

DRIVERS OF SOUTH AFRICAN TRANSPORT AND TRANSPORT INFRASTRUCTURE

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IMPORTANCE OF TRANSPORT INFRASTRUCTURE

There is no doubt that infrastructure in general and specifically transport infrastructure plays a major role in economic development (Weisbrod G 1997, Chapman P et al 2002) as well as in social development (UNCDF 2007). In addition, construction activities form a significant part of a country's GDP in South Africa the construction industry contributes 3,6% to the GDP (STATS SA 2008) and has been growing three times as fast as the total South African economy over the past five years. Currently there is a decline in the rate of growth, mainly in the residential building sector, due to the crisis related to declining asset values in the USA (the sub-prime problem), inflation and relatively high interest rates. Economists are, however, of the opinion that this is a short- to medium-term phenomenon that will correct 2010 (Rust et al. 2008). Ferreira and Khatami (1996) argue that investment in social and economic infrastructure will play an important role in increasing the productivity of labour and business. The importance of social development had been particularly highlighted in striving towards achieving the Millennium Development Goals (MDG 2007).

The South African government recognised the importance of transport and transport infrastructure in policies such as the Reconstruction and Development Programme (RDP 1994), the Growth Employment and Redistribution (GEAR 1996) and the Accelerated Shared Growth Initiative for South Africa – Asgisa (Mlambo-Ngcuka 2006). GEAR specifically states a requirement for “an increase in infrastructural development and service delivery making intensive use of labour-based techniques.” The Asgisa strategy refines the objectives of GEAR by placing specific emphasis on *“[aligning] economic growth with improvements to the well-being of the poor. In terms of political economy, this requires developmental strategies enabling the poor to participate in economic growth, as well as benefit from it. For example, giving the poor better access to economic opportunities (employment, assets and markets), as well as to basic public services (education, health, housing, water, sanitation, etc), would contribute significantly to growth.”* (Yemek E 2006).

The relationship between economic growth and infrastructure investment in terms of Gross Fixed Capital Formation (GFCF) is internationally recognised, and depicted in Figure 1 in terms of a selection of developed and developing countries (Investec 2005). Integral to the growth objective in AsgiSA is therefore the recognition that infrastructure investment in terms of GFCF should be lifted to 25% of GDP (with public and private sector contribution respectively at 9% and 16%) in order to achieve the targeted 6% economic growth rate. This recognition is also evident from the South African Government's decision to make special budget allocations towards infrastructure development (EN 2005). The striving towards improved infrastructure in South Africa is of course also currently being fuelled by the expectations of a world-class Football World Cup event in 2010. However, South Africa's growth is currently being hampered by two key constraints: lack of skilled manpower and lack of appropriate infrastructure (Bruggemans 2005).

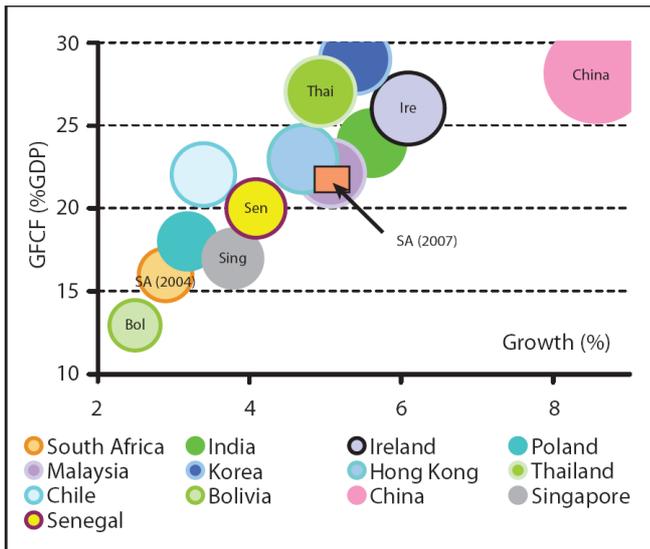


Figure 1:
The relationship between GFC and economic growth (after Investec, 2005)

SUSTAINABILITY AND TRANSPORT

The balance between economic development, environmental sustainability and socially acceptable infrastructure is critical:

"By promoting economic growth strategies based on expanded infrastructure which are environmentally responsible and socially acceptable we are bringing a sustainable future closer to today's reality."

