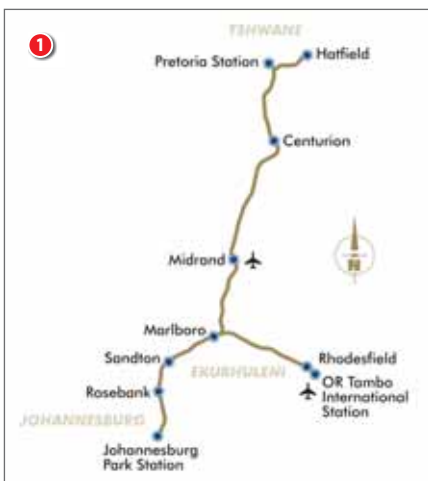




Johann du Plessis
 Commercial Advisor
 Gautrain Rapid Rail Link
 Dept of Construction Economics
 University of Pretoria
 johanndp@gautrainpo.co.za

Injecting a rapid rail link into a metropolis



INTRODUCTION

The Gautrain Project being developed in Gauteng is currently the largest construction project on the African continent. At an estimated cost of some R25 billion, it surpasses any previous single project in South Africa, and will result in a vital rapid rail link between Johannesburg, Pretoria and Johannesburg's OR Tambo International Airport. The total route length of 80 km will comprise some 15 km of tunnels in Johannesburg, about 10,5 km of viaducts along various sections of the route, and the balance will be on surface or in shallow open cut.

The Gautrain is being developed by the Gauteng Provincial Government through a Public Private Partnership concession contract with an international consortium of major players in the construction, public transport vehicle manufacturing and operations fields. While construction is taking

place over a period of some four years to 2011, the Concessionaire will operate the full system for a further 15 years. With ten stations being built along the route, profound land use challenges and opportunities arise. Superimposing a rapid rail artery of this magnitude onto the urban landscape of three metropolitan areas is bound to have considerable environmental and land use impacts. This article demonstrates how these impacts are being addressed and how the natural and built environment is being considered and perhaps even enhanced, rather than being adversely affected.

TRAVEL DEMAND AND NEED FOR A RAPID RAIL SYSTEM

Vehicle ownership in South Africa has increased sharply in the past two decades, in line with the accelerated socio-economic development of many of its citizens. This places heavy demands on the transportation systems,

The original paper, of which this article is an abridged version, was presented in June 2009 at the Urban Transport XV Conference in Bologna, Italy, and was also chosen as Best Paper (Traffic and Transportation) for 2009 by the SAICE Transportation Division earlier this year



- ① The Gautrain route
- ② Internal finishes within the station concourse shell at Sandton Station
- ③ Completed finishes on concourse level at Sandton Station

and in particular on the road systems, in the light of lower than ideal levels of rail freight and rail patronage. While Wegener and Fürst [2] argue that trip length should be negatively correlated with city size, metropolitan freeways in Gauteng have become heavily congested, filled with long trips and resultant travel times that are beyond what should be tolerable in South Africa.

With the hosting of the 2010 FIFA World Cup by South Africa, major infrastructure programmes were executed, including the construction of various new and enlarged sport stadiums, freeway and other road improvement programmes, and bus rapid transit (BRT) systems in different metropolitan areas. In Gauteng, the National Roads Agency is currently improving about 145 route kilometres of freeway. However, a major shortcoming in the bigger metropolitan transport framework has been the lack of a high capacity public transport facility to cater for travel demand between important activity nodes in Gauteng. The



Gautrain Rapid Rail Link is expected to address this shortcoming.

THE PROJECT IN BRIEF

The contract

The Gautrain is being constructed as a Public Private Partnership development in two major phases in the metropolitan areas of Johannesburg, Ekurhuleni and Tshwane (Pretoria). After a very extensive planning and bidding process

between 2000 and 2006, the project was awarded to an international consortium consisting mainly of Bombardier (Canadian), Bouygues Travaux Publics (French), Murray & Roberts (South African), Strategic Partners Group (South African) and RATP Développement (French). The private partner consortium, called Bombela Concession Company, has entered into a 19,5 year concession agreement with



the Gauteng Provincial Government for the design and construction (4,5 years) and the operation and maintenance (15 years) of the system. A total of 24 train sets, operating at 10 minute headways, will be used in conjunction with some 125 buses in feeder/ distribution services around stations.

