

Focus on CSIR Built Environment

November 2011

Aligned with the South African government's increased focus on the built environment – specifically infrastructure – the CSIR uses its multidisciplinary capabilities to develop innovations and solutions that will improve the built environment in a sustainable manner. The vast majority of CSIR research, development and innovation (R, D & I) activities relating to the built environment are combined within the CSIR Built Environment Unit.

Core focus

CSIR Built Environment supports South Africa's competitive performance and the welfare of its people through the development of technological solutions and the generation of knowledge to develop an efficient and globally-competitive built environment system in urban and rural areas.

Infrastructure

Infrastructure and associated operations are a prerequisite for economic growth and social development.

It is a national priority to expand and improve infrastructure such as roads, rail networks, bridges, airports, buildings and other facilities, without forfeiting environmental sustainability.

Social development takes place only with proper provision of basic amenities such as hospitals, schools and housing, together with infrastructure for water and sanitation, electricity supply, etc.

The built environment is a complex system with numerous elements and a number of external factors influencing it. Factors such as migration and urbanisation – by

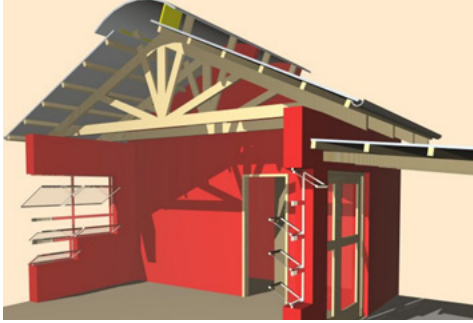
2013, 70% of the country's people will be living in cities – contribute to overloaded infrastructure, which in turn demands an increase in service delivery.

CSIR Built Environment conducts relevant R, D & I for contributing to cost-effective, long-lasting infrastructure as well as to maintain, improve and manage existing infrastructure.

The unit also responds to challenges facing South Africa, including with implementation and service delivery.



Curbing infection and cross-infection of drug-resistant TB



South Africa has insufficient health infrastructure to cope with the growing TB epidemic. Extensively drug-resistant (XDR) TB adds to increasing numbers of multi-drug-resistant (MDR) TB patients. The CSIR has set out to address the lack of appropriate infrastructure to address TB infection and cross-infection, a key constraint in the effective treatment and rehabilitation of patients. The CSIR has been instrumental in supporting the design, development and construction of dedicated, long-term accommodation units for drug-resistant TB patients. This project has received at least R92 million from The Global Fund and more than R115 million from seven provincial Departments of Health with a total of nine newly-designed TB facilities being constructed. The CSIR also provides technical advice and training to teams at hospitals to ensure the successful roll-out of the TB units.

R, D & I Competences

To address the challenges the country faces, CSIR Built Environment has clustered its expertise into certain competence areas. These are currently:

Building science and technology

Research areas:

- **Architectural engineering**
Social infrastructure and systems including public health facilities and educational facilities; building assessment tools, performance modelling, benchmarking, support systems and guidelines; energy-efficiency in buildings, cost-effective measures to reduce energy consumption; the efficient use of non-renewable resources; and the sustainable use of renewable resources.
- **Construction materials and methods**
Marginal and waste materials for building construction; cement composites; natural fibre composites; structural engineering; product

prototyping; and smart construction materials.

- **Construction industry improvement**

Support to promoting sustainable economic growth and skills development in the construction industry also through skills development for SMMEs; creates sustainable enterprises and stable employment; pursues opportunities of the green economy; alternative energy provision for the built environment; research on reducing the impact of HIV/Aids in the construction industry.

Infrastructure engineering

Research areas:

- **Transport infrastructure engineering**
Provides innovative engineering solutions for the design, construction and maintenance of transport infrastructure assets, focusing on roads and airports; research supports the provision of a sustainable and cost-effective transport network; accelerated pavement testing (APT) and advanced testing of materials, including traditional, waste and novel materials; engineering design, analysis and modelling; vehicle-road and infrastructure-environment interaction; geotechnical engineering; environmental engineering and sustainable construction; performance data capturing techniques and instrumentation for accelerated road materials and structures testing; and international research collaboration in APT.
- **Coastal engineering and port infrastructure**
Integrating a broad understanding of ocean forces and coastal structures, researchers provide predictive engineering solutions and decision support for the safe and cost-effective development and operation of ports and coastal structures; physical modelling of the environmental impact on ports and coastal structures; physical and numerical modelling of moored and manoeuvring ships; wave fore and hind-casting, and wave diffraction, refraction and reflection modelling; collection and managing real-time environmental data on waves, tides, currents, wind, weather and bathymetry for ship and port operations; monitoring the impact of the marine environment on coastal structures; and specialist support

to local and international port and harbour authorities, consultants and contractors.

