TRANSPORTATION ENGINEERING

Sustainable transport infrastructure investment: a case study for South Africa
Transport modelling with reference to the Gauteng Freeway Improvement Project
ON THE COVER
Keeping Gautrain spotless! The first ever rapid rail system for Africa and one of the biggest infrastructure projects in South Africa, connecting three of Gauteng’s most vibrant economic metropoles — Ekurhuleni, Johannesburg and Pretoria — is fast becoming a symbol of pride, prosperity and progress for Gauteng and the African continent.

TRANSPORTATION ENGINEERING
Sustainable transport infrastructure investment: a case study for South Africa
Transportation planning, implementation and operation for the 2010 FIFA World Cup
Transport modelling with reference to the Gauteng Freeway Improvement Project
Lagos goes ‘Lite’ with BRT
Some lessons from Lagos
How the bicycle can enhance sustainable transport

MARKET PERSPECTIVE
Banning labour brokers could damage the economy
Is the private sector ready to deal with the service delivery crisis?

IN BRIEF
WSP develops revolutionary financial model for road upgrades
Upgrading National Route 10
Software boosts roads design efficiency
Sabita 2008 Award for Outstanding Achievement in Bituminous Products Technology acknowledges new protocol for cooperation
Free-standing parking structures newly arrived in South Africa
Ultra-thin friction course proves a viable possibility for safety at SA airport runways
Buitengracht pedestrian bridge for 2010
Transnet Freight Rail selects concrete masts for Sishen-Saldanha electrical feeder line
George radar tower gets a lift
Nyeleti celebrates 10 years
Greater capacity within civil engineers’ reach

SAICE AND PROFESSIONAL NEWS
SAICE-DFC Water Competition 2009
Winners — 2009 CESA Glenrand MIB Engineering Excellence Awards
SAICE’s Graham Ross becomes full Member of Sigma Xi
Diarise this!

NOTICES
4th SARF/IRF Regional Conference for Africa
SATC 2010 – Walk Together

ISSN 1021-2000
Gautrain – freedom, convenience and comfort for the upwardly mobile

Gautrain IS CREATING a new and unprecedented legacy in public transport for the people of Gauteng.

Using the best commuter rail technology available in the world today, Gautrain will become the transport mode of choice for the upwardly mobile citizens of Gauteng. Providing an 80 km rapid rail link between three of the province’s most vibrant economic metropoles – Ekurhuleni, Pretoria and Johannesburg – the ‘Golden Train’ will bring jobs to people and people to jobs.

Gautrain has already made a significant impact on socio-economic development in Gauteng. By the end of May 2009, Gautrain had created or sustained an estimated 92 900 direct, indirect and induced jobs of which an estimated 18 200 are local direct jobs. These numbers imply that Gautrain has significantly exceeded its obligations towards targets set for job creation, local skills development and capacity building. In so doing, the project is delivering on its promises to invest in the welfare of its people facing tough times in an economic downturn.

Gautrain has also become a catalyst for a new urban landscape and inner-city rejuvenation, hence properties around Gautrain stations are escalating in value as investors are developing new mixed-use, high-density urban areas. For the citizens of Gauteng, the economic heartbeat of South Africa, Gautrain will also inspire a whole new lifestyle in which people conveniently work, seek entertainment and find places of residence along Gautrain’s route. This new lifestyle will also be enhanced by the fact that Gautrain will be integrated with other forms of public transport.

Relying on a dedicated bus fleet for transport to and from each station, Gautrain will give commuters a world-class service that is safe and on time, every time.

SUMMARY OF GAUTRAIN FEATURES

Safety and security

- Tight security on trains and stations through access control – only ticket holders will be able to access station precincts.
- Electronic surveillance with over 650 Closed-Circuit Television (CCTV) cameras.
- Visible policing.
- Two CCTV cameras per coach will record to an on-board DVD system. While images are stored locally they may also be viewed inside the driver’s cab.
- Two-way passenger emergency communication between alarm units inside the coaches and the driver.
- In the event of an accident, security threat, power failure or other emergency, alarm systems will register at the Operational Control Centre located in the Maintenance Depot for the immediate dispatching of the necessary safety, repair and emergency services. There will be direct communication with all the relevant authorities, such as the South African Police Services and the Gauteng Provincial Disaster Management Centre.

World-class comfort

- 24 Trains will ride on air suspension to ensure smooth travel at 160 kilometres per hour.
- Heating, ventilation and air conditioning will enhance comfort.
- Attractive carpets and upholstery that are durable and easy to clean, and that have been custom-designed for Gautrain.
- Easy access for children, mobility-impaired commuters, shoppers with heavy bags and the elderly. On-level boarding without a height difference or a gap between the train and the platform.
- Each train has a section allocated to wheelchairs. The entire Gautrain system will also accommodate mobility-, sight- and hearing-impaired passengers.
- Cleaning personnel, as well as an automatic train washing plant, will ensure that trains are kept clean inside and out.
Design features at Sandton Station and inside airport coaches will accommodate the needs of passengers who have to carry luggage.

Real-time passenger information
- Passenger information will be displayed inside trains and on stations.
- Bright yellow LEDs fitted to the front of the train will display the destination of each train.
- Two display units inside each train will update passengers on the train’s destination and progress along the route, and will notify them as stations are approached.
- In the unlikely event of delays, train drivers and conductors will be able to broadcast announcements using the train’s public address system.

Convenience
- Only 15 minutes between OR Tambo International Airport Station and Sandton Station.
- Only 42 minutes between Johannesburg Park Station and Hatfield in Pretoria.
- Trains every 12 minutes during peak hours, thereafter a train every 20 minutes.
- Bus service for passengers up to ten kilometres from stations.

Smart ticketing
- State-of-the-art contactless smart cards will enable commuters to load single trips or monthly tickets onto the same credit-card-sized card.
- The same card can be used over and over again without having to buy a new ticket for each journey.
- Commuters will simply hold a smart card near to a Gautrain card reader at all stations, parkades, bus entrances and exits in order for the system to register their journeys.
- Seamless transfers between Gautrain’s bus, train and parking services, with reduced fares for commuters using more than one service within a single journey.
- Smart cards will be available from all Gautrain station ticket offices and ticket vending machines. Retailers will also stock Gautrain smart cards.

High-tech monitoring of trains
- Computerised technology will monitor every component of the rail system, including all stations, trains and the entire fleet of 125 buses dedicated to Gautrain commuters.
- Central control of the system will be managed from the Operational Control Centre situated at the depot near Midrand.
- A fully computerised rail signalling system will be managed from the Operational Control Centre.
- Efficient signalling will prevent train-to-train collisions and ensure safe movements at switches and crossings, while also maintaining safe train headways.
- An automatic train protection system will monitor the speed of the train. Should the driver exceed the posted speed, automatic braking will prevent the train from exceeding the safe limits.
speed limit at any point by more than three kilometres per hour, an alarm will sound in his cab. At more than six kilometres per hour above the posted speed limit the service brakes will automatically be applied to slow the train to below the posted speed limit. The system also has the ability to bring a train safely to a stop in the unlikely event that a driver is incapacitated.

Extensive testing and commissioning, as well as training, is currently being carried out on the test track.

**ATTRACTIVE STATION ARCHITECTURE**

Gautrain’s station architecture represents the gathering places of typical African rural communities who often socialise or take a moment’s rest under a tree along-side one of the paths which connect to neighbouring communities. These trees are usually acacia trees.

Trees symbolise protection and an anchor for a community. Structurally, this is expressed as functional elements and unifying imagery in station architecture:
- ‘tree’ structures representing the acacia tree trunk and branches (station columns)
- ‘wave’ structures representing the umbrella canopy of the acacia (station entrance canopies)

Materials have been chosen to celebrate the wealth of natural materials available in South Africa through colour and texture in visible but inaccessible areas, and to provide a maintenance-friendly, durable, neutral backdrop so that signage is clearly legible.

**THE PRIDE OF AFRICA**

As the first ever rapid rail system for Africa and one of the biggest infrastructure projects in South Africa, Gautrain has become a symbol of pride, prosperity and progress for Gauteng and the African continent.
INTRODUCTION

Q. How does one motivate increased spending on infrastructure at a time when one of the longest periods of sustained growth in recent history has come to an abrupt halt?

A. By understanding that the longevity and economic value of infrastructure greatly transcend any swings in business cycles. Although sharp business downturns can drastically reduce the time horizon of specific investment decisions, it must be kept in mind that infrastructure plays a vital role in sustaining economic growth over the long term. In South Africa Arup has been helping to create a more robust appreciation of the economic role of transport infrastructure and how this can be sustained.

Other countries have responded to this predicament in various ways. In Britain the huge growth in the demand for transport eventually led to the realisation that a major expansion in transport infrastructure might be required, leading to the publication of the comprehensive Eddington Transport Study (2006). This report was innovative in that it sought to widen the scope of quantitative cost/benefit appraisal by developing techniques to place monetary values on factors such as improved efficiency of urban economies, and a wide range of environmental impacts.

In the USA too it was realised that more efficient management of existing facilities could not be the whole solution. Transportation for Tomorrow (2007) mapped out a strategy for responding to the massive growth in transport demand. Interestingly, the commissioners responsible were divided in their response to the situation faced by the USA: although most adopted a more proactive role for the public sector, a minority argued for a similar approach to that of the British to transport, with investment being more directly informed by economic appraisal and with greater private sector involvement.

South Africa has also experienced unprecedented sustained economic growth in the past 12 years. In the first 10 years after 1994 the priorities were, understandably, social infrastructure investment in the health, housing and education sectors. The country was unused to being part of global trends and is now waking up rapidly to the huge implications for telecommunications, electricity generation and transport demand. Just as harsh lessons are being learned in the country’s electricity sector, the South African Government has realised that continued economic growth could be severely constrained if plans are not made for long-term transport infrastructure development. However, it wanted to ensure that this takes place rationally and sustainably. In a nutshell, it wanted to know “what is needed to bring about a sustainable increase in spending on transport infrastructure”.

Arup in Johannesburg was awarded the study in March 2008 and it was completed in August of the same year. The study was partly desk research and partly undertaken...
through two one-day workshops, one for roads and one for rail and ports.

The report contains four main sections: statistics; the history of procurement; cost/benefit aspects; and whether institutional form matters.

**TRANSPORT AND ECONOMIC DEVELOPMENT: DO THE STATISTICS TELL A STORY?**

For at least 40 years economists the world over have studied the role of infrastructure in economic development. The broad consensus from all research is that transport infrastructure facilitates but does not create economic growth or development. But what of the long term? Do impacts vary over time or with different types of transport infrastructure?

Arup drew on some extraordinary statistical work done at the University of the Witwatersrand by Dr Peter Perkins (2003, 2005, 2006), now a senior statistician with Statistics SA. He prepared very long-term time series data sets of investment in transport, power generation and telecommunications infrastructure in South Africa, sourced from early British colonial government official reports, the South African Reserve Bank, Statistics SA, Spoornet, the CSIR, etc., as well as international sources. South African rail data went back to the beginnings of the industry in 1875, ports almost to the turn of the 20th century, and paved roads to the 1920s. These were all placed alongside data for GDP growth. All the values were, of course, based to a common reference year for comparability.

Perkins then conducted statistical tests and found that over the very long term, infrastructure investment does lead, or force, GDP development, thus corroborating the findings of more theoretical work. Comparison of the differing impacts of various transport modes, however, offers more interesting and perhaps controversial insights (see Figures 2–4).

It appears that rail freight transport growth is occasioned by periods of strong economic development rather than being itself the cause of general economic development. Investment is undertaken largely to capture specific trades rather than to seek to generate business speculatively. One policy implication from this is that major investments in new rail network capacity should be considered only if they are linked to a secured high-volume trade, where the economic benefits derive primarily from that trade and not from any wider economic impacts.

In contrast to rail investment, statistics showed the development of paved roads in South Africa to exhibit a long-term “forcing effect” on GDP growth, the evidence across the whole period measured being that investment in paved roads is supportive of general growth in GDP. In more recent years of high growth, road demand has absorbed previously developed capacity, with congestion being the inevitable outcome. The worsening freeway congestion indicates that it would be difficult to...
sustain long-term GDP growth without the further expansion of road transport infrastructure currently taking place.

Clearly, statistics do indeed matter. Perkins himself nevertheless cautions against relying solely on statistically based conclusions in making policy, and advises that investment decisions on which infrastructure to invest in should be supplemented by appropriate cost/benefit analyses. But before examining that subject, a historical question needs to be answered.

**DOES THE HISTORY OF PROCUREMENT APPROACHES MATTER?**

Arup also investigated trends in how transport infrastructure has been procured to see if any general guidelines could be discerned that could inform the development of a more sustainable South African approach.

At the global level cycles of private, then public, then back to private sector procurement can be discerned in both road and rail infrastructure development. The research tracked these cycles and found that an underlying explanation seemed to lie in changing perceptions of who benefits from infrastructure investment, the scale of the benefits, and the timescales over which they manifest themselves. The answers to these questions typically explain who should pay and how.

Almost all rail industries around the world started with private investment. Most moved on to public ownership and investment responsibility, although the past 20 years or so have seen greater emphasis on private investment again. In the roads sector, the cycle appears to have been the reverse.

In South Africa, these cyclic trends are not so clearly discernible, partly because in the long apartheid era the economy became increasingly isolated from international involvement. Rail indeed commenced in the private sector, with companies developing short freight and commuter lines in Durban and Cape Town from 1875 onwards (Figure 5). Inland, in the independent Transvaal Republic, the Zuid-Afrikaansche Spoorweg-Maatschappij (ZASM) privately developed a line from Pretoria and Johannesburg to the Mozambique port of Delagoa Bay (Maputo). Following Britain's 1902 military victory in the Anglo-Boer War, these three railways first fell under military jurisdiction and then were amalgamated into the single South African Railways and Harbours Company in an Act of that name in 1913.

Although owned ultimately by government, the SAR&H was a commercial entity, not a government department. It was mandated to be commercially viable but also to invest in an expanded network to open up the country for mining and agricultural development. The network thus expanded to more or less its current extent by the end of the 1920s, the only significant additions since being the Richards Bay coal line and the Sishen-Saldanha ore line in the 1970s and 1980s (Figure 1).

From the 1920s and 1930s onwards, road and air transport respectively began to emerge as competitors to rail, although the rail sector, increasingly protected by government, continued to grow its business right through until the 1980s (Figure 3) when partial transport deregulation legislation was introduced.

One consequence of this history is that, despite the dramatic loss of business to the roads sector, rail’s institutional heritage of being a custodian of national economic interest persists. This is a major factor preventing the SAR&H’s successor company, Transnet, from embracing some of the private sector involvement options by which railways in other countries have sought to recover a sustainable future for themselves.

Roads procurement in South Africa has gone through a similar cycle to that experienced elsewhere. In the 1930s, national and provincial Roads Boards were constituted with responsibility for funding and procuring the construction of a rapidly expanding roads network. At the time of the transition to democracy in the early 1990s, experiments were underway with private concessions to procure major road developments such as the Maputo Corridor concession. The National Roads Board led this initiative, operating increasingly commercially in its final years before the transition.

These experiences foreshadowed the establishment of a new agency structure at national level, one aim of which was to transfer the burden of national roads funding and maintenance from the public to the private sector. In the decade since its establishment, the South African National Roads Agency Ltd (SANRAL) has been able to move away progressively from
grant funding by central government to self-funding via concessioned and direct toll projects. The current Gauteng Freeway Improvement Project is the latest stage in this evolution (Figure 6).