Construction cost, programme and current status

The total approved contract value is approximately R25 billion. The bulk of the funding – around 88 percent – is from Government, with the balance being private sector debt, while the Concessionaire will carry operating costs.

The Concession Agreement was signed in September 2006, with Phase 1 planned to be operational by mid 2010, and final completion scheduled for 2011. Phase 1 comprised the section between Sandton Station and the OR Tambo International Airport, including the maintenance depot, while the balance of the route south to Park Station and north to Pretoria and Hatfield Stations form Phase 2. Although operational readiness of Phase 1 in time for the FIFA World Cup had never been a contractual requirement, all parties appreciate the importance of having achieved this.



INTEGRATING GAUTRAIN WITH ITS ENVIRONMENT

Development objectives

The Gautrain project is part of the strategic development goals of the Gauteng Province. It also meets the needs and requirements reflected in the National Land Transportation Transition Act of 2000, which requires Government to prioritise and promote public transport and to improve the image of public transport. Thus, already in 2001, the following were some of the objectives approved for Gautrain [4]:

- to stimulate economic growth, development and job creation
- to reduce severe traffic congestion in the Tshwane – Johannesburg corridor
- to promote the use of public transport



- 4 Aerial view of the viaduct 15 approach towards the OR Tambo International Airport Station
- 5 Aerial view of the depot in Midrand
- 6 Installation of parapets on viaduct 5 at John Vorster Avenue
- 7 Aerial view of viaduct 5 and Centurion Station
- 8 Glazing of the Centurion Station façade

- to contribute significantly towards urban restructuring, shortening of travel distances and improving city sustainability
- to stimulate the renovation and upliftment of the Johannesburg and Tshwane Central Business Districts
- to link the main economic nodes in Gauteng
- to comprise a significant part of a holistic transport plan and network for Gauteng.

The above presupposes a considerable degree of sustainable integration of Gautrain into Gauteng Province's transport system, economic development activities and natural environment. This was also a key requirement for the approval of the project by Government and is in line with current global thinking concerning successful integration of land use and transportation (Hine [5]).

Densification of land uses near rapid transit routes and stations has for the past few decades been a prime objective of authorities on different continents. Stockholm was one of the first cities to link new town development with guided transit planning.

Others, like Toronto, Hong Kong (with high government control over land), Lille Metropole, Edinburgh, Atlanta (MARTA), Auckland, and recently Shanghai, are some examples of application of the principles of so-called Transport Development Areas (TDAs).

South African metropolitan development has followed the North American pattern of ever increasing urban sprawl and great reliance on the motor vehicle. Any opportunity to turn this tide towards increased densities and transit usage is to be actively pursued.

Land use and modal integration around stations

In pursuance of integrated land use planning at stations, the Province embarked on an initiative with the local municipalities to develop functional area guidelines to supplement local spatial development frameworks in the vicinities of the respective Gautrain stations. The development of areas within a one kilometre radius of stations was considered, with a view to:

- creating or reinforcing densities
- promoting ridership (getting people to stations)

- establishing mixed land use around stations, thus with varying travel patterns throughout the day
- ensuring appropriate and high density land use
- establishing new urban form that embraces the Gautrain
- establishing integrated public transport nodes.

In most instances Urban Development Frameworks, taking full cognisance of the Gautrain stations and their impact on land use, have been completed and are being implemented.

The station precincts obviously present superb opportunities for commercial development and it is thus not surprising that land use applications for several million square metres of new development are being considered, representing potential capital investment in excess of the construction price of the entire Gautrain project in the next decade alone.

Physical integration with other modes of travel has received attention during the planning of the Gautrain stations. In addition to the integration afforded by the system's own feeder/distribution bus service



to and from stations, special attention was given to ensuring convenient transfers to alternative rail operated by the Passenger Rail Agency of South Africa or other transport modes, where applicable.