Katherine Sierra, Vice President for Sustainable Development, (World Bank 2007)

In South Africa energy use in buildings and the transport sector accounts for more than 50% of the country's total energy usage with about 25% attributed to the transport sector (DSAS 2005). This places special emphasis on sustainability aspects of transport and infrastructure provision and maintenance.

Figure 2 depicts the classic concept of sustainable development that includes elements of economic, social and environmental aspects within the supporting sphere of good governance.

In addition, the emerging Black middle class in South Africa pushed internal consumption to unprecedented rates, particularly in motor vehicle sales. About 5 million South Africans claim to own, use or maintain a motor vehicle, and drive approximately 5.6 billion kilometres per month. In addition, sales of motor vehicles are heading towards the 1 000 000 mark per year which will add significantly to current traffic volumes and road use as well as to the associated emissions (AMPS 2006).

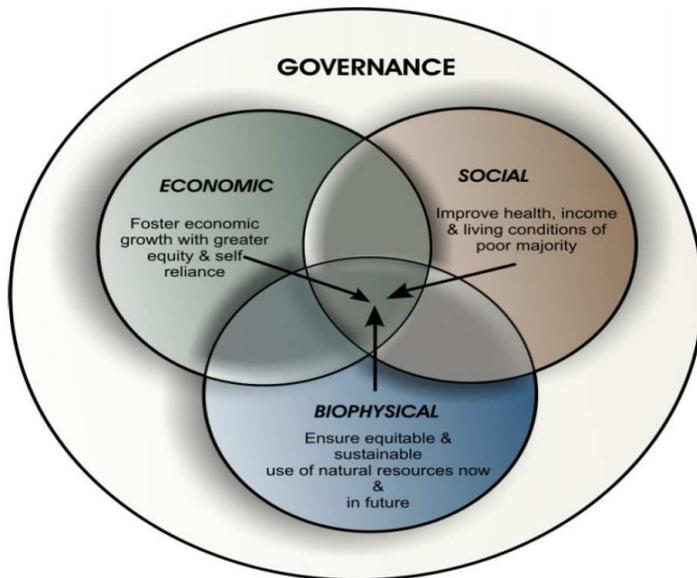


Figure 2: The classic concept of sustainable development – its trifocal spheres and the supporting “matrix” of good governance (DME, 2009)

The four major elements in Figure 2 are also of significant importance to the transport and transport infrastructure sectors and form the basis of a number of their drivers. Sustainability in the transport sector can be translated to:

- economic issues pertaining to both the impact of transport and transport infrastructure on the economy as well as to the issue of sustaining the sector through proper investment into the construction and maintenance of the infrastructure and other assets;
- social issues pertaining to providing benefit for all from the transport sector with focus on addressing the spatial imbalances from the apartheid legacy, the poorest communities and rural communities;
- addressing the environmental issues pertaining to transport that includes reduction of emissions, reducing energy use, recycling of construction materials, use of environmentally friendly materials etc; and
- providing the governance framework that can sustain the industry into the future.

IMPORTANCE OF SCIENCE, ENGINEERING AND TECHNOLOGY IN TRANSPORT

In general Science, Engineering and Technology (SET) have a broad impact on society, including the stimulation of economic growth (Bresnahan and Trajtenberg 2003) and socio-economic impact (Goldman SL 1989). The role of technology in the development of a country was also highlighted by Roux (2007) indicating the relationship between the UN Technology Achievement Index (TAI), GDP per capita as well as the Human Development Index (see Figure 2 below).