SANRAL’s good experience with a more commercial approach to roads procurement indicates that, in the right circumstances, private sector involvement in infrastructure procurement should be followed more extensively. The national Department of Transport (DoT) explicitly asked Arup to assess the pros and cons of private sector participation models as part of a more sustainable transport infrastructure funding programme.

In summary, the history of procurement approaches teaches us that unsustainable approaches tend to occur when there is a misalignment between costs incurred and benefits produced. There can be misalignment of scale, when too much is spent for too little gain. This usually occurs after a new transport technology emerges and the previous one cannot offer the same benefits, which is substantially the reason why huge institutional realignment of the rail sector has been needed over the past 20–30 years.

On the other hand, too little may be spent when the potential economic gains are far greater than the financial costs incurred. In South Africa this seems to be the case with the roads programme, where the procurement model only partially captures the scale of benefits estimated by cost benefit appraisal.

Cost/Benefit Analysis Matter?

In the South African context, one main reason for lack of sustainability in infrastructure development is that projects with poor economic prospects are often pursued for perceived social gain, while projects with potentially greater economic benefits are set aside because of perceived disbenefits to targeted groups. Explanations for this include poor appraisal methods, institutional mandates that allow government agencies to judge investment priorities by non-economic criteria, or simply unwillingness to accept appraisal results if they do not appear to support prevailing policy objectives.

Although decisions may ultimately have to be made on the basis of democratic mandates, decision-makers need to be aware of the benefits and costs of their actions. When this is not so, institutionally mandated decisions may be presented publicly as economically beneficial ones, leading to ongoing distortions in infrastructure investment priorities to the detriment of society as a whole.

In the UK, the conundrum of strong public support for railways, but evidence that the social benefits fell far short of the social costs, led the UK Government eventually to the most thorough re-examination of the case for transport infrastructure investment ever undertaken in Britain, namely the Eddington Transport Study (Eddington, 2006).

Eddington used the then current South and West Yorkshire Multi Modal Study to examine whether transport improvements add more value than just savings in travel time and costs for network users. He found that agglomeration, or urban efficiency gains could be measured and these can add a further 30–50% to conventionally calculated benefits. His next contribution to cost/benefit appraisal methodology concerned environmental impacts: he arrived at rationally defendable monetary values for a range of impacts, including global CO2 emissions, local air pollution, noise pollution and others. Eddington then developed four appraisal stages, starting with conventional costs and benefits only, and working up to the inclusion of agglomeration and finally environmental impacts. These were applied to a package of urban and interurban transport projects (both road and rail). The overall conclusions were that benefits remain high for many of these projects, even after the social and environmental costs and benefits have been fully accounted for. Eddington noted further that by excluding expensive rail projects from the appraisal, benefits were yet higher.

The implications of these findings are highly significant for projects in the UK and South Africa. London’s east/west Crossrail and the Gautrain Johannesburg/Pretoria rapid rail link have both faced sceptical responses from the respective treasuries because their conventionally calculated economic cost/benefit ratios are low – between 2:1 and 3:1 – even allowing for social and employment creation benefits. Recognition that the Gautrain might accelerate the already existing trends towards urban concentration and further CBD growth will be a key factor in its becoming a national economic asset.

In the main Eddington report (2006) this finding was couched with typically
British conciseness: “The benefits of transport infrastructure investments will tend to be higher where they occur in support of strongly growing urban centres and on links between points of access to an economy and those urban areas.”

In its report to the South African DoT, Arup therefore recommended that transparent cost/benefit analysis methods be introduced to all transport sectors. This recommendation applied especially to Transnet, the State-owned rail freight and ports utility. At present Transnet is mandated to have a financially sound bottom line, which it has been able to achieve given its sole operator status in both sectors. But it does not apply national economic cost/benefit criteria to its major investments, so there is no way of knowing whether these investments are adding to national economic welfare or not.

So, because South Africa’s overall economic strategy is to achieve “accelerated and shared economic growth”, cost/benefit analysis really does matter.

**DOES INSTITUTIONAL FORM MATTER?**

In the final area of investigation, the question was whether public or private ownership matters as far as effective infrastructure construction and operation are concerned. To answer this, Arup sought assistance from colleagues in London and Singapore. The former contributed a discussion on how highway development and maintenance is managed in the UK, plus an overview of the UK’s rail privatisation experience, while from Singapore research assistance was provided in the form of a case study of the corporatisation of Singapore Port.

The main lesson from the UK was that the key to sustainable highways investment programmes is flexibility in contract form. The question of public or private ownership or management appeared to be less important than seeking the most appropriate institutional mechanism for the job in hand. This entails, among other things, ensuring that implementing agencies have effective managerial as well as technical engineering skills.

The UK’s rail privatisation experience has become a paradigm for industry practitioners in other countries to either loathe or love and the comprehensive review from Arup in the UK offered both positive and negative lessons.

On the positive side it is evident that, for passenger operations, privatisation brought significant benefits to consumers. The competitive franchising model resulted in a multiplicity of operators competing not on the same tracks but within a clearly defined regulatory framework of targets and penalties. The system has been robust enough to survive several franchisee failures. Passenger numbers are at their highest level in history and private investment in new rolling stock has mushroomed (Figure 7).

On the negative side, privatisation of the infrastructure effectively failed due to inadequate knowledge of the condition of the physical asset and hence massive underestimation of the maintenance and renewal costs. The original privatised operator, Railtrack, focused more on share price management than on the technical aspects of the business, so that initially the share price rose as passenger numbers increased. Although from a private business standpoint this was a rational approach to achieving a sound credit rating for future investment funding, the public saw neglect of a public asset for short-term private gain. The Hatfield crash of 17 October 2000, in which four people died and dozens were injured, jolted Railtrack into awareness of its misjudgement of how extensive was the task of maintaining its infrastructure to modern safety standards. Government took Railtrack into administration and, against the regulatory economics evidence, recapitalised it and set it on its way again as the new, not-for-profit (but still notionally private) company, Network Rail.

Perhaps the most important lesson learned is that if a government regards as socially desirable a service that cannot be funded fully by the private sector, then it must take very seriously its responsibility for funding such a service. Taking this responsibility a step further, a government wanting a passenger rail service must ensure that mechanisms are in place to ensure good technical management of the network, as well as effective business management. And ultimately, running a national rail network costs more than could be justified in any commercial business framework. A clear lesson from the UK’s privatisation experiment is that without publicly subsidised infrastructure, the operators could not sustain their side of the bargain.

Key lessons for the sustainability of transport infrastructure investment in South Africa are that every possible effort must be made to understand the true costs of running a rail network. Given the country’s limitations on capital funding, it would be advisable also to identify the most cost-effective elements of the network in terms of selected service criteria, and concentrate available investment on these routes. This is what Arup advised in South Africa’s recent National Passenger Railplan. All routes were ranked in terms of a range of service criteria, leading to a set of priority rail corridors where improvement efforts will now be concentrated.

The case study of Singapore Port was requested specifically by DoT to discern lessons for South Africa’s ports sector. On the surface, the structures of the ports sectors in South Africa and Singapore are very similar. An infrastructure-owning agency also acts as a sort of in-house regulator, and a service provider runs the ports themselves. There the similarity ends, however, because Singapore Port is one of the most efficient in the world, whereas in South Africa’s ports productivity is relatively low, given the technical sophistication of the equipment available, and tariffs are regarded by the shipping industry as far too high.

The key lesson for South Africa in terms of achieving sustainable investment in its
ports infrastructure is that a protected commercial status is ultimately a hobbled commercial status. Singapore was willing to allow real commercial freedom to the Port of Singapore Authority in a manner that forced it to face up to and respond to the real demands of the international shipping industry. For this to happen in South Africa, Transnet’s port operating business will need to be released from its ties to all other elements of the wider Transnet business and be allowed to act as a freely competing private business with the freedom to choose how, and with whom, it will partner in both its port terminal and inland transport dealings.

CONCLUSIONS
Arup’s research suggests that roads investment is more positively correlated with economic growth in South Africa than either rail or ports investment. For any infrastructure, a sustainable increase in transport infrastructure spending will require all investment decisions to be informed by broad-based cost/benefit analysis. Rail investments will yield significant economic value only when focused on bulk commodity projects and on urban rail projects where pre-existing trends of urbanisation and urban economic growth can be demonstrated.

Private sector participation usually brings efficiency of procurement and cost control to transport infrastructure investments, but it needs to be focused on projects that are sound in national economic value terms for a sustainable increase in spend to occur.

Finally, private ownership of infrastructure is not a prerequisite for a sustainable increase in transport infrastructure investment to occur, but this goal will only be achieved in the public sector when public agencies are mandated, with regulatory supervision, to align their infrastructure investment decisions with demonstrated national economic value.

REFERENCES


CREDITS
This is a shortened version of an article that originally appeared in *The Arup Journal*, Vol 43 No 3, pp 34-43, 3/2008, reproduced here by kind permission of Arup Group. Images – Arup Photo Library.
Transportation planning, implementation and operation for the 2010 FIFA World Cup

BACKGROUND
The Transportation Division of SAICE organised symposia in 2007, 2008 and 2009, linked to the annual South African Transport Conference (SATC), at which information on the transportation planning, implementation and operation for the 2010 FIFA World Cup was presented. The presenters included representatives of central and provincial government, the 2010 host cities, as well as other affected parties such as SARCC (now PRASA), ACSA, FIFA/LOC, SANRAL and the Bombela Consortium (Gautrain). The purpose of the symposia was mainly to disseminate information and to improve coordination between the role players. Contact was made with the Parliamentary Portfolio Committee on Transport and in both 2007 and 2008, a representative from this Committee opened the symposia. In 2007, a presentation was made to the Portfolio Committee. The 2009 symposium was held on 9 July 2009, i.e. after the completion of the Confederations Cup, and substantial feedback from this event was provided.

The purpose of this article is to:

- provide a summary of the status quo on transportation planning, implementation and operation for the 2010 FIFA World Cup
- provide a summary of the most important lessons learnt during the 2009 Confederations Cup and make recommendations based on these lessons
- assess the potential transport risks for 2010 which were not tested during the Confederations Cup
- suggest appropriate actions for the way forward

STATUS QUO
Since the first planning work done by the national Department of Transport (DoT) in 2007, referred to as the Initial National Transport Operational Plan (IN TOP – Draft September 2007), most, if not all, of the nine host cities have completed Host City Transport Operations Plans (HCTOPs) and submitted them to the DoT. Some of the provinces have also completed Provincial Transport Operations Plans (PTOPs). Interaction between the DoT, the provinces, the host cities and FIFA/LOC on transport planning for 2010 has been taking place on an ad hoc basis since 2007. At present this interaction is more frequent and formal.

It is believed that the focus during the first part of 2009 was largely on the preparations for the Confederations Cup and therefore involved only the four Confederations Cup host cities. Official debriefing regarding the Confederations Cup experience has been done by the DoT and FIFA/LOC and all host cities attended. In August 2009 the DoT again convened the 2010 Land Transport Task Team (LTTT), whose purpose is to provide a forum for coordination between the Department and the host cities.

LESSONS LEARNT FROM THE 2009 CONFEDERATIONS CUP
The lessons summarised here are based largely on the presentations delivered at the symposium on 9 July 2009 dealing with the 2009 Confederations Cup experience. Possible actions for the nine months remaining until the 2010 FIFA World Cup have also been identified.

Manpower (human resources)
Lessons
In general, a lack of trained manpower was experienced on various levels:
- Volunteers did not have adequate training and had unrealistic expectations.
- Drivers did not know the road network and got lost.

Proposed actions
Training needs to be improved. An adequate budget should be made available for this. Mature people need to be appointed as volunteers, preferably by December 2009, to allow adequate time
for training. There is a role for GPS assistance for drivers.

Coordination/integration between organisations

Lessons
In general, coordination between the security organisations (SAPS, traffic police and other emergency services) and the transport organisations was poor, resulting in transport planning being abandoned at the last moment (in places).

Also, coordination between transport managers on the national, provincial and local levels was lacking, resulting in mixed or confusing messages being sent out to the public.

Proposed actions
Preparations for 2010 must be coordinated better. Transport plans must be discussed and approved by the security organisations. Security representatives must be part of the transport planning process. The transport function must be represented in control centres.

Transport planners must ensure that all levels of government are informed and know where they fit into the plans. This also applies to PRASA, ACSA, the minibus taxi industry, bus companies, etc.

Communication with the public

Lessons
Changing transportation plans and communicating them poorly to the public can be disastrous.

Proposed actions
The preparation of coherent Z-maps, and coordinated communication through the radio, TV and press must be achieved. Communication protocols must be in place.

Managing operations

Lessons
It was clear that provision of infrastructure alone will not deliver a successful event and that proper management of operations is essential.

Due to inadequate communication protocols and lack of CCTV coverage at places, it was difficult to monitor reported incidents.

Proper signage is key in directing spectators, and although this was good at some places, it was lacking in other areas.

The most severe pressure on the transport system occurs after the final whistle, and post-match activities can assist in alleviating this pressure. Vehicle loading techniques were also poor.

There was a lack of sheltered waiting areas. Spectators do not appreciate being cold and wet.

Unofficial parking of private vehicles in restricted areas occurred and caused serious problems and delays.

Charging for shuttle services to and from park-and-ride sites was found to be ineffective and was quickly abandoned.

Negotiations with FIFA/LOC were poor.

Proposed actions
Responsibility matrices have been prepared, but it has to be ensured that 100% buy-in is achieved. All personnel need to know where they fit in and what their responsibilities are, and then they must accept these responsibilities. It must be ensured that positions are filled by adequately trained people. Funding has to be secured for the execution of the operational plan.

On host city level, regular meetings or workshops between all role players are required in the next nine months. On the national level, the same is required.

Communication protocols between different organisations must be clearly defined beforehand. Transportation managers must have access to CCTV images. Adequate CCTV coverage should be available.

Coordination between organisations (government departments and FIFA/LOC) with respect to signage must be achieved.

Where feasible, post-match activities should be investigated. Improved vehicle loading techniques must be established.

Protection against the elements should be provided wherever possible; this is particularly important for Cape Town and Port Elizabeth.

Parking of private vehicles must be planned and controlled effectively – road closures must be enforced.

Shuttle services should be provided free to spectators. Payment to contractors for these services must be further investigated and could be negotiated with FIFA/LOC.

Firmer negotiations with FIFA/LOC are required in good time to ensure effective and implementable plans.

Use of public vs private transport

Lessons
Minibus-taxis were employed as a mass mover of spectators, but proved not to be well suited for this purpose. Trains were provided in places, but were poorly used.

Park-and-ride facilities were generally well supported by the public, although servicing of the sites was inadequate at places. The balance between the use of private and public transport is questioned but will vary between venues.

Proposed actions
Minibus-taxis should not be employed as a mass mover. They should be used in areas of lower demand. The availability of the train service should be marketed/communicated better.

Servicing of park-and-ride facilities needs to be properly planned. Loading areas and techniques should be tested and fine-tuned. Park-and-walk is an excellent option where feasible.

Security

Lessons
Adequate lighting was not provided along walking routes – from or to park-and-ride sites, stations, etc.

The SAPS presence was good but can be further improved.

Proposed actions
More attention must be given to lighting levels, and routes must be checked beforehand. Temporary lighting should be installed where necessary. As a general rule, this should include all access roads around the stadiums where pedestrians will walk and where loading and off-loading of passengers will occur. This is critical to improve spectator safety and security.

The presence of SAPS personnel at park-and-ride sites, pick-up points and along pedestrian routes is crucial.