- **Research facilities and platforms**

Research facilities and platforms, including laboratories and workshops, provide specialised testing services for the CSIR to develop specific equipment for the R&D needs of the infrastructure engineering sector. These include the hydraulic modelling hall (Stellenbosch); the heavy vehicle simulator; the soils and cementitious materials laboratory — ISO 17025 accredited; the asphalt laboratory — ISO 17025 accredited; the road materials dynamic testing laboratory; the bituminous binders laboratory — ISO 17025 accredited; the chemical laboratory and mechanical workshops.

Technology promotes longer-life roads



South Africa's national road network is, overall, older than 25 years, which exceeds the design life of roads. National roads carry very high traffic volumes; the N3 has carried the equivalent of 20 years of anticipated traffic in a period of two years. Based on 2010 figures, the value of South Africa's road network was R1 047 trillion, with the road maintenance backlog being R100 billion.

The use of high-modulus asphalt (HiMA) technology in road construction can lead to roads that last longer and need less maintenance, thus also fewer delays for road users. HiMA decreases the life-cycle costs of roads and increases sustainability due to the lower use of non-renewable materials. The CSIR and the Southern African Bitumen Association (Sabita) have developed and conducted research on HiMA mixes suitable for heavily-trafficked roads in South Africa. Local materials and performance-related testing were used to develop a product with significantly-improved properties compared to conventional asphalt mixes. Extensive research on HiMA mixes by the CSIR and Sabita led to the development of preliminary guidelines for the design of HiMA mixes and roads containing HiMA layers. The guidelines will feed into the updated, comprehensive South African Road Design Method undertaken by the CSIR and others for the South African National Roads Agency Ltd (SANRAL).

South African bridge management system used widely



As a major infrastructural asset, bridges need to be maintained regularly. The CSIR recommends inspections every five years and a maintenance strategy based on a priority list of bridges in need of repair. Defects can thus be identified timeously for repair. The CSIR developed the Struman bridge management system (BMS) in collaboration with a local consulting engineering firm some years ago. The system comprises customised and regularly updated software, manuals and training programmes for clients, ensuring that qualified engineers who act as bridge inspectors have a consistent approach in rating the condition of bridges. Locally, SANRAL has implemented the Struman BMS and the system is used in most provinces. The BMS is also used in African countries, including Namibia, Botswana and Swaziland; and in Taiwan and Dubai.

Infrastructure systems and operations

Research areas:

- **Network asset management**
Asset management systems, including bridge management systems; abnormal load management; heavy vehicle self-regulation; overload control; performance-based standards for heavy vehicles.
- **Passenger transport**
Modelling travel behaviour and the economics of transport and transport operations; transport economics; aviation operations economics; informing the design of passenger transport service contracts, including the Pan-African aviation services.
- **Systems and traffic management**
Research on traffic safety engineering and traffic management; assessment

of the strategic transport needs in the country; transport systems and the management of these, including greening of transport.

Logistics and quantitative methods

Research areas:

- **Statistical modelling and analysis**
Multivariate time series for count data; application of Bayesian methods; structural equations modelling; extreme value theory; spatial and temporal data analysis; design of indicators; development of standards; experimental design; regression; forecasting methods; classification; questionnaire design; and sampling.
- **Advanced modelling and supply chain research**
Optimisation and heuristics;