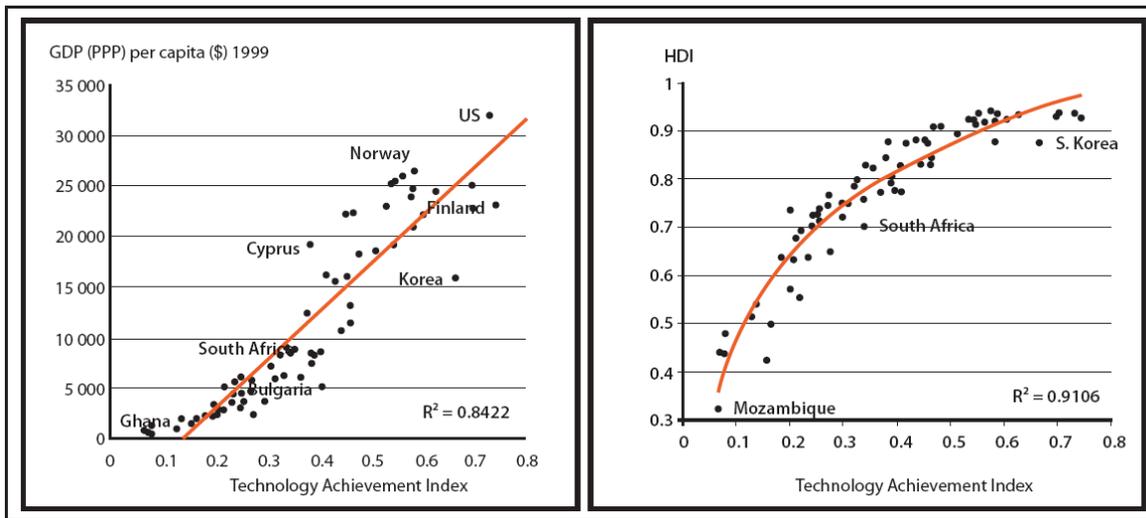


Figure 2: The dependence of wealth and living standards on technology (after United Nations reported in: Roux, 2007)

SET and innovation relating to disciplines in transport is therefore one of the major factors in ensuring that transport systems and infrastructure is of the desired quality and impacts optimally on both the economy and society whilst minimizing its impact on the environment. The National Research and Development Strategy of South Africa (DST 2002) specifically states:

“Innovation is the key process by which products, processes and services are created, and by which businesses generate jobs and wealth. In addition, in the social sphere, effective innovation has a direct impact on the reduction of poverty and the improvement of the quality of life of our people. It is critical, therefore, to increase the rate and quality of innovation in South Africa.”

The SET base in the transport disciplines is diverse and there are specific gaps in knowledge especially pertaining to local issues such as local environmental conditions, local construction materials, the urban form relating to the apartheid legacy (which impacts on transport systems), rural development requirements etc.

THE STATE OF INFRASTRUCTURE IN SOUTH AFRICA

There is concern about the ageing state of infrastructure all over the world. The Urban Land Institute in the USA states that:

“The United States, in particular, and most of Europe stumble to repair and retool aging roads, plants, and levees that may no longer serve a changing paradigm for how people will live and work in the future.” (ULI 2007)

The ULI also refers to the estimation by the World Bank that the projected funding gap for infrastructure in the USA is ominously huge at \$1.6 trillion over the next five years. Asia’s needs are estimated at \$1 trillion over the next five year period.

The South African Institute for Civil Engineers (SAICE) recently assessed the status of infrastructure in South Africa and developed an infrastructure report card (SAICE 2006). SAICE reports that, although the South African government has embarked on a programme of increased

infrastructure spending, there is still a failure to invest in the maintenance and renewal of infrastructure.

According to SAICE infrastructure in South Africa fall into the following categories of grades (see Table 1). Thus according to SAICE most of the infrastructure in South Africa is in a fair, poor or very poor state.

Some examples of the reasons for this status are quoted by SAICE as:

- accommodation needs in the nation as a whole but, more importantly, population movements across the nation, together with new household formation is faster than population growth;
- a long history of neglect of maintenance of infrastructure;
- the hugely successful rollout of new infrastructure, but generally without concomitant growth in the resources (principally skills and budgets) allocated to looking after the infrastructure;
- an overall skills shortage, especially of engineers and artisans, and a slow rate of new entry to the profession;
- institutional changes (for example in local government); and
- a number of unsustainable investments that have been made.

Table 1: Summary of infrastructure status according to SAICE report card

Rating	Sector
Very Good	No infrastructure
Good	Heavy haul freight railway lines; airports owned by the Airports Company of South Africa
Fair	Water, sanitation and solid waste management in major urban areas; national roads; Transnet owned ports; general freight railway lines; national and local energy distribution networks; hospitals
Poor	Bulk national water infrastructure; non-urban solid waste management; non-national roads; passenger railway lines; non-urban electricity distribution networks
Very Poor	Non-urban sanitation; some uneconomical general freight railway lines.