FURTHER ISSUES FOR 2010

Over and above the lessons learned from the Confederations Cup for the local management of transport, the following are considered critical issues for 2010:

Transport information to international visitors:
The DoT’s website (www.transport.gov.za/findyourway) has reasonably good information. This is likely to be the first point of access to transport information for most foreign visitors in 2010. This website needs to be updated, marketed, linked to host city websites and actively monitored.
Other communication: Apart from the websites, other channels of communication to international visitors must be prepared, updated and made available at ports of entry – printed media, adverts, etc.

Regional transport: This was tested only to a limited extent during the Confederations Cup and transport demand patterns are expected to be dramatically different in 2010. The buses that the DoT has acquired need to be made operational and the operational plan will have to be evaluated. The extreme demands expected on the airlines and ACSA also have to be evaluated.

Regular coordination: Regular meetings (probably monthly) are required at which the host cities’ progress can be evaluated and coordination on all levels pursued. The same applies to regional transport.

Testing of readiness: Host cities need to develop methods for simulating or testing the operational readiness of their venues and all other transportation elements (airport, bus/taxi terminals, stations, etc.). Checklists have been developed by the DoT but these need to be expanded and a roll-out plan must be developed. Such plans need to be quite detailed and should address the different stages before and after each game – “where, when and what actions must happen”.

Contingency plans: A set of “what if” scenarios (transport-related) must be developed and each host city and the regional transport need to be tested against these scenarios for robustness of the plans to ensure suitability and to develop alternative plans if necessary.

Verify demand estimates: The demand estimates used in planning up to now need to be verified constantly. As tickets are being bought (especially by foreigners) and accommodation booked, the information must be made available and the existing models adjusted if necessary.

Location of accommodation: Accommodation was highlighted as an issue. From a transportation viewpoint, the location of the major accommodation nodes and facilities needs to be confirmed. Accommodation that is two to three hours away from match venues will increase the demand for regional travel.

CONCLUSION
In conclusion, it should be said that although the score of 7.5 given by FIFA President Sepp Blatter for South Africa’s performance during the Confederations Cup is neither too bad nor too good, the experience in 2010 can be much better if the transportation-related lessons learnt are noted and acted upon. The information provided above represents the feedback from the Confederations Cup host cities. It implies that the 2010 efforts should be well resourced, well funded, well rehearsed and well tested, and that adequate attention should be given to detail. The different organisations involved with transportation in 2010 have an enormous responsibility in making the 2010 FIFA World Cup a resounding success for South Africa.
Transport modelling with reference to the 
Gauteng Freeway Improvement Project

**INTRODUCTION**

Road infrastructure construction costs have spiralled over the past decade and the ability of the road authorities to secure funding for road network expansion has become increasingly difficult. Road authorities either have to prioritise improvement schemes and determine what can be done with the available funds and/or find the means to fund road improvement schemes. The Gauteng Freeway Improvement Project (GFIP) currently being implemented by the South African National Roads Agency Limited (SANRAL) falls into the latter category. Transport models were used extensively for making decisions on what should be constructed and the affordability of the options.

This article describes the various transportation/traffic model types and their uses. Some of the more important elements in the development and use of a strategic transport model are explained, with reference to the GFIP work.

**WHAT ARE TRANSPORT/TRAFFIC MODELS?**

According to the Oxford Dictionary (1976), a model is "a simplified description of a system, etc. to assist calculations and predictions". Despite all the technology and research available to us today and the packaging of this knowledge into the various transport/traffic modelling suites, a traffic/transport model is still a simplified description of the dynamics of a transport system considering the complexity of the multitude of individual trips made. Nevertheless, these models are the tools that are used to capture as much information as possible about current transport trends and the data are used to assist in calculating and predicting the "what ifs".

**LEVELS OF TRANSPORT/TRAFFIC MODELS**

The various transport and traffic models have been developed to fulfil different purposes. Each type requires a different level of information, from generalised costs and distribution functions in strategic models to reaction times and decision points in micro simulation models. The models will now be described briefly.

**Strategic (macro) models**

Strategic models are developed for large areas, using the classical four-step transport process:

- trip generation
- distribution
- modal split
- assignment

These models are link-based, i.e. they take congestion into account but not the effects of intersections. Where possible, they should form the basis of more detailed modelling work since they provide a wider area perspective of transport-related interventions, i.e. land-use development and major road improvement schemes. However, these models do not contain all roads in the network and are often limited to Class 1, 2 and 3 roads in very large areas. A strategic model was the basis for the GFIP modelling work and provided input into more detailed models.

**Simulation (meso) models**

The simulation model is a more detailed level within which the operations of intersections can be examined. The areas modelled are generally smaller: for example, an area the size of the Johannesburg CBD may be examined with a large simulation model whereas a small model would be used to examine a few intersections in a small network or corridor. These models include intersection lane configuration and, in some cases, traffic signal optimisation.

**Micro simulation models**

Micro simulation models are designed to visually demonstrate how traffic would flow through a system by depicting the interaction between individual vehicles while travelling through a road network. This provides a means to examine the interaction of traffic and its likely reaction to changes in the road network being modelled. These models have very good graphic capabilities.
INTERACTION BETWEEN MODEL LEVELS
The interaction between a strategic model, a simulation model and a micro simulation model is very useful if known major road improvements are expected to change traffic patterns in and through a local study area. Although it is possible, it is not advisable to combine link-based (strategic) and simulation models.

In the GFIP work, output from the strategic model was passed on to the various design consultants as input into meso and micro models. The strategic-level output included base year submodel comprising sections of freeways and trip matrices of light and heavy vehicles entering and leaving the various interchanges. This approach ensured that the trips entering and leaving at each section’s “ends” corresponded to the information provided for the next section. The strategic model also provided trip matrix forecasts based on predicted changes in land use and initial estimates of the effect of freeway improvements and of course the impact of applying tolls.

STRATEGIC MODEL DEVELOPMENT
The development of a strategic model can either be done from scratch or be based on a model that has already been developed. The use of an existing model for large areas saves a significant amount of time and money. Models can be converted between packages, provided that the modeller understands the processes in both modelling packages and is able to replicate the necessary parameters so that the output in the “translated” model is closely matched to the original model.

The processes used in the development of the GFIP model included:

- Choice of the base model
- Data collection
- Updating and calibration of the modelled road network
- Calibration of trip generation rates
- Calibration of distribution functions
- Choice of assignment algorithm
- Calibration of the base year
- Trip matrices
- Development of model forecasts

Choice of base model
Over the past few decades, strategic transportation models have been developed for most of the metropolitan areas and the PWV (Gauteng) as a region. Due to the time constraints for the development of the GFIP model, it was necessary to use as much previous work as possible. The strategic transport models evaluated for use as the basis of the GFIP model were:

- The Gauteng Transport Study of 2000 (GTS2000), Gauteng provincial model
- The Super Highways model, which was a modification of the GTS2000 developed to test the possibility of tolling provincial roads in the province
- A combination of the more detailed City of Johannesburg (CoJ) and City of Tshwane (CoT) transport models

The GTS2000 model was the preferred choice owing to the following main advantages:

- It contained the required network coverage and detail.
- The land use information has been updated over the years and is in a format that corresponded to the model’s zone systems.
- The trip distribution functions had been based on household survey data.
- All processes had been documented.

The GTS2000 model was, however, an Emme/2 model and the GFIP model was to be developed using the SATURN suite (Van Vliet, 2008). This entailed a conversion process. In addition, the GTS2000 was calibrated to a 2002 base year and did not specifically model heavy vehicles.

Data collection
A significant amount of information was contained within the GTS2000 model. In order to update this model to reflect the base year (2006) traffic conditions, the following data requirements were identified to calibrate the model:

- A comprehensive set of travel times on the freeways and provincial “alternative” routes in order to calibrate the modelled road network
- A comprehensive set of traffic counts collated from previously acquired data sets and from traffic count surveys undertaken to augment the data set (a significant amount of time was spent ensuring that the traffic count data base was “balanced” for the GFIP model)
- Updated land use obtained from town planners reflecting the base year situation, including residential units by income group, employment by category and floor area for retail

The development of a strategic model can either be done from scratch or be based on a model that has already been developed. The use of an existing model for large areas saves a significant amount of time and money. Models can be converted between packages, provided that the modeller understands the processes in both modelling packages and is able to replicate the necessary parameters so that the output in the “translated” model is closely matched to the original model.
in industrial development (forecasts were obtained for the 2010, 2015, 2025 and 2035 design years)

**Network development and calibration**

The GTS2000 Emme/2 model was converted into SATURN format (Figure 1). Most of this process is relatively straightforward since the same information is used in both models, albeit in different formats. The GFIP model network comprises 899 zones, 8 136 nodes and 20 670 links. An important aspect of the conversion process was the replication of the volume delay functions so that the traffic speeds are similarly influenced by traffic volumes.

An extremely important element of the development of any model is to ensure that the network is represented as accurately as possible. This entails a thorough audit of the network. In the conversion of networks from Emme/2 to SATURN, it was found that the SATURN software is more "strict" when it comes to network logic checks and some network errors are highlighted and rectified.

The conversion of the volume delay functions involves determining the SATURN function parameters that produce the same volume delay curves as the Emme/2 functions. This process is relatively straightforward as shown in the comparison of the two curves in Figure 2, but one must ensure that the functions are applicable to the actual on-street traffic characteristics.

Calibration of the model network also entails a thorough check of the "shortest" or "preferred" routes between origin and destination pairs. This was achieved by plotting a series of routes or "forests" from selected zones to all other zones (see example in Figure 3).

In the GFIP model, the volume delay functions were calibrated to match the journey time survey results to an acceptable level of accuracy. This is not a straightforward process since the first step is to ensure that the modelled journey times reflect representative traffic volumes. To accomplish this, a trip matrix was created using matrix estimation based purely on the traffic counts. This process may irreparably alter the trip distribution within the matrix but...
can match link volumes reasonably well. The resultant trip matrix was therefore used in the calibration of the volume delay functions and then discarded. The emphasis in this work was to optimise the volume delay functions necessary to represent the different road capacities, free-flow speeds, the rate of speed deterioration that best represents roads that are also impacted by gradients, interchange merges and weaving, etc. Figure 4 shows the calibration results of 1 of the 66 routes that were surveyed and modelled in the GFiP model. The graphs depict the correlation between the modelled and measured journey times in each direction on the N1 freeway between the Buccleuch and Diepkloof N12 interchanges. Both directions are modelled with the same volume-delay function, yet the different traffic volumes in each direction result in representative speeds and therefore journey times being modelled.

These results show that the major road network in the model “reacts” well in terms of calculated speed based on traffic volumes. With this result, together with logical routing through the network, the modelled network was deemed fit for use.

**Calibration of trip generation rates**

The trip generation rates commonly used for traffic impact studies (DoT, 1995) are based on entry/exit counts. In a strategic traffic model, traffic zones should be homogeneous land-use types, but this is seldom the case, mainly because of the size of the zones. As a result it can be expected that the trips generated from/to large zones would be significantly lower than the sum of those measured at the “gates” of all of the developments within the zone. The main reasons for this would be:

- The larger the zone containing mixed land uses, the higher the probability of intra-zonal trips, thus reducing the number of trips entering/leaving the zone.
- The commonly used trip generation rates were documented in 1995. It is estimated that the morning and evening peaks have been spreading by 10 to 15 minutes per year. Therefore what used to happen in the peak hour now happens in 2 to 2.5 hours. Considering that the model is based on a single hour, the modelled peak hour’s generated trips are a fraction of the DoT manual’s figures due to peak spreading.

Through an iterative process that consisted of adjusting the trip generation rates, trip distribution function and trip matrices in the GFiP model, it was found that the average trip generation rates entering the road network from the zones was 37% of those calculated using the recommended rates as provided in the SA Trip Generation Rate Manual (DoT, 1995).

**Calibration of distribution functions**

The semantics involved in the description of the trip distribution function can be quite diverse. Essentially, it is a function that describes the probability of a trip being made in relation to the distance or cost associated with making that trip. From a loaded modelled network, the generalised cost of travel between all origin-destination (OD) pairs is calculated and by then applying the distribution function to these costs, the probability of trips being made between the OD pairs is calculated. These probabilities are then factored up to the zone’s trip ends (generations and attractions) to produce the initial base year trip matrix.

In the GFiP model, the initial distribution function was based on those developed for the GTS2000 model. However, no such work has been done in relation to the movement of heavy vehicles, which have been previously assumed to be a proportion of...
the total vehicle matrix. This is fundamentally wrong as trucks do not “commute” from residential areas. In the GFIP model, the heavy vehicle matrix was derived from the land-use data pertaining to industrial and retail floor area, as well as employment data. Due to the spatial distribution of industrial zones, a distribution function that produced a longer average trip length than for private vehicles was selected. The total number of heavy vehicle trips was assumed to be equal to the same proportion of heavy vehicles in the traffic counts on the freeways. The heavy vehicle trip ends were distributed among the traffic zones in proportion to the size of the industrial and retail components in each zone.

**Calibration of the base year trip matrices**

The calibration of the base year trip matrices required iterations between the above processes and only then were the matrices adjusted based on observed traffic counts where necessary. This should be the last step in the process and used to make relatively small “final” adjustments to the trip matrices. This process is heavily reliant on the calibrated network and making sure, as far as possible, that the correct trips between OD pairs pass through the count locations, i.e. the trip routing is logical. If this is not the case, matrix estimation using traffic counts can have a detrimental effect on the trip distribution in the trip matrices. If multi-user trip matrices are used, i.e. light and heavy user classes, then multi-user class matrix estimation is required. The degree of calibration of a model is often measured by comparing the counts and modelled link flows using the GEH statistic and the $R^2$ value.

In the GFIP model development, prior to using matrix estimation based on counts, the model was displaying $R^2$ values above 80%. An assessment of some of the outliers revealed that most of these resulted from the position of zone connectors in relation to a traffic count. Matrix estimation based on traffic counts was therefore used to make relatively slight adjustments to areas of the model where the assigned volumes did not match the counts to an acceptable degree of accuracy due to zone connectors, land-use variations or insufficient network detail.

**MODEL VALIDATION**

Model validation is used to test the robustness of the model. This involves comparing model outputs with data that was not used in the calibration process. An option here would be not to use approximately 20% of the traffic counts in the calibration process and to compare the calibrated assigned volumes with these counts to validate the model. In the GFIP model, counts on various sections of freeway were excluded from the calibration process and use for validation purposes.

**CHOICE OF ASSIGNMENT ALGORITHM**

The assignment algorithm commonly used in modelling packages is the equilibrium assignment. This method assumes that trips would distribute themselves on alternative routes in such a way that the cost of travel is the same on all paths used between an origin and a destination. An alternative method is a stochastic assignment algorithm by which trips are assigned only to routes that are within a specified range of the minimum perceived cost between OD pairs (Van Vliet, 2008). The distribution of trips between these routes is based on a distribution function (such as a normal distribution) as specified by the modeller.

Another option is an elastic assignment algorithm which allows the user to define a rate (or factor) that is applied to the “current” cost of travel between OD pairs and defines “acceptable” travel costs. When the demand trip matrix for the design year is assigned, trips between OD pairs that would have been higher than the “acceptable” trip costs are reduced on the basis that the balance would not travel during the peak hour or would use an alternative mode of transport. The result is the creation of a “supply” trip matrix from the demand matrix. An advantage of this algorithm is that it results in more realistic link volumes in the design year forecasts, yet the latent demand is retained in the model so that if the network is improved and the travel costs reduce, more of the demand matrix can be assigned to the network in the modelled hour.