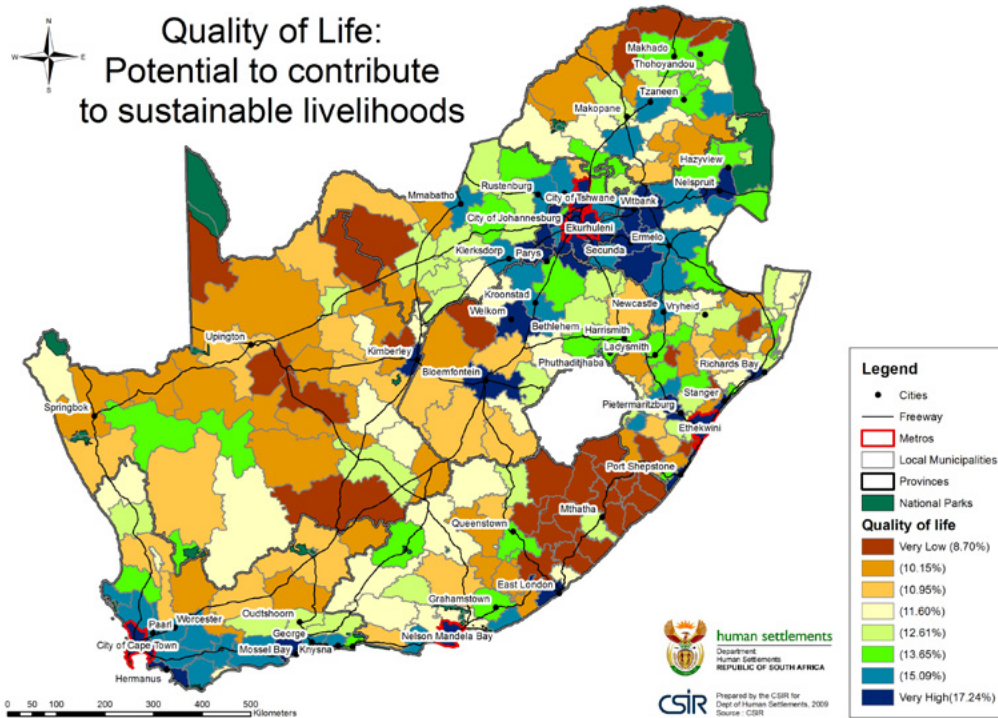
development of quantitative supply chain analysis tools; routing optimisation; complexity science; humanitarian operations research and logistics; inventory requirements; planning in uncertain environments; operational research techniques; supply chain management; freight logistics strategies; and agricultural supply chains.

State of Logistics series informs decision-making



The State of Logistics™ survey, a CSIR trade mark, has been published for the past seven years. The survey was initiated by the CSIR to provide decision makers with proper data, information, etc. to optimise supply chain management and reduce overall logistics costs. The surveys also quantify important indicators annually to obtain trends over time. There is no doubt that the State of Logistics™ surveys, jointly released by the CSIR and its partners in this initiative – IMPERIAL Logistics and Stellenbosch University – are seen as an authoritative report for the country. Apart from the US state of logistics report that has been published annually for more than 20 years, the SA State of Logistics™ survey is the only other report published worldwide annually on the logistics costs of a country.

Urban and regional analysis crucial for planning



The three spheres of government need informed decision-making for long-term planning, investment and development of cities, settlements and regions, and improved municipal service delivery. Officials need access to the analysis, evaluation and simulation of urban and regional planning and development, as well as growth approaches and policies. A successful project in this area is the CSIR’s updating of the Human Settlements Atlas 2009 for the Department of Human Settlements. It is the third edition in the atlas series, which is aimed at guiding investments in housing and settlements, from a very dysfunctional, inequitable space economy towards more sustainable human settlements. The investment atlas includes a conceptual framework, spatial analyses and recommendations for investment in housing and supportive services. Individual spatial maps cover various aspects, such as access to job opportunities, population trends, and environmental suitability. The CSIR converted data into detailed, interpreted analyses to support decision-making.

Planning support systems

Research areas:

- **Urban and regional planning**
Growth management; functional regions and settlements dynamics; socio-ecological resilience and vulnerability; planning processes and instruments; intergovernmental and municipal planning; urban growth simulation; spatial and integrated urban and regional analysis; remote sensing; developing social facility guidelines and space requirements; accessibility analysis; typology development; urban morphological analysis; systems analysis; and scenario development
- **Sustainable human settlements**
Support the creation of functional settlements; housing options and urban development, such as medium-density mixed housing and gated communities; integrated settlement

design for sustainability and planning and designing safer communities; water and sanitation research and policy input through to monitoring and evaluation; resource-efficient technology alternatives that support human settlements, i.e. appropriate water and sanitation infrastructure and technologies and the acceptability of these; a sanitation technology demonstration centre for public information purposes.

Agrément South Africa

This certification agency is an independent, national body for the evaluation and certification of innovative and non-standard construction products and services. The agency is managed by CSIR Built Environment and reports to the Ministry of Public Works.

COLLABORATION

CSIR Built Environment continually strengthens its collaboration with private and public sector partners and research peers, both nationally and abroad. The unit remains agile to also respond to new opportunities and existing challenges that face South Africa.

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