Prior to 2005, public sector investment in South Africa as a percentage of GDP dropped to less than half of that of previous levels. Thus adequate maintenance levels were not maintained in many areas (particularly roads and railways) and new capacity additions were kept to a minimum with emphasis shifting to other social objectives (Bruggemans 2006). This is exacerbated by the fact that the previous government did not acknowledge the infrastructure needs of the majority of South Africans. This resulted in eventual bottlenecks and unnecessary shortages (e.g. electricity, municipal infrastructure), congestion (e.g. ports, roads), overloading (roads), damage (roads,

harbours), underutilisation and loss of relative importance (railways) and technology shortcomings (communication). In addition, the consequential erosion of construction capacity was extremely detrimental eventually halving the industry's size relative to GDP compared with the preceding decades. The loss of critical engineering skills was severe.

The generally poor state of infrastructure in South Africa, particularly transport infrastructure, also leads to high costs in logistics. In South Africa the cost of logistics as a percentage of GDP is approximately 15% - significantly higher than that of its trade partners and some developing countries (CSIR, 2008). The National Freight Logistics Strategy, NFLS (DOT 2005) considers the system to be "*structurally incapable of appropriately allocating costs and raising efficiency*". Elements of the system perform well, but the overall system performance and especially the state of infrastructure constitutes the bulk of the problem. The view of the NFLS is that an integrated system-level approach is required, that shifts the system's emphasis from a focus on supply towards the demand-driven delivery of freight logistics services. The concise summary of the problem statement that the NFLS responds to is:

"The freight system in South Africa is fraught with inefficiencies at system and firm levels. There are infrastructure shortfalls and mismatches; the institutional structure of the freight system is inappropriate and there is a lack of integrated planning. Information gaps and asymmetries abound; the skills base is deficient and the regulatory frameworks are incapable of resolving problems in the industry."

The South African government is currently addressing this issue with the recent special investment of R600 billion into infrastructural development (Van der Merwe, 2008). However, it should be realised that sustainability issues are paramount, and that the future maintenance and environmental issues related to transport and transport infrastructure must be addressed.

DRIVERS, TRENDS AND ISSUES IN THE TRANSPORT INFRASTRUCTURE SECTOR

Recent studies investigated the current drivers, trends and issues related to transport infrastructure provision in South Africa (Rust and Venter 2004) as well as to the construction industry (Rust *et al*, 2008). These studies highlighted the following as important issues to be considered:

Institutional drivers

- *Lack of institutional capacity* that impacts seriously on service delivery
- *Integration of government planning of infrastructure* across all levels of government remains problematic and is particularly related to capacity problems and systems incompatibility

Economic drivers

- *Continued growth in of the South African economy* which remains an important priority for the South African government
- *The second economy: transport and transport infrastructure* is a major driver in facilitating the stimulation of growth in the second economy (Yemek 2006)
- *Continued globalization of markets and production: the process of globalisation* has drawn attention to the productive potential of cities (Rust *et al* 2008) and increasing global economic interdependence is reducing the ability of national governments to regulate or govern their own economies with a consequent greater vulnerability to global slowdowns.

- *Growing regional cooperation in Africa and SADC:* initiatives such as the New Partnership for Africa's Development (NEPAD) provide a platform for common markets and harmonized standards and procedures for infrastructure provision thus making it easier to integrate operations across borders.
- *Fluctuating funding:* The fluctuation of funding for transport infrastructure causes significant problems for the industry in terms of positioning themselves during periods of high investment and scaling down in periods of low investment.

Human resource drivers

- *Skills shortage:* Whereas Western Europe, North America, India and China have between 130 and 450 people per engineer, only one of every 3200 South Africans is an engineer, a ten to twenty-fold disadvantage (SAICE 2006). South Africa is also steadily losing skilled manpower, especially civil engineers (Creamer 2007). The shortage of professionals in infrastructure-related disciplines can be associated with reduced knowledge-generation activity and R&D (DST 2002). Civil construction companies continue to struggle to procure sufficient skilled labour in order to cope with current work volumes. No less than 94% of respondents to the civil construction survey during the 2nd quarter of 2007 indicated that shortages of skilled labour were “hampering” their activities and “impairing” their ability to complete contracts on time (Bruggemans 2007).