An important output required from the GFIP model was that it should estimate toll revenue from various freeway improvement schemes and toll strategies. As the base year traffic volumes were known, the daily flow profiles enabled annual traffic volumes to be estimated. This could then be repeated using the forecast traffic volumes. If, for the design years, only a portion of the demand matrix were to be assigned (as would be the case when using the elastic assignment algorithm), the change in the daily flow profiles would make it very difficult to convert the resultant modelled hourly flows into annual flows.

**DEVELOPMENT OF MODEL FORECASTS**

The main point of developing a model is to test “what if’s”, in particular what will happen at some future date when some or other road network improvement has been implemented. Traffic growth can be based on an estimated annual growth in demand, which is applied by factoring up an entire matrix. However, with this approach the trip end growth is the same for a fully developed, densely populated area with no room to grow and an agricultural area that currently generates few trips but may be developed into residential estates in the near future. The preferred method for large strategic models is therefore to update the matrix in accordance with predicted changes in land use and the distribution functions (a gravity model).

In the GFIP work, the pre-“matrix estimation” assignments were relatively acceptable and the matrix adjustments based on counts were relatively minor.

When forecasting, some parameters are assumed to be fixed with time, e.g. the trip cost distribution function. This does not mean that one can simply use the design year land-use data to calculate new trip ends and then apply the probability matrix used to derive the base year “prior” matrix to determine the design year matrix. This would not take into account the “model quirks” ironed out in the final calibration of the base year model. It also does not necessarily mean that one can apply the new trip ends and factor up the base year matrix, since changes to the network in certain areas would change the trip probability matrix.

In the GFIP modelling work the base year trip cost distribution function was used to derive the trip probability matrix for the various phases of network upgrades. The future trip ends from the predicted land use were used to factor up the probability matrix (so far the same process as for the base year prior matrix). The design year matrices were therefore calculated by subtracting the future matrix, calculated from the probability distribution matrix, from the equivalent base...
year “prior” matrix (determined by the same processes) and adding these changes to the calibrated base year matrix. This method “retained” changes in the final step of the base year calibration process, i.e. the small adjustments made for the “quirks” in the model.

CONCLUSION
The development of the GFiP strategic traffic model was a challenge due to the time constraints. This made it essential to draw on the work that had been undertaken by other engineers to develop regional strategic models. Having access to these models and to updated traffic and land-use data made it possible to produce a reliable and robust strategic traffic model. This was used to test the various road upgrading schemes for a number of design years.

It was found vital to spend time coding and checking the modelled road network, including the calibration of the speed-flow relationships. This is not a straightforward task considering the size of the model, but persistent use of logic and of the modelling suites’ network analysis tools proved well worth the effort and time.

ACKNOWLEDGEMENTS
The author wishes to thank the following organisations that were integral in the GFiP project:
SANRAL for the opportunity to undertake the modelling work and the support given throughout the project and for permission to publish this article.
Goba (Pty) Ltd in joint venture with Tolplan (Pty) Ltd, the consultants appointed to undertake the strategic modelling work for the entire project, as well as the detailed design of various sections of the current freeway upgrades.

REFERENCES
Lagos goes ‘Lite’ with BRT

Lagos, the commercial capital of Nigeria, recently became the first city in Africa to implement a Bus Rapid Transit (BRT) system. Termed a “BRT Lite” because of its more limited scope and design standards compared with full-specification BRTs (such as the touchstone, Bogota’s TransMilenio), the Lagos system provides an opportunity for South Africans involved in planning and deploying BRT systems to take note of what has worked (and what has not) in African conditions. Key characteristics of the system are described here.

DESIGN AND CONSTRUCTION
The BRT Lite, opened in March 2008, consists of a single line 22 km long through one of the most congested corridors in the city. The route follows a dual-carriageway radial highway between Mile 12 and Lagos Island (the traditional CBD). The bus lanes are separated from other traffic by kerb-stones 400 mm high along two-thirds of their length and by road markings along another 20%, with the remainder being operated in mixed traffic.

By implementing a single corridor with a wide available right of way, system planners were able to collapse the implementation period, from conception to operation, to a mere 15 months. Delivery cost came in at US$1,7 million (about R12 million) per km, less than the US$2,5 to 3 million typically cited for South American systems. Stations are constructed to a lower design standard than the fully enclosed stations planned for South Africa and do not offer step-free boarding (see Figure 1), but do prioritise orderly passenger boarding which is evidently a problem in Nigeria.

OPERATIONS
Altogether 260 buses operate local and express services along the corridor, seven days a week. Amazingly, the service does not run according to a timetable: headways are so low (typically between 30 and 60 seconds) that vehicles are simply dispatched as fast as possible. During peak periods, passenger waiting times may approach 15 minutes, falling to near zero in the off-peak periods. The commercial speed varies between 25 and 30 km/h depending on the direction.

INVolVEMENT OF PRIVATE SECTOR
The Lagos Metropolitan Area Transport Authority (LAMATA) was created in 2002 to plan and implement the BRT (and other transport projects) in Lagos. Authorities used the BRT project as an opportunity to formalise and upgrade parts of the formerly self-regulating minibus and midibus industry, which is plagued by low service quality and severe on-the-road competition.

The BRT Lite service is operated under a franchise agreement by a newly created cooperative, comprising officials and owners from the National Union of Road Transport Workers (the equivalent of our taxi mother bodies). The cooperative is responsible for procuring and maintaining...
buses, operating depots and buses, and managing staff. It initially procured 100 standard high-floor buses with commercial loans, but demand for the service was so high that 120 additional buses needed to be procured at speed by a state-owned company and leased to the operator.

Resistance from existing operators was reduced by the decision not to remove parallel informal services, but merely to restrict them to operating on the service roads – a choice made considerably easier by the fact that the high-volume corridor needs the capacity of both services to satisfy demand. Fares are pre-collected by the banks which (through private ticket vendors) act as ticket distributors and security monitors. The banks thus ensure loan repayment by having the initial lien on revenues, with only the balance being passed through to the operator and LAMATA. No operating subsidies are paid. An effective organisational innovation is the acceptance by all operators of collective liability for the obligations they have entered into. Any individual default, such as vehicle unavailability or revenue siphoning, triggers a penalty against all members – promoting individual compliance through group pressure.

Ridership

In January 2009 the BRT Lite was carrying almost 200,000 passengers per weekday, exceeding volumes on many BRT systems in South America. This represents about a quarter of all trips made along the corridor. About 85% of BRT passengers switched from informal minibuses and about 4% from cars. Passengers benefit through significantly reduced travel times (especially for longer trips), gains in reliability and, for some, reduced and more predictable fares. Interestingly, congestion has decreased even for parallel operators on the service roads due to the partial rehabilitation of the roads and intersections.

Prognosis

Operational problems related to insufficient capacity, low-speed sections and vehicle maintenance seem to stem from the system’s popularity as much as from design issues. LAMATA considers the BRT Lite to be a huge success and is currently planning for its expansion, as well as for the introduction of other higher-capacity modes to Lagos.

NOTE

This article is based on information provided by Mr Gbenga Dairo, Technical Advisor, LAMATA, Lagos.

| Table 1 Lagos chose from a range of BRT options; those highlighted seemed to fit local realities best within deliverability constraints (Source: Evaluation and documentation of Lagos BRT-Lite, LAMATA, 2009) |
|-----------------|-----------------|-----------------|-----------------|
| **Components**  | **Stage I**     | **Stage II**    | **Stage III**   |
| Running Ways    | Shared lanes in mixed traffic/some preferential treatment | Designated lanes/HOV lanes/queue jumper segments | Dedicated lanes and segregated facilities |
| Stations        | Improved shelter, signage and amenities | Additional passenger information, safety and security amenities | Enhanced station services and fare collection |
| Vehicles        | Exterior aesthetic and ride/comfort features | Improved boarding accessibility and information features | Diversified vehicle sizes, materials, capacities |
| Service         | Improved service frequency and reliability | Extended stop distances, skip-stop and express services | Regional co-ordination, high frequency and reliability |
| Route Structure | Single route with transfer connections | Multiple route operations with transfer facilities and unique identity | Integration with regional network/direct transfer options |
| Fare Collection | Increase pre-paid fare sales | Introduce proof of payment fare systems | Utilise electronic fare collection system |
| ITS             | Signal preference enhancements to improve travel time and schedule adherence | Passenger information to increase convenience and ridership | Docking enhancements to reduce boarding times |
|                 |                  |                  | Vehicle location and surveillance to improve system coordination and safety/security |

1 Stops are low platform but boarding is speeded up by the provision for orderly passenger queuing; tickets are bought before entering the stop and cancelled by bus staff once on board the vehicle.

2 Along approximately 60% of its BRT Lite corridor, Lagos located bus lanes and stops in a secondary median between the main carriageway and service roads.
Some lessons from Lagos

In June 2009 the City of Tshwane’s BRT Project Office hosted a World Bank-led workshop on public transport restructuring. A highlight was the presentations made by colleagues from Nigeria on their experiences with implementing the “BRT Lite” system in Lagos. Listening to the enthusiastic endorsement of the system by the public transport union representatives – the people who turned from operating old, inefficient and poorly regulated minibuses and midibuses to being keen participants in introducing a new concept – it struck me that we in South Africa, busily driving our own BRT schemes, might sit up and take notice of a few things:

- **The BRT scheme was fitted to local needs and conditions.** While retaining the essence of international BRT practice, planners in Lagos designed components to match local constraints (see Table 1 on page 24). Some elements, such as the lack of median lanes and open stations, have been criticised for deviating from what is generally considered “best practice”, but this is exactly the point: system designers were not afraid to re-think the BRT concept to match local needs. The focus seems to have been more on deliverability and getting buy-in from all stakeholders than on perfect design. This implied, in some cases, “designing down” from leading examples, but resulted in a working system that can be incrementally improved. For example, the fare system is paper-based, requiring no advanced electronics, but implemented in such a way as to control revenue flows strictly and to limit risk. Similarly, the decision not to remove parallel informal transport services, or simultaneously reorganise feeder services, helped considerably to secure community and political support without negatively affecting the inherent superiority of BRT operations.

- **Planners spent a lot of time developing partnerships** with incumbent operators and other constituencies. Sure, history and conditions vary, and the BRT Lite scheme did not come with the acrimonious baggage of nationwide transformation of the informal public transport industry. But the city seemed to recognise that extra effort was needed to build trust through a long process of talking and listening. Deviating from the top-down processes followed in cities such as Bogota, where tendering concerns caused system planning to occur entirely without the input of future operators, Lagos authorities workshoped design and operational decisions with incumbent operators over a period of months. Union bosses agreed early on, with input from Lamata, on the need to change their business model in order to become more efficient and sustainable. Lamata talks about the principle of “developing engagement from receiving and not giving information”. J O Spencer, a key union official of the 1st BRT Co-Operative Society Ltd, says the city “realised and appreciated the progressive contributions and input [provided] by the Union leaders at meetings.” The result is that the operators now display a strong sense of ownership of the BRT system, which augurs well for its sustainability and growth. Lamata also reports extensive community outreach, during which the BRT Lite was explained and adopted as “a means of solving their problems, not those identified by others, and without imposing alien solutions upon users”. Significant effort went into publicity, including television and print media advertising, community meetings and mobilisation of key community supporters. By situating the BRT as a “community project created, owned and used by Lagosians,” operators were probably pushed to overcome their short-term fears in the public interest.

- **Strong public organisational capacity was established** through the creation of a public agency specifically tasked with implementing the BRT and also with delivering progressively improved public transport across the city. Most successful BRT systems have in common the presence of a strong, dedicated public agency that takes responsibility for specifying and maintaining service standards and sustainability. Its value has also been proved here in Africa. Lamata is well staffed (interestingly, drawing on the expertise of returned Nigerians who had worked abroad), has dedicated funding, a clear mission and the necessary regulatory powers to implement what it plans.
How the bicycle can enhance sustainable transport

INTRODUCTION
With consistent economic and population growth since the 1960s, urban sprawl has taken on massive proportions aided by the attraction of rural people to possible employment opportunities in towns and cities. Expansion of residential areas has been mainly by single-story dwellings which complicates both public transport (rail, bus, taxi, etc) and private transport (motor vehicles, motor bikes, bicycles, walking, etc).

It is high time that all modes of transport be considered when offering passenger transport by integrating whichever modes are appropriate for a specific location. This will require renewed thinking, especially by mass transport operators.

This article explores how one of mankind’s greatest inventions, the bicycle, can contribute to making passenger transport more sustainable.

WHY THE BICYCLE?
The bicycle has many attributes for short-distance mobility:
- Affordability. The purchase of a new or used bicycle is within the reach of most South Africans.
- Low running cost. The bicycle is the most efficient mode of transport with regard to energy requirements.
- Cleanliness. The bicycle does not pollute the air and is noiseless.
- Health. The bicycle offers excellent exercise and therefore a healthy pastime.
- Congestion. The more cyclists there are in an urban area, the less congestion there is due to the lower space requirements of cyclists and fewer motor vehicles.

There are, however, a few disadvantages related to cycling:
- Vulnerability. Despite South African law defining both bicycles and motor vehicles as “vehicles”, the bicycle is the more vulnerable when sharing the same road space.
- Weather. Wind, and especially rain, are not pleasant factors for the cyclist, but can be overcome with proper clothing. The bottom line is that safe facilities should be created for bicycles so that this mode can be integrated with passenger transport.

HOW TO INTEGRATE THE BICYCLE INTO PASSENGER TRANSPORT
Since more bicycles are sold in South Africa than motor vehicles, the logic of integrating the bicycle into passenger transport should not be questioned. For trips of 10 km or less the bicycle is an ideal mode of travel provided the travelled way contains safe facilities for cycling, namely well-designed, continuous cycle paths for a door-to-door trip.

When a commuting trip has to be combined with mass transit, the measures indicated in Table 1 have to be considered.

The “Method of integration” in Table 1 needs some explanation:
- The term “Safe routes” comes up in all columns because safe riding facilities are paramount for any of the
feeder routes to the main modes of transport. Without the implementation of cycle paths on which cyclists can experience a reasonably safe ride to railway stations or bus terminals, cyclists will not support the main transport modes.

Secure parking is also an issue in each of the integration cases. Combating bicycle theft is a challenge and hence secure parking must be on offer at railway stations and bus terminals to ensure that the bicycle is part of a commuter’s return journey.

Many examples of lock-up facilities are available, from simple racks to which bicycles can be locked, to large bicycle parking areas with only one security entrance.

Bicycles on trains and racks on buses – the needs of many commuters are access to a passenger transport terminal and then further transport, after the rail or bus trip, to the final work destination. Being able to pedal to the terminal, place one’s bicycle on the main transport mode and complete the trip on one’s bicycle will

Table 1 Measures for integrating the bicycle into passenger transport

<table>
<thead>
<tr>
<th>Mode of transport</th>
<th>Method of integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>Safe routes to stations</td>
</tr>
<tr>
<td></td>
<td>Secure parking</td>
</tr>
<tr>
<td></td>
<td>Bicycles on trains</td>
</tr>
<tr>
<td></td>
<td>Bicycle hire at stations</td>
</tr>
<tr>
<td>Bus/minibus-taxi</td>
<td>Safe routes to terminals/ranks</td>
</tr>
<tr>
<td></td>
<td>Secure parking</td>
</tr>
<tr>
<td></td>
<td>Racks on buses</td>
</tr>
<tr>
<td>Private motor vehicles</td>
<td>Creation of park-and-ride facilities</td>
</tr>
<tr>
<td></td>
<td>Safe access routes</td>
</tr>
<tr>
<td></td>
<td>Bicycle parking and hire</td>
</tr>
<tr>
<td>Bicycles</td>
<td>Bicycle master plans</td>
</tr>
<tr>
<td></td>
<td>Safe routes</td>
</tr>
<tr>
<td></td>
<td>Parking facilities</td>
</tr>
<tr>
<td></td>
<td>Hire facilities</td>
</tr>
</tbody>
</table>

Monitored multi-level indoor parking, Utrecht, Holland
Secure bicycle parking at the University of California, Berkeley Campus
Covered bicycle racks at transport terminal in RAI Convention Centre, Amsterdam
reduce daily commuter costs, apart from being very convenient.