Environmental integration

Legislative framework

Environmental concerns regarding physical development in South Africa are regulated, inter alia, by the National Environmental Management Act (Act 107 of 1998) and the Environment Conservation Act (Act 73 of 1989). The Gauteng Department of Agriculture and Rural Development (GDARD) acts as provincial implementers of these acts. GDARD issues Records of Decision (RoDs), approving or disallowing projects or aspects thereof, based on Environmental Impact Assessments (EIAs). The RoD on the proposed Gautrain Rapid Rail Link contained a series of conditions including the formulation and approval of an Environmental Management Plan (EMP) that will govern design, construction of, and ultimately operations and maintenance activities on the rail system.

Environmental impact in practice

Naturally, the most visible impact of such a mammoth project is likely to be the civil construction work. Building operations are bound to be disruptive at times, with very visible impacts on the environment, including large earth embankments or cuts, numerous large, very busy construction sites, and the like. Furthermore, noise pollution during construction has to be kept to within acceptable limits, particularly in or close to residential and business areas.

Several occasions arose during the planning and design of the system when very positive environmental impacts resulted. Examples are:

- Near Marlboro Station, where the line is on viaduct, increasing the viaduct spans obviated the need for deviation of a very large sewer main, which could have posed a major environmental risk.
- The route through Centurion was originally planned to be in a tunnel. Dolomites in the area prompted an alternative alignment on viaduct, which does have a visual impact, but was considered preferable to the risks associated with tunnelling through dolomites. Furthermore, a Water Management Plan regulates the handling of storm

water from the system throughout the dolomite area, to reduce runoff into the dolomite substrata.

- North of Centurion, an at-grade U-shaped reinforced concrete structure is used across an area of varying geological nature to reduce the adverse impact the rail line could have had in an area of deep dolomites.
- In a part of the tunnel section where geotechnical investigations indicated extremely variable rock conditions, it was decided to employ a Tunnel Boring Machine (TBM) which was imported from Germany to drill and place the lining to some three kilometres of tunnel under Johannesburg.
- Naturally all of the cut and fill slopes in the formation are being landscaped and grassed as soon as civil construction allows this, to limit the impact on the physical environment.
- Concerning noise and vibration, the specification for the system has very strict international compliance standards, and where these standards could not normally be attained at rail reserve edge, noise barriers and/or vibration dampening pads are used to mitigate any adverse effects.

A GLIMPSE INTO THE FUTURE

The Gautrain is the first of its kind, not only for South Africa, but for the entire African continent. More systems such as this one have to, and will, follow. Furthermore, the Gautrain system will have to expand in future, and provision is made in the planning and design of the system to extend the southern, northern and eastern ends, should future demand warrant this.

With tremendous densification around the Gautrain stations, urban form in the Gauteng province will be transformed. New population concentrations will create demand for goods and services on a scale that will see the birth of several new cities along the rapid rail route. Modderfontein and Midrand are relative green field areas at present. In the near future these will become highly urbanised as a result of the rapid rail line. New residential and work opportunities, not only in new cities, but in the greater metropolis served by Gautrain, will tend to shorten work trips, to great advantage of those who will seize the opportunity.

Combined with the Gautrain there is enormous current investment in bus

systems and improved road capacity, from urban street to freeway level. The different BRT systems currently being implemented in Gauteng are in line with advanced systems on different continents, such as the East Bay Bus Rapid Transit [6], scheduled to be operational in 2011. Johannesburg's BRT Rea Vaya (we are moving) will comprise some 750 buses operating on 120 kilometres of routes in Phase 1, with 150 bus stations, integrating with Gautrain at Park, Rosebank and Sandton Stations. This and other similar systems in adjacent cities in Gauteng, together with the rail rapid system being injected in their midst, will indeed change travel patterns and the entire urban fabric of the region in years to come. Being fully compliant with the ideals and principles of the national Department of Transport's long-term strategy [7], Gautrain is bound to be a catalyst in bringing about the desired outcomes of the national strategic action plan

Interventions such as the Gautrain Rapid Rail System will hopefully aid in bringing new life and vigour to the Gauteng metropolis that is not only the financial hub of South Africa, but indeed of Africa. It will have to take its place amongst the modern metropolitan regions of the world in years to come, and is on course to be up to the challenge.

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