Environmental issues

- Amidst world-wide recognition of the “peak oil” crisis as well as the emphasis on climate change it is pertinent to consider the energy and resource consumption of the transport sector.
- Cement production is, after the burning of fossil fuels, the biggest anthropogenic contributor to greenhouse gas emissions (Du Plessis 2002). The cement industry world wide emits more than 1.37 billion tons of carbon dioxide per year (Humphreys and Mahasenani, 2002). Although cement makes up only 12-14% of the final concrete mix, additional embodied energy comes from the transportation and extraction of aggregates and, in the case of reinforced concrete, the manufacturing of steel.
- The Department of Mineral and Energy affairs reported that, in 2004 transport consumed 25.7 per cent of energy in South Africa (DME 2006). This is second only to the 36 per cent of energy consumed by industry.

Societal drivers

- *Continued population growth and urbanisation:* Some 3.3 billion people – more than half of humanity – are now living in cities (UNPF 2007). By 2030, cities will be home to almost 5 billion people with 81% located in developing countries. Many of the new urbanites will be poor, and probably unlikely to afford infrastructure service costs. However, unlike other cities where birth rates are driving urban population growth, migration from rural areas is largely driving urban population growth in South Africa (STATS SA 2007).

Operational drivers

- *Logistics*: Logistics is recognised as a very important driver in the South African industry. The ASGISA strategy recognises the importance of the removal of six constraints to economic growth. One of these constraints is “*the cost, efficiency and capacity of the national logistics system, which was pushing up the price of moving goods and conveying services over long distances*” (Mpahlwa 2006).
- *Traffic congestion*: The current traffic congestion experienced in cities will increase as the economy grows and as demand for private transport increases.
- *Law enforcement*: In a scenario of increased population growth and increased traffic growth, law enforcement becomes an increasingly important issue.
- *Safety and security*: In South Africa security, especially personal security remains a major issue. This factor impacts on the design of the urban environment as well as transport systems.

SET drivers

- *Materials technology*: The main issues relating to traditional construction materials include the scarcity of natural materials for road building, the increasing cost of bitumen due to rising oil prices, the potential future scarcity of cement, the fact that cement manufacturing causes a significant amount of greenhouse gasses and the need for innovative construction materials with enhanced performance.
- *Information and communication technologies (ICTs)*: ICTs and related technologies will play a significant part in the future transport sector, particularly relating to intelligent systems for traffic control, intelligent construction processes and the monitoring and control of the performance of transport infrastructure assets.
- *Energy optimisation*: The current focus on the importance of energy use optimisation is of major importance to the design, construction and operation of the transport environment due to the fact that in South Africa this sector consumes a major portion of the available energy in the country.
- *Environmentally-friendly solutions*: As indicated above, environmental issues are becoming increasingly more important in the transport sector. In the future more emphasis will be placed on mitigating these impacts with specific solutions.
- *Alternative fuels*: The drive towards finding hydrogen-based and other alternative fuels for transport and energy creation will continue to impact on the design, construction and operation of the transport environment.

CONCLUSION

Transport and transport infrastructure are recognised as major factors that influence the socio-economic development of any country. However, in the future several drivers will influence the nature of transport in South Africa with specific emphasis on those drivers that are related to sustainable development. The face of transport and transport infrastructure will have to change to deal with aspects such as environmentally friendly solutions, poverty alleviation, mobility and access to the poor and rural transport and accessibility.

REFERENCES

AMPS. 2006. South African Advertising Research Foundation, 2006.

ASGISA. 2006. *Accelerated and Shared Growth Initiative of South Africa, Annual Report*.

Bresnahan T and Trajtenberg M. 2003. General Purpose Technologies: Engines of Growth? *Journal of Econometrics*, Vol 65, No 1, p83-108.

Bruggemans, C. 2005. *Limits to Growth*, FNB-Economic Subscriptions, First National Bank, July 26, 2005.

Bruggemans, C. 2006. *Infrastructure Take-off*, FNB-Economic Subscriptions, First National Bank, December 12, 2006.

Bruggemans, C. 2007. *Fixed Investment Shapes 2010 Outlook*, FNB-Economic Subscriptions, First National Bank, March 12, 2007.

Chapman P, Stephens J and Swanson J. 2002. *The economic impact of transport projects: developing guidance in the UK*. Paper presented at the conference on economic development and transport, University of Portland, Oregon.

Cremer. 2007. *Drainage of engineers from municipal water sector*, Cremer Media's Engineering News online, March 2007. Available from <http://www.engineeringnews.co.za>

CSIR 2008. *Fifth Annual State of Logistics Survey for South Africa*, CSIR, Pretoria.