“Bicycles on trains” is a concept used by several countries, e.g. France, the UK, Switzerland and Australia. In Cape Town, there was a time when bicycles were allowed to travel in the guard’s van, but this van has disappeared and bicycles on trains along with it. Where bicycles are allowed on trains, they are usually confined to one well signed coach (often in the middle of the train) and generally allowed only outside the peak hour for commuters.

“Racks on buses” is a fairly new development which is well used in American cities. Canberra in Australia is also a very good example of this progressive innovation. The racks can be attached on either the front or rear of the bus and if there is conflict with the local traffic laws, then the latter should be adapted to allow the fitting of racks.

For private motor vehicle drivers and passengers, park-and-ride facilities and lift clubs should be encouraged to reduce congestion during peak travel periods. In addition, bicycle parking and bicycle hire, where appropriate, should be created at park-and-ride locations. This will assist commuters in outlying areas to ride to the facility, park their bicycles and join the lift club vehicle.

Similarly, on arriving at the parking hub near the city centre, a bicycle (personal or hired) can be used to travel the remaining distance to the place of employment.

Bicycle master plans should be developed for all urban areas and be part of Integrated Development Plans (IDPs), Spatial Development Frameworks (SDFs), etc, to ensure that the many advantages of the bicycle are not overlooked.

CONCLUSIONS

All transport and spatial planning, especially for urban areas, must take the bicycle mode into consideration.

Bicycle facilities must become part of integrated passenger transport plans.

Bicycle master plans should be developed by all cities and towns.

Safe bicycle facilities and secure bicycle parking as set out in the Pedestrian and bicycle facility guidelines of the national Department of Transport, should be used for uniformity in design.

With global warming, economic upheaval and higher fuel costs on the doorstep, the bicycle can contribute to affordable, non-polluting mobility and be integrated into passenger transport.

REFERENCES

Department of Transport 2003. Pedestrian and bicycle facility guidelines.

Federal Transit Administration (USA) 1999. Bicycle and transit: A partnership that works.


Nabti, J. and Ridgway, M. undated. Innovative bicycle treatments. Institute of Transportation Engineers.
Informal methods of social control: managing speed behaviour on SA roads

THE ENGINEERING PROCESS of setting speed limits is specialised and considers a wide array of factors, including the number of crashes, existing engineering interventions, types of vehicle, road users, vehicle volumes, modes of transport, road alignment, socio-economic and human factors, as well as the road environment in general. Fieldwick and De Beer (1988) emphasised that an urban speed limit is a necessary and effective road safety tool. Speed limits convey important information to drivers as to what the safe maximum speed is for a certain road considering the prevailing conditions. Roads have prescribed speed limits that fit the individual road’s primary function. These limits are determined by considering the quality and type of road, the type and mix of road users and traffic, and the surrounding environment.

Law enforcement activities and engineering interventions, such as speed enforcement by camera and traffic calming measures on lower-order roads, are by far the most popular methods of speed control in South Africa. Road user education, or more specifically driver education, follows and then social marketing messages that focus particularly on speed-related behaviour. South Africa has extensive legislation and regulations regarding speed behaviour but compliance with these regulations still depends on the road user’s understanding of when, where and how to comply, and – in South Africa – “why should I comply?” A different approach

<table>
<thead>
<tr>
<th>Year</th>
<th>December Fatal Crashes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>11%</td>
</tr>
<tr>
<td>2002</td>
<td>12%</td>
</tr>
<tr>
<td>2003</td>
<td>10%</td>
</tr>
<tr>
<td>2004</td>
<td>11%</td>
</tr>
<tr>
<td>2005</td>
<td>12%</td>
</tr>
<tr>
<td>2006</td>
<td>11%</td>
</tr>
<tr>
<td>2007</td>
<td>10%</td>
</tr>
<tr>
<td>2008</td>
<td>11%</td>
</tr>
</tbody>
</table>

December fatal crashes as a percentage of the total number of crashes per year.
should perhaps be considered as law enforcement and physical measures might not be the only methods for controlling the deviant behaviour of individuals such as drivers who exceed the speed limit.

“Social control entails rules of behaviour that should be followed by the members of a society. Some of the rules of conduct fall into the realm of good manners as the cultures define the rules” (Social control law, 2006). This quote suggests that in society, people who violate norms can be subjected to gossip, public ridicule, social ostracism, insults and even threats of physical harm by other members of their community.

EMERGING SOCIO-ECONOMIC PRESSURES ON SPEEDING BEHAVIOUR

The global economic crisis is having its effect on the South African economy and one of the main problems associated with it is the erratic oil prices. The increases and short-lived decreases in the fuel price influence all South Africans one way or another.

The question this article seeks to answer is whether or not the escalation in fuel prices has brought about an unanswerable question: whether or not the escalation will continue in one way or another.

Department of transport (nDot) on the posted by the road traffic Management information available in the form of reports crashes on south african roads, information pertaining to specific sections of the reports on road traffic crashes in South Africa could be compared for the period 1998 to 2008/9, different reports were used in the attempt at such a comparison. The number of fatal crashes and fatalities that occurred during the December holiday season of each year (Figure 1) is one of the more consistent indicators. This indicator was considered to benchmark the road safety status quo of South Africa through the number of fatalities made public in January each year.

In an attempt to understand to what extent speed is a contributory factor in fatal South African crashes (based on the assumption that speed is recorded correctly and objectively), the speed factor was expressed as a proportion (percentage) of the total number of reported fatal crashes per year, as well as of December fatalities for the past 8–10 years (Table 1).

The RTMC confirmed that there was a decrease in fatal road crashes and associated fatalities during the December 2008—January 2009 holidays and indicated that the reduction in fatalities was not due to fewer vehicles being on the road, as would be expected in view of the financial crisis, but instead was attributed to the success of the Arrive Alive campaign, increased visible policing and enforcement.

PERCEPTION OF SPEED

Masango (2005) revealed that 30% of drivers exceed the 120 km/h limit, 14% exceed 130 km/h and 6% drive faster than 140 km/h. These were the findings of an extensive speed analysis of about 25 million vehicles of all types in 2004. Bester and Geldenhuys (2007) stated that the percentage of vehicles (excluding trucks, minibus-taxis and buses) exceeding the posted speed limit on roads in South Africa decreased between the years 2002 and 2005, but that there was an increase in all vehicle speeds (excluding trucks, minibus-taxis and buses) in the following year, 2006. The researchers concluded that an increase in fatal crashes due to inappropriate speeds in 2006 could be expected.

One of the reasons cited to influence adherence to speed limits is the perception that speed limits need to be credible, in other words, the speed limit should be as high as the majority of the driving population are comfortable and safe on a particular stretch of road (Goldenbeld & Van Schagen, 2007). Where there is general acceptance and agreement that the posted speed limit for a specific road is reasonably correct, it might be perceived as credible and the posted sign might subliminally effect greater compliance with the rule. Work by the SWOV Institute for Road Safety Research in the Netherlands confirmed

<table>
<thead>
<tr>
<th>Year</th>
<th>Speed related fatal crashes</th>
<th>Average exceeding speed limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2001</td>
<td>no estimates or reference to speed as contributory cause</td>
<td>no estimates</td>
</tr>
<tr>
<td>Year 2002</td>
<td>30%</td>
<td>976</td>
</tr>
<tr>
<td>Year 2003</td>
<td>28%</td>
<td>950</td>
</tr>
<tr>
<td>Year 2004</td>
<td>29%</td>
<td>993</td>
</tr>
<tr>
<td>Year 2005</td>
<td>40%</td>
<td>1201</td>
</tr>
<tr>
<td>Year 2006</td>
<td>no estimates or reference to speed as contributory cause</td>
<td>1220</td>
</tr>
<tr>
<td>Year 2007</td>
<td>no estimates or reference to speed as contributory cause</td>
<td>1261</td>
</tr>
<tr>
<td>Year 2008</td>
<td>75%</td>
<td>733</td>
</tr>
</tbody>
</table>

The RTMC issued a media report indicating that “speed was still the contributory factor in approximately 75% of crashes” during the December 2008—January 2009 festive season. This means that despite the global financial crisis, drivers are still not adhering to the speed limit as one would have expected.
the fact that at least one third of all crashes can be related back to the speeding behaviour of drivers (Van Schagen, 2008; Beilinson, 2004). Van Schagen (2008) indicated that between 35 and 45% of the driver population in the Netherlands exceeded the highway speed limit of between 100 and 120 km/h in 2005. Norwegian research (Ragnoy, 2008) indicated clearly that a reduction in speed reportedly also brought about a reduction of 16% in injuries and a 42% reduction in fatalities.

CHOICE OF SPEED – A COMPLEX HUMAN PROCESS
Driving behaviour and driving performance involve complex social and psychological processes during which driving behaviour is influenced by motives and attributes that are indirectly transferred to other drivers. In a survey (Van Schagen, 2008) of 8 000 Dutch drivers, various reasons were given as to why some drivers exceed the speed limit and others adhere to it (Table 2).

In the 1980s Fieldwick and De Beer (1987), through a comprehensive study comparing South Africa with other international countries, concluded that South African drivers favour higher driving speeds than drivers in countries such as New Zealand, Finland and the USA. The study considered speeding behaviour from the angle that a vehicle’s speedometer is a credible indication of the travelling speed, and indicated that exceeding the speed limit is mostly a choice after all external and internal factors (see Mehmood, 2007) have been considered by the driver. It boils down to a deliberate decision by the driver either to adhere to or ignore the posted speed limit. Choice of speed is therefore a complex process to understand.

EXCESSIVE SPEED IN THE CURRENT ECONOMIC SITUATION
The escalation of fuel prices in 2008 also brought about rises in food prices and other basic living costs. These normally stem from increased prices related to transport services. The fluctuating fuel price influenced all South Africans one way or another. The question asked in the first part of this article was whether or not the escalation in fuel prices has

---

**Table 2 Reasons for exceeding or adhering to the speed limit in the Netherlands**

<table>
<thead>
<tr>
<th>Reasons for exceeding the speed limit</th>
<th>Reasons for not exceeding the speed limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adapting to other drivers’ increase in speed</td>
<td>1. Safety reasons</td>
</tr>
<tr>
<td>2. Driver is late for a meeting, etc</td>
<td>2. It is the law</td>
</tr>
<tr>
<td>3. No particular reasons</td>
<td>3. It is comfortable to drive at the correct speed</td>
</tr>
<tr>
<td>4. Driver did not notice the speed limit</td>
<td>4. High costs associated with speeding</td>
</tr>
<tr>
<td>5. Out of boredom</td>
<td>5. Not in a hurry to get anywhere</td>
</tr>
</tbody>
</table>

---

*Example of managing speed behaviour on SA roads*
brought about an unintentional reduction in speed behaviour on South African roads. In other words, is it possible that drivers are consciously or unconsciously driving more slowly in order to save costs directly related to fuel and indirectly related to living costs in general?

Previous research efforts suggested that this might be possible. South African research found that when the rural speed limits were lowered in the 1970s due to the oil crises experienced in 1973 (OPEC fuel crisis) and in 1979 (Iranian fuel crisis), drivers adapted their behaviour accordingly (Fieldwick and Fernie, 1980). Along with the lowering of speed limits, the South African Government at the time also introduced another type of social control in the form of restricted hours for buying fuel. This formal method of control ensured that drivers had to adapt their driving style in order to make the best of the fuel they had at their disposal. Fieldwick and De Beer (1987, 1988) also indicated that the oil and fuel crises experienced during the 1980s had contributed to drivers adhering to speed limits and obeying the law in an attempt to save fuel, but also in an attempt to stay clear of the informal social control carried out by fellow road users, who censured those “wasting fuel” by waving their arms and making disagreeable verbal comments to those drivers who ignored the speed limit!

Commercial literature suggests that the same type of informal social control is being exerted today, not in the form of restricted fuel sales or the fear of being censured by other drivers, but in the form of feeling the effects of the global economic crisis at home, and therefore
applying self-discipline and good governance to personal spending, which could include fewer holidays or driving more slowly and adhering to the speed limits.

Internationally, one of the responses to the global economic crisis has been to advise drivers to drive more slowly in an attempt to save costs on fuel (Shell, 2008). South African-based car manufacturers, fuel companies and organisations such as NAAMSA and the AA have been issuing and publishing advice with regard to saving on fuel costs by driving more slowly. But traffic crashes ultimately have their origin in the way that people think, act or react (behavioural aspects) and feel (emotional components), which makes it essential to take cognisance of the psychological and behavioural aspects that lie at the core of most societal problems. Driving at excessive and inappropriate speeds becomes a personal choice and an attitude towards the law enforcement authorities, towards fellow road users and towards life itself. Thus a change in thinking, perceptions, attitudes and behaviour is called for to address the underlying causes of social problems such as road traffic crashes.

Consideration should be given to the role (and extent) that social approaches to changes in behaviour can play in altering undesired road user behaviour. When the disciplines associated with understanding social behaviour, and the motivations, cognition and emotions responsible for specific road user behaviour, are considered, it becomes clear that deeper behavioural strategies are essential in changing unwanted road user behaviour. Although the primary aim of fuel price hikes is not to alter any particular behaviour, the secondary and unintentional spin-offs could in the long run contribute to making South African roads safer. Indeed it may be safe to say that thinking differently about the problem might bring about alternative solutions to changing the road user behaviour that is responsible for the carnage on our roads.

REFERENCES
The list of references is available from the editor

Traffic crashes ultimately have their origin in the way that people think, act or react (behavioural aspects) and feel (emotional components), which makes it essential to take cognisance of the psychological and behavioural aspects that lie at the core of most societal problems. Driving at excessive and inappropriate speeds becomes a personal choice and an attitude towards the law enforcement authorities, towards fellow road users and towards life itself.
A MODERN NEW DOUBLE-STOREY building welcomed soccer fans arriving at Doornfontein Station en route to Coca Cola Park (previously known as Ellis Park) in Johannesburg during the 2009 Confederations Cup. The Doornfontein railway station was one of the projects identified to be part of South Africa’s infrastructure upgrade in time for next year’s 2010 FIFA World Cup.

At a contractual value of just under R75 million, the project was completed within budget and on schedule for the official opening ceremony on 11 June 2009 by Prasa (Passenger Rail Agency of South Africa) CEO Tshepo Lucky Montana.

When Rainbow Construction embarked on this project, safety was given priority and a number of challenges were overcome successfully.

The platforms were built in such a way as to rule out overcrowding and allow access only to people actually travelling on the train. “Commuters enter the station on the first floor, purchase their tickets, pass through turnstiles with their tickets and then move down to the ground floor to board the train from the platforms. Located on the first floor are the ticket offices, security, a satellite police station and retail facilities,” explains Gerald Loe, Contracts Director at Rainbow Construction. “The new design includes six staircases to eliminate congestion and three elevators to give the disabled access to platforms.”

