • Pollution • Traveling Time • Mobility	• Public Transport • Congestion • Pollution • Traveling Time • Mobility		
Infrastructure	• Road and route networks • Median bus only lanes	• Rail network • Construct/built new rail line	• Rail network • Construct & built new underground rail line & ancillary facilities		
Ingredients/Components	• Use 160 seater buses • Road & bus based • Park & ride schemes • Distance based fare system • Multiple route corridors (incl. inner city distribution) • Rea Vaya trunk or 500m feeder corridor	• Single rail line • Can be linked to NMT proposals/projects • North – South Link • 80 km route length • anticipated high ridership levels	• Multiple lines & grid to serve all high commuting zones/areas • Nodes to be extended according to demand		
Status	• Expected to be operational by 2009	• To be operational by 2010	• Shelved		
Key Points	• Project Focused • Inward Looking • Incremental • "Stand alone" challenges			• Strategic • Outward Looking • Comprehensive • Vertical and horizontal linkages challenges	
Overall Comment	**Intergrated Comprehensive Transportation Planning, Management & Sustainability Approaches, Models, Programmes, Projects & Ideas**				

Figure 3: Comparative Analytical Matrix of Greater Johannesburg Area Transportation Perspectives

4.0 RECOMMENDATIONS[iv]

A number of recommendations emanate from this study. Only major themes are indicated and discussed here;

1. Need for a GJA underground railway urban mass transport system requires further work and may be a tenable option in the future. Given the fact that land for freeways and highways construction and expansion is slowly diminishing in the GJA, the only viable option may be to go underground. The proposal may require refinement and customization to Johannesburg local conditions but benchmarking can be done from international case studies such as the London and Paris underground railway systems.
2. Gautrain rapid rail link line cannot be expected to solve the GJA's traffic congestion and decongestion challenges. It is however an important consideration and should make a significant contribution in reducing traffic congestion and decongestion, but in itself, cannot be the panacea.
3. The spatial development frameworks and route corridors (satellite and hubs concepts) in the GJA are an initiative that require strengthening and further support so that they contribute meaningfully to transportation planning with a view to lowering and reducing the traffic volumes and loads on key distributors/arterials in the GJA.
4. Existing public mass transport system initiatives and proposals such as the BRT and Rea Vaya should be buttressed so that a functionally effective and efficient transportation system for the GJA is realised. This will complement the Gautrain rapid rail link.
5. The hardware infrastructure options and strategies need to be complemented by a software implementation strategy and options. In this grain, initiatives such as SANRAL's i-transport project, dedicated lanes, HOV lanes, bus lanes, bicycle lanes and ancillary facilities become key initiatives in traffic congestion ad decongestion measures and actions to resolve the GJA traffic congestion problem.
6. Partnerships, collaboration and networking activities, ventures and proposals/project between government, private sector and civil society have potential in addressing the Greater Johannesburg Area traffic congestion and decongestion problem. Such potential should be tapped and optimized for efficient flow and movement of traffic in the GJA.
7. It is important to realize that spatial fragmentation legacy has been carried forward in terms of the GJA planning institutions, systems and processes. The polycentric spatial configuration, fabrication and metropolitan conurbation of the GJA in terms of Sandton, Randburg, Midrand, Soweto, etc. is a unique feature of the area that in itself is a strength as well as a cause for concern. A need to realign and recast them in the light of integrated and comprehensive transportation planning is compelling. This stems from the fact that the different municipalities that comprise the GJA have and are busy conceiving and implementing spatial development frameworks, transportation blue prints and strategies within the confines and purview of their areas of jurisdiction and mandate. These plans are therefore inconsistent, uncoordinated and not harmonized with each other. Under such a context it becomes difficult to tackle congestion and decongestion challenges that are and need inter-jurisdictional planning, development and management. The Gauteng Strategic Transport Master Plan and institution established by government is therefore a step in the right direction. It seeks to close such gaps and provide a departure point for collective resolution of the issues within the orbit of an over-arching cross cutting transport authority for the GJA. Also, post Apartheid intergovernmental alignment is therefore a move in the right direction[v].
8. Funding and support for research and development and experimentation works in traffic congestion and traffic decongestion plans, designs, proto-types, projects/proposal remain important areas as the quest and search for a lasting, durable and stable sustainable traffic congestion and decongestion solution for GJA continues to gather momentum.