DME 2006. *Digest of South African Energy Statistics*. Department of Minerals and Energy Affairs, South Africa.

DME, 2009. *A Strategic Framework for Implementing Sustainable Development in the South African Minerals Sector: Towards Developing Sustainable Development Policy & Meeting Reporting Commitments*. Department of Minerals and Energy, South Africa.

DOT 2005. *National Freight Logistics Strategy*, Department of Transport, Pretoria, 2005.

DSAS 2005. *Digest of South African Energy Statistics 2005*. Department of Minerals and Energy, Pretoria.

DST. 2002. *South Africa's National Research and Development Strategy*. Department of Science and Technology, Pretoria, South Africa.

Du Plessis C. 2002. *Agenda 21 for Sustainable Construction in Developing Countries: A discussion document*. CSIR Report No Bou/E0204, CSIR, Pretoria.

EN 2005. *R320 billion public-infrastructure spending plan*. Engineering News Volume 25 No 46.

Ferreira, D. & Khatami, K. 1996. *Financing Private Infrastructure in Developing Countries*. World Bank Discussion Paper No. 343. Washington DC.

GEAR 1996. *Growth, Employment and redistribution – a macroeconomic strategy (GEAR)*. Government of South Africa.

Goldman SL. 1989. *Science, Technology, and Social Progress*. Lehigh University Press.

Humphreys K and Mahasen M. 2002. *Toward a Sustainable Cement Industry Substudy 8: Climate Change*. World Business Council for Sustainable Development.

Investec 2005. *Prospects 2004-2009: Gross Domestic Fixed Investment Outlook*, SA Economic Research 1st Quarter 2005.

MDG. 2007. Website for Millenium Development Goals, <http://ddp-xt.worldbank.org>, accessed in July 2007.

Mlambo-Ngcuka, P. 2006. *A Catalyst for Accelerated and Shared Growth – South Africa (AsgiSA)*. Background Document, Media Briefing held on 6 February 2006. Available at: <http://www.pmg.org.za/bills/060206asgisummary.htm>.

Mpahlwa, M. 2006. Parliamentary media briefing by Minister Mandisi Mpahlwa, Cape Town, February 2006.

Mpahlwa, M. 2006. Parliamentary media briefing by Minister Mandisi Mpahlwa, Cape Town, February 2006.

RDP 1994. *The Reconstruction and Development Plan*. The African National Congress.

Roux, A. (2007) "Business Futures 2007". Institute for Futures Research, University of Stellenbosch.

Rust, FC and Venter, C. 2004. *Transportek Foresight Study : Final Report March 2004*. Technical Report No TR-2004/16, CSIR, Pretoria.

Rust, F.C., Botha, C., van Wyk, L., Steyn, W., du Plessis, C., Landman, K. and Coetzee, M. 2008. *South African Construction Industry Technology Foresight Study: Summary report of desk top study*. CSIR Technical Report: CSIR/BE/SRM/ER/2008/0063/B.

SAICE 2006. *The SAICE Infrastructure Report Card for South Africa: 2006*. The South African Institute for Civil Engineers, Midrand South Africa.

STATS SA 2007. Mid-year population estimates 2007, Statistics South Africa, *Statistical release P0302*, July 3, 2007.

STATS SA 2008. Statistics South Africa, *Statistical release P0441*, Second Quarter.

ULI 2007. *Infrastructure 2007: A Global Perspective*. The Urban Land Institute and Ernst & Young. Washington D.C.

UNCDF. 2007. *Localizing the Millennium Development Goals*, available from United Nations Capital Development Fund website, www.uncdf.org, accessed in July 2007.

UNPF. 2007. *State of the World Population 2007: Unleashing the Potential of Urban Growth*, United Nations Population Fund.

Van der Merwe, C (2008). South Africa pushes ahead with R600bn infrastructure plan. *Creamer Media's Engineering News*, October 2008.

Weisbrod G and Weisbrod B. 1997. Assessing the Economic Impact of Transportation Projects: How to Choose the Appropriate Technique for Your Project. *Transportation Research Circular No 477*, Transportation Research Board, Washington DC.

World Bank. 2007. Website of the World Bank, <http://web.worldbank.org> accessed in July 2007.

Yemek E. 2006. *Budgetary Perspectives on Shared Growth Policy Interventions in South Africa*. Occasional paper, IDASA – Africa Budget Unit.