The completely new structure was erected after many months of planning and formwork designs. It features walls 45 m long by 14 m high, and 350 mm thick. The walls have varying wall soffit heights, supported by columns 300 mm in diameter and of various heights ranging from 6 to 12 m. The station deck area is approximately 165 m long by 30 m wide. The deck is made of bondecking, steel trusses and girders totalling 290 tons; these had to be hoisted over electrical cables with two tower cranes, 35 and 50 m high.

With regard to passenger safety, during construction Doornfontein Station was still a working station with trains passing through without stopping. “Therefore,” Loe confirms, “adhering to optimal safety measures to protect workers and commuters alike was not negotiable. Fortunately, the station was closed to all commuters during the construction period from April 2008 to June 2009. Controlling the movement of site personnel with the trains passing by required precise access control. Flagmen were trained and became Metrorail accredited. They were placed at strategic positions at all times to instruct the train drivers to blow their horns and to ensure that contracting personnel moved well clear of the passing trains.”

The challenge of live wires running above the station had to be overcome to ensure that safety was never compromised. Loe says, “We had to strictly follow PRASA’s SPK7/1 document which is their specification for working close to high-voltage equipment. With four overhead electrified railway cables, each carrying more than 3 000 V, as well as moving trains, working safely at all times was very important. Daily toolbox talks occurred at which all contracting personnel were constantly made aware of the dangers of working around live wire conditions.”

Confederations Cup 2009 saw trains stopping at Coca Cola Park’s Doornfontein Station
Two dedicated safety officers and an external railway safety consultant were based on site full-time.

Any work close to the tracks that could not be executed within SPK7/1 conditions required careful and concise planning as occupations had to be applied for from Metrorail, giving at least 21 days’ advance notice in writing.

Unexpected discoveries brought their own set of challenges because no previous plans existed due to the fact that the original structure was so old. During the piling process, numerous previously unknown services, such as water and sewage pipes and existing concrete obstructions, were encountered. As piling was a critical part of the construction, additional teams and plant were introduced onto the site to ensure that any obstructions were timeously addressed so that the piling could continue according to schedule.

Contractors addressed skills development by giving several short courses to flagmen, banksmen and safety officers, as well as enhancing the skills of learner foremen. A Rainbow Construction bursary student studying quantity surveying also gained valuable work experience during the project.

Loe concludes by pointing out Rainbow Construction’s commitment to providing high-quality workmanship in the interests of infrastructure development in South Africa in time for the largest global sporting event ever to be held on African soil – the 2010 FIFA World Cup. The Doornfontein Station is vital in ensuring that tourists will be able to travel safely and efficiently to and from soccer venues, hotels, shopping centres and other tourist attractions.
BANNING LABOUR brokers could negatively affect sectors such as infrastructure and telecommunications and could harm the economy.

In an era of growing global unemployment – a trend which SA is at pains to counter – that would be a disastrous unintended consequence.

The Temporary Employment Services (TES) industry covers not only unskilled workers, but a whole range of professionals, all regulated under the same legislation. The infrastructure projects currently being rolled out across the country in the electricity, roads, rail and telecommunications sectors rely on high-level project-based skills, particularly in engineering and information technology.

Such skilled individuals tend to move on when the start-up phase is complete and the project enters an operational or maintenance phase. No business can expect to thrive in an increasingly competitive market if it is expected to retain these expensive skills on a permanent basis.

Moreover, no business can be expected to staff up to meet peak demand, and then be faced with retrenchments in a downturn. Financial markets make provision for cyclical growth in every industry, and it follows that organisations should look to staff accordingly.

The TES sector helps companies to face global competitive pressure, allowing them to adapt their cost base and staffing levels. In fluctuating economic conditions, flexible employment comes to the fore as a way of balancing supply and demand.

The TES industry will be the first to create jobs as soon as the economy recovers. It will also increase the participation rate in the labour markets by providing more work opportunities to more people. It will play a vital role in developing basic skills, reducing joblessness, providing a transition to permanent employment and contributing to the economy as a whole.

To compare human trafficking to labour broking, and to call for a ban on labour brokers, as labour minister Membathisi Mdladlana has done, is unfortunate in the extreme.

However, we fully support the government’s stance that labour broking should be properly regulated. Most of the professional firms in the sector have for several years provided a range of benefits to temporary workers. We applaud any moves to ensure that rogue labour brokers are brought into line. But not all brokers should be tarred with the same brush.

Current labour legislation more than adequately addresses the use of labour brokers; what is needed is effective enforcement of those laws. Only then can government, business and labour move ahead with their vision to provide decent work and sustainable livelihoods for all.

However, it is simplistic to say the only ‘decent work’ is permanent work. That certainly isn’t the definition subscribed to by the International Labour Organisation (ILO). Far from disregarding the rights of workers, the TES industry has played, and continues to play, a positive role in driving South Africa’s economy.

During 2008, the European Union – in collaboration with the confederation of trade unions across Europe – legitimised the TES industry across 28 countries, at the same time strengthening the regulatory framework with regard to worker benefits. The EU regards the TES sector as an integral part of a functioning economy, and believes it will play a vital role in creating jobs when the upturn comes.

Ciett, the international body representing the interests of private employment agencies across the world, argues that the sector makes a positive contribution to the labour market in providing work to job-seekers, improving labour market flexibility, helping to create jobs that would not otherwise exist, acting as a stepping stone to permanent employment and enhancing worker employability by keeping workers in touch with the job market and providing training.

The TES industry also creates opportunities for disadvantaged and diverse groups to enter the labour market. These include the long-term unemployed, first-time entrants to the labour market, women accessing the labour market, older people and disabled workers.

Job flexibility should not, however, be achieved through compromising on the rights and working conditions of the workers. We support calls for making regulation more effective so as to unlock the contribution of agency work to job creation. This will ensure that our temporary workers have access to the same rights as permanent workers with regard to employment benefits and unemployment protection.
BIGEN AFRICA ASKS:

Is the private sector ready to deal with the service delivery crisis?

SERVICE DELIVERY (or the lack thereof) is currently the talk of town. It seems as if the new government has been taken by surprise by the recent uprisings so soon after the election. Government initially appeared confident that the economic crisis will not impact on government spending. In addition, there was a belief that the effects of the crisis would indeed be somewhat masked through increased government spending on infrastructure in the next two years. Reality, it seems, is turning out differently – we see capital budgets of government departments contracting and we see departments running out of funds barely five months into the new financial year. The service delivery crisis is thus a real crisis, as the means to deal with it is declining, while people are becoming more dependent on public services due to the deteriorating economic situation. It cannot be “business as usual” for government!

Against this background we hear government making all the right noises to deal with this crisis. Capital efficiency, for example, is stressed in speech after speech. This is an imperative, because let’s face it, post-apartheid South-Africa is littered with projects that reflect the “toilets in the veld” syndrome of the pre-apartheid days. The reality that government alone cannot fund the infrastructure backlog (as it is often referred to) is also slowly becoming apparent. For more than a decade one could detect reluctance at government level to consider commercial finance of infrastructure and too often the attitude was, “We do not have to borrow, there is enough money.”

Well, that has changed now, and more and more we hear that it is imperative that local authorities should borrow money to finance their infrastructure requirements. Of course many people will be concerned about increased borrowing at local authority level and the impact that that might have on tariffs etc, but there is another side to borrowing that most of these concerned citizens ignore. Borrowing (or debt) forces a certain discipline, a focus on efficiency, best practice and customer service. That is exactly the type of discipline and focus that we, and all those demonstrating in the streets about poor service delivery, have been asking for.

Creating this discipline and focus, especially at local authority level, is probably the biggest challenge facing government. It will certainly take strong leadership and political will, but at least we can take heart from all that is being said around this topic – measuring performance, accountability and “getting rid” of those who don’t do their jobs. It is also time that we stop blaming all the capacity woes at local authorities on affirmative action. That is a far too simplistic view.

Our new Minister of Finance is quoted as saying: “A crisis is a terrible thing to waste” – how strikingly apt for the current situation! It is clear that if dealing with the service delivery crisis requires “business unusual” from government, then the same applies to us in the private sector. We cannot continue to offer the same products and services to government, even though they may have sufficed in the past. We have to impress on government the need for, and facilitate the integrated development of, infrastructure, because that is the road to increased capital efficiency. Too often consultants offer “silo” solutions for integrated challenges. We have to demonstrate to government that there are better ways to finance municipal infrastructure than through the World Bank’s model of PPPs. We have to assist government to build capacity at local authority level, because that is the way to access all the funding that is necessary to build the required infrastructure. We have to convince government that in its role as (co)funder of municipal infrastructure it has to apply the same strict criteria that commercial lenders do in order to enforce discipline, best practice and customer service. We have to assist government to “make things work” under the current legal frameworks that have been established, because the principles embedded in these frameworks hold the promise of a better society that is sensitive to the plight of the poor.

What is called for is a greater partnership between private sector institutions and government institutions on specific municipal infrastructure interventions. The World Bank’s PPP model is highly focused on a single commercial venture, but interventions on a much broader scale will have a dramatic impact on the total community of the specific municipality. There are a few examples of such interventions, but it is early days and we need many more to overcome the crisis. We need success stories, and we have to contribute to make them happen. The time is ripe, but are we ready?
WSP DEVELOPS REVOLUTIONARY FINANCIAL MODEL FOR ROAD UPGRADES

IN SOUTH AFRICA – and in Gauteng in particular – it has become common for an area such as Dainfern-Fourways to develop faster than the supporting bulk service infrastructure. This has resulted in major upgrades being required before new developments can be allowed. In general, an individual development cannot afford these upgrades. A financial model has been developed by WSP SA Civil and Structural Engineers that will assist in obtaining a fair contribution from various role players so that the required infrastructure can be provided.

The proposed model has been accepted by the engineering departments of city councils and metropolitan municipalities, as well as by the road authorities, according to Harm Schreurs of WSP SA Civil and Structural Engineers. The next phase is to get the legal departments and town councillors to adopt the model. In order to illustrate how the concept will work, the Dainfern North case study has been identified by WSP. Schreurs explains: “The City of Johannesburg is one of four major developers in a relatively large geographical area. All four developers have agreed to the model subject to a reasonable outcome. In addition, the Development Bank of South Africa (DBSA) has indicated that it would be willing to finance the infrastructure. The loan would be paid back via bulk service contributions.”

Schreurs adds that WSP SA Civil and Structural Engineers’ Pretoria office has been appointed by Gautrans, the provincial road authority, to compile a traffic model for the study area. The traffic model will take into consideration all of the existing traffic within the node, as well as all of the through traffic and the potential traffic. It will then determine which roads need to be built and upgraded to accommodate all of this traffic. A costing will be obtained for these road upgrades and a cost-per-trip calculated in order to recover these costs. In this way the model will establish how much money must be recovered from each development’s bulk services contributions in order to repay the DBSA.

Building small sections of the road network at a time is uneconomical and usually inadequate for most of the larger developments. The phasing of large projects is commonplace and contributes to the problem. The solution is to upgrade large sections of the network under a single contract. Financing the infrastructure up front is of the utmost importance and if this can be achieved through implementation of the financial model, it will be a breakthrough for infrastructure development countrywide.

Schreurs concludes, “Once we have developed a model that works both technically and legally, i.e. one that works within existing legislation and council structures, it can be adopted in any area where there is demand for development.”

WSP Group plc, winner of the 2008 Sustainable Consultant of the Year Award, is a global design, engineering and management consultancy specialising in projects for the property, transport and environment sectors. Its 10 000 employees in 40 countries are committed to working with clients to create built and natural environments for a sustainable future.
THE KWEZI V3 / Stemele Bosch Africa / Goba Joint Venture are The South African National Roads Agency Limited’s (SANRAL’s) appointed consulting engineers for upgrading National Route 10, Section 4 from Cypress Grove to Tafelberg. This 26.4 km section of the N10 is situated between the towns of Cradock and Middelburg in the Eastern Cape.

The project entails rehabilitation and widening of the road, and includes some significant changes to the vertical alignment to increase the design speed to 120 km/h. Stemele Bosch Africa is responsible for the geometric design, with KV3 responsible for the materials aspects and Goba the stormwater and culvert design.

The project has been planned in two phases with the first 16.7 km of roadworks currently under construction as Phase 1. This length includes the construction of a new reinforced concrete bridge crossing the Venterspos Stream.

Along with a number of borrow pits, a hard rock quarry has been established for the production of surfacing stone, base and sub-base. Sufficient material has been produced for the construction of Phase 2 layerworks and has been stockpiled on site.

Phase 2 will include the addition of passing lanes through the Witkransnek Pass. Widening here will require blasting of the in situ sandstone rock and lateral bank stabilisation of the cut slopes.

Phase 1 is expected to be completed in July 2010. Tenders for Phase 2 are due to be advertised later this year.

Stemele Bosch Africa’s Roads Division offers consulting engineering and project management services for national, provincial, urban and rural roads. Specialist consulting services include investigations and feasibility studies, design, procurement, contract administration, construction monitoring and project management.

Other specialist technical divisions in Stemele Bosch Africa include water, irrigation, wastewater, sanitation, and environmental and solid waste.

INFO
Greg Cummings / Gary Hughes
Stemele Bosch Africa (Pty) Ltd
041 363 0598
SOFTWARE BOOSTS ROADS DESIGN EFFICIENCY

ONE OF THE MOST IMPORTANT challenges facing South Africa as a whole remains the creation and maintenance of infrastructure. The national and provincial departments of roads and transport lead the way in ensuring that the existing transport infrastructure remains adequate and reliable, while being expanded where needed. Technology – and especially professional software designed specifically for this purpose – plays an important role in enabling engineers to get on with the job of designing in a productive manner.

The departments of transport in the Eastern Cape and in KwaZulu-Natal recently acquired Knowledge Base’s Civil Designer for their civil engineers.

Bruce Acutt, who heads up the survey division at the KwaZulu-Natal Department of Transport says, after considering various options to upgrade their design software, they decided on Civil Designer because most consulting engineers with whom they deal already use this locally-developed and tailor-made civil engineering software. “From a compatibility point of view it made sense and it will now be used by all the project managers in the 12 cost centres of the province.”

He says Civil Designer has already been used for survey purposes at the department, but will now be used extensively in the design of rural roads and bridges and occasionally for storm water design. At the provincial head offices, the software will also be used in the design of their African Renaissance projects relating to major regional roads. The department is currently busy with a training programme for those not yet familiar with the new software.
Mr Unathi Dyubula of the design section of the in-house construction unit at the Eastern Province Department of Roads and Transport in East London believes the software will assist them in their capacity to deliver on their numerous projects.

He says: “Because our section is already familiar with this software, we are convinced it will be very useful for our roads and storm water construction projects. Those of our technicians who are not already trained in using the software, will undergo the necessary training.”

SABITA’S OUTSTANDING ACHIEVEMENT AWARD FOR 2008 ACKNOWLEDGES NEW PROTOCOL FOR COOPERATION

THE BITUMINOUS PRODUCTS INDUSTRY’S most prestigious award – the Southern African Bitumen Association (Sabita) Award for Outstanding Achievement in Bituminous Products Technology – was presented to Krishna Naidoo of Ethekwini Municipality (KwaZulu-Natal) and consultant Tony Lewis for 2008 for their outstanding efforts to advance sustainable practice.