5.0 CONCLUSIONS

The research, findings and discussions have highlighted that solving traffic congestion and traffic decongestion in GJA is and will and has never been a simple and straight forward linear and vector equation. It is a complex equation that involves matrices and requires a thorough, cautious and multi-pronged transportation and land use collaboration and partnership approach. Creating and recreating, making and remaking, fabricating and re-fabricating, structuring and restructuring, shaping and reshaping, engineering and re-engineering, formulating and reformulating, modelling and re-modelling, simulating and re-simulating, projecting and re-projecting, developing and implementing mitigating plans, policies, responses and alternative traffic congestion ad decongestion actions has and continues to be fertile ground for experimentation and tackling. This paper is one such attempt in making a contribution towards the entrenchment of enhanced transportation responses with regard to resolving the traffic congestion and decongestion challenges in the GJA. However, it should be pointed out that traffic congestion and decongestion measures and plans that will remedy and change the landscape and traffic architectural façade of Johannesburg is not a preserve for traffic and transportation planners alone, neither is it for urban and land use planners solely, but the greater built environment professions and beyond have each critical roles and areas of input which without them the GJA congestion and decongestion challenge will remain largely unpacked and unresolved. Supporting and entrenching a GJA urban mass transportation dynamics laboratory or on a much bigger scale, a transportation research laboratory in a research institution such as the CSIR can provide footage and anchorage to the incubation and delivery of appropriate urban mass transportation technologies, models and responses that will better tackle and address head on the congestion and decongestion challenges in GJA than has happened hitherto.

It is intriguingly interesting to note that a complex, unique transportation jigsaw such as that epitomized by the GJA defies generalizations. It thus befits such a study, phenomena and city size system that more questions should be raised rather than answers in conclusion, such as: how best can the transportation institutional framework be adapted and upgraded to be appropriate and relevant to the changing and dynamic urban transportation realities of GJA? How best and under what conditions can the implementation of long term sustainable urban transportation infrastructure projects in GJA be undertaken and achieved? What is the best and optimum form of urban design and roads and route network form shape and size that can contain and absorb the changes in traffic volume, desire lines and spatial growth nodes existing and projected within the Greater Johannesburg region, now and in the future? What components and inputs and form should an integrated and comprehensive GJA transportation master plan take? What are the capacity building and science and technology transportation sustainability issues underpinning a transportation revolution and transformation in the Greater Johannesburg Area?

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[i] See the multiple works of David Smith, Alan Mabin, Llindsey Bremmer, Vanessa Watson, Philip Harrison and many others

[ii] Sulphur oxides (SO_x)Nitrogen oxides (NO_x), Volatile Organic Compounds (VOCs), poly-aromatic hydrocarbons (PAH), hydrocarbons (HC), particulate matter (PM), methane (CH_4) and carbon monoxide (CO)

[iii] SANRAL i-traffic project will be extended to other national freeways in Gauteng in line with contract awards in areas such as along the N1 past Pretoria , the N4 towards Witbank, the N1 down to the N12 at Soweto, the N12 to the South of Johannesburg, as well as between Gilloolys and Daveyton, the N17 between the N3 and Dalpark and the N3 from Buccleuch to Vosloorus et cetera.

[iv] These recommendations are not exhaustive or neither inclusive nor exclusive of any other noble ideas and proposal for traffic congestion and decongestion measures and strategies to address the greater Johannesburg congestion challenge. These are presented to stimulate debate and continue work towards the development of an authentic, indigenous appropriate traffic congestion and traffic decongestion response to the greater Johannesburg challenge.

[v] For Example the Strategic Plan (such as CoJ IDP, Gauteng GDS, NSDP) and policy imperatives such as (IDP Strategic Thrusts (CoJ), Strategic Levers (GDS), Principles of Vision (NSDP) leading to practical alignment in terms of interdepartmental alignment and progress/action are crucial milestones and building blocks for greater success in future.