The presentation followed Sabita’s Annual General Meeting in Durban on 18 June 2009 and acknowledged the recipients’ “exceptional courage, leadership and enthusiasm in pioneering the introduction of warm mix asphalt technology in Ethekwini Municipality through establishing partnerships with industry for the planning, construction and systematic appraisal of trial sections.”

The award citation notes that the recipients spearheaded the first formal warm mix asphalt trials in South Africa, placing an initial trial section at the end of 2008 and a second trial section during May 2009.
“It is noteworthy that the recipients have established a broad base of cooperation between the asphalt industry, clients and consultants to underpin the orderly introduction of innovative technology. To this end they have established a protocol of procedures that will serve as a national template for the introduction of a range of innovative products.

“The scope of their achievements also extended to the use of reclaimed asphalt, not only in warm mix, but also in their ongoing efforts to use this hydrocarbon asset to blacktop gravel roads in a cost-efficient manner.

“All these activities are considered to be landmarks on the road to more sustainable practice in the warm mix asphalt sector at a time when this aspect is a global focal point in road construction. We have no doubt that the outcomes of the project have already reflected and will continue to reflect notable progress to advance best practice in bituminous product technology in the interests of reduced reliance on non-renewable resources and reduced harmful emissions.”

Although a number of people representing various manufacturers of asphalt and additives have all contributed significantly to the impetus and success of these initiatives, Messrs Naidoo and Lewis have been identified as having led and guided the initiative.

FREE-STANDING PARKING STRUCTURES
NEWLY ARRIVED IN SOUTH AFRICA

MANUFACTURER AND DISTRIBUTOR of free-standing parking structures Modular Parking Solutions (MPS) has introduced a free-standing parking deck in South Africa that can double the capacity of an existing or new surface area. This comes at a time when South Africa needs additional parking space at a lower cost and erected in a short space of time, says MPS’s Managing Director Peter Tullener.

Prefabricated elements are installed on any surface without any traditionally excavated foundations. The finished structure can be demounted and reassembled on another site in the desired configuration. The system is designed and manufactured to ensure the complete lock-down integrity of the system.

Installation of the MPS system can be phased to retain spaces for an ongoing parking operation and its revenue stream. It is an efficient solution to increasing capacity between the surface and multi-storey car parks.

The MPS system has the following advantages: it doubles up parking without increasing the original footprint, is less expensive than purchasing additional land; is cost-effective in comparison with conventional concrete structures; is time saving; has no foundations; and can embody perimeter cladding that can be used for advertising space.

The MPS deck can be operational within 14 weeks where 100 parking bays are installed per month. It does not require excavation, piling or the erection and striking of any concrete shuttering. The entire structure is delivered to site in 6 m (20 ft) containers ready for the erecting crews. “The steel structure makes this system a more cost-effective option owing to the cost of the materials and labour required for the off-site manufacturing and on-site erection,” notes Tullener.

The structure is mounted on steel bearing plates which are placed on the existing surface. This removes the requirement for excavating for footings and foundations. The existing substrate is suitable for the new bearing plates so the structure can be placed directly onto the wearing layer of the existing parking facility.

Tullener says that the perimeter of the structure can be clad with precast decorative panels to enhance its appearance. If advertising is placed on the cladding, it can be used to recoup at least some of the initial capital cost of the project.

The MPS system has various other advantageous features: all-weather ramps with single, two-way or individual entry and exit points; double-wave crash barriers around the perimeter and ramps; bright underfloor, upper-deck and emergency lighting; lightning protection;
a dedicated internal drainage system, which is ducted to existing drains; an emergency staircase; optional pedestrian strips; waterproof screeds; traffic markings; and flexible layouts and designs.

The basic elements of the system are square modules which can be installed in undefined ways in order to obtain different forms. The spherical joint and the eight pillars ensure perfect verticality and resistance in case of soil subsidence, also allowing for unevenness in the ground below.

The height of the deck can be between 2.5 and 4.1 m. The vehicle access and exit points to and from the first floor are facilitated by ramps, variable in length and width.

All the steel elements of the MPS system are treated with hot zinc galvanisation by immersion, giving the steel double protection, both physical and electrolytic. The deck is composed of concrete slabs and profiled steel sheeting. The thickness of the concrete deck is 150 mm. This includes a UV-stable polyurethane, non-slip wearing layer and traffic demarcations.

Tullener explains that the MPS system is an Italian patented system known as Fast Park in Europe, and has been used in a diverse range of applications in Europe. It has been installed in European railway stations and has been of particular benefit to all transport interchanges where it has provided a temporary or intermediate parking solution. It is appropriate for highly frequented and congested parking areas because the installation can be phased to ensure increased use of existing parking operations and revenue protection, while also reducing disruption during installation.

The MPS system has also been installed in Rome’s Leonardo da Vinci Airport following an urgent need to increase car parking capacity in anticipation of a world event. One phase of the original installation has since been relocated to Milan’s Linate Airport.

In congested city centres the MPS system is an ideal solution between surface and multi-storey car parks. As the structure is 100% demountable and reusable, planners can be assured that if they are given only temporary permission, it can be easily removed to make way for development.

As the structure is surface mounted, it does not affect underground services or archaeological remains. There are no hydrological considerations and, in the case of contaminated land, there will be no disturbance. Since the construction does not have to be demolished or disposed of after use, but simply dismantled, there will also be a residual and asset value to the owner,” says Tullener.

MPS systems have proved useful in hospitals. The installation is a compartmental progression across a car park using only a pick-up, small forklift truck and hand tools. Installation is therefore accomplished without the disruption normally associated with traditional building.

An MPS system has yet to be sold in South Africa, but Tullener’s marketing drive is making impressions in the hospital industry, he says. Owing to the expected influx of tourists for the 2010 FIFA World Cup, this system could be of interest to transport and logistics officials. The company is able to offer finance options which provide significant tax benefits.
ULTRA-THIN FRICTION COURSE PROVES A VIABLE POSSIBILITY FOR SAFETY AT SOUTH AFRICAN AIRPORT RUNWAYS

NACO-SSI AIRPORT CONSULTANTS, a joint venture between NACO (Netherlands Airports Consultants) and SSI Engineers and Environmental Consultants (SSI), both DHV group companies, considered the application of alternative wearing course materials to reduce the cost and frequency of surface maintenance as much as possible, during the recent rehabilitation and upgrading of Runway 03R-21L at OR Tambo International Airport.

SSI’s Pieter Molenaar presented a paper on the relevant mix design and performance characteristics considered during the development process at the Second European Airport Pavement Workshop in Amsterdam in May this year. The paper was compiled together with Piet Agema of Airports Company South Africa (ACSA).

“The objective was to develop an ultra-thin friction course (UTFC) for South African conditions, complying with the International Civil Aviation Organisation’s (ICAO) recommended friction properties for newly constructed runways,” said Molenaar.

Runway 03R-21L is the main arrivals runway at the airport, typically accommodating 90% of all landings. Special consideration therefore had to be given to the ICAO-recommended requirements for safe landing conditions in all weathers. Although existing runway surface layers might meet the ICAO requirements immediately after construction, their surface properties are known to deteriorate to intervention levels over relatively short periods owing to the very high rate of landings. Frequent maintenance interventions are required to address, among other issues, the removal of deposits from rubber tyres which reduce the skid resistance and texture depth.

One of the requirements for assessing the suitability of a new proposed friction course was to engage ACSA and the various airline operators in the evaluation process. The airlines were asked to comment on the expected tyre wear for aircraft and the possibility of improved safety conditions arising from a change in the runway surface.

As part of an ongoing upgrading programme of airside infrastructure at OR Tambo International Airport, the consultants proposed to conduct an asphalt mix development programme based on experiences gained in Denmark in applying a UTFC at Copenhagen Airport.

Trials revealed that crushed dolerite aggregate outperformed the quartzite and granites which were locally available in close proximity to the

Ultra-thin friction course (UTFC) being applied to airport runway
construction site. During the asphalt paving trials it was confirmed that the ICAO-recommended requirements for newly constructed asphalt surfaces – texture depth of more than 1 mm and friction values exceeding 0.74 (65 km/h wet) – could be achieved after a few months of traffic, allowing the bituminous film to wear off from the aggregate surface. A styrene-butadiene rubber (SBR) polymer, modified bitumen emulsion tack coat, applied at a rate of 1 l/m², bonds the UTFC to the underlying surface.

The UTFC has now been in service for more than two years. Tests indicate that the friction values have increased with time, especially in the touchdown areas. More frequent landings might even improve the skid resistance. Although a build-up of rubber deposits in the touchdown areas is being experienced, this does not seem to affect skid resistance adversely when tested with a grip tester. Friction values are still well above the minimum threshold for maintenance planning.

It is also interesting to note that the UTFC mix composition applied at OR Tambo International Airport resembles a similar mix currently being specified in various states in the US for improved skid resistance on roads and as a protective shield against ageing of the underlying surfacing.

“We have therefore proposed that consideration be given to the possible application of this ultra-thin bonded wearing course mix as a suitable alternative to friction courses for airport runways. Further research will be undertaken in this regard,” concludes Molenaar.

CAPE TOWN IS CURRENTLY being transformed by a number of transportation projects that are readying the city for the 2010 FIFA World Cup. Vela VKE Consulting Engineers’ Cape Town office is playing its part on a number of fronts.

The Structures Division is involved in developing two new pedestrian bridges that will provide safe access from the CBD to the new 68 000-seater stadium being built on Green Point Common. The first of these structures is a structural steel bridge, 101 m long and 4 m wide, which crosses the busy Buitengracht arterial as it enters the city. As the bridge is situated in a busy urban environment, a simple but bold beam structure was considered appropriate. Because of the limited space for the approach ramps, the vertical rise of the bridge had to be limited and up-stand beams were the only option.

However, the need to provide multiple access points onto the structure meant that an up-stand beam was possible only on one side. A design using a fabricated steel “torsion” box was therefore developed to handle the asymmetrical support condition. The result is a unique deck section.

The design team includes GAPP Architects and the bridge incorporates some unusual features such as LED lighting in the handrail units, lifts for disabled access and a laminated glass weather screen.

The site of the bridge has set the design team some interesting challenges. Working next to two of the city’s biggest hotels has meant that noise disruption must be kept to a minimum. All of the bridge’s...
Concrete and steel components will therefore be fabricated off-site and erected during the hotels’ low season between April and October. One side of the bridge will in fact be founded on one hotel’s underground parking garage. Reducing the weight of the structure wherever possible was therefore critical. For this reason a light steel deck structure was the preferred option.

This project is scheduled for completion in December 2009. Construction of a second pedestrian bridge on the fan mile to the stadium would have begun in July 2009.

PRESTRESSED CONCRETE MASTS have been specified by Transnet Freight Rail (TFR) for a capacity upgrade on the Sishen-Saldanha iron ore rail link. Manufactured and delivered by CMA (Concrete Manufacturers Association) member Infraset, the masts will carry a supplementary feeder line that will be used to boost the supply of electrical power to the overhead track line. Infraset began delivering the masts in May 2009 and the last deliveries are scheduled for December. Once the masts have been planted and the new electricity feeder cable installed, TFR’s Sishen-Saldanha line will be able to accommodate higher volumes of rail traffic, thereby making provision for the anticipated increased tonnages of iron ore exports.

CMA director John Cairns says concrete masts are the most appropriate choice for this type of application because, unlike other materials such as steel, they are entirely maintenance-free.

“Concrete masts retain their structural integrity and aesthetic appeal without the need for routine and expensive maintenance such as de-rusting and painting. As a section of the line runs adjacent to the Atlantic shoreline between Strandfontein and Saldanha, where the sea spray quickly corrodes anything made of steel, the inert properties of concrete are especially apt in this application. In addition, the high strength-to-weight ratio of prestressed concrete masts gives them a

INFO

John Anderson
021 417 2900
andersonj@velavke.co.za

Artist’s impression of the Buitengracht pedestrian bridge
distinct advantage over masts manufactured from other materials.”

Infraset won the tender last year; it entailed not only the manufacture but also the delivery of the masts to site at 120 m intervals.

“Delivery has presented us with a considerable logistical challenge because the line stretches some 860 km,” says Infraset’s general manager railway products, Kobus Burger. “The contract involves the road delivery of more than 7,000 masts, 12 and 13 m high, each of which weighs over 2 tons. Our trucks are making round trips of up to 1,000 km, all of them on sections of rough gravel surfaces. Furthermore, we are complying with extremely high quality and safety requirements.”

The masts are being manufactured in De Aar, Northern Cape, where there are ample supplies of good-quality aggregate and cement. ISO 9002 accredited, the De Aar factory is owned jointly by Infraset and Empowa Investments through the BEE joint venture company Empowa Grinaker-LTA (Pty) Ltd.

Rated at 64 kNm, the masts are being manufactured to stringent quality standards and are cast in a rectangular, tapered I-section design with high-strength, high-density concrete in a smooth attractive finish.

The resilience of prestressed concrete enables it to recover from the effects of a greater degree of overload than any other type of structural material. Furthermore, unlike other materials, concrete suffers no loss of strength over the years, being resistant to insects, fire, rot and corrosion. It is interesting to note that the first major project in which concrete masts were used for overhead electrification was in 1999 on TFR’s Kimberley-De Aar line. “Those masts still look as good today as they did then,” says Burger.

Infraset masts are manufactured at ISO 9002 accredited factories in a wide range of strengths and sizes to fill most requirements in MV and LV lines. They also comply with Eskom DTC 0106 and various SABS and Spoornet specifications.

STEFANUTTI STOCKS WAS awarded the construction of a radar tower at George airport in October 2008. The project was completed on schedule in July 2009.

The 55-m-high concrete radar tower is situated on the eastern side of the main runway and forms part of a national upgrade of the radar coverage throughout the country for the air traffic industry by the Air Traffic and Navigation Services Company (ATNS). The tower has been equipped with an approach radar, comprising primary and secondary radar.

Adverse weather conditions in the Western Cape, as well as a tight programme, led Stefanutti Stocks Civils and the consulting engineers, Mzansi Africa Civils, to investigate various alternative methods of construction. The most innovative and practical engineering solution was to construct the central shaft using the method of slip-forming and to construct the two external platforms at ground level. These platforms were lifted individually into their final positions over a period of 20 days.

The radar tower has a total height of 55 m, including a spherical radome that protects the radar antenna from the elements. The concrete shaft, with an overall plan size of 6.4 x 6.4 m, is founded on sixteen 520 mm diameter driven cast-in-situ piles. The 38-m-high shaft walls were slip-formed by the Stefanutti Stocks Civils sliding teams over a period of seven days.

Vanguard (experts in lifting and transporting heavy equipment), in conjunction with Stefanutti Stocks Civils, designed the lifting rig for the platforms. The rig consisted of steel beams mounted to the top of the tower and to the underside of each platform, with four lifting points each connected to a 70 ton strand jack.

Due to the limited lifting capacity of the strand jacks, each platform was lifted into position individually. Once the two concrete platforms had been hoisted to their final positions, they were connected to the shaft with shear keys through openings left in the shaft walls.

INFO

John Cairns
011 805 6742
Two hoist beams supported by electrical hoists were installed to facilitate lifting/maintenance of the radar equipment and a galvanised structural steel staircase was provided inside the shaft for access. The generator and UPS tracking buildings are situated at ground level adjacent to the radar tower.

The full scope of works included the electrical reticulation, air-conditioning, lightning and fire protection, as well the installation of the UPS and generator.

“Having completed similar towers previously, we were prepared for the challenges and were able to make some improvements to the construction process,” says Frank Oliveira, Stefanutti Stocks Civils contracts director for the project. “Bad weather often makes operations difficult, but the site team performed well and the project was completed on schedule.”

Did you know?
The term RADAR originated as an acronym of “radio detection and ranging”, which has since entered the English language as a standard word: radar. A radar system transmits electromagnetic waves which are reflected off a target and received back by the radar receiver located in the same location as the transmitter. The technology is used in many applications, such as weather prediction, police and military applications, marine and ocean wave monitoring, speed monitoring and air traffic control.

NYELETI CELEBRATES 10 YEARS

NYELETI CONSULTING, WHICH was founded by Stanford Mkhacane and Pine Pienaar on 1 August 1999 with offices in Polokwane and Pretoria, celebrated its 10th anniversary on Saturday evening 1 August 2009 at the Performer Theatre in Pretoria with an evening of good food, friendship, song and dance. Even the freezing cold weather on the evening could not dampen the festive spirit among Nyeleti staff and their guests.

Ten years ago the new company’s focus was on developmental and job creation projects. However, as time progressed, Nyeleti (meaning star in Tsonga and symbolising the aspiration of the firm to deliver excellent service to its clients) saw the need for expansion into diversified fields of the engineering industry where technically more challenging projects could be undertaken. It was within the initial few years of Nyeleti’s existence that several key staff members joined the company, significantly strengthening the technical arm of the firm and transforming Nyeleti into a multi-disciplinary organisation focusing on road and bridge design, road rehabilitation and maintenance, water infrastructure design (including pipe lines, reticulation networks and water retaining structures), building services (including structural design and wet services), project management, traffic and transportation engineering, and occupational health and safety services. In 2001 a third office was established in the Ekurhuleni area.

In 2008 Nyeleti merged with the firm Daling, De Lange & Van Tonder. This firm was exactly 20 years old and brought considerable experience to the Nyeleti team, experience which could be transferred to its group of relatively young designers at the time.

From humble origins only ten years ago, Nyeleti’s staff complement has grown to 80 people. Thus far Nyeleti has met its initial objective to establish a truly empowered, proudly South African company that provides excellent service to its clients. The company slogan, Engineered to Excel, supports this goal.

Nyeleti’s expertise and commitment in the engineering field has been recognised through a number of awards received, among others being category winner, as well as over-all winner, of the Johannesburg Sakekamer / Sake / Netstar / PricewaterhouseCoopers Company of the Year competition in 2005. The firm is also particularly proud of its BBBEE status – Nyeleti currently has an AAA+ rating (Level 1 Contributor), the highest grade possible.

INFO
Frank Oliveira
frank.oliveira@stefstocks.com

INFO
Pine Pienaar
ppienaar@nyeleti.co.za

The George radar tower under construction with platform lifting in progress

Nyeleti staff and guests celebrating the company’s 10th anniversary recently
GREATER CAPACITY WITHIN CIVIL ENGINEERS’ REACH

Skills-sapped civil engineers hard-pressed to meet current infrastructure demands could increase their capacity to deliver Africa-wide road networks vital for regenerating the continent’s economy – without increasing their skills base.

According to civil engineer, Marius Esterhuyze, the answer lies in a paradigm shift – a new approach to project design that replaces skills-hungry methods that involve the redundant re-creation of design information.

A technology specialist at design software innovator Autodesk, Esterhuyze says the new approach, called building information modelling (BIM), would increase engineering firms’ productivity, helping them to deliver road networks essential for redressing the economic imbalances of Africa.

At the AfricaRoads 2009 conference earlier this year, representatives from across the infrastructure sector urged authorities to invest in African road networks so as to reduce transport costs and regenerate the region’s economy. Existing inadequate road systems increase transport costs by as much as 70% over those in Europe and the US, stifling the region’s competitiveness. And the longer the economic slowdown persists, the more the region will be disadvantaged.

While better roads are an economic imperative, civil engineering professionals’ capacity has been depleted by the global technical skills shortage. South Africa has one of the lowest engineer-to-citizen ratios (473:1 000 000) in the world. Meanwhile, although there has been an increase in the number of engineering professionals employed in South Africa since 1996, the edge has been taken off any gains by the high number of engineering professionals employed in the financial services and business sectors. There has been an annual average growth rate of nearly 10% in engineering professionals working in the financial sector, compared with very small growth in construction (4%).

Esterhuyze says engineering firms could replace traditional ‘siloed’ project workflows of preliminary design, then detailed design and finally the creation of construction documentation, with the new BIM method. Its model-centric environment enables firms to use fewer resources by developing all three design stages concurrently. BIM underpins the civil engineering design programme, AutoCAD Civil 3D, which helps firms to create and deliver transportation, land development, and environmental projects more efficiently. Johannesburg-based Croswell Engineers reported 60% reduction in design time in the development of 4 km of dual and single lane roads at the Lanseria Corporate Estate, north of Johannesburg.

INFO
Mary Jeary
jmj@global.co.za
SAICE-DFC Water Competition 2009

ON A VERY COLD and wintry day in Johannesburg, the finals of the SAICE-DFC Centenary Schools Water Competition 2009 were held at the Sci-Bono Discovery Centre in Newtown, Johannesburg, with the Deputy-Minister of Water and Environmental Affairs, Ms Rejoice Mabudafhasi, officiating. This competition never fails to excite the teams, spectators and everybody involved!

The competition, which started in 2003 as part of the centenary celebrations of the South African Institution of Civil Engineering (SAICE), was renamed AQUALIBRIUM during the event.

Winners of the regional competitions, organised by SAICE branches, came to Johannesburg from across the country to battle the local winners for top honours. Learners were flown to Johannesburg and accommodated in a good hotel – an experience that many learners and some educators will never forget. The teams were also taken to Montecasino, with its distinctive architecture, for dinner. For most this was their first experience of the ‘big city’.

Learners are not often exposed to the practical application of processes that influence their daily lives, e.g. the distribution of potable water. In designing and building a water distribution network, learners are exposed to the intricacies of such systems and are challenged to solve these by marrying the theory and practice of maths and science, making this one of very few competitions to succeed in this objective. The competition tasks the teams to design

1. Zandile Ntchuca (Port Rex Technical High School, East London) watching the flow of water with a keen eye
and build a model water distribution network and to distribute three litres of water equally between three points on the grid using two different diameter pipes and connecting pieces. Teams are judged on how well they execute the task – working on a penalty points system.

After much deliberation, discussions on design and the ultimate construction of the water distribution network, the 2009 winning team was Grantleigh High School from Richards Bay with 115 penalty points. Second was Hoërskool Duineveld from Upington with 200 penalty points, followed by Maritzburg College from Pietermaritzburg with 220 points. The prize-money for the winning teams, their schools and teachers amounted to R21 000.

The presence of a person of Ms Mabudafhasi’s stature really made the event very special for these teams, reinforcing the importance of discussions and activities surrounding water issues.

In her address the Deputy-Minister said, “We are here to celebrate the innovation of our vibrant youth who are demonstrating eagerness to become leaders and environmental ambassadors, particularly with regard to the equitable distribution, efficient use and conservation of water. Investing in youth gives satisfying hope for tomorrow. I have no doubt that our future is in good hands only if we continue in this trend. In a water-scarce country like ours it
is necessary that we understand the importance of all the issues – from the conservation of water and the quality and quantity of water, to the distribution of water and how it impacts on our daily lives.”

The Deputy-Minister concluded by saying to the learners, “You are now the ambassadors who must spread the message that water is a precious commodity, which should be conserved, respected, recycled and re-used in order to ensure that there will be ‘some for all, forever’ in our beautiful country!”

Ms Mabudafhasi was also appreciative of the sponsor of the 2008 and 2009 competition, DFC Water (Pty) Ltd, saying, “It is heartening to see that the private sector is playing a pivotal role to ensure the continuation of this worthwhile and exciting competition, and I would like to commend DFC Water for their involvement over the past two years. Good news is that the Water Research Commission has also joined in this effort.”

The competition strengthens government’s initiatives aimed at encouraging learners to take mathematics and science at school and to follow a career as a science or civil engineering professional. Only in this way can we assure that the quality of life of all South Africans will be better in future!

Please turn page for more photos
The team from the Cape Academy of Mathematics, Science and Technology putting their maths and science to good use. From left: Jenaide Peters, Chad Levendal (sitting), Nabeelah Harris, Eric Bezuidenhout & Amelia Grimsell (adjudicators)

Zanele Mazibuko (left) and Vuyani Khumalo from the Bukhulani Secondary School, Johannesburg, hard at work

Salome Morole from the Phomolong Secondary School, Johannesburg

Eric Louw Hoërskool, Musina. From left: Stacey Scheepers, Arizta Nel, Cron Drude, Debbie Besseling (adjudicator)

Christian Brothers College, Bloemfontein. From left: Gareth Douglas (adjudicator), Siyabulela Mokuri, Nonceba Masupe, Thando Nkwane

Port Rex Technical High School, East London. From left: Andrew van der Westhuizen, Lani van Vuuren (adjudicator), Zandile Ntchuca, Brandon Hoys

Cron Drude from the Eric Louw Hoërskool, Musina, lending a man’s hand to the one-man-two-girls team

Prof Zweistein (Kim Mather, a civil engineering professional) and wife Nicky entertained everybody with their ‘Fun Science Show’
SAICE’s Graham Ross becomes full Member of Sigma Xi

WHEN GRAHAM ROSS retired at the age of 69 one might have expected him to relax and enjoy doing nothing. Instead of which we find he earned his PhD at the age of 74, and then at the age of 79 authored *The Romance of Cape Mountain Passes* to mark the 100th anniversary of the founding of our Institution, and this year, turning 85, he issued the 4th edition of *Mountain Passes, Roads and Transportation in the Cape – a Guide to Research*.

Graham was elected an Honorary Fellow of SAICE in 2001, and we are very pleased to learn that his efforts have now also been recognised in the United States by his promotion to full Member of Sigma Xi, which “Scientific Research Society is the honor society of scientists and engineers that recognises scientific achievement”.

Congratulations, Graham!

SOMETHING FOR FREE!

Possibly the largest single database on roads in South Africa

The 4th edition of *Mountain Passes, Roads & Transportation in the Cape – a Guide to Research*, by Dr Graham Ross, is now available in CD format from SAICE National Office. The CD is available FREE OF CHARGE on request, and Dr Ross has given permission to allow any other interested person to also make a copy of the disk, for his/her own purposes, the only requirement being that the author be kept informed, so that his list of holders of this edition of the Guide to Research is kept comprehensive.

Copies available from:
Linda Erasmus
Manager: Executive Office at SAICE
011 805 5947
lerasmus@saice.org.za
<table>
<thead>
<tr>
<th>Date</th>
<th>Event and CPD validation number</th>
<th>Presenters</th>
<th>Contact details</th>
</tr>
</thead>
<tbody>
<tr>
<td>06 October</td>
<td>Cape Town</td>
<td>Structural Failures</td>
<td>Tony Aimer</td>
</tr>
<tr>
<td>12 – 13 October</td>
<td>Cape Town</td>
<td>Handling Projects in a Consulting Engineer’s Practice</td>
<td>Wolf Weidemann</td>
</tr>
<tr>
<td>10 – 11 November</td>
<td>Structural Failures</td>
<td></td>
<td>Dawn Hermanus</td>
</tr>
<tr>
<td>10 – 11 November</td>
<td>Structural Failures</td>
<td></td>
<td><a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
</tr>
<tr>
<td>15 – 16 October</td>
<td>Cape Town</td>
<td>Business Finances for Built Environment Professionals</td>
<td>Wolf Weidemann</td>
</tr>
<tr>
<td>17 – 18 November</td>
<td>Structural Failures</td>
<td></td>
<td>Dawn Hermanus</td>
</tr>
<tr>
<td>03 – 04 November</td>
<td>Johannesburg</td>
<td>Coastal Engineering and Management</td>
<td>Keith Mackie</td>
</tr>
<tr>
<td>10 – 11 November</td>
<td>Structural Failures</td>
<td></td>
<td>Sharon Mugeri</td>
</tr>
<tr>
<td>17 – 18 November</td>
<td>Structural Failures</td>
<td></td>
<td><a href="mailto:cpd.sharon@saice.org.za">cpd.sharon@saice.org.za</a></td>
</tr>
<tr>
<td>24 – 25 November</td>
<td>Port Elizabeth</td>
<td>The Application of Finite Element Method in Practice</td>
<td>Roland Prukl</td>
</tr>
<tr>
<td>7 – 13 November</td>
<td>Structural Failures</td>
<td></td>
<td>Dawn Hermanus</td>
</tr>
<tr>
<td>5 – 11 December</td>
<td>Structural Failures</td>
<td></td>
<td><a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
</tr>
<tr>
<td>17 – 18 November</td>
<td>Port Elizabeth</td>
<td>Project Management and MS Projects Hybrid Course</td>
<td>Les Wiggill</td>
</tr>
<tr>
<td>26 November</td>
<td>Structural Failures</td>
<td></td>
<td>Sharon Mugeri</td>
</tr>
<tr>
<td>24 – 25 November</td>
<td>Structural Failures</td>
<td></td>
<td><a href="mailto:cpd.sharon@saice.org.za">cpd.sharon@saice.org.za</a></td>
</tr>
<tr>
<td>7 – 11 December</td>
<td>Midrand</td>
<td>Practical Geometric Design</td>
<td>Tom McKune</td>
</tr>
<tr>
<td></td>
<td>Structural Failures</td>
<td></td>
<td>Dawn Hermanus</td>
</tr>
</tbody>
</table>

For more information on courses, venues and course outlines please visit [http://www.civils.org.za/courses.html](http://www.civils.org.za/courses.html) or contact cpd.sharon@saice.org.za

---

4th SARF/IRF Regional Conference for Africa

**PRESERVING AFRICA’S ROAD NETWORK**

**11 – 13 October 2010**

Lord Charles Hotel, Somerset West, Cape Town, South Africa

Conference and exhibition organised by the South African Road Federation and the International Road Federation

Call for papers on the following topics:

- The importance of road asset preservation and asset management systems for the effective management of road networks
- Institutional and financial arrangements, including private sector involvement for effective road maintenance
- Maintenance programme implementation issues, including constraints to effective implementation
- Sustainable standards and construction techniques for road maintenance, including Expanded Public Works Programmes (EPPWPs)
- The impact of freight operations on road conditions and the influence of environmental criteria on road maintenance
- The influence of road conditions on road safety

Oral and poster papers relevant to the above theme are invited. Abstracts are due by 30 November 2009. The abstract template is available from the conference website (www.sarf.co.za). Further details are available from:

The Secretariat, +27 (0)12 667-3681, confplan@iafrica.com

---

SATC 2010, 9 – 12 August 2010

**Walk Together**

The 29th Southern African Transport Conference (SATC 2010) will take place at the CSIR International Convention Centre (CSIR ICC). The Minister of Transport will be the patron of the conference, while the co-sponsor will be the Transportation Research Board of the USA. The conference will provide a platform for national and international dialogue on transport as a development priority. It will also serve as a forum for discussion and information exchange on the implementation of transport policy, strategy and technology applications for aspects and modes of transportation. Sustainable transport will be one of the key issues that will be debated and for which action plans will be formulated.

Everyone in any way connected with transport should benefit from attending this conference. Prospective authors are invited to submit papers that are relevant to the conference theme. For more information on the conference, and on discussion topics and abstract deadlines, please contact:

Ammie Wissing, Conference Secretariat

+27 (0)12 348 4493, wissing@iafrica.com, www.satc.org.za